Mid Sussex District Council

Sustainable Energy Study

Final Report

AMEC Environment & Infrastructure UK Limited

October 2014

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Executive Summary

Purpose of this Report

The purpose of this report is to help Mid Sussex District Council develop planning policies for renewable energy and climate change in the emerging Mid Sussex District Plan 2014-2031 (the District Plan). These policies need to reflect national and local priorities for reducing carbon emissions and responding to climate change based on the specific characteristics of Mid Sussex.

Key considerations for planning policy development in the District include:

- Understanding the latest national policy and legislative context regarding how local authorities should plan for climate change, both in terms of reducing carbon emissions and ensuring resilience to the impacts that are already faced. The on-going housing standards review being progressed by government, which aims to reduce regulation on house building, will also have key implications for the preparation of new planning policies.

- The District's potential for new renewable and low carbon energy projects (e.g. wind turbines, solar, hydro and biomass schemes), considering energy generation potential alongside environmental and technical constraints, including designated landscapes. In this regard, we can draw on the conclusions of the previous energy capacity study for West Sussex published in 2009[1] and accompanying landscape evidence.

- The level of new development, including new homes and associated employment planned by the Council through allocations in the District Plan (or Neighbourhood Plans), considering what requirements can be placed on developers to maximise energy efficiency, encourage the take-up of renewable technologies and reduce carbon emissions associated with the built environment.

Key findings

Potential for new renewable and low carbon energy projects

The potential for new large-scale renewable/low carbon energy projects in Mid Sussex is limited due to a range of technical constraints (e.g. communication links and airport/radar, particularly for wind) as well as nationally important landscapes (area of outstanding natural beauty and nearby national park). Whilst such constraints do not necessarily preclude renewable energy development, the range of issues simply increases the risks for potential developers. This is one of the reasons why there has been no significant interest from developers in bringing forward major renewable energy projects in Mid Sussex to date.

[1] West Sussex Sustainable Energy Study, Centre for Sustainable Energy, 2009

Potential for community-led energy projects

Given the limited potential for larger commercial scale renewable energy projects, one opportunity may be for community-led renewable/low carbon led schemes at a smaller scale, for example a community owned wind turbine(s), solar farm or biomass scheme. These types of project are encouraged in national planning policy and could be delivered as part of neighbourhood plans or other local initiatives to help support energy security, respond to fuel poverty and reduce carbon emissions. Similar schemes in the UK typically involve the local community having shared investment in project, which could offset their energy bills or provide a longer term financial return on their investment.

Landscape capacity

With Mid Sussex covered by an area of outstanding natural beauty (High Weald) and adjacent to a national park (South Downs), the potential for landscape impacts was a key issue raised in previous work commissioned by the Council. Whilst landscape designations need not necessarily preclude renewable energy schemes, it is likely that if projects do come forward then the focus will be on well designed smaller scale schemes which are sensitive to landscape character and site-specific characteristics.

Delivering on-site renewables and zero carbon development

A traditional approach to ensuring that new residential/commercial developments are energy efficient and reduce carbon emissions is to ask a developer to provide a specific percentage of renewable energy on-site as part of their scheme (typically 10%). A similar model could be adopted in Mid Sussex however consideration needs to be given to wider national initiatives, including changes to building regulations, which will already necessitate use of on-site renewables. For example, from 2016 all new homes are expected to be ‘zero carbon’, to be enforced through building regulations through a combination of energy efficiency (better building performance), on-site renewables and off-site measures known as ‘allowable solutions’ (likely to be a financial contribution paid by the developer).

A wider approach to housing and development standards

Established standards already exist to help ensure sustainable design and construction for new homes and commercial developments, namely the Code for Sustainable Homes and BREEAM respectively. Typically, local planning authorities have required that developers achieve a particular rating against these standards, for example that all new homes are to be built to Code for Sustainable Homes Level 4 and non-residential development to achieve BREEAM ‘Excellent’. The caution with pursuing this approach is that the government is now proposing to scale back use of the Code for Sustainable Homes. Many elements of the Code are to be incorporated within future revisions to building regulations to help achieve the zero carbon building standard (building regulations are expected to be set at a level commensurate with Code Level 4). It is for these reasons that the government’s latest consultation on housing standards suggests that planning authorities should no longer include Code requirements in their plan.

Summary

There are two main areas where planning policy can assist with the take-up of renewable energy and energy efficiency in Mid Sussex, reflecting the policy context and key findings in this report:

- Providing a policy which both supports and encourages renewable energy schemes, including community-led schemes, subject to considering the local environmental impacts (from impacts on landscape to heritage and amenity).

- Providing a policy which requires developers to actively plan for energy efficiency and renewable energy as part of new development projects (including sites allocated in the District Plan or future neighbourhood plans), linking with national policy. The focus here will be on ensuring that developer's actively respond to national targets, such as zero carbon homes from 2016, given the land-use implications that this could have for their masterplans (e.g. the need to consider on-site generation to achieve the zero carbon standard).

In developing the policy recommendations in this report it is important to note that the national policy context is still evolving, with further government announcements pending in relation to its housing standards review and timetable for delivering zero carbon homes. It is for these reasons that the policy wording may need to be revisited as the plan-making process continues.

Contents

1. Introduction

1.1 Context

Mid Sussex District Council (the Council), alongside Arun, Chichester, Horsham and Worthing Councils, commissioned a Sustainable Energy Study in 2009[2] to investigate the opportunities for renewable and low carbon energy across West Sussex County. This work informed policies within the Mid Sussex District Plan submitted in July 2013 (since withdrawn). With work now underway on a revised District Plan, the Council is seeking to update its renewable energy evidence base and draft new policies based on the latest national policy context. This links with wider evidence commissioned by the Council, including an updated Mid Sussex Capacity Study[3].

1.2 Purpose of this Report

The objectives addressed in this report can be summarised as follows:

- **Policy & legislation** – To establish the latest position in what is a an ever changing national policy context, reflecting targets for climate change as well as the government's zero carbon buildings programme and on-going housing standards review. This will be central to the development of planning policies for the emerging District Plan.

- **Resource Assessment** – To assess the current contribution from decentralised renewable / low carbon energy technologies operating in Mid Sussex and the opportunity for new projects, considering wind, solar, biomass and decentralised energy supply such as combined heat and power (CHP) networks. As part of this assessment, cumulative effects and cross-boundary issues will also be addressed.

- **Feasibility Assessment** – To consider the feasibility for delivering new renewable energy projects, accounting for both technical constraints (resource availability and environmental considerations) and financial constraints (to inform a revised viability assessment).

- **Local Policy Development** – To provide draft policy options to test as part of the emerging District Plan reflecting feasibility, viability, cumulative impacts and how constraints can be overcome.

[2] 'West Sussex Sustainable Energy Study', Centre for Sustainable Energy, 2009
[3] 'Mid Sussex Capacity Study', LUC, 2014

2. Policy Context

2.1 National Policy and Legislation

2.1.1 National Legislation

The 2008 Climate Change Act commits the UK Government to delivering an 80% reduction in carbon emissions by 2050 (against a 1990 baseline) in order to help mitigate future climate change. With energy use from the built environment accounting for a significant proportion of the UK's total carbon emissions[4] the Government has identified both the spatial planning system and building regulations as having key roles to play. This is complemented by the Planning and Energy Act 2008, which first allowed local planning authorities to request on-site renewable or low carbon energy generation as part of new developments, typically referred to as the 'Merton rule' (e.g. that 10% of a development's energy demands shall be met via the use of on-site renewables). As part of the government's 2014 Deregulation Bill, it was proposed that the Planning and Energy Act would be modified to remove these provisions. However, the government has since stated that this requirement will remain following concerns from renewable energy groups.

2.1.2 National Planning Policy and Guidance

The role of the planning system in reducing emissions is affirmed in the National Planning Policy Framework (NPPF)[5] by encouraging local planning authorities to plan for new development in ways which reduce emissions (linked to wider policies on reducing the need to travel by car), actively supporting energy efficiency improvements to buildings and linking with the government's policy for zero carbon buildings (zero carbon homes from 2016). The NPPF also requires local planning authorities to have a positive strategy to promote energy from renewable and low carbon sources, design policies to maximise renewable and low carbon energy development, consider identifying suitable locations for such developments, support community-led initiatives and identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon sources[6].

The NPPF is accompanied by Planning Practice Guidance (PPG), which provides further details on how local planning authorities can promote the development of renewable energy strategies in their areas, balanced against the views of communities and local environmental impacts (Refer Box 2.1).

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[4] In 2009 buildings accounted for about 43% of all the UK's carbon emissions - source: Department for Communities and Local Government, https://www.gov.uk/government/policies/improving-the-energy-efficiency-of-buildings-and-using-planning-to-protect-the-environment (accessed February 2014)

[5] Department for Communities and Local Government, March 2012

[6] Refer Paragraphs 95-97, NPPF

Box 2.1 Extract from Planning Practice Guidance

Paragraph: 003 Reference ID: 5-003-20140306

How can local planning authorities develop a positive strategy to promote the delivery of renewable and low carbon energy?

The National Planning Policy Framework explains that all communities have a responsibility to help increase the use and supply of green energy, but this does not mean that the need for renewable energy automatically overrides environmental protections and the planning concerns of local communities. As with other types of development, it is important that the planning concerns of local communities are properly heard in matters that directly affect them.

Local and neighbourhood plans are the key to delivering development that has the backing of local communities. When drawing up a Local Plan local planning authorities should first consider what the local potential is for renewable and low carbon energy generation. In considering that potential, the matters local planning authorities should think about include:

- the range of technologies that could be accommodated and the policies needed to encourage their development in the right places;
- the costs of many renewable energy technologies are falling, potentially increasing their attractiveness and the number of proposals;
- different technologies have different impacts and the impacts can vary by place;
- the UK has legal commitments to cut greenhouse gases and meet increased energy demand from renewable sources. Whilst local authorities should design their policies to maximise renewable and low carbon energy development, there is no quota which the Local Plan has to deliver.

In particular, the PPG lends support to 'community-led' renewable energy initiatives, directing to further guidance provided by DECC[7], which identifies opportunities including:

- Community-owned renewable electricity installations such as solar photovoltaic (PV) panels, wind turbines or hydroelectric generation.
- Members of the community jointly switching to a renewable heat source such as a heat pump or biomass boiler.
- A community group supporting energy saving measures such as the installation of cavity wall or solid wall insulation, which can be funded wholly or partly by the Green Deal.
- Working in partnership with the local Distribution Network Operator (DNO) to pilot smart technologies.
- Collective purchasing of heating oil for off gas-grid communities
- Collective switching of electricity or gas suppliers.

For larger 'nationally significant' renewable energy projects, the government's National Policy Statement for Renewable Energy Infrastructure (EN-3)[8] applies. These larger scale projects would be determined via the Planning Inspectorate rather than the local planning authority, with a threshold of 50 MW for onshore projects (e.g. 14 or more large wind turbines) and 100 MW for offshore.

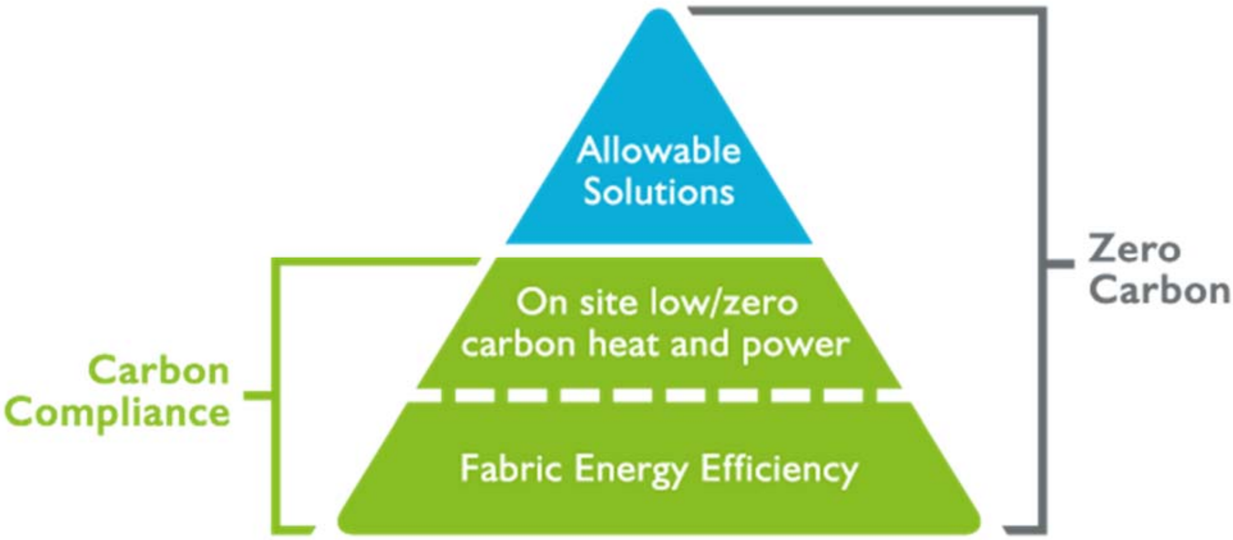
[7] https://www.gov.uk/community-energy (Accessed October 2014)
[8] DECC, July 2011

2.1.3 Building Regulations and Standards

Changes to national building regulations are on-going, alongside a government review of housing standards to reduce the number of requirements on developers. This is linked to achieving a target for zero carbon homes from 2016, which has involved incremental changes to Part L (Conservation of Fuel and Power) of the original 2006 Building Regulations: 2010 regulations represented a 25% improvement in carbon performance against 2006, with 2013 regulations representing a further 6% improvement.

The zero carbon hierarchy proposed by government is outlined in Figure 2.1. The key issue is the mechanism and final approach to delivering 'allowable solutions' (which could be off-site measures) where further guidance is awaited from government. From a planning perspective, the main consideration is what impact the 'on site low/zero carbon heat and power' could have for the masterplanning of strategic sites. It is considered important for developers to take this into account in preparing their proposals.

Figure 2.1 Zero Carbon Hierarchy



Source: Zero Carbon Hub

The government's latest consultation reports on housing standards suggests that nationally recognised standards, such as the Code for Sustainable Homes (CSH), should no longer be requested as part of local plans, with many elements of the CSH to be incorporated within national building regulations, broadly equivalent to CSH Level 4.

> *"From the date of the statement* [the Policy Statement to be published setting out the government's final list of standards], *local planning authorities will continue to be able to set and apply policies in their local plan requiring development in their area to comply with energy efficiency standards that exceed the energy requirements of building regulations until the zero carbon home policy has been put in place. This will happen alongside the commencement of the amendment to the Planning and Energy Act 2008, which,*

subject to Parliamentary approval, we anticipate would be in late 2016. The Government has stated that from that point forwards the energy efficiency requirements in Building Regulations will be set at a level equivalent to Code Level 4. Until the amendment is commenced, we would expect local planning authorities to take the statement of the Government's intention into account in applying existing policies and not set conditions requiring energy efficiency requirements above a Code level 4 equivalent."

For reference, and to inform wider viability testing, Table 2.1 summarises the likely cost implications of achieving particular CSH levels, Building Research Establishment Environmental Assessment (BREEAM) rating and zero carbon standard. The key point here is that from 2016 the zero carbon standard is likely to present the 'baseline' to which all homes need to be built, as such it would not necessarily be seen as an extra over cost. In addition, the government has signalled that the main elements of CSH Level 4 are likely to form the basis for future building regulations. The combination of CSH Level 4 and the zero carbon standard are therefore ultimately likely to form the future baseline for building regulations, most likely from 2016. The ability to go further than this is then subject to cost and viability implications, with CSH Levels 5 and 6 having significant extra over costs (at least £6k per dwelling). Fundamentally, this is why there has been limited widespread national take-up of these standards. If the Council did want to pursue these higher standards then it would need to be considered as part of a plan-wide viability appraisal.

With regard to BREEAM, national information on extra over costs is limited when compared to the CSH. However, figures suggest that achieving a BREEAM Very Good-Excellent rating should not have a major cost impact for a scheme. BREEAM Outstanding is of course more challenging and costly to implement, as would be expected since it is deliberately intended to be the highest level of environmental performance for a building.

Table 2.1 Costs associated with sustainable building standards

Standard	Cost implications
Residential development	
Compliance with current Building Regulations (Part L) 2013	No E/O cost (baseline)
2016 Building Regulations (Zero Carbon standard)	£6,700-7,500 per dwelling (pd) for detached houses £4,100-5,100 pd for semi-detached/mid-terraced £2,300-2,500 pd for apartments *Source: Cost Analysis: Meeting the Zero Carbon Standard, Zero Carbon Hub, February 2014*
CSH Level 4 CSH Level 5 CSH Level 6	Up to £2,500 pd £6,000-9,000 pd £15,000-20,000 pd *Source: Cost of Building to the Code for Sustainable Homes, Element Energy & Davis Langdon, 2013*

Non-residential	
BREEAM 'Very Good'	Up to 0.2% increase in capital cost for a building (0.2% uplift for school, 0.04% for warehouse, 0.24% for supermarket, 0.17% for office and 0.14% for mixed use)
BREEAM 'Excellent'	Up to 1.8% increase in capital cost for a building (0.7% uplift for school, 0.4% for warehouse, 1.76% for supermarket, 0.77% for office and 1.58% for mixed use)
BREEAM 'Outstanding'	Up to 10% increase in capital cost for a building (5.8% uplift for school, 4.8% for warehouse, 10.1% for supermarket, 9.8% for office and 4,96% for mixed use)
	Source: Table 3: Capital cost uplift for a range of building (their source Target Zero), The Value of BREEAM, A BSRIA Report by James Parker, 2012

2.1.4 UK Implementation of EU Directives

UK policy is influenced by a number of European Directives relevant to climate change and the built environment:

EU Energy Performance of Buildings Directive – The recast version of this Directive outlines requirements for all new non-domestic buildings occupied and owned by public authorities to be 'nearly zero energy' from December 2018 onwards. This will then be extended to all new buildings constructed from December 2020 onwards. A further requirement is that prior to construction the technical, environmental and economic feasibility of alternative energy systems must be reviewed and documented. This specifically includes decentralised energy systems based on energy from renewable sources.

Energy Efficiency Directive – This includes a requirement that Central Governments purchase only products, services and buildings with high energy-efficiency performance.

2.1.5 Other Drivers

The Energy Act 2008 enabled market incentives for some forms of low/zero carbon energy generation through provision of feed in tariffs (FiTs) and the renewable heat incentive (RHI).

FiTs: the scheme was introduced in 2010, aiming to encourage the deployment of small-scale renewable energy technologies (less than 5 megawatts (MW). It is open to organisations, businesses, communities and individuals. Similar to other renewables support schemes, payment is made for each kilowatt hour (kWh) of electricity generated. As in the case of the Renewables Obligation (RO), the rate paid is dependent on the technology used to produce the electricity. The rate is fixed for a 20 year period from date of registration on the scheme. Eligibility is determined and administered by the Office of Gas and Electricity Markets (Ofgem) and payments are made from the energy suppliers[9].

[9] A full list of Registered FIT Licensed Suppliers is available at https://www.ofgem.gov.uk/environmental-programmes/feed-tariff-fit-scheme/applying-feed-tariff/registered-fit-licensed-suppliers (Accessed October 2014

RHI - The RHI is a financial support scheme that aims to increase significantly the proportion of heat that is generated from renewable sources. It was introduced in 2011 initially for non-domestic sectors[10]: industrial and the commercial sector; the public sector; not-for-profit organisations; and communities. The scheme is a DECC policy mechanism and is administered by Ofgem.

It has certain similarities to FITs with various payment rates determined by technology type; the scheme provides payment for every eligible unit of heat produced (i.e. per $kWh_{thermal}$) and the payment rate is fixed for a 20 year period.

Green Deal[11] **-** Alongside these market incentives the Government has also introduced the Green Deal. This initiative promotes the installation of energy efficiency measures to householders and businesses to help reduce energy use and bills. There is no upfront cost to the consumer; instead a finance package will be repaid via a charge on their existing electricity bill over a specified period. The Green Deal 'Golden Rule', set out in legislation, specifies that any additional charge on the electricity bill must be less than the expected savings from the retrofit over the specified period.

2.2 Mid Sussex Sustainable Communities Strategy 2008-18

The Sustainable Communities Strategy, prepared by the Mid Sussex Partnership, is clear that more energy and resource efficient developments are to be promoted alongside ensuring adaptation to future climate change. In addition, the need to encourage developments and projects which reduce CO_2 emissions is also identified.

2.3 Implications for the emerging District Plan

This national and local policy context has the following implications for the District Plan:

- The Council needs to plan for renewable and low carbon energy, looking out how take-up can be encouraged, whilst also reflecting the needs of local communities and local environmental impacts. In particular, national guidance is clear that community-led schemes should be considered. For Mid Sussex, neighbourhood planning may be one opportunity for exploring the potential for community-led schemes.

- The Council can still request a proportion of on-site renewables from new developments (i.e. Merton Rule), which is still retained in the Planning and Energy Act 2008, based on the feasibility and viability of doing so.

- Planning policies need to take account of the government's timetable for zero carbon homes, with developers needing to consider the potential land-use implications of incorporating on-site renewable/low carbon technologies as part of achieving this standard. This will be important to 'future proofing' development projects to ensure they factor in the higher standards to be implemented by government in the future.

[10] The scheme was expanded to the domestic sector in April 2014
[11] https://www.gov.uk/green-deal-energy-saving-measures (Accessed September 2014)

- Whilst targets to achieve particular levels of the Code for Sustainable Homes could still be set (dependent upon financial viability), it is likely that setting specific requirements in local plans will soon no longer be supported by government.

3. Mid Sussex's Carbon Profile

3.1 Existing Energy Consumption

National figures from the Department for Energy and Climate Change (DECC) provide a breakdown of energy consumption for Mid Sussex District. The latest figures for electricity and natural gas are from 2012[12].

3.1.1 Electricity Consumption

The trend in electricity consumption for domestic and commercial customers 2005-2012 is shown in Figure 3.1; a steady decline in domestic energy demand is evident. For domestic consumers, the average electricity consumption per meter in Mid Sussex in 2012 amounted to 4,502 kWh, which is higher than the average for Great Britain as a whole of 4,014 kWh. For non-domestic consumers, the average electricity consumption per meter in Mid Sussex in 2012 amounted to 48,898 kWh, which is lower than the average for Great Britain as a whole of 75,372 kWh. In Mid Sussex there is therefore a higher than average domestic energy consumption and significantly lower than average non-domestic consumption.

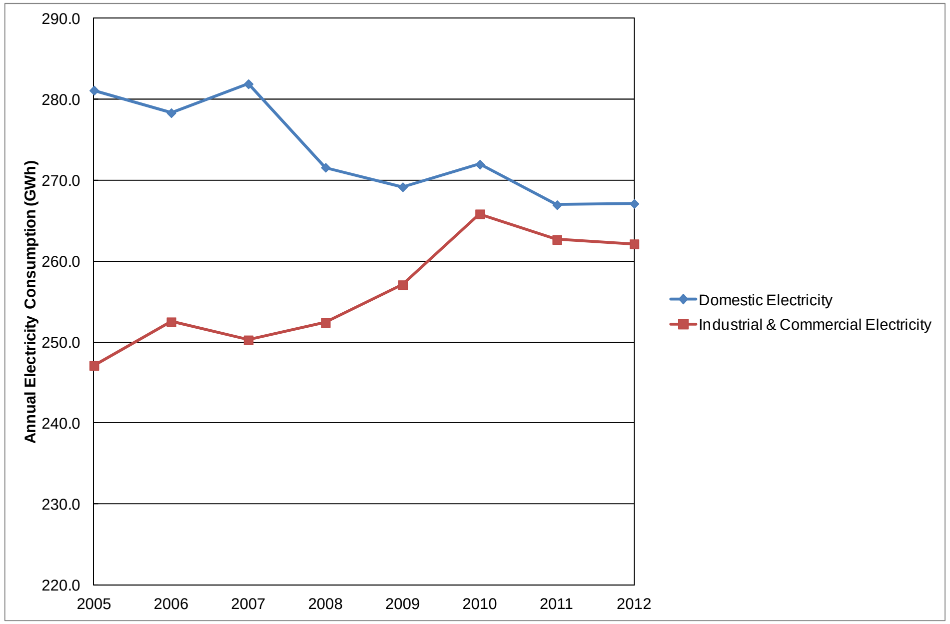
3.1.2 Natural Gas Consumption

In the case of gas consumption the consumption trend is as per Figure 3.2. A decline in consumption can be seen in the case of both domestic and non-domestic consumers. For domestic consumers, the average gas consumption per meter in Mid Sussex in 2012 amounted to 15,060 kWh, which is higher than the average for Great Britain as a whole of 14,080 kWh. For non-domestic consumers, the average gas consumption per meter in Mid Sussex in 2012 amounted to 386,948 kWh, which is lower than the average for Great Britain as a whole of 688,941 kWh.

In Mid Sussex there is therefore a higher than average domestic gas consumption and lower than average consumption from non-domestic users.

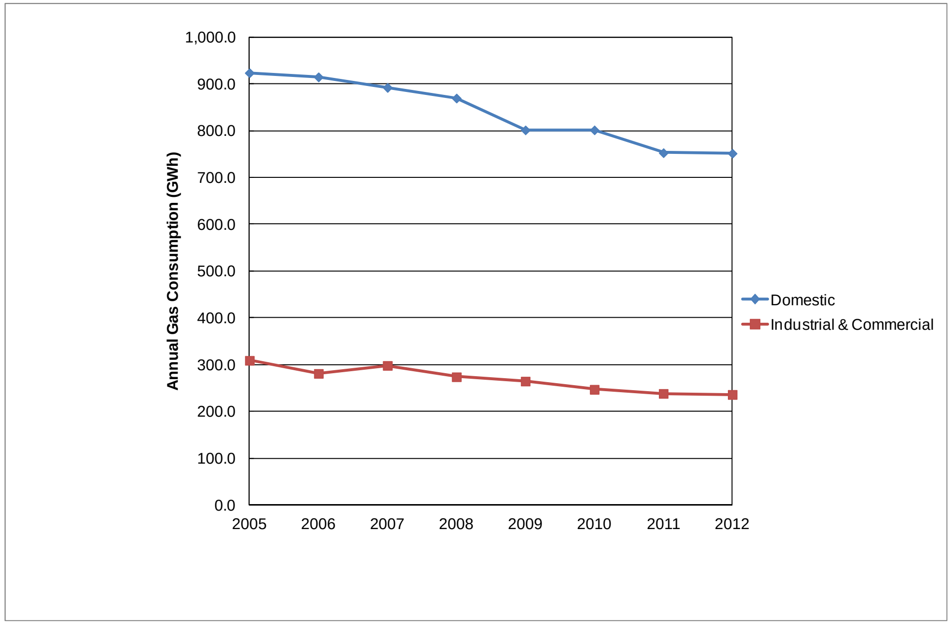
[12] https://www.gov.uk/government/statistics/mlsoa-electricity-and-gas-2012 (Accessed August 2014)

Figure 3.1 Existing Electricity Consumption



Source: DECC Statistics

Figure 3.2 Existing Natural Gas Consumption

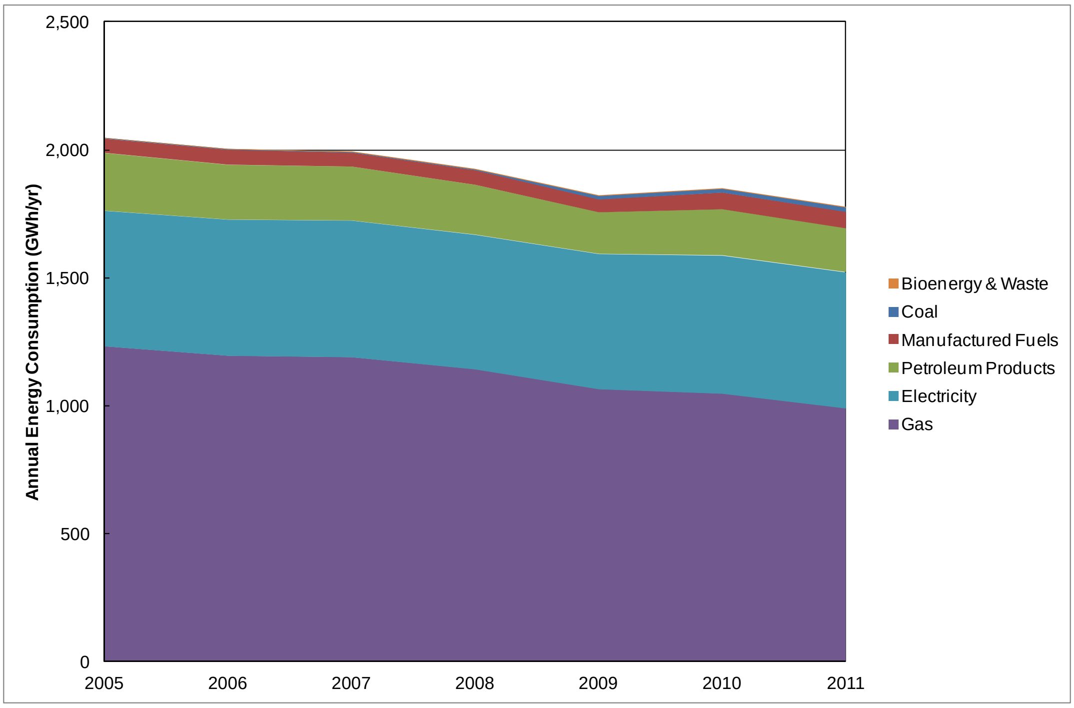


Source: DECC Statistics

3.1.3 Total Energy Consumption

Electricity and natural gas are the predominant energy sources used in Mid Sussex, amounting to around two thirds (68%) of non-domestic energy consumption and the vast majority of domestic energy consumption (98%). A summary of the total energy consumption within the District broken down by energy source is provided in Figure 3.3.

Figure 3.3 Regional Energy Consumption by Energy Source



Note: DECC Statistics. Petroleum products are those not used in transportation. Manufactured fuels are secondary fuels such as coke and breeze not used in electricity generation

Existing energy consumption within Mid Sussex is dominated by electricity and mains supplied gas. A summary of key details is provided in Table 3.1.

Table 3.1 Existing Energy Consumption in Mid Sussex (2011)

Energy Source	GWh/yr	tCO_{2e}/yr
Total Energy Consumption, of which:	**1,780**	**508,790**
Natural Gas	991	182,379
Electricity	530	259,890
Petroleum Products	173	43,384
Manufactured Fuels	65	17,502
Coal	18	5,636
Bioenergy & Waste	3	
Average Consumption Per Meter	**kWh/yr**	**tCO_{2e}/yr**
Domestic Natural Gas - Mid Sussex (Great Britain)	15,060 (14,080)	2.8
Non-Domestic Natural Gas - Mid Sussex (Great Britain)	386,948 (688,941)	71.2
Domestic Electricity - Mid Sussex (Great Britain)	4,502 (4,014)	2.2
Non-Domestic Electricity - Mid Sussex (Great Britain)	48,898 (75,372)	24.3

Note: Transport fuel consumption is excluded from these figures. Rounding of figures means sub-totals may not sum accurately. All carbon emissions calculated using latest published emission conversion factors from DECC

3.2 Future Energy Consumption

The previous draft of the District Plan provided an indicative housing requirement of approximately 530 dwelling per annum. Whilst this may be subject to change, it is a helpful starting point to consider what the District's future energy demands could be.

Table 3.2 Submission District Plan Proposed Housing Development Summary

Item	Number of Units
District Plan Requirement	10,600
Completions	-522
Net Total Housing Requirement	10,078
Total Housing Commitments	4,213
Total to be identified	5,865
Burgess Hill Strategic Development	3,865
Elsewhere in the District, as allocated through Neighbourhood Plans or other appropriate planning documents	2,000
Average rate of completions	530 pa

Table 3.3 provides an estimate of the energy demand associated with this future housing growth. Against a 2011 baseline, these new homes could increase the District's energy demands by up to 12%.

Table 3.3 Summary of Estimated Future Energy Demand (New Developments)

Housing	No. of Units	Heat Demand (GWh/yr)	Electricity Demand (GWh/yr)	Total Energy Demand (GWh/yr)
Total Housing Commitments	4,213	30.0	9.8	39.8
Future Commitments	5,865	37.3	49.9	87.2
Total	10,078	67.3	59.7	127.0
% of 2011 Demand		9%	22%	12%

Note: At this stage no details regarding the mix of dwelling types to be built is available. In developing an estimate of the forecast energy requirements of these proposed developments a number of assumptions need to be made to inform our energy demand assessment (Refer Appendix A for details).

It is likely that the majority of units constructed over the lifetime of the plan will need to meet zero carbon home standards once introduced in 2016. This will involve minimum performance standards as set via Building Regulations in terms of both fabric energy efficiency and on-site energy generation requirements. All remaining regulated carbon emissions will then need to be offset via 'allowable solutions'. Such allowable solutions could include district heating or retrofit efficiency measures implemented in neighbouring existing properties.

The combination of these requirements means that the energy demand estimates provided here are likely to be an upper limit to future energy demand. The use of allowable solutions may well have a small impact in reducing energy consumption (and associated carbon emissions) within existing buildings, for example if the allowable solution includes investment aimed at improving energy efficiency within existing communities.

All new non-domestic buildings from 2019 onwards will need to meet zero carbon building standards although there is less detail from government as to how this will be delivered.

3.3 Low and Zero Carbon Generation

In Mid Sussex, as across the rest of the UK, there is a continuing growth in the extent of energy generation available from renewable or low carbon sources. Renewable energy and low carbon generation can come in the form of either stand alone devices used at individual building level (e.g. roof mounted solar PV or a small scale wind turbine) or in decentralised systems supplying a number of buildings (e.g. district heating). Before considering what new potential exists for renewable and low carbon energy, it is first helpful to look at what *existing* schemes are operational in Mid Sussex. A summary of known existing renewable energy capacity is provided in Table 3.4.

Table 3.4 Existing Renewable / Low Carbon Energy Generation Capacity in Mid Sussex

Technology	Number of Installations (No.)	Installed Capacity (kW_e)	Installed Capacity (kW_{th})	Commentary
Biomass Heating	1		300	Hoathly Hill
Sewage Gas Electricity	1	465		Goddards Green (Southern Water Services)
Non-Domestic Renewable Heat Incentive (Biomass, Heat Pumps, Solar Collectors, Biogas)	8		1,400	RHI DECC Statistics at April 2014
Non-Domestic Solar PV	42	1,346		Feed in Tariff - DECC Statistics at June 2014
Domestic Solar PV	1,355	4,544		Feed in Tariff - DECC Statistics at June 2014
Non-Domestic Wind	2	4		Feed in Tariff - DECC Statistics at June 2014
Domestic Wind	2	11		Feed in Tariff - DECC Statistics at June 2014
Domestic Micro-CHP	3	3		Feed in Tariff - DECC Statistics at June 2014
Total		6,373	1,700	

Source: RESTATS database, DECC statistics, ECO/Green Deal statistics

Note: this is not intended as a definitive list of *all* renewable and low carbon energy schemes in Mid Sussex but it provides an overview based on publicly available information.

Whilst the majority of these installations serve individual buildings there is a biomass fed community heating scheme feeding the Hoathly Hill Community. This provides space heating and hot water to a total of 27 buildings.

3.4 Summary

This section of the report establishes the baseline in terms of Mid Sussex's current energy demand, emissions and existing contribution from renewable and low carbon sources of energy. In summary our assessment shows that:

- Proposed growth via the District Plan is unlikely to have a significant impact on energy demand (less than 12%) or associated emissions, given minimum energy efficiency requirements and use of renewable energy under building regulations. The key issue will of course be to ensure that developer's future proof their schemes in response to the national target for zero carbon homes from 2016 given associated design implications.

- The biggest challenge will be to see how energy efficiency and renewable energy can be maximised within the *existing* built environment, particularly reflecting on the limited prospects for strategic scale renewables in the district (both at present and in terms of future potential – see also section 4). Allowable solutions may be one approach to responding here, for example if it involves a 'retrofit' project but the main mechanism is likely to be through national energy legislation to decarbonise the national grid. The ability for planning policy to affect change on the existing built environment in terms of energy efficiency and renewable energy is therefore somewhat limited.

- Where new renewable and low carbon energy schemes have come forward in Mid Sussex, this has been predominantly via domestic scale installations, such as solar PV, driven by financial incentives such as the FiT. The take-up of strategic/commercial scale energy projects has been limited.

4. Resource Assessment

4.1 Summary of Potential Capacity

A review of the original West Sussex wide study has been carried out in order to provide an understanding of the scale of renewable energy that could be realised in Mid Sussex. Table 4.1 highlights the technologies investigated and their potential energy generation capacity.

If the full potential from all of these technologies could be exploited, then some 100,000 tonnes of CO_{2e} per year could be offset, equivalent to around 20% of Mid Sussex's annual emissions from a 2011 baseline. The figures in Table 4.1 are indicative, and based on a number of assumptions, but they demonstrate a helpful order of magnitude as to what could potentially be achieved.

It is important to note that where sites or areas are shown as subject to technical and/or environmental constraints (or that they lie beyond such constraints) this is not to reflect a judgement on whether a site would be suitable in planning terms. Our assessment is simply to identify what technical potential exists. Any specific proposal for a site or area would need to be based on site-specific work, environmental surveys, discussions with Mid Sussex District Council (as local planning authority) and consultation with local communities.

Table 4.1 Estimated Potential Deployment by Technology

Technology	Potential Capacity (MW)	Electricity Generation (MWh/yr)	Heat Generation (MWh/yr)	Abatement Potential (tCO_{2e})
Wind	7.5	14,250	NA	6,890
Solar PV (Ground Arrays)	13	14,520	NA	7,020
Solar PV (Building Mounted)	20	17,420	NA	8,420
Solar Thermal	10	NA	6,740	1,240
Hydro	0.1	958	NA	460
Biomass (Wood / Energy Crops)	23 / 0.3	2,985	71,395	14,580
Biomass (Waste Streams)	9	71,567	178,916	67,540
District Heating	10 – 20	NA	*	*
Heat Pumps	< 0.1	NA	160	40
Micro-CHP	< 0.01	-	-	-
Geothermal	NA	NA	NA	NA
TOTAL				106,180

Note: Abatement potential means what level of CO_{2e} could be offset through the use of the different technologies, (rounded to 2 significant figures)

* District heating generation dependent upon number of schemes taken forward and end consumer mix.

The remainder of this section provides a more detailed review of the potential from these different renewable and low carbon energy sources.

4.2 Wind

At a height of 45 m above ground level (agl) the average annual wind speed in Mid Sussex is shown in Figure A.1. It can be seen that the majority of average wind speeds are in the range 6.3 – 6.6 ms^{-1}. Developers will typically consider wind turbines in areas where the average wind speed is 6 ms^{-1} or higher. However, wind speed is only one factor influencing the commercial viability of wind turbines. The recently updated capacity study[13] lists several key issues:

Environmental Designations - Mid Sussex has a number of important biodiversity, landscape and heritage designations which can limit capacity of the District to accommodate development. These include Sites of Special Scientific Interest (SSSI), ancient woodland, Sites of Nature Conservation Importance (SNCIs), local nature reserves and biodiversity opportunity areas (BOAs).

Landscape Capacity – Preservation of landscape character areas and national landscape designations in the form of the High Weald AONB and South Downs National Park.

Historic Environment – Taking due account of listed buildings, registered parks and gardens, scheduled monuments, conservation areas, registered battlefields and heritage at risk.

In addition, impacts on amenity (e.g. noise), transport and wider environmental factors also need to be taken into account. These, and other relevant factors in development potential, are summarised in Table 4.2.

Table 4.2 Constraints Considered for Wind Assessment

Constraint	Description	Impact on siting of wind turbine
Wind Resource	Reviewing published average wind speed data for areas within the Mid Sussex boundary	Wind turbines best sited where mean average wind speeds are highest
Environmental	Designated landscapes, heritage sites, wildlife sites and protected species	Development needs to be sensitive to these designations and key features of interest
Infrastructure	Roads, railways, power lines, airfields, airports	Turbines need to be sited away from major infrastructure
Noise	Separation distances to buildings and development areas	Wind turbines must be sited at sufficient distance from existing buildings to ensure noise levels meet national requirements.

[13] Capacity of Mid Sussex District to accommodate development, LUC (2014)

Constraint	Description	Impact on siting of wind turbine
Flood Risk	Proximity to water courses	Siting turbines in areas of flood risk would require expensive foundations and make access for maintenance more costly
Ministry of Defence	MOD owned sites and related radar operation issues	Turbines need to be at a distance from MOD sites that avoids any compromising of MOD activities.
Grid Connection	Proximity to a feasible grid connection point	This will indicate whether substantial cabling and support infrastructure may be required
Grid Capacity	Availability of the distribution network to incorporate the additional power output.	Lower network capacity may require upgrades to grid infrastructure such as substations and safety systems (at a cost to the wind developer)
Safeguarded CAA sites, NERL and other radar systems (aviation issues):	Potential issues of interference with radar systems.	Careful siting will minimise impacts on radar systems and reduce any potential mitigation costs
Radio / Communications Links / fixed microwave links:	Existing location of communication links	Careful siting will minimise impacts on the links and reduce any potential mitigation costs
Construction	Outline construction requirements	Avoiding complex development areas (e.g. wetland areas), minimising the need for more complex wind turbine infrastructure.
Access	Ease of access to site for construction / maintenance.	Due to the size of medium to large scale wind turbine components access can determine if a site will be physically and economically feasible.

Application of these constraints suggests that the technical potential available for medium to large scale wind within Mid Sussex amounts to 7.5 MW of capacity. Fundamentally, there is limited scope for significant wind farm development given the combination of environmental designations, communication and radar issues and proximity to existing communities. Any proposal for a wind farm would need to consider all of these factors, but in our view it is likely that where such development does come forward then it is more likely to be smaller scale, e.g. one or two turbines in a given location (Further details are provided in Appendix A).

4.3 Solar

4.3.1 Solar Photovoltaics (Solar PV)

Building Mounted Solar PV

The technical potential available in Mid Sussex for building mounted solar PV is estimated at 20 MW_p. Building mounted solar PV can be installed on both domestic and non-domestic properties where roof orientation and over-shading allow. It is noted that the data presented in Section 3.3 shows that there is already around 6 MW_p of solar PV capacity installed within Mid Sussex (approximately 4.5 MW_p of domestic installations and 1.5 MW_p of non-domestic installations).

Solar PV is an integral part of building design in achieving compliance with Zero Carbon Homes (ZCH) requirements. It is therefore anticipated that there will be additional Solar PV capacity associated with major future developments in the area (e.g. at the allocated sites around Burgess Hill). Further details are provided in Appendix A.

Ground-Based Solar PV

Ground-mounted solar PV arrays offer further potential for an estimated 13 MW_p of capacity. Land availability for such arrays will be restricted by constraints similar to those applied in the case of wind. Given the capacity constraints it is unlikely that single site multi-Megawatt schemes will be brought forward in the Mid Sussex area. There is growing interest in community owned assets such as solar farms, financed via public share offerings, crowd funding or a combination of both. One such example is the Cuckmere Community Solar Company[14]. Similar types of schemes could be brought forward in Mid Sussex.

4.4 Hydro

The West Sussex wide study carried out in 2009 did not consider hydropower opportunities in any detail. An Environment Agency (EA) study of potential hydropower opportunities across England and Wales[15] shows no large scale (i.e. Megawatt scale) hydro opportunities identified within Mid Sussex.

There are a number of small scale hydropower (0 – 10 kW) sites identified as having potential within the EA study. A total of 40 locations with greatest development potential and associated details are summarised in Appendix A. While the precise details of each given scheme would be subject to more detailed feasibility work, an initial estimate is that this would amount to a maximum technical capacity of 100 kW capable of generating in the region of 960 MWh of electricity per annum. Hydro power will therefore only make a small contribution to low/zero carbon energy generation in the District.

4.5 Biomass

4.5.1 Woodland Residues and Energy Crops

The 2009 Sustainable Energy Study provides analysis of the total resource available for use in supplying to either heat only systems or large scale CHP. The summary figures are provided in Table 4.3.

[14] http://cuckmerecommunitysolar.com/who-we-are/ (Accessed September 2014)
[15] ‘Mapping Hydropower Opportunities and Sensitivities in England and Wales’, Environment Agency (2010)

Table 4.3 Woodland Residues and Energy Crops

Energy Source	Annual Yield (odt/yr)	Potential Heat Capacity (kW_{th})	Potential Electrical Capacity (kW_{e})
Woodland Residues	**16,153**	**23**	**-**
Broadleaved	9,925	14	-
Other	6,228	9	-
Energy Crops	**2,511**	**-**	**0.3**
Miscanthus	2,511	-	0.3
Short Rotation Coppice	0	-	-

Note: Energy Crops yields based on utilising 5% of available arable land once environmental designations have been accounted for

This provides an indication of the extent to which local resources could provide fuel supply. It does not necessarily mean that there is demand for all of this energy resource. The appetite for local landowners to exploit this resource within the biomass supply market will be determined by the number of existing suppliers already operating in the area (see list in Appendix A).

There are a limited number of large facilities operating within a 50 mile radius of Mid Sussex with significant demand for biomass fuel. All of these will have existing contracts in place. For these reasons it is unlikely that the entire energy potential identified here will be taken up.

4.5.2 Waste

The waste management hierarchy seeks to reduce, re-use or recycle waste prior to any energy recovery. Given recycling and recovery targets it is therefore likely that the waste stream available for energy generation will reduce over time. This is shown through comparison of the 2004/05 based figures used in the original 2009 study and most recent figures for 2012/13[16].

[16] West Sussex Minerals Local Plan and Waste Local Plan, Annual Monitoring Report 2012/13, West Sussex County Council (Accessed September 2014)

Table 4.4 Waste Arisings Figures for West Sussex

Year	Municipal Solid Waste (tonnes)	Commercial and Industrial Waste (tonnes)	Construction and Demolition Waste (tonnes)
2004/05	464,341	819,425	1,447,652
2012/13	414,000	604,000	949,000
Difference	-11%	-26%	-34%

Figures from the 2009 study, produced on a demographic pro rata basis, can therefore be seen as an upper boundary for potential energy generation (Table 4.5).

Table 4.5 Estimated Energy Generation Potential from Waste Streams

Waste Stream	Applicable Technology	Quantity of Waste (tonnes/yr)	Energy Generation Capacity (MW_e)
Commercial and Industrial Waste	EfW CHP	64,025	6.4
Municipal Solid Waste	EfW CHP	15,721	1.6
Agricultural Waste	Anaerobic Digestion	107,922	0.4
Waste Wood – Construction & Demolition	EfW CHP	3,510	0.5
Food waste- commercial and industrial	Anaerobic Digestion	25,610	0.1
Food waste – municipal solid waste	Anaerobic Digestion	13,804	0.1
Total		230,592	9.0

Source: West Sussex Sustainable Energy Study (2009)

Since waste management is strategically addressed at County level in West Sussex any large scale energy from waste facilities will be developed in partnership with the Borough and District Councils. A large scale facility is presently proposed for Horsham.

A downward trend in waste arisings means that any solution proposed at County Level will incorporate a large proportion of existing waste arisings (certainly in terms of MSW and potentially also in relation to food waste). For this reason it is unlikely that any large scale EfW facilities will be proposed within Mid Sussex.

Anaerobic digestion can be carried out at much smaller scales than EfW and therefore offers more potential for small scale facilities to be developed within Mid Sussex. As with EfW, any large scale facility proposed at County Level would be unlikely to be situated within Mid Sussex.

4.6 Heat

4.6.1 Solar Thermal

As the existing statistics for Mid Sussex show in Section 3 the number of solar thermal systems installed is not known at this point but does not make up a significant proportion of existing capacity. The technical potential for further installation is limited by a number of factors:

- Not all buildings have suitable roof areas available;
- For any given building only one of heat producing technologies is likely to be installed (e.g. biomass boiler rather than solar thermal, or heat pump);
- For any given building only one of solar thermal or solar PV is likely to be installed;
- Since solar thermal systems can only meet a proportion of overall building hot water demand they offer a limited contribution to the achievement of zero carbon homes standards. It is not therefore likely to feature extensively within proposed zero carbon home designs;
- Properties that are off the national gas grid will benefit most from the introduction of solar thermal systems; and
- In some instances built heritage designations may preclude installation of solar thermal systems.

It is unlikely that solar thermal will feature significantly in future development within Mid Sussex (either domestic or non-domestic). It is most likely to be installed as a retrofit measure on a proportion of existing properties (predominantly domestic). Domestic capacity is estimated at 7 MW_{th} and non-domestic capacity at 3.3 MW_{th} based on working assumptions regarding available roof areas (see Appendix A for details).

4.6.2 Heat Pumps

While the majority of properties in Mid Sussex have access to natural gas, there are a number of dwellings that do not (estimated at around 7,500[17]). These dwellings are therefore likely to offer the most economic opportunities for heat pump installation.

The heat output from heat pumps (whether ground, air or water) is lower than a typical wet radiator system fuelled via natural gas or oil. For this reason heat pumps are generally best used with underfloor heating, providing a larger surface area for supply. If used to supply a wet radiator system then these radiators need to be much bigger than conventional systems.

[17] DECC Statistics 2014

Consequently it is more difficult to retrofit heat pump systems in existing buildings than it is to install them in new build properties.

Large scale heat pumps, serving multiple properties, form part of the mix of technologies the UK Government anticipates will contribute to low carbon energy supply from 2030 onwards. A resource map providing an indication of areas where potential for water source heat pump use at this scale does not identify immediate opportunities within Mid Sussex[18].

In summary, heat pump opportunities are likely to be confined to new building properties and buildings not served by the national gas network. This provides only a small contribution to overall energy supply.

4.6.3 Micro-CHP

Micro-CHP are small scale combined heat and power (CHP) units designed for use in domestic premises. These units therefore feed space heating and hot water circuits in the dwelling just as a conventional boiler, but also provide additional energy output in the form of electricity. The electricity produced requires a single cable connection and can be readily integrated with existing electrical circuits.

Previous field trials conducted by the Carbon Trust suggest that micro CHP is best suited to larger houses[19]. There are a small number of commercially available units currently within the UK market, though this is anticipated to increase given the feed-in tariff support available to micro-CHP users.[20]

As can be seen in Section 3 the present installed capacity of micro-CHP in Mid Sussex is 3 kWe. It is not anticipated that this figure will rise significantly in future.

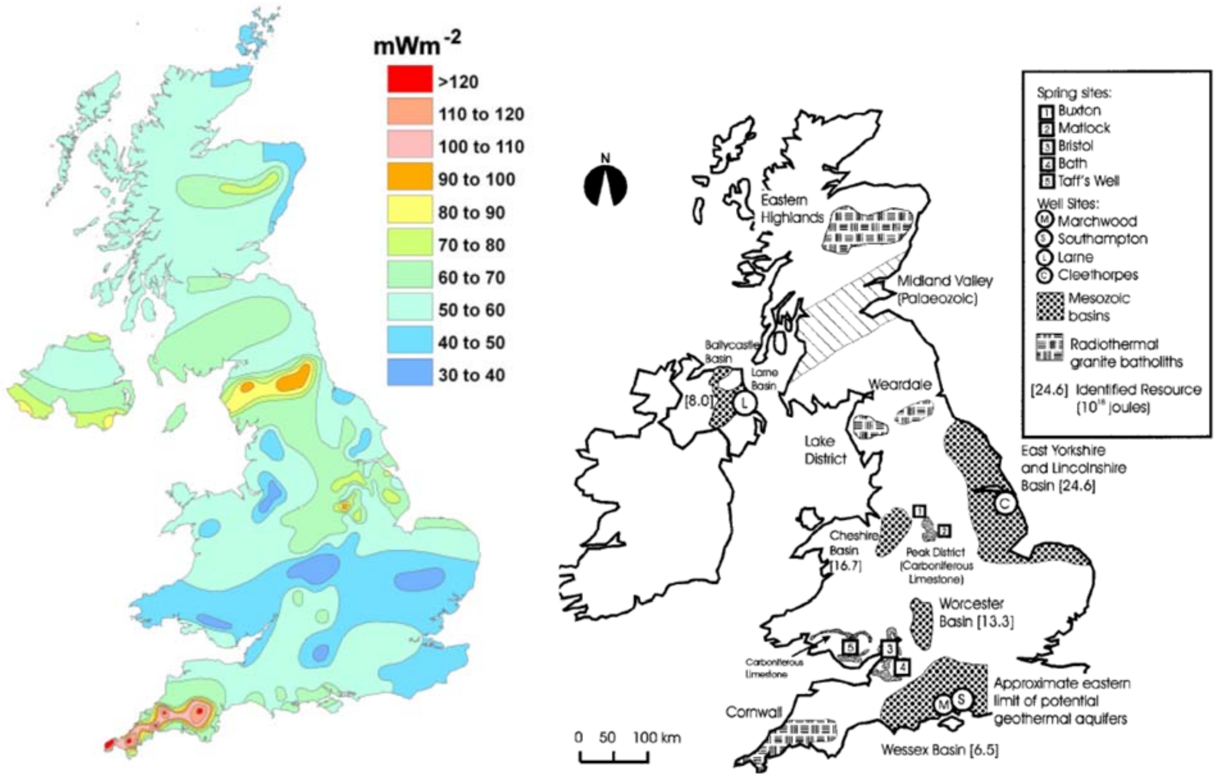
4.6.4 Geothermal

The potential for geothermal energy generation in the UK has been analysed as part of the Deep Geothermal Review study undertaken by DECC and summarised in a report released in October 2013[21]. The report used evidence from a number of previous studies examining the potential for geothermal energy generation in different areas of the UK.

The report identifies the key areas for UK geothermal resource which include granite outcrops in South West and northern England, and hot sedimentary aquifers in the Wessex and Cheshire basins (Figure 4.1). The Southampton Geothermal Heating Company (SGHC) was set up to exploit this resource in terms of the district heating scheme operational within Southampton.

[18] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/353979/decc_water_source_heat_map.pdf (Accessed September 2014)
[19] http://www.carbontrust.com/media/77260/ctc788_micro-chp_accelerator.pdf (Accessed September 2014)
[20] http://www.ecuity.com/wp-content/uploads/2013/03/The-role-of-micro-CHP-in-a-smart-energy-world.pdf (Accessed September 2014)
[21] Deep Geothermal Review Study Final Report Department of Energy & Climate Change (DECC) October 2013

Figure 4.1 Heat Flow Map of the UK (Left); Location of Sedimentary Basins and Major Radiothermal Granites (Right)



Source: DECC

The report identifies key criteria for the viability of any geothermal power generation systems in terms of being able to access a thermal store of greater than 100 deg C at a depth of no greater than 5 km. On this basis, the report does not identify any significant potential for geothermal power production within the Mid Sussex region.

4.6.5 District Heating

Ongoing tightening of carbon performance requirements of both domestic and non-domestic buildings means that the potential development of district heating networks is being given greater scrutiny. Large scale networks, serving hundreds of properties, operate across the UK and are typically supplied by large scale combined heat and power plants. These large networks are operated by Energy Service Companies (ESCOs) that also have responsibility for the billing of consumers on the network.

Identifying a large enough consumer base for heat is critical to maximising the commercial viability of such large scale networks. Smaller scale decentralised networks are less risky to set up initially and can be as simple as a single boiler serving a block of flats. If designed for future change, such small scale networks could eventually be interlinked to form a larger neighbourhood scale network.

It is difficult to truly assess the potential for such district heating schemes based on the commercial sensitivity associated with the extent of future heat demand.

The 2009 Study carried out an assessment of the potential for large scale network deployment based on three ‘rules of thumb’:

1. Minimum development of 100 dwellings;
2. Minimum heat density of 3,000 kW/km^2 equating to 50 dwellings per hectare; and
3. Non-domestic heat consumers within 1 km of the new development available as an anchor load.

The sites identified in Mid Sussex on this basis, and yet to be developed, are listed here.

Table 4.6 Potential District Heating Sites

Site Ref	Town/Parish	Timescale for Development	Potential Anchor Loads
345	Burgess Hill	6 years -2031	2 schools, 2 colleges, primary school, trading estate, Leisure centre,
083	Burgess Hill	6 years -2031	2 schools, college, primary school, care home, Leisure centre
081	East Grinstead	6 Years - 2031	supermarket, college, 2 schools, primary school, hospital,
525	East Grinstead	Not currently deployable	supermarket, college, 4 schools, primary school, hospital,
528	Burgess Hill	Not currently deployable	2 schools, college, primary school, care home, Leisure centre
485	Haywards Heath	1-5 years	Princess Royal Hospital, swimming pool, primary school, 2 schools, village hall,
091	Burgess Hill	1-5 years	2 schools, college, primary school,
080	Burgess Hill	6 years - 2031	2 schools, 2 colleges, primary school, Leisure centre
246	Haywards Heath	6 years - 2031	Princess Royal Hospital, Hurstwood Grange school
493	Burgess Hill	6 years -2031	Leisure centre, college, school
494	Lindfield	1 -5 years	2 primary schools, 3 schools, college, Heath centre, Princess Royal hospital
233	Burgess Hill	1 -5 years	2 schools, college, primary school,
557	Burgess Hill	Not currently deployable	2 schools, college, primary school, care home,

Source: West Sussex Sustainable Energy Study (2009), MSDC updates and AMEC review of anchor loads

4.7 Summary

This section of the report has looked at the renewable resource availability within Mid Sussex and the potential capacity to develop low/zero carbon technologies in the region. The assessment shows:

- Significant constraints on large scale wind or solar farm (ground mounted solar PV) development within the district;

- Substantial potential biomass resources (woodland residues, energy crops) but limited potential for landowners to enter the supply chain given the combination of a large number of existing suppliers in the local area and limited numbers of large consumers to supply;

- Availability of both food and animal waste for anaerobic digestion, which is more likely to be supplied to a West Sussex wide energy recovery plant;

- Some small scale hydro scheme development potential;

- Some potential for development of district heating networks within the three main urban areas; and

- Small scale contributions from other technologies such as heat pumps, solar thermal and micro CHP.

The overall assessment suggests that large scale low/zero carbon energy generation schemes are unlikely to come forward in major numbers. Instead there may be a few medium scale wind and solar projects potentially brought forward as community operated assets. Beyond this, contributions are individual dwelling led with the exception of a few potential district heating schemes.

5. Policy Recommendations for the District Plan

5.1 Overview

Based on the evidence presented in this report we propose two main policies for testing via the plan-making process, which is to include consultation with residents and subsequent examination by the planning inspectorate. The development of these draft policies included discussion with a group of officers at a workshop on 19th September 2014.

The key considerations for developing these policies are the tests of ‘soundness’ enshrined in national planning policy. To be considered sound, policies need to be positively prepared, justified, effective and consistent with national policy (NPPF, para. 182). The implications of these four tests for our policy recommendations are therefore as follows:

- Positively prepared: the policies are consistent with the national priority for delivering sustainable development and ensure that the Council is taking a positive approach to both considering the potential for and planning for renewable energy and more efficient developments.

- Justified: this report provides the evidence base necessary to support the policies, from an understanding of the district’s renewable energy potential to the wider policy and legislative context that the policies need to respond to.

- Effective: the policies can be tested via the plan-making process, with the evidence base used to inform discussions with neighbouring authorities. Fundamentally, the study is not directly identifying significant projects which would have cross boundary implications.

- Consistent with national policy: the policies reflect the NPPF, PPG and other key legislation presented in Section 2. However, it is important to note that national policy for both renewable energy and climate change is ever changing (not least housing standards review and timetable for zero carbon homes) so there will need to be some flexibility and recognition that policies may need to be updated as the plan progresses through examination.

5.2 Draft Policy 1: Sustainable Design and Construction

Draft policy wording for testing

The following policy would replace adopted Local Plan Policy B4, to provide a much clearer set of requirements for developers in response to the latest national policy position:

All new major development proposals (defined as the creation of 10 dwellings/1000m^2 floorspace or more, or application sites over 1ha) must be accompanied by a Sustainability Statement which addresses the following aspects of sustainable design and construction:

<u>Energy efficiency</u>

Demonstrating how the proposals take account of the following energy hierarchy:

- **Minimising energy use through the design and layout of the scheme and its individual buildings.**
- **Supplying energy efficiently, through assessing feasibility and viability of establishing or connecting to communal heating networks (supplied by biomass boilers, biomass/gas CHP or heat pumps).**
- **Using renewable sources of energy.**

For new residential developments, applicants must demonstrate how their proposals also address the national timetable for zero carbon homes, including fabric energy efficiency standards, on-site renewable/low carbon technologies and allowable solutions once adopted by government.

<u>Waste and resources</u>

Demonstrating how the development will maximise an efficient use of resources, including minimising waste and maximising recycling/re-use of materials through both construction and occupation.

<u>Water use</u>

Demonstrating how the development will maximise water efficiency, in accordance with policy DP41 Water Infrastructure and the Water Environment.

<u>Resilience to climate change</u>

Demonstrating how the risks associated with future climate change have been planned for as part of the layout of the scheme and design of its buildings to ensure its longer term resilience.

Other approaches considered

- A Merton Rule style policy was considered, but with national building regulations already likely to necessitate consideration of on-site renewables (e.g. via the zero carbon homes hierarchy) it is considered more important to ask developers to take this into account in preparing their schemes given the implications it could have for design and layout.
- Specific Code/BREEAM levels could be set in the interim period until the recommendations from the government's housing standards review are implemented however there are risks that the policy could become rapidly out-of-date. The direction of travel with government policy clearly seems to involve no longer using the Code for Sustainable Homes.

5.3 Draft Policy 2: Renewable Energy Schemes

Draft policy

Proposals for new renewable and low carbon energy projects, including community-led schemes, will be permitted provided that any adverse local impacts can be made acceptable, with particular regard to:

- **Landscape and visual impacts, including cumulative impacts, such as on the setting of the South Downs National Park and High Weald Area of Outstanding Natural Beauty, and the appearance of existing buildings.**
- **Ecology and biodiversity including protected species, and designated and non-designated wildlife sites.**
- **Residential amenity including visual intrusion, air, dust, noise, odour, traffic generation, recreation and access.**

Assessment of impacts will need to be based on the best available evidence, including landscape capacity studies.

Other approaches considered

- The Council could set a specific target – e.g. xMW installed capacity by 2020 - but with a range of constraints and potential limited in the district it is suggested that this would be hard to justify based on the evidence presented in this report.
- Some authorities have sought to allocate specific sites for renewable energy development but there would need to be clear interest from a developer or landowner to do this, and a wider range of evidence prepared to justify the allocation of a site in the plan. This may be an opportunity to consider via neighbourhood plans however, linked to the promotion of 'community-led' projects where there is an appetite to do so.

5.4 Monitoring and implementation

The key to effective monitoring is the use of a limited number of indicators that are based on readily accessible information. While a wide raft of indicators can be used, the broader the range then the more difficult and time-consuming the process of monitoring becomes. The process of monitoring is assisted by a number of datasets already recorded by other bodies. One such example would be the technology type, capacity and number of installations within Mid Sussex recorded by Ofgem in the context of registration for payment of FiTs and RHI.

It is suggested that monitoring could focus on two indicators which should be relatively straightforward to monitor:

- The number of Sustainability Statements submitted for major applications in accordance with the policy requirement.

- Number of MW installed capacity from new energy projects granted planning consent. This could exclude householder applications (to save time/resources) and focus on stand-alone schemes or community-led projects incorporated as part of major developments.

5.5 Policy Cost Impacts

5.5.1 Sustainable Design and Construction

Draft Policy 1 relating to Sustainable Design and Construction does not set out minimum requirements of developers in terms of particular sustainable construction standards (e.g. Code for Sustainable Homes Level 5, BREAAM Excellent for non-domestic buildings etc.). What it does do is to encourage developers to utilise the energy hierarchy to best effect in terms of energy efficiency of the built form and use of on-site renewables.

As previously discussed in Section 2.1.3, in the case of domestic properties the combination of requirements similar to CSH Level 4 and the zero carbon standard are likely to form the future baseline for building regulations (most likely from 2016). Given this baseline, the present policy does not impose any extra over costs since no explicit requirement to exceed Building Regulation requirements is proposed.

In the case of non-domestic developments, Table 2.1 provides a summary of what national information there is regarding extra over costs of development. These figures suggest that achieving a BREEAM Very Good-Excellent rating should not have a major cost impact for a given scheme. BREEAM Outstanding is more challenging and costly to implement, as would be expected since it is deliberately intended to be the highest level of environmental performance for a building.

5.5.2 Renewable Energy Schemes

The present draft policy has no direct impact on development costs of any given renewable energy scheme. It may however have indirect impacts in the case of a specific proposed development in ensuring no adverse landscape/visual, ecology/biodiversity or residential amenity impacts. Any proposed scheme will account for these factors as a matter of course in the preparation of a planning application. The business case for any such scheme will therefore inherently account for any cost implications of the policy.

Technologies costs are linked to market developments and, to an extent, the direction of UK Government policy in the level of market support that it provides to different forms of energy generation. While recognising the fluid nature of such costs it is useful to provide some guidance figures here in terms of the relative scale of costs associated with each technology type considered in this report. These details are provided in Table 5.1.

Table 5.1 Illustrative Costs of Technologies

Technology Type and Scale		Installation Cost Range (£/kW)		
Technology	**Scale of Capacity (MW)**	**Low**	**Medium**	**High**
Wind	< 0.015	5,000	5,500	6,100
Wind	1 – 5	1,600	2,000	2,300
Wind	> 5	1,130	1,600	2,040
Solar PV (Domestic)	< 0.004	1,500	1,900	2,500
Solar PV (Commercial)	1 - 10	900	1,000	1,100
Dedicated Biomass	5 - 50	2,540	3,695	5,210
Biomass CHP	5 - 50	2,700	3,900	5,000
Anaerobic Digestion	< 0.25	4,000	6,000	8,000
Anaerobic Digestion	> 0.5	3,000	4,500	6,000
Hydro	< 0.015	4,200	9,500	21,400
Hydro	0.1 – 1	2,000	4,500	10,000
Hydro	5 - 16	NA	3,150	NA
Solar Thermal*	0.001 – 0.005	3,000	4,000	5,000
Heat Pumps**	0.001 – 0.02	700	1,100	1,600
Micro-CHP***	0.001 – 0.005	1,800	NA	3,000
Geothermal	> 0.1	2,350	4,740	7,000
Geothermal CHP	> 1	2,650	5,240	7,540

Source: 'Electricity Generating Costs 2013' (DECC, July 2013). Note that this includes an estimate of pre-development as well as construction costs.
* Energy Saving Trust figures
** Average of small market survey at April 2014. Water and air source pumps are at lower end of this range; ground source heat pumps at upper end.
*** https://spiral.imperial.ac.uk/bitstream/10044/1/9844/6/Green%202012-08.pdf

Having reviewed the capital costs associated with development of given renewable energy schemes, it is also useful to consider the order of magnitude costs associated with their operation and maintenance. These costs assist in any subsequent viability appraisal work and are provided in Table 5.2.

Table 5.2 Illustrative Operating and Maintenance Costs of Technologies

Technology Type and Scale		O&M Cost Range (£/kW/yr)		
Technology	**Scale of Capacity (MW)**	**Low**	**Medium**	**High**
Wind	< 0.015	66	73	81
Wind	1 – 5	24	30	35
Wind	> 5	26	37	47
Solar (Domestic)	< 0.004	19	24	32
Solar (Commercial)	1 - 10	21	23	25
Dedicated Biomass	5 - 50	77	112	158
Biomass CHP	5 - 50	104	150	192
Anaerobic Digestion	< 0.25	616	924	1,232
Anaerobic Digestion	> 0.5	477	715	953
Hydro	< 0.015	49	110	248
Hydro	0.1 – 1	46	104	231
Hydro	5 - 16	NA	44	NA
Solar Thermal*	0.001 – 0.005	45	60	75
Heat Pumps*	0.001 – 0.02	21	33	48
Micro-CHP*	0.001 – 0.005	18	NA	30
Geothermal	> 0.1	18	36	53
Geothermal CHP	> 1	17	34	49

Source: ‘Electricity Generating Costs 2013’ (DECC, July 2013).
* Energy Saving Trust figures

MID SUSSEX DISTRICT COUNCIL

Mid Sussex District Council

Sustainable Energy Study

Final Report - Technical Appendix

AMEC Environment & Infrastructure UK Limited

October 2014

Appendix A
Technical Assessment

A.1 Wind

The amount of energy any single wind turbine can generate is directly related to the speed of the wind it experiences. The first requirement when assessing the potential for use of wind turbines is therefore to consider the annual average wind speed in a given area. DECC's UK wind speed database is based on use of the NOABL model, a wind flow model based on a mass-consistent model method. The NOABL database contains estimates of wind speed at 10 m, 25 m and 45 m above ground level to 1 km grid square resolution assuming ground cover of short grass and no obstacles (e.g. trees or buildings). The model makes some important assumptions and approximations. However, the results are useful as a rough guide and have been shown to match reasonably well to observed wind conditions.

At a height of 45 m above ground level (agl) the average annual wind speed in Mid Sussex is shown in Figure A.1. It can be seen that the majority of average wind speeds are in the range 6.3 – 6.6 ms^{-1}. Developers will typically consider wind turbines in areas where the average wind speed is 6 ms^{-1} or higher.

Wind speed is only one factor influencing the commercial viability of wind turbines of course. The other relevant factors are considered in the following sections.

A.1.1 Wind Turbine Development

When considering the installation of any turbine the owner or developer needs to consider what size of turbine is best suited for the wind resource available. The feed-in tariffs (FiTs) for wind turbines are structured according to the rated output of the turbine (in kW). The physical size of turbines within each FiT band is summarised in Table A.1.

Table A.1 Working Definition of Wind Turbine Sizes

Feed-in Tariff Band (Installed Capacity) (kW)	Hub Height (m)		Blade Diameter (m)		Total Height (m)		Comment
	Min	Max	Min	Max	Min	Max	
Less than or equal to 1.5	10	18	1	3.2	10.5	19.6	
1.6 – 15	10	25	2.8	9	11.4	29.5	
16 – 100	15	39	9	22	19.5	50	
101 – 500	30	65	13.5	56	36.75	93	
501 – 1,500	30	80	40	77	50	118.5	

Feed-in Tariff Band (Installed Capacity) (kW)	Hub Height (m)		Blade Diameter (m)		Total Height (m)		Comment
	Min	Max	Min	Max	Min	Max	
1,501 – 2,000	60	105	60	93	90	151.5	Most common max size is 127 m
2,001 – 3,000	60	105 76		126 98		168	145 m is maximum consented currently

Note: Hub height measures the distance from the ground to the centre point of the rotating blades of the turbine. Total height measures the height from ground level to the tip of the blades when at their greatest vertical extent.

A.1.2 Methodology

A number of constraints need to be applied when considering the potential for wind development in the region.

Table A.2 Constraints Considered for Wind Assessment

Constraint	Description	Impact on siting of wind turbine
Wind Resource	Reviewing published average wind speed data for areas within the Mid Sussex boundary	Wind turbines best sited where mean average wind speeds are highest.
Environmental	Designated landscapes, heritage sites, wildlife sites and protected species	Development needs to be sensitive to these designations and key features of interest
Infrastructure	Roads, railways, power lines, airfields, airports	Turbines need to be sited away from major infrastructure
Noise	Separation distances to buildings and development areas	Wind turbines must be sited at sufficient distance from existing buildings to ensure noise levels meet national requirements.
Flood Risk	Proximity to water courses	Siting turbines in areas of flood risk would require expensive foundations and make access for maintenance more costly
Ministry of Defence	MOD owned sites and related radar operation issues	Turbines need to be at a distance from MOD sites that avoids any compromising of MOD activities.
Grid Connection	Proximity to a feasible grid connection point	This will indicate whether substantial cabling and support infrastructure may be required
Grid Capacity	Availability of the distribution network to incorporate the additional power output.	Lower network capacity may require upgrades to grid infrastructure such as substations and safety systems (at a cost to the wind developer)
Safeguarded CAA sites, NERL and other radar systems (aviation issues):	Potential issues of interference with radar systems.	Careful siting will minimise impacts on radar systems and reduce any potential mitigation costs
Radio / Communications Links / fixed microwave links:	Existing location of communication links	Careful siting will minimise impacts on the links and reduce any potential mitigation costs

Constraint	Description	Impact on siting of wind turbine
Construction Outline	construction requirements	Avoiding complex development areas (e.g. wetland areas), minimising the need for more complex wind turbine infrastructure.
Access	Ease of access to site for construction / maintenance.	Due to the size of medium to large scale wind turbine components access can determine if a site will be physically and economically feasible.

Each of these constraints reduces the available land area where there is greatest potential for wind development. The following figures show the areas of land affected by each constraint.

Figure A.1 Average Annual Wind Speed in Mid Sussex

Figure A.2 Environmental Designations

Figure A.3 Cultural Designations

Figure A.4 Infrastructure Constraints

Figure A.5 Radar/Communications Constraints

Figure A.6 Noise Buffer Constraints

Details of the constraints applied in determining the wind capacity potential in Mid Sussex are summarised in Table A.3.

Table A.3 Buffers Applied to Site Constraints

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
Motorway	Blade Tip fall over (125m) measured to edge of highway boundary – normally post and rail fence.	National Planning Policy Guidance Note 22 (Companion Guide[24]) defines fall over distance as being "the height of the turbine to the tip of the blade" (p.171, para 51) and states in para 52 that: "it may be advisable to achieve a set-back from roads and railways of at least fall over distance". When commenting on the Reading the turbine the Highways Agency in 2002 required a separation distance of 2 blade lengths from the tower to the motorway fence i.e. 70m, whereas the total height of the turbine is 120m. The Reading Turbine is actually 149m from MW boundary. NB If the maximum separation buffer cannot be achieved, the Highways Agency, as statutory consultee, should be consulted in DP1.	Blade Tip fall over + 50m (175m for 125m N90) measured to edge of highway boundary – normally post and rail fence.	Highways Agency: SPATIAL PLANNING ADVICE NOTE: SP 02/06 States: "Assessment of the risk associated with structural failure suggests that a reasonable offset would be to site the wind turbines at a distance of not less than (H + 50) metres where H is the maximum height to the tip of blade. The offset should be measured from the highway boundary fence rather than the edge of carriageway so as to ensure the safety of our roadside equipment and our workforce. However, analysis of the risk posed by 'icing' suggests that it would be wise to adopt a minimum offset of 100 metres. Therefore, no turbine should be sited closer to the trunk road boundary than the greater of (H + 50) or 100 metres." The later edition Spatial Planning Advice Note 04/07 "Planning Applications for Wind Turbines sited near to Trunk Roads" advises that commercial wind turbines should be set back from the trunk road boundary by their height + 50m, which is widely understood to mean blade tip + 50m.

[22] The minimum separation distance considered reasonable to expect the Local Planning Authority and the consultee to accept. There is a probability that negotiation and discussion will be required. **It is important to note that:**

1. The results of the Feasibility Study, in terms of turbine numbers, predicted annual energy production and costs are based on the minimum separation distances to identified constraints, unless the maximum separation distance can be achieved without reducing the installed capacity of the site and
2. These buffers are to be treated as guidance only, since it is not possible to stipulate separation distances for every site specific eventuality.

[23] Considered the failsafe separation distance, where no negotiation with consultees/LPA will be required and no material planning objections will be put forward once the planning application has been submitted.

[24] In England this is the national planning advice on wind energy, which all local planning authorities will use as guidance when assessing planning applications.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
Trunk Road	Blade Tip fall over measured to edge of highway boundary – normally post and rail fence.	The 2nd Swaffham Turbine (120m blade tip) is 150m from the Trunk road. The Swaffham Ecotech turbine (100m blade tip) is 125m. Not aware of any turbines within fall over distance to Trunk Roads. Consider this is an appropriate minimum separation distance for reasons set out for motorways. NB If the maximum separation buffer cannot be achieved, the Highways Agency, as statutory consultee, should be consulted in DP1.	Blade Tip fall over + 50m measured to edge of highway boundary – normally post and rail fence.	Consider this is an appropriate maximum separation distance for reasons set out for motorways.
A Road	Blade tip fall over measured to the edge of the highway boundary.	Consider this is an appropriate minimum separation distance for reasons set out for motorways, given the likely traffic flows on main roads. Aware of one example of a 120m blade tip turbine being approved 82m from an A road (Manchester City Football Club). NB If the maximum separation buffer cannot be achieved, the Highways Authority, as statutory consultee, should be consulted in DP1.	Blade tip fall over measured to the edge of the highway boundary +10%.	Precautionary principle, considered best practice approach.
B Road	50m (assumed max blade length) from center point of turbine tower i.e. no part of blade should be overhanging the highway boundary.	Arguably, contrary to advice contained with in PPS22, but there are examples of turbines within fall over distance to minor roads. NB If the maximum separation buffer cannot be achieved, the Highways Authority, as statutory consultee, should be consulted in DP1.	Blade tip fall over measured to the edge of the highway boundary.	Precautionary principle, based upon guidance in PPS22: "it may be advisable to achieve a set-back from roads and railways of at least fall over distance". Discussions with planning officers has shown that adherence to this guidance is expected.
Minor Road	50m from center point of turbine tower i.e. no part of blade should be overhanging the highway boundary.	Arguably, contrary to advice contained with in PPS22. BUT: 2nd Swaffham Turbine is within fall over distance of a minor road (c.35m). The Reading turbine is 48m from a minor road. A turbine in Dagenham (Ford) is over sailing a road with public access – although there have been incidents of ice fall… There are other examples of operational wind turbines within fall over distance to minor roads. i.e. Royd Moor turbines (0.5mw bonus) operating	Blade tip fall over measured to the edge of the highway boundary.	Precautionary principle, based upon guidance in PPS22: "it may be advisable to achieve a set-back from roads and railways of at least fall over distance". Discussions with planning officers has shown that adherence to this guidance is expected.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
		since 1993 within fall over distance to minor road. B If the maximum separation buffer cannot be achieved, the Highways Authority, as statutory consultee, should be consulted in DP1.		
Unclassified Road, but adopted public highway.	50m from center point of turbine tower i.e. no part of blade should be overhanging the highway boundary.	As for Minor Road above.	50m from center point of turbine tower i.e. no part of blade should be overhanging the highway boundary.	As per Map A: Justification for minor roads.
Railway (all)	Blade tip fall over measured to the edge of the railway track.	Companion Guide to PPS22 states: "it may be advisable to achieve a set-back from roads and railways of at least fall over distance". NB If the maximum or minimum separation buffes cannot be achieved, Network Rail, as statutory consultee, should be consulted in DP1.	Blade tip fall over +10% measured to the edge of the railway track.	Network Rail, objected to a planning application for 5 turbines in Sedgemoor District Council in 2006, where a turbine was exactly fall over distance to track. The objection was only removed when the scheme was amended and a fall over +10% separation distance was achieved.
Permanent Structures which are not buildings i.e. water tanks; communications towers.	If there is no public access, no buffer should be applied. However, account needs to be taken of construction activities which may require that a 15m buffer is applied for the foundation. For structures used for the storage of "hazardous materials" blade tip fall over distance.	These are essentially plant and machinery not on public land. There do not appear to be any insurance restrictions for these non occupied buildings. The PSB would though need to undertake an appropriate Risk Assessment to ensure that Personnel accessing the plant are adequately protected i.e. wearing a hard hat in the area swept by the turbine blades.	50m from center point of turbine tower i.e. no part of blade should be overhanging the structure. For structures used for the storage of "hazardous materials" blade tip fall over +10% separation distance.	Precautionary approach based on tone of PPS22. It is arguable that nearby sites covered by the Control of Major Accident Hazards (COMAH) Regulations and Nuclear Installations will require consultation and/or site specific risk assessments in DP1.
Public Car Parks and Public Open Space	50m buffer from centre of turbine i.e. not over hanging.	Public Car Parks and public open spaces are in effect public rights of way (PROW). PPS22 states that: "and the minimum distance is often taken to be that the turbine blades should not be permitted to over sail a public right of way."	Blade tip fall over distance.	Companion Guide to PPS22.
Private/Staff car parks	No Buffer, but ideally 50m buffer from centre of turbine i.e. not over	The option to lease should specify that it may be necessary for health and safety reasons to exclude access under the swept area of the	Blade tip fall over distance (125m) from centre point of turbine	Minimises any potential safety risk, in terms of ice and component/blade failure.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
	hanging.	turbine – should, for example, insurance be problematic and/or a planning condition on health and safety is attached.	tower.	
Commercial Buildings	No over sailing of building by blades i.e. 45m buffer for N90.	Contrary to PPS22 Companion Guide, which states: "Fall over distance (i.e. the height of the turbine to the tip of the blade) plus 10% is often used as a safe separation distance". However: The Reading turbine (120m blade tip) is 68m from an office building; A turbine (120m blade tip) at Dagenham is 77m from a commercial building; Business Development are aware of 2 turbines with blades oversailing a factory by up to 8m i.e. towers 27m from factory. But due to a reported component failure incident and risk of ice, the blade swept area i.e. circle of 35m radius is fenced off to prevent access and walkways/fire escapes within swept area have been roofed. At Manchester City Football Club, a 120m to blade tip turbine was approved within a car park, 52m from an athletic stadium and 110m from main football stadium. However, due to concerns from the Health and Safety Executive the turbine is no longer being built. NB There are potentially public liability and safety issues which need addressing regarding public access beneath the swept area of the turbine blades e.g. some turbine manufactures require all personnel to wear hard hats under the turbine and explicitly state that manufacturers are not liable for public injury caused by mechanical failure/ice through. INSURANCE Ace confirmed that having a building within the topple zone is material information; however, in the context of clients portfolio, advised that it	137.5m (fall over +10% for a 125m tip turbine)	Complies with recommendations set out in the Companion Guide to PPS22 (Blade tip fall over distance +10% "often used as a safe separation distance"). However, Nordex have restrictions over the maximum height of buildings and proximity to turbines. Advice from Nordex being that no part of the swept area should be affected by turbulence of

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
		wouldn't impact the overall premium. Aon's advice was to apply commonsense and consider each site on a case-by-case basis. The following flags increase the level of concern on insurance terms: Occupied buildings; High value buildings and infrastructure (eg electricity pylons, pipelines, bridges etc); Large congregations of people; and Proximity of the building to the turbine (particularly if it approaches the oversail area).		
Third party Residential Building[25]	Site layout design should be based on the 40dB contour which will typically result in a separation distance of 500m. Where predicted turbine noise levels exceed 40dB there needs to be evidence that prevailing back ground noise will be no more than 5dB below predicted turbine noise i.e. if turbine noise predicted to be 42dB background needs to be 37dB. For sites in Scotland with	Based on known planning conditions it is assumed that the LPA will require a daytime limit of between 35-40dB or background +5dB, normally whichever is the greater. A more conservative approach is taken by applying the 40dB contour, in recognition of parliamentary pressure to revise noise guidance and review permissible separation distances between turbines and properties. The use of the 40dB contour also takes account of the fact that PfR sites have emerged to be often in rural areas, where background noise levels are low. At Feasibility, the issue of visual dominance/over bearing on residential properties should be taken into account i.e. if 500m achieved but property is at the bottom of a hill with uninterrupted principal views to the turbine on top of the hill, this is unlikely to achieve planning permission.	35dB contour which will typically result in a separation distance of 750m .	750m is arguably the minimum optimum separation distance to ensure that visual and noise effects do not significantly affect residential amenity, and takes account of backbench MP calls for set separation distances between turbines and housing. It should be noted that each site should be considered on its merits and planning appeals have been dismissed on residential amenity grounds even where separation distances considerably in excess of 450m have been achieved. The 35dB noise contour represents the definitive safeguard beyond which currently no noise monitoring or assessment is required. Important to note the 2009 Shipdham Appeal decision, in which the Inspector found (broadly) that background monitoring must be undertaken at the Noise Sensitive Property, since otherwise

[25] For all noise sensitive constraints in Feasibility Studies, the noise contour derived separation distance should in the first instance be based on the 80m hub Nordex N90 High Speed 2.5MW turbine. If the relevant noise contour cannot be achieved the 80m N90 Low Speed 2.5MW turbine should be used. Judgement is required for sites where existing background noise levels may allow the minimum 43dB buffer to be exceeded. The Feasibility Study should be based upon the turbine selected for achieving compliance with the minimum buffer requirement.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
	10 or more turbines, the Feasibility Study should include three layout designs: 1. No properties within 35dB contour; 2. No properties within 750m of any turbine; 3. No properties within 40dbB contour. Layout design 2 (750m) should be used as the basis for the MW capacity of the site. Caravan Parks and campsites are classed as noise sensitive land uses and should be treated as third party residential buildings. Although a degree of judgment is required for campsites.	40dB is the upper daytime level and assumes that background noise levels are no more than 35dB. (taking into account the reduction of 2dB from LAeq – LA90 and use of 4m receiver height and use of mixed ground and reflect published guidance: (2009) Prediction and Assessment of Wind Turbine Noise. Acoustics Bulletin, Volume 34 Issue 2.) Bowdler, D., Bullmore, A., Davis, B., Hayes, M., Jiggins, M., Leventhall, G. & McKenzie, A. Companion Guide to PPS22 states (p.171 para 51). “The minimum desirable distance between wind turbines and occupied buildings calculated on the basis of expected noise levels and visual impact will often be greater than that necessary to meet safety requirements. Fall over distance (i.e. the height of the turbine to the tip of the blade plus 10% is often used as a safe separation distance.” Examples of minimum separation distances to turbines include: Due to high background noise levels Manchester approved turbine (120m blade tip): Nearest 3rd party residential property is 125m. The Swaffham Ecotech turbine is 360m from nearest 3rd party house. An ecotricity turbine at the B&Q warehouse in Worksop, is believed to be <200m from housing. Dundee Turbines: Closest property is 330m from a turbine, however, noise (monitoring found no excedence of permitted levels) shadow flicker complaints - turbines programmed to shut down. Again there are safety concerns regarding residential properties if located within c.300m of turbines – some reports indicate that ice is thrown upto 250m from turbines and that the max		there is significant doubt about the representativeness of the data – if a resident therefore denies access, it could be problematic. Secondly the Inspector, found that planning conditions alone were not sufficient to protect NSP’s. Therefore advice from the HMP is that all developments should comply with ETSU without mitigation being required, since conditions requiring/enforcing mitigation are open to legal challenge on the basis of failing some of the 6 tests for conditions set out in Planning Circular 11/95. So, if turbines need to be powered down to meet noise limits, significant risk that EHO not accept mitigation (since not enforceable) and an open invitation to objectors to challenge the decision.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
		distance debris could be thrown is ~600m. Nordex guidance (Precautions for Icing Conditions, 2007) on ice through states "Objects, which are closer to a wind turbine than 1.5 x the sum of hub height and rotor diameter, can be endangered from falling ice." Noise levels from microwind maybe limited to 45dB (DCLG News release 13/3/08).		
Residential property owned by the PSB (ie within PSB property Boundary and confirmed as being in residential use)	No residential property within blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed 55dB.	As for third party residential (fall over +10% to occupied buildings requirement in PPS22) and ETSU (summary, para 24) advises that lower noise levels can be increased from 35-40 to 45dB and that the level above background can be increased beyond the permitted 5dB level. As ETSU states that it is the lower day and night limits which can be increased to 45dB it may be (this is an untested theory) possible to increase the maximum permissible day time level to 50dB (as there is a difference of 10dB between the lower limits for third parties and those with a financial involvement). A 5 dB increase in the ETSU-R-97 stakeholder limit may also be permissible, as this would then result in a minimum buffer justification sound level which would be broadly comparable to the lower of the WHO's guidance levels for gardens or balconies, generally applicable to daytime, and would not be seen as being too dissimilar to the ETSU-R-97 guidance. However, this would still result in higher than acceptable noise levels at night, which would require the provision of secondary glazing at the property and alternative ventilation, unless windows (existing/new) in the same room could open onto non-noise affected facades. Worth noting that although the Noise Exposure Criteria set out in PPG24 Noise apply to new housing and existing noise levels (i.e. new housing adjacent to motorways) a noise level of 55dB is deemed acceptable, although mitigation maybe required. Legal agreement can be negotiated with PSB to	300m. 45dB noise contour	ETSU-R-97 stipulates that the fixed lower day and night time limits can be 45dB where the occupier has a financial . In areas where background levels are above 45dB it would be possible to decrease the separation distance until the background + 5 has been complied with. NB This is dependent upon changes to the tenancy agreement or financially involving the occupier (not the owner) of the property.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
		agree acceptable noise. Although at the limits of acceptability, negotiation/legal agreement may be possible with PSB to remove residential use of building. NB This is dependent upon financially directly involving the resident (not the owner) of the property (as set out on p66 of ETSU-R-97, through for example, rent reduction.		
Staff Accommodation i.e. at hospitals.	Not within the blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 53dB (LA90) noise contour.	Distance based on fall over +10% to occupied buildings requirement in PPS22. Using the 53dB(LA90) noise contour assumes a 20dB attenuation for closed windows with 2dB subtracted to allow for conversion from LAeq to LA90, resulting in internal noise levels of 35dB – in compliance with ETSU-R-97. This approach is based on the accommodation being either closed ventilation (windows do not open) and/or the EHO/PSB accepting that it is sufficient mitigation for the windows to be shut if noise is disturbing occupiers. It also assumes that outside space for these receptors is not considered to be noise sensitive. Government guidance available in “Health Technical Memorandum 08-01: Acoustics” does not consider permanent staff accommodation and therefore the most appropriate UK design guidance is BS 8233:1999 “Sound insulation and noise reduction for buildings - Code of practice”. The protection of staff outdoors is not relevant and hence only internal levels require consideration. The 53 dB level may cause an exceedance of the desirable internal level of 35 dB (BS 8233:1999) by 3 dB, if an assumed maximum of 15 dB and not 20 dB attenuation through the window. However, in modern healthcare facilities closed windows even this may be acceptable as HVAC systems should provide acceptable levels of ventilation. If existing background (night-time) noise levels exceed 53dB at the external façade of the accommodation, likely that noise levels from the turbines could be increased to match but not	Not within the blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 43dB (LA90) noise contour.	This assumes that windows are opening and that the EHO/PSB considers that noise levels should take this into account. Based on principal of ETSU-R-97 that there is a 10dB(A) allowance for attenuation through an open window and that 2dB is subtracted to allow for the use of LA90 rather than LAeq. This approach achieves the 35dB sleep disturbance noise level with an open window. If existing background (night-time) noise levels exceed 43dB at the external façade of the accommodation, likely that noise levels from the turbines could be increased to match but not exceed background levels.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
		exceed background levels. There may though be a requirement to ensure that the frequency distribution of noise is taken into account. i.e. that lower frequency noise from turbines does not exceed the lower frequency background noise.		
Hospital Wards (measured to external façade)	Not within the blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 48dB (LA90) noise contour.	Distance based on fall over +10% to occupied buildings requirement in PPS22. The World Health Organisation 1999 Guidelines for Community Noise recommends that the guideline values indoors on wardrooms are 30dBLAeq. Using the 48dB(LA90) noise contour assumes a 20dB attenuation for closed windows with 2dB subtracted to allow for conversion from LAeq to LA90. This approach is based on the accommodation being either closed ventilation (windows do not open) and/or the EHO/PSB accepting that it is sufficient mitigation for the windows to be shut if noise is disturbing occupiers. It also assumes that outside space for these receptors is not considered to be noise sensitive. The HTM-08-01 (for new healthcare buildings) recommends that internal sound levels during the night are 35 dB LAeq,T, there may therefore be some latitude in increasing the minimum buffer to 53dB where the windows do not open. The Hayes McKenzie Partnership adopted this approach when conducting a noise assessment for a 2008 planning application for a wind turbine at the QEH Hospital in King's Lynn. If existing background (night-time) noise levels exceed 48dB at the external façade of the ward, likely that noise levels from the turbines could be increased to match but not exceed background levels.	Not within the blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 38dB (LA90) noise contour.	This assumes that windows are opening and that the EHO/PSB considers that noise levels should take this into account. Based on principal of ETSU-R-97 that there is a 10dB(A) allowance for attenuation through an open window and that 2dB is subtracted to allow for the use of LA90 rather than LAeq. If existing background (night-time) noise levels exceed 38dB at the external façade of the ward, likely that noise levels from the turbines could be increased to match but not exceed background levels. The HTM-08-01 (for new healthcare buildings) recommends that internal sound levels during the night are 35 dB LAeq,T, there may therefore be some latitude in increasing the maximum buffer to 43dB where the windows open.
Prison accommodation Blocks (measured to external façade)	Not within the blade tip fall over distance +10% In addition, where possible, the turbine layout should be configured to ensure that	Using the 53dB(LA90) noise contour assumes a 20dB attenuation for closed windows with 2dB subtracted to allow for conversion from LAeq to LA90, resulting in internal noise levels of 35dB – in compliance with ETSU-R-97. This approach is based on the accommodation	Not within the blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure	This assumes that windows are opening and that the EHO/PSB considers that noise levels should take this into account. Based on principal of ETSU-R-97 that there is a 10dB(A) allowance for attenuation through an open window and that 2dB is subtracted to allow for the use of LA90

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
	predicted noise levels do not exceed the 53dB (LA90) noise contour.	being either closed ventilation (windows do not open) and/or the EHO/PSB accepting that it is sufficient mitigation for the windows to be shut if noise is disturbing occupiers. It also assumes that outside space for these receptors is not considered to be noise sensitive. If existing background (night-time) noise levels exceed 53dB at the external façade of the cell block, likely that noise levels from the turbines could be increased to match but not exceed background levels. There is no known design guidance for acceptable noise levels at prisons.	that predicted noise levels do not exceed the 43dB (LA90) noise contour.	rather than LAeq. This approach achieves the 35dB sleep disturbance noise level with an open window. If existing background (night-time) noise levels exceed 43dB at the external façade of the cells, likely that noise levels from the turbines could be increased to match but not exceed background levels.
Halls of Residence	Not within the blade tip fall over distance +10% In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 53dB (LA90) noise contour.	Using the 53dB(LA90) noise contour assumes a 20dB attenuation for closed windows with 2dB subtracted to allow for conversion from LAeq to LA90, resulting in internal noise levels of 35dB – in compliance with ETSU-R-97. This approach is based on the accommodation being either closed ventilation (windows do not open) and/or the EHO/PSB accepting that it is sufficient mitigation for the windows to be shut if noise is disturbing occupiers. It also assumes that outside space for these receptors is not considered to be noise sensitive. If existing background (night-time) noise levels exceed 53dB at the external façade of the Hall, likely that noise levels from the turbines could be increased to match but not exceed background levels.	Not within the blade tip fall over distance +10% In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 43dB (LA90) noise contour.	This assumes that windows are opening and that the EHO/PSB considers that noise levels should take this into account. Based on principal of ETSU-R-97 that there is a 10dB(A) allowance for attenuation through an open window and that 2dB is subtracted to allow for the use of LA90 rather than LAeq. This approach achieves the 35dB sleep disturbance noise level with an open window. If existing background (night-time) noise levels exceed 43dB at the external façade of the hall, likely that noise levels from the turbines could be increased to match but not exceed background levels.
Public Building ie Schools	Not within the blade tip fall over distance +10% In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 53dB (LA90) noise contour.	Public buildings have a much greater sensitivity than commercial/industrial buildings. PPS22 Companion guide p171, para 51: "Fall over distance…. Plus 10% is often used as a safe separation distance". The World Health Organisation 1999 Guidelines for Community Noise recommends that the background sound pressure level in classrooms does not exceed 35dB (55dBLAeq – 20 dB subtracted for attenuation through a closed	Not with in 450m. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 43dB (LA90) noise contour (to classroom façade) and/or	Minimises any potential safety risk, in terms of ice and component/blade failure and minimises power loss from turbine shut down due to noise and shadow flicker. 43dB standard ETSU night time level allowing for attenuation through open window.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
	No playing field should be within the 53dB(LA90) noise contour	window and an allowance of 2dB for LAeq – LA90 conversion). The 53dB LA90 contour should be measured at the nearest classroom façade. "Building Bulletin 93 - Acoustic Design of Schools. A Design Guide" provides design guidance for new schools. Internal targets range from 30 to 40 dB LAeq, 30min and when corrected for the LA90, 10min metric and the temporal variation, the levels are comparable to those stated within the WHO guidance. The WHO guidance also recommends that for outdoor playgrounds the SPL from external noise sources should not exceed 55dB (53 = -2dB for LAeq-LA90). Increasing the minimum buffer requirement to 48dB would reduce the risk of community concerns unless the school has some direct involvement with the proposals, i.e. an interactive science project. 48 dB would be comparable to the lower WHO guidance level. Achieving these levels is dependent on the ventilation in the school not being dependant on opening windows.	53dB(LA90) noise contour to playing field.	
PSB Property Boundary	5m from maximum horizontal length of blade tip. So 55m if max blade length assumed to be 50m.	Ensures that there is no possibility turbine will oversail 3rd party land and provides some degree of micro—sighting should it be required.	- -	
Public Right of Way	50m from centre point of turbine tower i.e. no part of blade should be overhanging the public right of way.	Companion Guide to PPS 22 states (p172 para 57) "Similarly, there is no statutory separation distance between a wind turbine and a public right of way. Often, fall over distance is considered an acceptable separation, and the minimum distance is often taken to be that the turbine blades should not be permitted to oversail a public right of way." At a Public Inquiry in August 2007, no challenge was raised to turbines located just overhang separation distance from public footpaths. Industry wide premise that turbines should not oversail public rights of way.	Blade tip fall over distance.	Companion Guide to PPS22.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
Bridleway	50m from centre point of turbine tower i.e. no part of blade should be overhanging the public right of way.	Para 56 p. 172 of the Companion guide sets out that the British Horse Society has suggested a 200m separation distance. The BHS November 2008 policy note on turbines reiterates the 200m distance, but with a maximum separation to national trails of 4 x tip height i.e. 500m. BUT tested at appeal (Cemmaes Wind Farm) the inspector concluded: "What cannot be concluded from the evidence is that there is a generic proven difficulty (I.e. with wind turbines and horses). What can be concluded is that the 1995 BHS policy, which may influence many riders, riding schools and clubs is overtly alarmist in a way which is not supported by evidence. It is not accepted that wind turbines necessarily or even more than occasionally alarm horses. The evidence is not there". A presentation at a BHS conference has also recently concluded that wind turbines pose no discernible risk to horse riding.	200m from centre point of turbine tower.	To appease and minimize any cause for objection from horse riding community, in line with PPS22 companion guide.
Woodland	Non classified woodland no buffer. However, where there is sufficient space on site, after all other constraints have been taken into account, turbine locations should avoid over sailing all woodland i.e. 45m buffer. A 70m buffer for a 125m tip turbine should be applied to any Ancient Woodland.	No specific statutory guidance recommending separation distances. However, ecological importance of woodlands for birds and bats increases with the age and species diversity of the woodland. To prevent unnecessary loss of habitat through construction of foundations. Natural England Feb 2009 guidance on Bats and Wind Turbines identifies that some bat species have a high sensitivity to wind turbines and as a result a minimum separation distance of 50m between the habitat and the blade tip is required. This equates, broadly, to a separation distance of 70m between turbine tower and the edge of the habitat. In some instances the removal of sufficient woodland to achieve a 70m or less separation distance and additional net replanting elsewhere, may be an acceptable mitigation option. Also, bat roosts can be moved under license in cases of	70m from centre point of turbine for all woodland (as shown on a 1:25,000 map/site visit). This distance should be maximised where other site specific constraints allow.	Ecological surveys may identify bat populations within woodland, for which Natural England are likely to require a separation distance. Natural England Feb 2009 guidance on Bats and Wind Turbines identifies that some bat species have a high sensitivity to wind turbines and as a result a minimum separation distance of 50m between the habitat and the blade tip is required. This equates, broadly, to a separation distance of 70m between turbine tower and the edge of the habitat.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
		over-riding public interest in order to enable development - need to demonstrate though that there was no alternative and that the works are necessary for reasons of overriding public interest (not economic gain) – considered unlikely NE would want to set a precedent that the need for turbines overrides the protection in situ of bats.		
Field Boundaries and non-protected hedgerows	Non designated hedgerows and/or field boundaries no buffer. However, where there is sufficient space on site, after all other constraints have been taken into account, turbine bases should be 70m from field boundaries. In addition any removal of hedgerows should be avoided wherever possible.	Field margins and hedgerows are important wildlife corridors and are often managed for biodiversity under the DEFRA Environmental Stewardship Scheme. These features are known movement corridors for some bat species and therefore NE may request a c.70m buffer if high risk bat species are present. Removal of hedgerows requires the LPA to approve a hedgerow removal notice under the Schedule 4 of the Hedgerow Regulations (1997) and the 1995 Environment Act.	70m from turbine tower and in accordance with NE 2009 bats and wind turbines guidance.	Field margins and hedgerows are important wildlife corridors and are often managed for biodiversity under the DEFRA Environmental Stewardship Scheme. These features are known movement corridors for some bat species and therefore NE may request a c.70m buffer if high risk bat species are present. Application 1/1386/2007 refused by Torridge DC (29/2/08), due to objection from NE as turbines oversailing hedgerows used by bats commuting and foraging.
Hedgerows (protected)	70m. Can only be applied when local information and/or surveys are available to confirm that the hedge is/qualifies for protection.	Hedgerows are wildlife corridors, utilised by, for example, bats. Protected hedgerows species rich and established. Likely to be used as bat movement corridors, especially in low land/sheltered sites. Any woodland/hedgerow will need to be surveyed for breeding birds/protected species before removal.	70m	Natural England Feb 2009 guidance on Bats and Wind Turbines identifies that some bat species have a high sensitivity to wind turbines and as a result a minimum separation distance of 50m between the habitat and the blade tip is required. This equates, broadly, to a separation distance of 70m between turbine tower and the edge of the habitat.
Water Courses Adopted by local Drainage Board **and/or** those identified on a 1:50,000 map[26], including reservoirs.	15m from turbine centre point.	Drainage Boards normally require that no part of development within c.10m of an adopted drainage water course. With an assumed foundation radius of 15m, the minimum separation distance is therefore taken to be 15m. On a site by site basis this could be reviewed and an engineering solution negotiated with the Env. Agency/Drainage Board. The Environment Agency requires an 8m	70m.	Likely minimum separation distance required by Natural England to protect the use of water courses as movement corridors by birds/bats. 70m increase for N100 - BATS

[26] Local Drainage Board provides site specific maps of adopted waterways.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
		separation to main rivers, inclusive of foundations.		
Navigable Waterways i.e. canals	20m to allow for construction of turbine foundations (see water courses above).	Applied in the absence of any specific guidance or known best practice.	50m (not over sailing) to water way and any moorings or public rights of way adjoining the waterway i.e. towpaths.	Companion Guide to PPS 22 states (p172 para 57) "Similarly, there is no statutory separation distance between a wind turbine and a public right of way. Often, fall over distance is considered an acceptable separation, and the minimum distance is often taken to be that the turbine blades should not be permitted to oversail a public right of way." An assessment of whether house boats are noise sensitive receptors will need to be undertaken. This may be dependant on whether or not the boats are independently powered and can therefore relocate.
11,33kV lines (Poles)	No Buffer.[27] Oper	ation: Based on assumption that should the DNO (National Grid do not have responsibility for 11/33/132kV network) require a 1.5 x the blade tip height (187.5m for 125m tip turbines) fall over separation distance, the section of line could be placed underground or re-routed. Construction: Consideration could also be given to covering lines with "sheath insulation" and or fencing to protect construction activities within c.12m and that micro sighting will enable construction activities to not conflict with safety criteria. In addition to trenching the cable, it may be cost effective to de-energise the line, in order to comply with HSE requirements during construction, should the DNO raise no concerns with separation distance between the line and the operating turbine. NB. HSE guidance note GS6 and Energy Networks Association Technical Specification 43-8 set out that within 15 meters of any overhead line supported on steel towers or 9 meters of any	1.5 x the blade tip height (187.5m for 125m tip turbines)	Companion Guide to PPS para 55 on p.172 states that "wind turbines should be separated from overhead power lines in accordance with the Electricity Council Standard 44-8 "Overhead Line Clearances". This reference should in fact be to ECS 43-8. The EC has now been abolished and DNO's/NGrid do not appear to be applying these separation distances (fall-over+ maximum swing of overhead wires), instead are stipulating 1.5 x the blade tip height (187.5m for 125m tip turbines). Scottish and Southern have requested (Rushy Mead site) that: "The clearance between any overhead line and a wind turbine shall not be less than 1.5 times the height of the turbine, taken to the top of the turbine blade" (PR-PS-340 APPLICATION OF CLEARANCES TO OVERHEAD LINES AT LV TO 400kV).

[27] The Feasibility Study should specify the indicative costs of trenching the 11/33kV cables through the 1.5 x blade tip fall over zone.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
		overhead line supported on wood poles, the relevant network operator must be consulted. i.e. DNO for 11/33kV lines.		
11,33,66 and 132kV electricity lines	Not over sailing, for 11 and 33kV poled lines and tip height plus 10% for 33, 66 and 132kV lines on pylons.	11,33 and 132kV (Not 132 in Scotland) lines are the responsibility of the DNO. If the maximum buffer cannot be achieved consultation with DNO to be undertaken. Tip height + 10% for 33-132kV based on National Grid's minimum requirement for 275kV and above lines. Notwithstanding this, if the installed capacity of the site would be likely to support the cabling of over head lines this should be taken into account.	1.5 x blade tip height.	Scottish and Southern DNO have advised (September 2009): "The clearance between any overhead line and a wind turbine shall not be less than 1.5 times the height of the turbine, taken to the top of the turbine blade" (Ref.PR-PS-340 APPLICATION OF CLEARANCES TO OVERHEAD LINES AT LV TO 400kV) Note that this reference has not been validated.
275 – 400kV in UK and 132kV in Scotland	Tip height plus 10%[28]	In England and Wales National Grid are responsible for 275kV and above. In Scotland National Grid are responsible for 132kV and above. In October 2009, National Grid issued PS(T)087 – Issue 2 – Overhead line separation from wind turbines. It establishes that there is no impact on transmission lines by turbines that are sited more than 3 rotor diameters away from the line. In addition it does not prohibit closer sitting (provided that separation is greater than topple distance) but instead encourages early communication with NGET. The definition of topple distance has changed from tip height plus 20m to tip height plus 10%. National Grid, when consulted by Local Planning Authorities on planning applications (e.g. Ford	3 rotor diameters (c.300m).	In some instances National Grid have requested a separation distance much greater than blade tip height +10%, due to extra strain/wear and tear placed on the HVLines caused by turbulence and wake effects from the turbines. This issue has yet to be tested at Public Inquiry. Current guidance from National Grid (PS(T)087 – Issue 2 – Overhead line separation from wind turbines) is that there is no impact on transmission lines by turbines that are sited more than 3 rotor diameters away from the line.

[28] Assumes that cost of trenching HV line is not economic.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
		Turbines, Dagenham) have requested that separation distances are based on the blade tip fall over distance + the maximum calculated swing of the HV cable. Fall over +10% would be a minimum allowing for a 12m cable swing. This is broadly in line with Electricity Association Standard 43-8 Overhead Line Clearances (2004) – which is referenced in National Grid guidance "Sense of Place" these Design Guidelines have been developed by National Grid to address the issues associated with developing sites crossed by, or in the vicinity of, pylons and high voltage overhead lines.		
High pressure fuel pipelines (ie those identified through linesearch.org.uk)	125 – Blade Tip Fall Over. NB Separation distances for other fuel lines (medium, local high pressure and lower pressure gas pipelines and gas mains) should be determined by the standard separation distance required by the operator for construction activities. Local gas network operator should be consulted for information on the network in the vicinity of the site.	National Grid (Transco) has prepared a confidential internal report on separation distances between wind turbines and high pressure gas pipelines. This risk assessment concluded that blade tip fall over distance is required. Responding to consultations Transco have stated that an objection will be raised to any turbine within this distance. Experience to date is that Transco do not impose weight restrictions on plant crossing pipelines ie access tracks can cross pipelines. Clarification should be sought from pipe operator. Some turbine manufactures recommend fall over separation distances to "sour" gas pipe lines.	150m Precautionar	y principle separation distance, to allow for micro-sighting of turbines. The National Grid risk table for development near high pressure gas pipelines http://www.nationalgrid.com/NR/rdonlyres/325B83B7-096C-4599-BBE2-D944E9307509/19056/aptdstmay07.pdf identifies as negligible the risk from pilling at 150m+ to a high pressure gas pipeline.
Sewage and Water Pipes	No buffer	Not considered sensitive No	buffer	Not considered sensitive
Fixed Links (Microwave/Scanning Telemetry)	100m[29] Fixed links: 2nd and 8th Fresnel Zone (where	Default separation distance requested by majority of fixed link operators. Bacon Report/Ofcom and majority of fixed link	100m (Fixed Links) 1km + Blade length to Scanning Telemetry	Default separation distance request by majority of fixed link operators Basically scanning telemetry links operate at a

[29] Distance between blade tip (when at 90 degrees from vertical) and the centre of fixed link.

Constraint	Minimum Buffer Requirement[22]	Minimum Buffer Justification	Maximum Buffer Requirement[23]	Maximum Buffer Justification
	frequency of link is available) and/or operator defined (if achievable) Scanning Telemetry links: 8th Fresnel zone.	operators will accept a separation distance of the 2nd Freznel zone in most instances. 25m PAGER POWER additional buffer to 2nd Fresnel – LOOK AT PPower smaple report…	links.	lower frequency and so are liable to increased disruption to the signal path from turbines: http://www.jrc.co.uk/windfarms/
Turbine Warranty	-	Different manufacturers put in place different warranty restrictions and/or these maybe negotiable.	There should be no buildings taller than 15m within 300-400m of turbines and there should be no buildings within blade tip fall over distance.	Nordex advised in meeting of 8.5.08 with commercial director that they have recently turned down some single turbine sites because of their proximity to buildings. Nordex advised keeping the topple distance completely free of buildings (also driven by insurance) and restricting building heights to less than 15 feet within an approximate area of 300/400 meters of the base of the turbine.
Turbine Optimisation	5 rotor diameters down wind (SW assumed prevailing direction for turbine orientation) x 3 rotor diameters cross wind.	Minimum required to ensure turbulence and wake effects do not significantly reduced output/affect performance.	6 rotor diameters down wind (SW assumed prevailing direction for turbine orientation) x 4 rotor diameters cross wind.	More conservative separations.

A.2 Solar

A.2.1 Solar Photovoltaics (PV)

Solar PV systems exploit the direct conversion of daylight into electricity in a semi-conductor device. The individual cells are interconnected to form a module (more commonly known as a panel). These modules can either be mounted on building roofs (a roof mounted array) or simply installed at ground level (a ground based array or solar farm). A typical domestic installation will cover a roof area of 7 – 14 m^2 with an output of 1 – 2 kW of electricity (referred to as kW peak output or kWp). Solar farms typically range in size from around 1ha -50 ha (depending upon land availability).

To maximise the electricity output from a solar PV system it needs to be:

- Orientated to be South facing; and
- Clear from any obstruction (overhanging trees or vegetation) or overshading from neighbouring buildings.

The electricity output from solar PV panels can be used directly in the home or business premises to which they are connected. During periods of the day when any surplus electricity is generated (i.e. more than is needed for use in the premises) then this can be exported to the national grid. Present feed-in tariffs offer owners of these systems a tariff payment for each kWh of electricity produced. Any exported electricity attracts an additional (lower) payment for each kWh supplied to the grid.

A.2.2 Solar Assessment Methodology

Previous assessment work focused on building mounted solar photovoltaics (PV)[30]. The assessment methodology applied the following working assumptions:

- Domestic properties (including flats) – 25% will have suitable aspect features; will not have planning constraints and will not be subject to shading. These roofs will accommodate a 2 kW rated system. A load factor of 0.09 is used in estimating the potential annual energy yield from these systems.
- Commercial properties – 50% will not have issues with shading; these properties will accommodate a 5 kW system. A load factor of 0.09 is used in estimating the potential annual energy yield from these systems.

The present study has extended the scope of assessment to include ground mounted solar PV arrays. Available land areas within the Mid Sussex District Council boundary have been reviewed. This excludes all Grade 1 agricultural land and accounts for a buffer around buildings.

Key issues to address in the assessment of available land areas include:

[30] 'West Sussex Sustainable Energy Study', Centre for Sustainable Energy (2009)

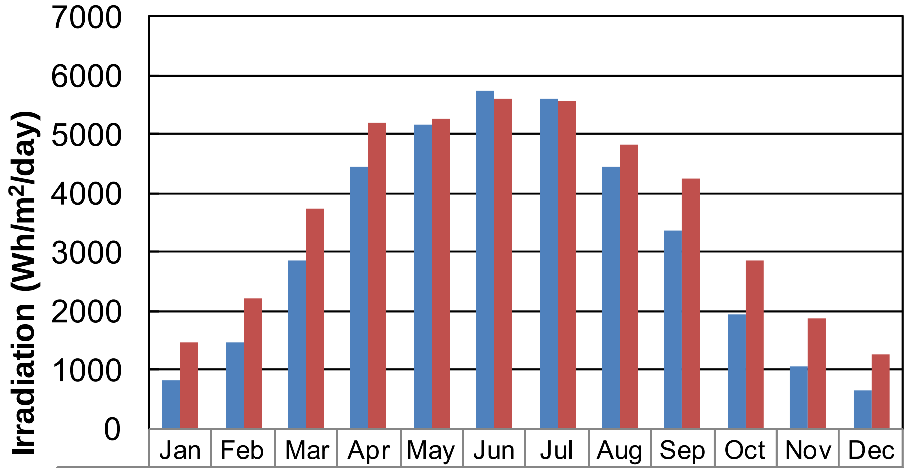
- Land area – area of unconstrained land available for development, constraints include watercourses, waterbodies, pathways, trees, overhead lines etc.;
- Land use – high value agricultural land should be retained for agricultural use where possible, brownfield sites are the most desirable;
- Topography – flat land is most suitable for solar development, otherwise levelling of the land may be required which incurs additional costs and site works;
- Sensitivity – if the site has value in terms of local or national designations is it likely to be unsuitable for development;
- Flood risk – areas with significant risk of flooding could be problematic for developments;
- Glint and Glare **-** Glint and glare results from reflection of sunlight off solar panels, it is not likely to be a major issue but can present an issue for aviation/driver safety;
- Landscape and Visual –any nearby sensitive receptors increase the visual impact of the potential development.

A.2.3 Solar Resource

The average incident solar radiation in Haywards Heath (as representative of Mid Sussex as a whole) is estimated to be 2,760 Wh/m^2 /day for a horizontal plane (Hh) and 3,290 Wh/m^2/day on an optimally inclined plane (Ho), corresponding to an average annual solar radiation of 1,142 kWh/m^2 and 1,343 kWh/m^2 respectively[31]. The optimum inclination angle for solar panel installed in Mid Sussex is 38°. Figure A.9 shows the local average monthly radiation based on long term averages.

[31] http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php PVGIS © European Communities, 2001-2012

Figure A.9 Long Term Average Monthly Radiation in Haywards Heath



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hh	805	1460	2850	4460	5150	5750	5590	4440	3370	1940	1040	644
Hopt	1470	2220	3740	5180	5250	5590	5580	4840	4250	2850	1860	1250

A.2.4 Ground Based Solar PV Arrays

In addition to the key issues outlined in Section A.2.2, there are general issues that need to be considered when looking at a ground-based solar PV development.

- **Security** of a solar farm is an important consideration. Sites are generally surrounded by security fencing with monitored CCTV cameras installed. Natural features such as hills, rivers etc. can assist in securing a site. Ideally a site would have one secure entrance and be difficult to access from other locations. Isolated sites are vulnerable.

- **Delivery** of solar panels and associated equipment is done by a standard vehicles with no abnormal loads required with the potential exception of the transformer. Some sites may not have standard access.

- **Grid capacity**: Should a development be considered beyond this assessment, there are two important factors to be considered: the nearest grid connection point and the capacity of the local network to accept the additional electricity generated by the solar farm. It is strongly recommended that the local Distribution Network Operator is contacted to establish the grid capacity and the cost of connecting to the local grid network. The point of any connection will depend upon existing local electrical loads and the scale of any proposed solar PV development. This level of detail isn't available at this stage of assessment.

- **Land Availability** – The size of land area will determine the energy generating potential of the proposed solar PV array. As an approximate rule of thumb 2 Ha of land is required for each 1 MW of generating capacity[32].
- **Gradient Slope –** Land areas with a slope of 5% or more are difficult to develop in terms of optimising the orientation of panels (as well as general accessibility issues).
- **Orientation of Slope –** South facing slopes are best suited to maximising energy yields.

Application of these constraints results in land area availability as shown in Figure A.7 (Area of Solar Ground Based Array Potential). This results in a total potential land area of around 25 Ha.

A.2.5 Energy yield calculation

The potential solar farm capacity has been calculated based on a density of 1MWp per 1.5 hectare and the estimated annual energy output then calculated using the method outlined in the '*Guide to installation of Photovoltaic systems MCS 2012*'[33]. A kWh/kWp value of 871 has been used based on tilt angle of 20^{o} which is not optimal for this area but allows greater density of panels to fit into the available area. Orientation directly south and no shading has been assumed.

Of the total potential land area around 1% may be developed; this would yield a development capacity of 13 MWp.

A.3 Hydro

Hydropower is a technology that is well established. Water flowing from a higher to a lower level is used to drive a turbine, which produces mechanical energy, which is usually turned into electrical energy by a generator. The energy produced is directly proportional to the flow volume of water and the head (distance from higher to lower level). There are high head–low volume applications and low head-high volume applications.

Larger scale projects involve a reservoir where a large body of water is stored (dammed) and then released to lower level enabling energy generation. The larger majority of schemes, however, are so called run-of-river schemes where water flow is diverted along a channel and through a turbine before being discharged back into the river at a lower point. A further design type, the Archimedes screw turbine, can be located directly in the flow of the river.

A.3.1 Hydro Assessment Methodology

The Environment Agency (EA) published a report looking at the opportunities for hydropower alongside the environmental sensitivity associated with exploiting hydropower opportunities to give a national overview[34]. This therefore provides a guide as to areas most likely to have potential to host a hydropower scheme. It is indicative

[32] http://www.solar-trade.org.uk/solarFarms.cfm (Accessed February 2014)

[34] Mapping Hydropower Opportunities and Sensitivities in England and Wales, Environment Agency (2010)

only, and does not avoid the need for further analysis on a site by site basis to assess the viability of any given scheme.

The EA study suggests a number of potential sites within Mid Sussex that may sustain a hydropower scheme. These have been reviewed with regard to:

- General location – proximity to built up areas
- Ecological – proximity to designated habitat areas and any specific species
- Landscape/Historic – proximity to conservation area or significant landscape features
- Flood risk – extent of flood risk zone

The potential sites identified are listed in Table A.4.

Table A.4 Potential Small Scale Hydropower Development Sites

Ref	Feature	Estimated Maximum Head (m)	Potential Power Output Range (kW)	Development Sensitivity	Estimated Annual Energy Generation (kWh/yr)
1	Waterfall	11.4	0 – 10	Medium	37,454
2	Weir	10.9	0 – 10	Medium	35,736
3	Dam	10.0	0 – 10	Medium	22,410
4	Waterfall	9.8	0 – 10	Medium	32,320
5	Weir	9.8	0 – 10	Medium	32,205
6	Weir	9.6	0 – 10	Medium	31,497
7	Waterfall	9.4	0 – 10	Medium	30,951
8	Waterfall	9.4	0 – 10	Medium	30,809
9	Weir	9.3	0 - 10	Medium	30,658
10	Dam	9.2	0 – 10	Medium	20,511
11	Weir	8.9	0 – 10	Medium	29,252
12	Weir	8.8	0 – 10	Medium	28,851
13	Dam	8.5	0 – 10	Medium	19,052
14	Dam	7.8	0 – 10	Medium	17,405
15	Weir	7.4	0 – 10	Medium	24,332
16	Weir	7.3	0 – 10	Medium	24,858
17	Weir	7.3	0 – 10	Medium	11,913
18	Weir	7.1	0 – 10	Medium	11,599

Ref	Feature	Estimated Maximum Head (m)	Potential Power Output Range (kW)	Development Sensitivity	Estimated Annual Energy Generation (kWh/yr)
19	Weir	7.1	0 – 10	Medium	48,748
20	Weir	7.0	0 – 10	Medium	14,259
21	Dam	6.8	0 – 10	Medium	15,127
22	Weir	6.6	0 – 10	Medium	21,762
23	Dam	6.6	0 – 10	Medium	14,697
24	Weir	6.6	0 – 10	Medium	13,390
25	Dam	6.5	0 – 10	Medium	14,571
26	Weir	6.5	0 – 10	Medium	44,743
27	Dam	6.2	0 – 10	Medium	13,928
28	Dam	5.8	0 – 10	Medium	13,061
29	Weir	5.8	0 – 10	Medium	11,832
30	Weir	5.4	0 – 10	Medium	18,388
31	Weir	5.4	0 – 10	Medium	37,286
32	Weir	5.4	0 – 10	Medium	18,207
33	Weir	5.4	0 – 10	Medium	17,621
34	Weir	5.3	0 – 10	Medium	10,680
35	Weir	5.2	0 – 10	Medium	36,160
36	Dam	5.2	0 – 10	Medium	11,670
37	Dam	5.2	0 – 10	Medium	11,625
38	Weir	5.2	0 – 10	High	29,020
39	Weir	5.1	0 – 10	High	28,919
40	Weir	5.1	0 – 10	Medium	40,677

A.3.2 Site Classification

The overall sensitivity of a given site was evaluated using a three stage process. This process considered the presence of diadromous, migratory and mobile species as listed in Table A.5.

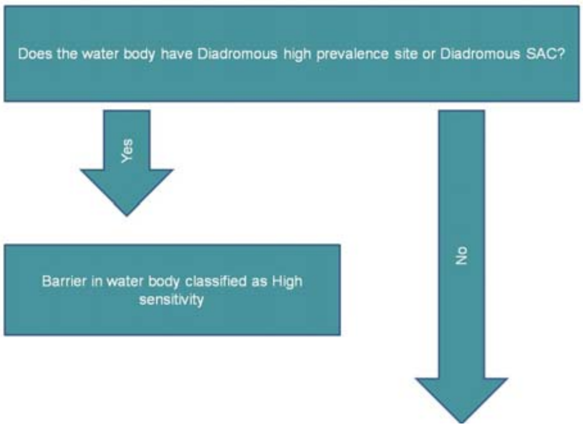
Table A.5 Fish Species Groupings

Diadromous Species	Migratory Species	Mobile Species	Non-Migratory Species
Salmon Barbel		Bleak	Bream (Silver)
Shad (Allis and Twaite)	Dace	Bream (Common)	Loach (Spined and Stone)
Lamprey	Grayling	Carp Stickleback	(3 and 9 spined)
Eel Chub		Carp	(Crucian)
Smelt Pike		Gudgeo	n
Trout		Perch	
		Roach	
		Rudd	
		Bullhead	
		Tench	
		Minnow	

The three stages of the evaluation process are as follows:

Figure A.10 Site Classification Process

Stage 1

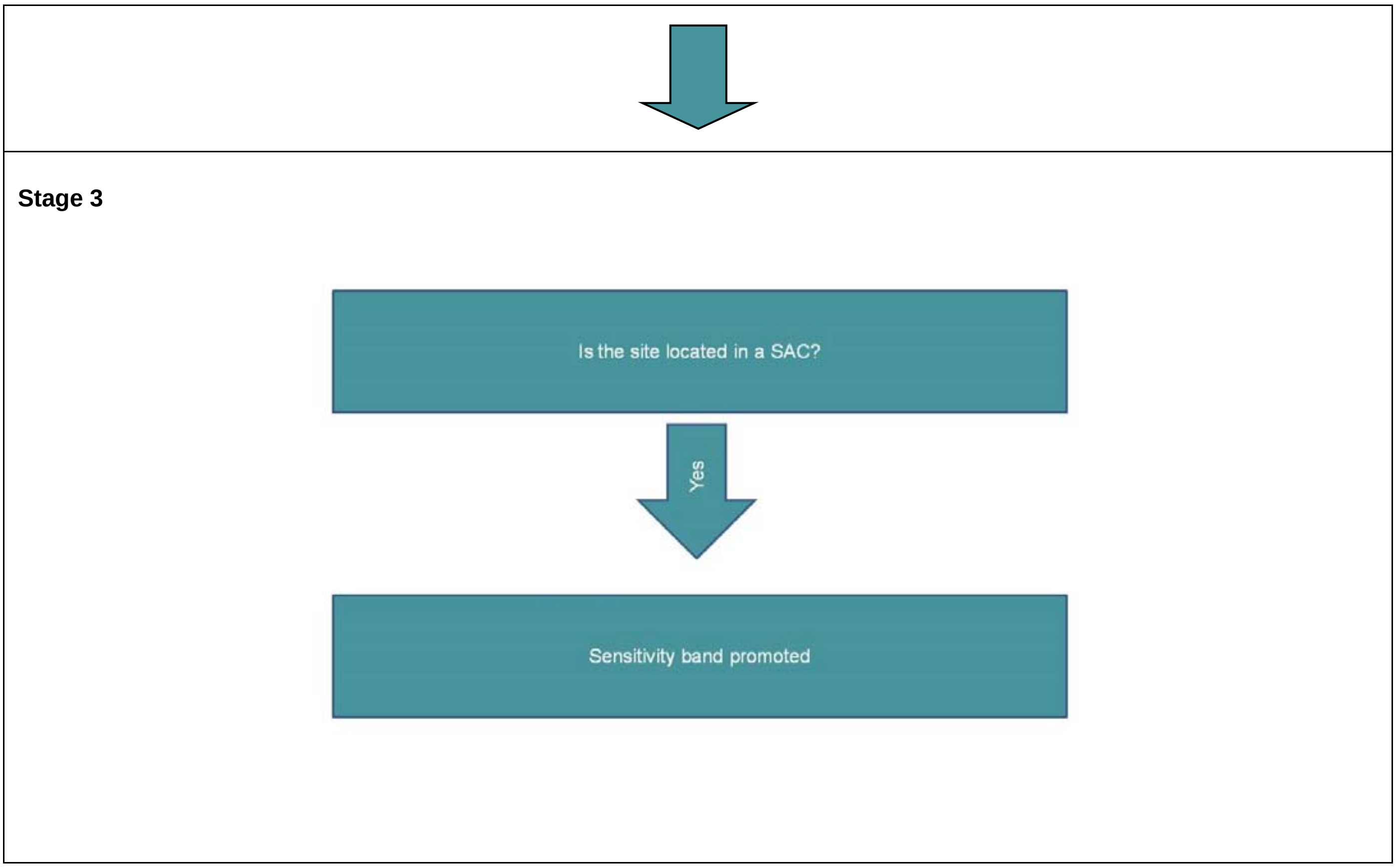


Stage 2 Site scored using:

Diadromous	Medium Probability of Presence	3 pts
	Low Probability of Presence	0 pt
Migratory Species	High Probability of Presence	4 pts
	Medium Probability of Presence	2 pts
	Low Probability of Presence	0 pt
Mobile Species	High Probability of Presence	2 pts
	Medium Probability of Presence	1 pt
	Low Probability of Presence	0 pt
	Presence of Non-migratory species not considered	

Barriers Scored based on Total Score:

Total Scores	**Sensitivity Band**
6 – 9	High
3 – 5	Medium
0 – 2	Low



A further categorisation of ‘Win-Win’ was applied to those locations with a medium to high power potential and which sit within a heavily modified water body (as defined in the Water Framework Directive).

The resulting locations of potential development are shown in Figure A.8 Areas of Hydro Development Potential.

A.4 Biomass

A.4.1 Woodland Residues and Energy Crops

The West Sussex Sustainable Energy Study provides an estimate of resource availability in terms of:

Woodland Residues – virgin (i.e. untreated) wood residues arising from forestry and arboricultural activities. The total technical resource available from sustainable management of woodland in Mid Sussex is estimated and an associated energy generation capacity determined based on combustion to generate heat.

Energy Crops – Assessment of land availability and landscape considerations provides an estimate of the land area available for the cultivation of either miscanthus or short rotation coppice (SRC) energy crops.

This resource is evaluated in terms of supplying fuel into the biomass market, rather than an energy generation potential specifically for the Mid Sussex area.

In the case of woodland residues, for example, the extent of resource depends on how much woodland is actively managed within Mid Sussex and the incentives for landowners to extract and process woodfuel.

In the case of energy crops several factors will influence the extent to which landowners will be willing to grow such crops:

- Long term supply contracts with end users;
- Financial incentives to grow and harvest the crops;
- Conflict over land-use for food production; and
- Logistics of fuel processing.

There are a number of biomass suppliers already operating in the area. For the purposes of illustration, those suppliers operating within a 50 mile radius of Haywards Heath are listed in Table A.6.

Table A.6 Biomass Suppliers within South East of England

#	Supplier	Location	Log	Chip	Pellet	Briquette
1	ComCenSus Ltd	RH19 2PF		x		
2	Country Tree Surgeons Ltd	RH10 4HL	x		x	
3	South East Wood pellets	TN8 6LD		x		x
4	Horsham Active Woodland Trust	RH5 5HE	x			
5	Hayes Farm Partnership	RH20 2HL			x	
6	Liston Products limited	BN7 3DF		x	x	
7	Balcombe Estate	RH17 6QN	x		x	
8	South East wood fuels	RH13 9DN		x	x	
9	Four seasons fuel ltd	RH14 9DG	x			
10	Wiston Estate	BN44 3EA			x	
11	Sussexlogs	BN13 1NX	x			x
12	South East wood fuels ltd	BN8 6BY	x		x	

#	Supplier	Location	Log	Chip	Pellet	Briquette
13	Brownings Farm Woodfuel	TN22 5HG	x			
14	South East wood fuels ltd	TN6 1TX		x	x	
15	Foxhills Tree services Ltd	TN33 9JR			x	
16	Crowhurst Farm Developments	TN33 9PU			x	
17	Discover Trees - Northiam	TN31 6QL	x			
18	Discover Trees	8JJ	x			
19	Home Counties Wood fuel Ltd	TN3 9JT			x	
20	Capel Group	TN12 7HE			x	
21	Phase One Joinery	TN3 8AD				x
22	CPL Kent	TN26 2PJ	x	x		x
23	Godinton Park	TN33 3BP			x	
24	Eco tree care and conservation ltd	CT4 8EU	x			
25	Cork Farm Woodfuels	CT4 8BN	x			
26	Torry Hill Farm	ME90SP			x	
27	Envirocology	ME9 9PB	x		x	
28	South East Wood Fuels	ME9 0AP		x	x	
29	GPP Wood Fuel	TN12 9RR		x		x
30	Bertie's Wood Fuel	TN11 0DU	x		x	x
31	Parkwood Logs	ME18 5BA	x			
32	Sprint fuels Ltd	ME1 3QX		x		
33	Kent County Council	DA12 3HX	x			
34	Rekola Recycling Ltd	RM1 64AT			x	
35	Balcas Brites England and wales	RM1 43TD		x		
36	Heat Logs of Barking	RM12 4XR				x

#	Supplier	Location	Log	Chip	Pellet	Briquette
37 The	Renewable fuel Company (UK) Ltd	E11 2DD		x		x
38	Big K products UK ltd	N17 9QU	x			x
39	HWR Ltd	N18 3PU			x	
40	Kenkko Ltd	NW4 2DG	x	x	x	x
41	Forest Fuels Ltd	WD7 9EG		x	x	
42	Land Energy Ltd	EC1N 8HN		x		
43	Greater London	DA11 0SD	x			
44	Clearpower Ltd	W1D 2EU	x	x	x	x
45	Eastwood Power	W1S 1YH	x	x	x	
46	JR (London) Ltd	SW17 0RG		x		x
47 Log-	Delivery.co.uk	KT3 3ST	x	x		x
48 CPL	South London	KT9 2JT	x	x		x
49 Sam	Goody Trees	KT12 4LF	x			
50	LC Energy Ltd	TW13 4NA			x	
51 South	East Wood Fuels	SL0 9LA		x	x	
52	Fuel CHP Ltd - IVER hub	SL0 9LA		x	x	
53 South	East Wood Fuels	HP7 0PP		x	x	
54 High	Wycombe Hub	SL0 9LA		x	x	
55	Fuel CHP Ltd - Chilterns Hub	SL0 9LA			x	
56 Penn	Street Farm	HP7 0PP		x	x	
57 Forever	Fuels Ltd	SL6 8RT		x		
58	GV Recycling	RG5 4HJ			x	
59	Logboys GU15	3AN	x			
60 UK	Wood Pellets	RG21 8UU		x		x
61 Stickland	Wood Yard	RG24 7NH	x		x	

#	Supplier	Location	Log	Chip	Pellet	Briquette
62	Hampshire Woodfuel Cooperative Ltd	RG25 2PL			x	
63	GK Benford & Co	RG29 1QX	x	x	x	x
64	Hampshire Woodfuel Cooperative, Odiham	RG25 2PL	x		x	
65	Mark Howard	GU10 5PR	x			
66	The Eko Company	GU30 7SB	x	x		x
67	Sustainability Centre (Wood4heat)	GU32 1HR			x	
68	Wesnet Services Ltd	PO8 0JE	x			
69	South Coast Firewood	PO17 5PN	x			x
70	Forest Heat Energy Ltd	PO108QA		x	x	x
71	Covers Timber & Builders Merchants	PO19 8PE		x		x
72	Dryad Tree Services	GU3 3ET			x	
73	LC Energy Ltd	GU5 9BH		x	x	
74	LC Energy Ltd	GU5 9QA	x	x	x	x
75	Redwood Tree Services Ltd	GU24 9BY			x	

Source: http://www.woodfueldirectory.org

Given the extensive number of suppliers already operating in the area it is unlikely that a significant number of further suppliers based within Mid Sussex will enter the supply market via woodland management.

In terms of large scale consumers of biomass there are a small number within the proximity of Mid Sussex (50 mile radius used for consistency with supplier data). A summary of these users is provided in Table A.7.

Table A.7 Large Biomass Consumers

Facility	Location	Capacity (MWe)	Capacity (MWth)	Total Capacity (MW)
Hoathly Hill Community Biomass Project	RH19 4QG		0.3	0.3
SHOREHAM RENEWABLE ENERGY GENERATION PROJECT	BN41 1WF		32	32
Cophall Wood (ATT)	Polegate	19	42.2	61.2
AHS Energy (Combustion)	TN31 6QP	4.5		4.5
Ridham CHP Plant	ME9 8SR	23	51	74
Redhill Road Biomass Power Plant	KT11 1EQ		2.5	2.5
Bracknell Forest Biomass Centre	Bracknell		1.1	1.1
Pegham Renewable Energy Facility (ACT – Gasification)	PO15 6SD	2		2
Basingstoke skip hire	RG24 8NU	0.75	5	5.75
Slough Heat and Power	Edinburgh. St Slough	40 20		60
Beacon Community College	Crowborough		1	1

Source: RESTATS database

All of these facilities will have existing fuel supply contracts in place. It is therefore difficult to see how further suppliers operating within Mid Sussex could easily enter the market for energy crop supply.

A.5 Solar Thermal

Solar thermal systems use solar energy to heat water which is stored in a hot water cylinder. A boiler or immersion heater is required to provide an additional source of heat over and above the energy available from the sun. Solar thermal panels (collectors) come in two designs:

- **Evacuated tube**: Water flows through a number of copper pipes, which in turn are sealed in a glass tube. This reduces heat losses and makes these systems very efficient at transferring the heat of the sun to the water;

- **Flat Plate**: Water flows through copper pipes that are encased with a glass covered plate.

Solar collectors are suitable for use in both domestic and light industrial premises as well as part of systems supplying swimming pools.

A.5.1 Installation Considerations

There are a number of factors to consider in relation to solar thermal system installation including:

a) As with solar PV systems the optimum roof space available to solar thermal systems is South facing areas with little or no immediate overshading;

b) The system must include a hot water cylinder to store the resulting hot water. It is therefore more costly to install a solar thermal system in properties with an existing combi boiler since there is no existing water tank;

c) The proposed installation area of the roof must be structurally capable of supporting the weighted of the water-filled collector;

d) Solar collectors are eligible for Renewable Heat Incentive (RHI) payments for each kWh of heat produced in a year;

e) Solar collectors are likely to be most cost effective when reducing water heating demand from electricity or oil/LPG fuelled systems, i.e. those not on the national gas grid.

A.6 Heat Pumps

There are three different forms of heat pump that can be used to provide space heating.

A.6.1 Ground Source Heat Pump

A ground source heat pump extracts heat from the ground, which can then be used to supply radiators, underfloor or war air heating systems and hot water systems. A mixture of water and antifreeze is circulated around the so called ground loop, which is a loop of pipe arranged either horizontally (in a trench) or vertically (in a borehole). The circulating water/antifreeze fluid absorbs heat from the ground and this is then passed through a heat exchanger and into the heating system.

A.6.2 Air Source Heat Pump

Air source heat pumps extract heat from the outside air using the same approach as a fridge uses to extract heat from its inside. Heat from the air is absorbed at low temperature into a fluid. This fluid then passes through a compressor where its temperature is increased, and transfers its higher temperature heat to the heating and hot water circuits of the house. The heat in the house can then be provided via an underfloor system, warm air circulated by fans or a wet radiator system using outsized radiators.

A.6.3 Water Source Heat Pump

Water source heat pumps extract heat from water bodies. These can be lakes, ponds, rivers, springs, wells or boreholes. The heat transfer rate from water is higher than that from the ground or the air. So called ‘open loop’ designs circulate water via a heat exchanger and then discharge it back to the original source; a ‘closed loop’ system operates in a similar manner to a ground source heat pump with a water/antifreeze fluid mixture being circulated through pipes set within the water source.

An extraction licence is required from the Environment Agency when using open loop heat pumps that require more than 20 m^3/day of water to be abstracted from the water source (typically a 4 kW system and above). A discharge consent is also required for the cold water that has flowed through the heat pump.

Closed loop systems do not require any licensing from the Environment Agency.

A.6.4 Heat Pump Use

The heat output from heat pumps (whether ground, air or water) is lower than a typical wet radiator system fuelled via natural gas or oil. For this reason heat pumps are generally best used with underfloor heating, providing a larger surface area for supply. If used to supply a wet radiator system then these radiators need to be much bigger than conventional systems.

While the source of heat is renewable (ground, air or water), circulating fluid requires electricity to power the pumps. For this reason heat pumps are less economic to install in areas where natural gas fed heating systems already operate. In situations where heat pumps are replacing oil or electric heating systems the savings in terms of energy and cost will be more attractive.

A.7 Future Energy Consumption

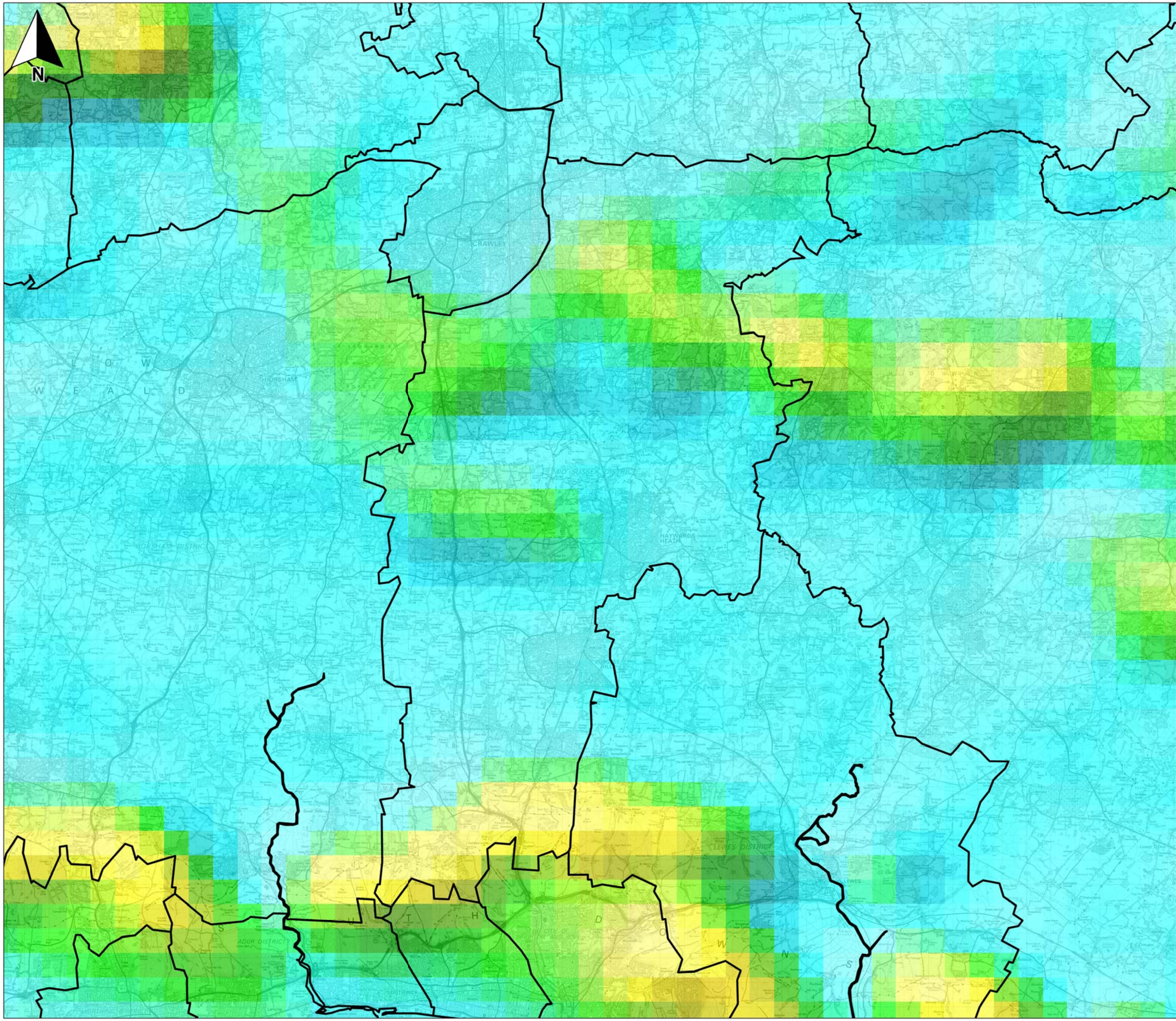
Working assumptions:

Total Housing Commitments

- All 4,213 units are delivered to 2010 Building Regulations.
- Dwelling mix is 40% : 40% : 20% in terms of 2-bed : 3-bed : 4-bed.

Future Commitments

- All 5,865 units delivered to 2016 Building Regulations.
- Dwelling mix is 10% : 40% : 40% : 10% in terms of 1-bed : 2-bed : 3-bed : 4-bed



Key

Council boundary

NOABL Windspeed at 45m a.g.l. (m/s)

11.6
7.2
6.6
6.3
1.4

0 km — 9 km
Scale 1:150,000 @ A3

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Figure A.1

Average Annual Wind Speed in Mid Sussex

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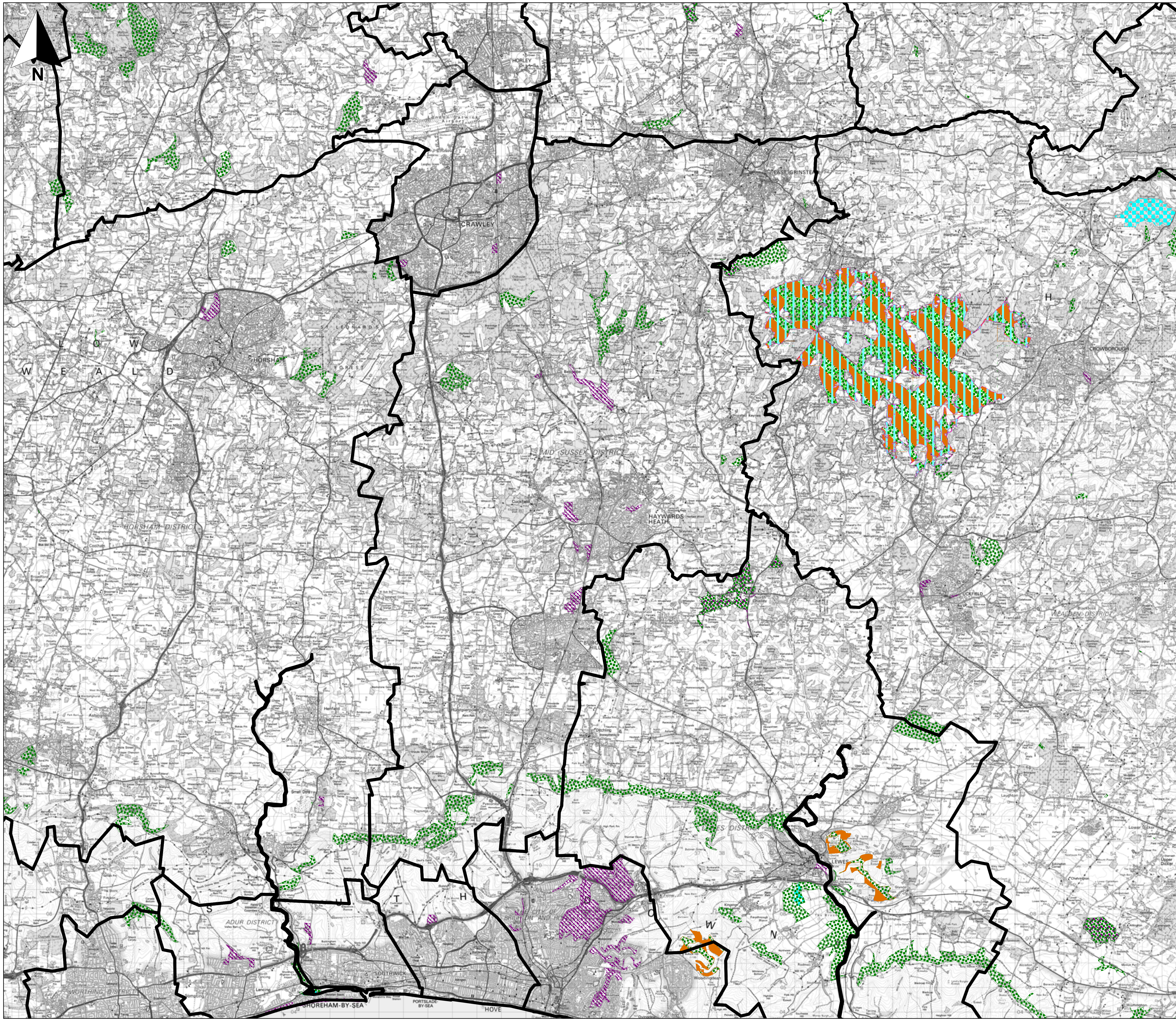

Key

- Council boundary
- Sites of Importance for Nature Conservation (SINC)
- Sites of Special Scientific Interest (SSSI)
- Special Protection Area (SPA)
- Ramsar
- Special Areas of Conservation (SAC)
- National Nature Reserve (NNR)
- Local Nature Reserve (NNR)
- Important Bird Areas (IBA)

0 km 9 km

Scale 1:150,000 @ A3

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Figure A.2

Environmental Designations

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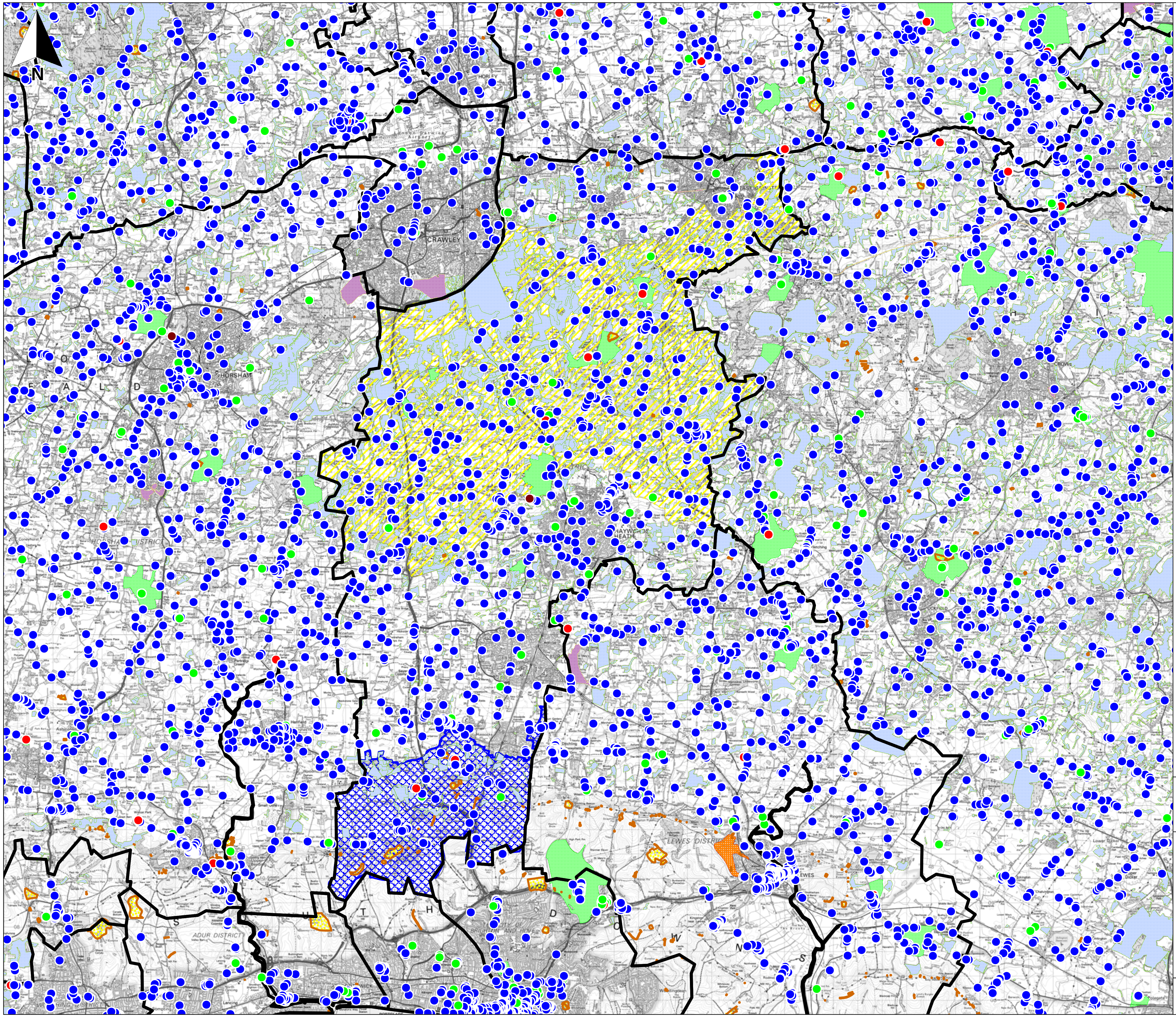

Key

- Council boundary
- Scheduled monument
- Historic battlefield
- Country park
- Registered Parks & Gardens
- Ancient woodland
- Area of outstanding natural beauty
- National park

Listed Buildings

- Grade I
- Grade II*
- Grade II

0 km — 9 km

Scale 1:150,000 @ A3

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Figure A.3

Cultural Designations

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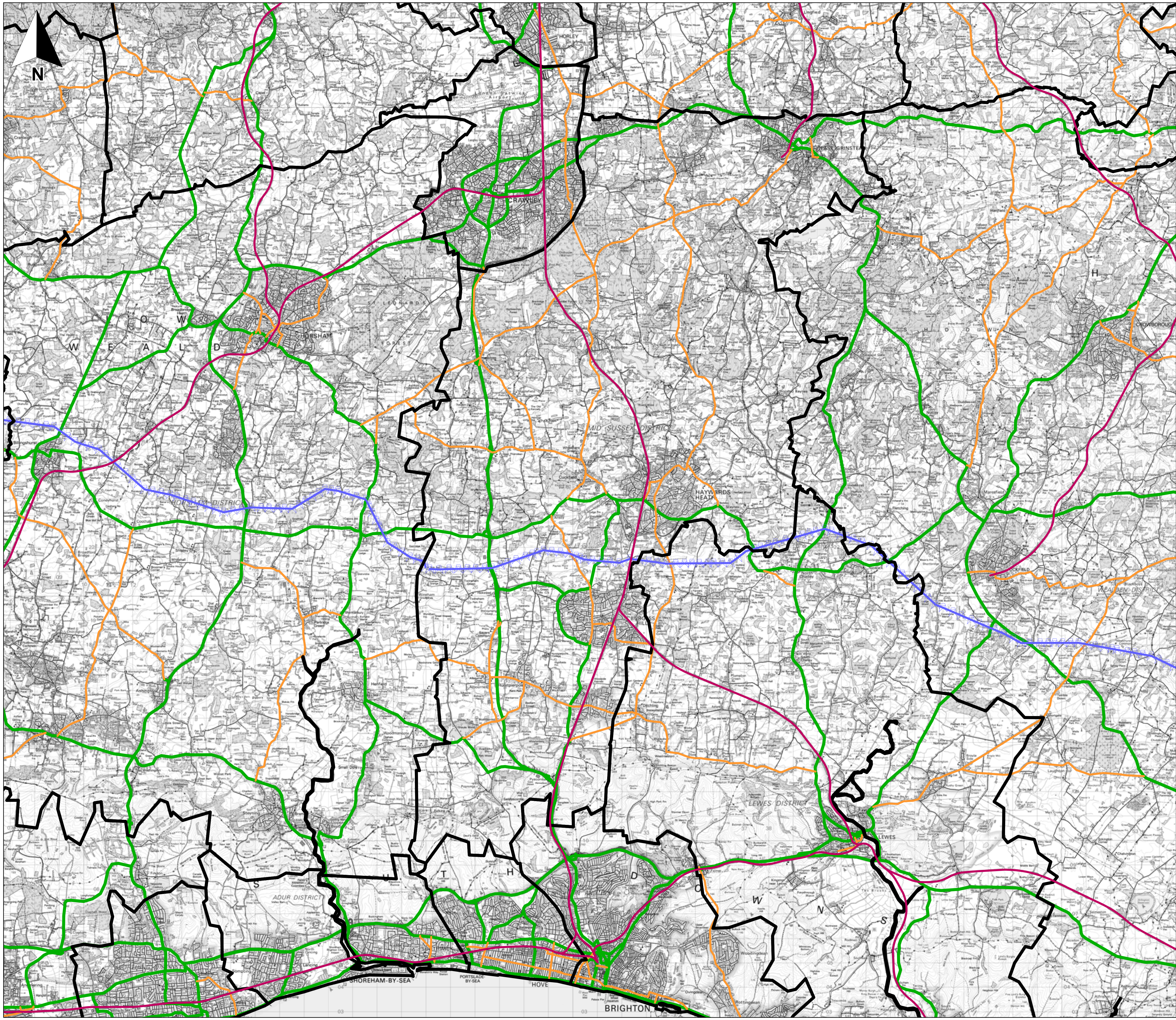

Key

- Council boundary
- Minor road
- B road
- A road
- Rail line
- Gas transmission pipeline
- Electrical transmission overhead power line
- Electrical cable

0 km 9 km

Scale 1:150,000 @ A3

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Figure A.4

Infrastructure Constraints

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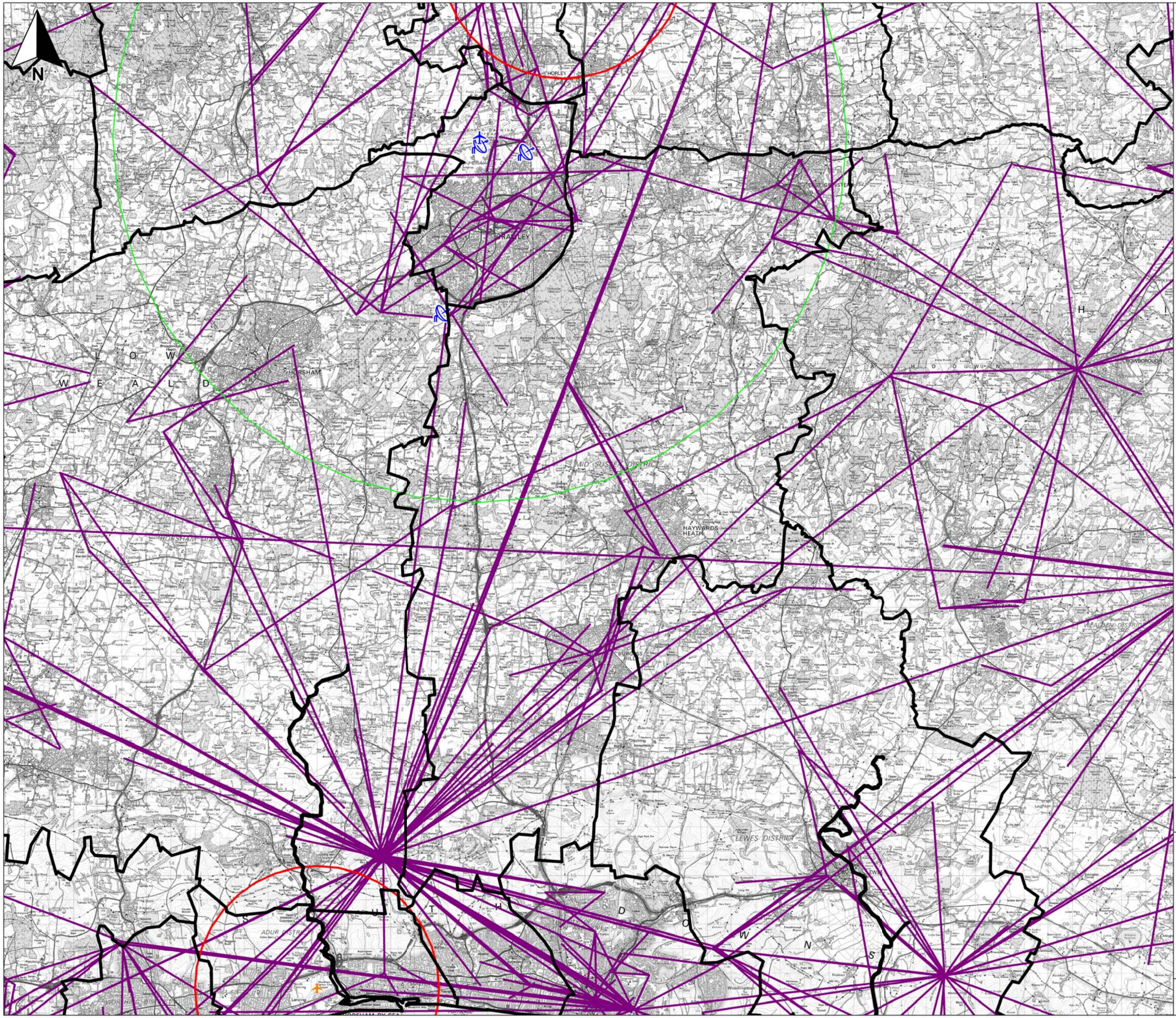

Key

- Council boundary
- Microwave links
- Potential MOD air traffic control
- Potential MOD radar zone
- Non-safegaurded airport
- Non-safegaurded airport 5 km buffer
- Safegaurded airport 15 km buffer

0 km 9 km

Scale 1:150,000 @ A3

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Figure A.5

Airports, Radar and Communications Constraints

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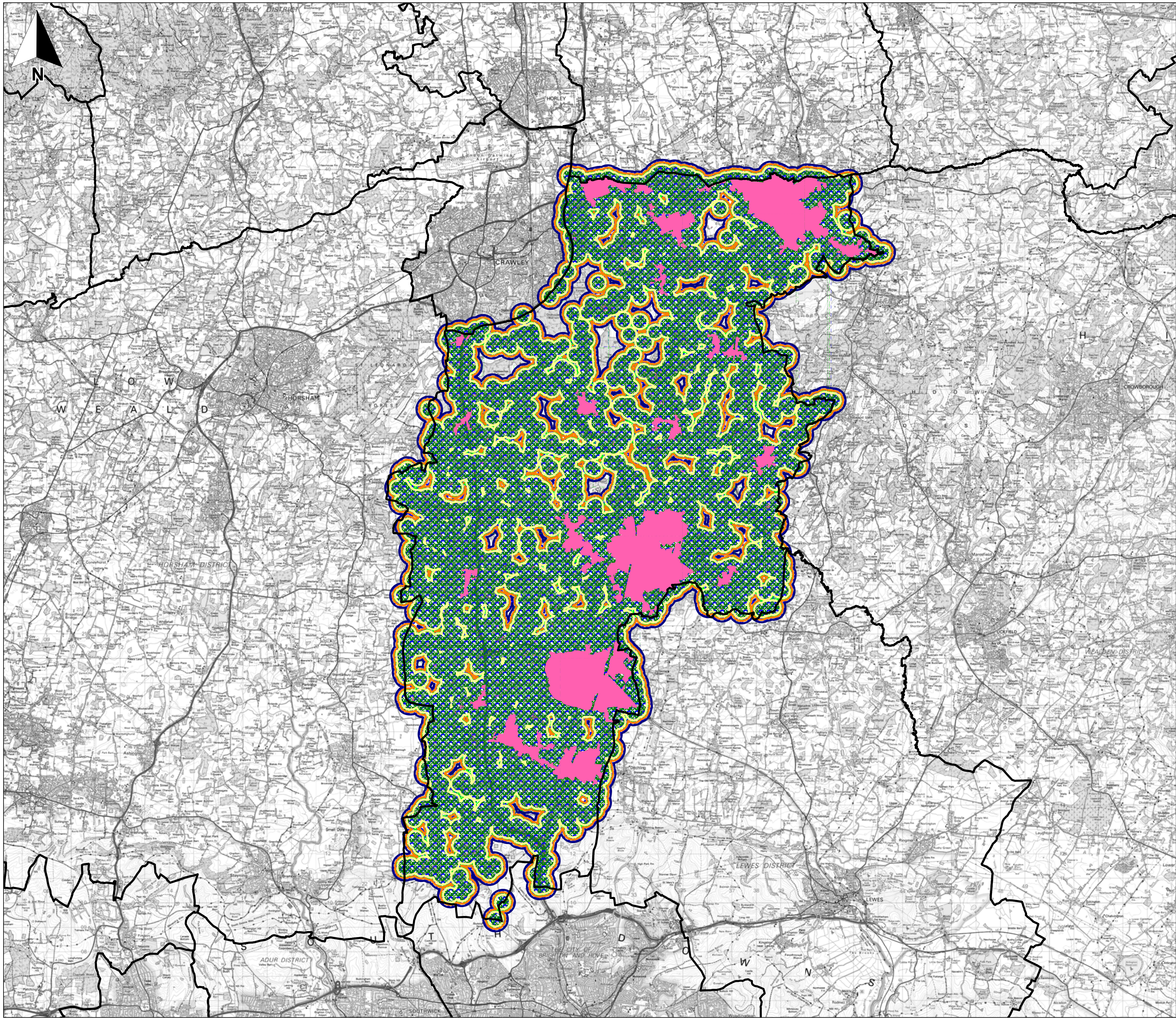

Key

- Council boundary
- Urban areas and buildings
- Addresspoint 300 m buffer
- Addresspoint 400 m buffer
- Addresspoint 500 m buffer

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Figure A.6

Noise Buffer Constraints

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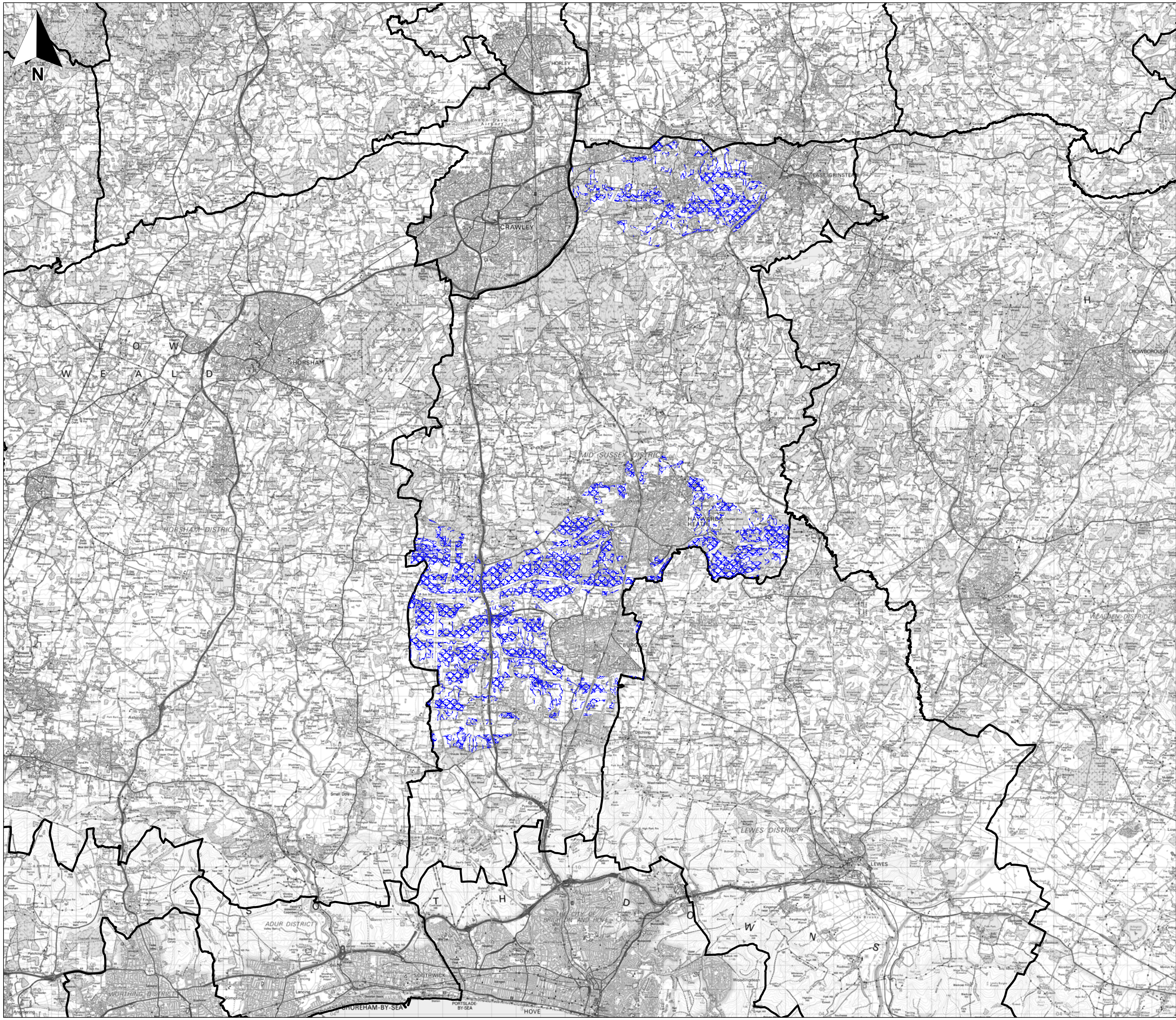

Key

Council boundary

Areas of ground mounted solar array potential

0 km 9 km

Scale 1:150,000 @ A3

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Figure A.7

Area of Solar Ground Based Array Potential

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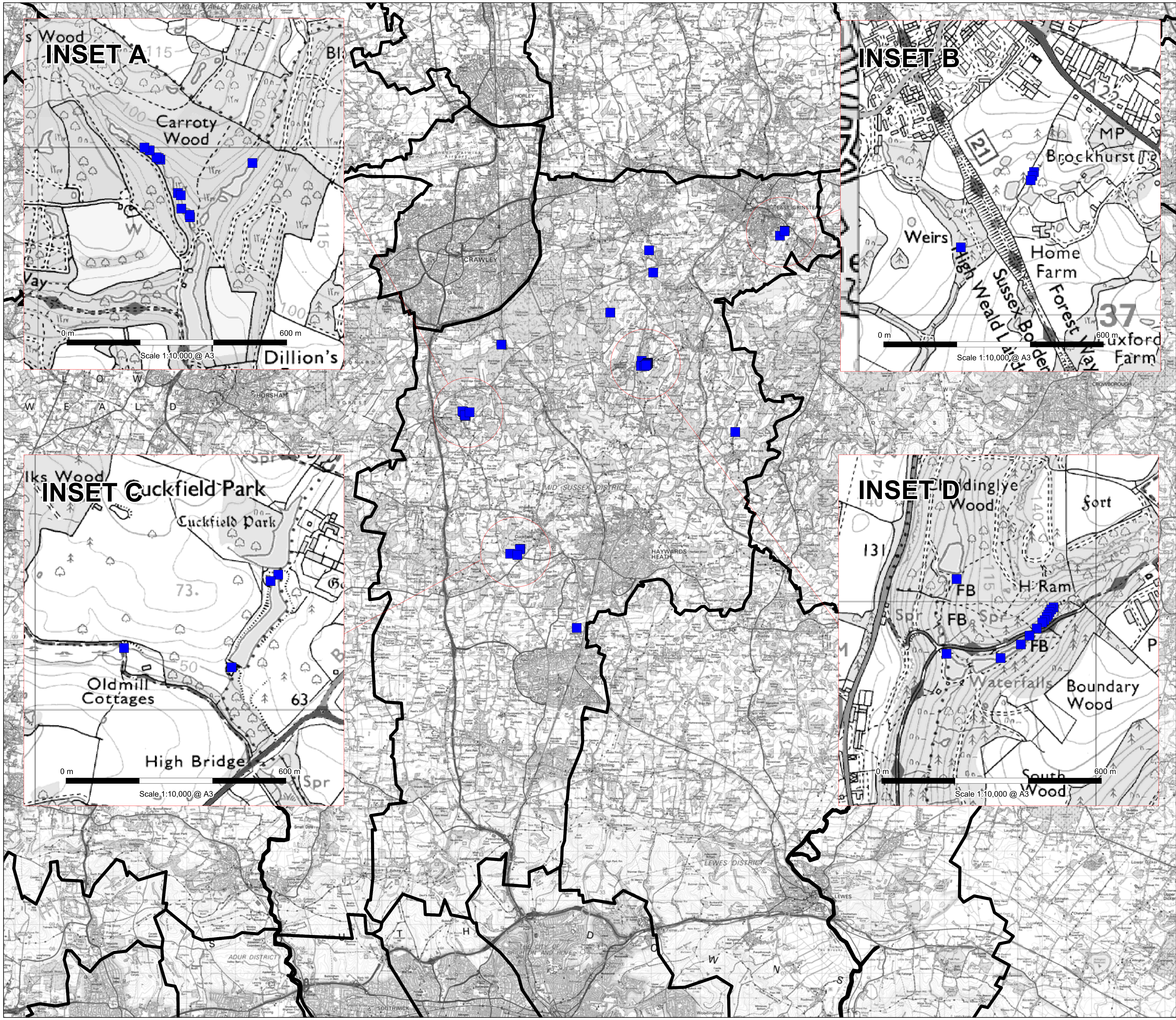

Key

Council boundary

Sites of hydro potential

0 km 9 km

Scale 1:150,000 @ A3

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Figure A.8

Areas of Hydro Development Potential

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