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ROTHERHAM METROPOLITAN BOROUGH COUNCIL

Rotherham Low Carbon and Renewable Energy Study

November 2011

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ROTHERHAM METROPOLITAN BOROUGH COUNCIL

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November 2011

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EXECUTIVE SUMMARY

Introduction

This report relates to a Renewable and Low Carbon Energy Evidence Base Study commissioned by Rotherham Metropolitan Borough Council (RMBC) in July 2011 to facilitate the formulation and justification of Local Development Framework (LDF) policies relating to renewable and low carbon energy.

This report is designed to follow on from the regional study, undertaken by AECOM, entitled 'Low carbon and renewable energy capacity in Yorkshire and Humber'. A review of the AECOM study identified a number of areas where the original energy Opportunity Plan (EOP) could be improved. WA has sought to make these improvements by enhancing the original study whilst avoiding any unnecessary repetition. The following areas were selected for more detailed/finer grain analysis:

- Heat and power mapping
- Large scale wind resource
- Medium scale wind (Feed in Tariff) resource
- Biomass (specifically dedicated energy crops and woodlands)

Heat and Power Mapping

The current total energy demand for Rotherham Metropolitan Borough (RMB) based on the analysis contained in this report but excluding transport is estimated at:

Electricity	788	GWh/yr
Heat	2,560	GWh/yr
Total	3348	GWh/yr

This equates to a total annual CO₂ emission figure for RMB, excluding those associated with transport, of 983,000 tonnes.

In comparison, energy demand values provided by DECC identified gas consumption as being 2,477GWh/yr and electricity consumption as being 563GWh/yr for 2009. These came

to an overall total value of 3,040GWh/yr. This is a reasonably good agreement given the assumptions used in the demand modelling.

The heat mapping exercise identified several high density heat loads that are potentially exploitable for retrofitting district heating/CHP schemes. Potential candidate sites include:

- Wath Upon Dearne – area around Beech Road, Avenue Road and Sandymount Road.
- Holmes, Rotherham – area around Hartington Road, Cavendish Road, Josephine Road and Belmont Street
- St Ann’s, Rotherham - RMBC Leisure Centre and housing to the east (*it is understood that a 500kW biomass boiler was installed nearby at Shaftsbury House in 2007 but has yet to be fired. Furthermore, it is not clear that the leisure centre is serviced by this and so there is some potential for expansion*)
- Moorgate, Rotherham - Rotherham District General Hospital and adjacent housing
- Rawmarsh – Goosebutt Street, Netherfield Lane and Spalton Road.
- Locations along Bawtry Road, Bramley, Rotherham

Wind

The potential for large and medium scale wind resource is shown below. This was revised from the regional study to include medium scale wind turbines under the Feed in Tariff.

Revised Potential Wind Resource in Rotherham							
Scale	Area (ha)	Number of Turbines	Capacity (MW)	Energy (GWh/yr)	CO ₂ Savings (t/yr)	Electricity Demand	Total Energy Demand
Large	517	27*	55	180	90,444	31%	6%
Medium	304.5	133	66.5	219	97,877	39%	7%

*equivalent number of 2MW wind turbines.

Although this represents the practically available wind resource in RMB, site specific constraints may arise during the planning and the development of a wind project which may prevent this resource potential being fully achieved.

Biomass

The potential for biomass energy crops was revised as part of this study as the original biomass data was not available. The total yields were used to estimate a practical resource potential for heat and electricity generation from biomass, as shown below.

Revised Current Capacity and Potential Biomass Resource in Rotherham					
Renewable Energy Resource	Current Capacity MW	Current Capacity GWh	Potential Resource - heat (MW)	Potential Resource - electricity (MW)	Potential resource GWh
Energy crops	0	0	7.4	3.7	88.8
Forest residues	1	2	1.2	0.6	14.4

The biomass resource in RMB is limited and could meet just 6% of its electricity needs. To increase this additional biomass resource will need to be imported from outside the Rotherham boundary.

Energy Opportunity Plan

The table below shows the revised Energy Opportunity Plan based on the findings of this study and the regional study undertaken by AECOM.

Revised Current Capacity and Potential Renewable Resource in Rotherham					
Renewable Energy Resource	Current Capacity MW	Current Capacity GWh	Potential Resource - heat (MW)	Potential Resource - electricity (MW)	Potential resource GWh
Large scale wind	26	69	0	55	179.7
Medium scale wind	0	0	0	66.5	219
Small scale wind	0	0	0	1	1
Hydro	0	0	0	1	3
Solar PV	1	1	0	12	9
Solar Thermal	0	0	18	0	11
Air source heat pumps	0	0	10	0	15
Ground source heat pumps	0	0	6	0	11
Biomass energy crops	0	2	7.4	3.7	88.8
Biomass woodfuel	1	0	1.2	0.6	14.4
Biomass agricultural arisings	0	0	5	2	38
Biomass waste wood	0	0	2	1	14
Energy from waste wet	0	0	1	1	11

Energy from waste poultry litter	0	0	0	0	0
Energy from waste MSW	0	0	2	1	20
Energy from waste C&I	0	0	4	2	35
Energy from waste landfill gas	1	6	0	0	0
Energy from waste sewage gas	0	2	0	0	6
Total	29	80	56.6	146.8	572.7*

*This is equivalent to approximately 18% of the current energy demand in RMB

Wardell Armstrong Revisions	
AECOM study	

RMBC is currently preparing a Local Development Framework to identify key areas for development over the 15 years from 2012 - 2027. This study has assessed the potential for low carbon and renewable energy resources within the LDF target and specifically in the key areas highlighted for development, which include:

- Waverley
- Bassingthorpe Farm
- Dinnington

The study identified that large mixed-use developments may be able to benefit from district heating and combined heat and power plants or wind turbines whilst smaller developments may not have high enough energy demand or the land area to accommodate these technologies, however building integrated renewable technologies could provide significant CO₂ savings for these buildings. As part of the assessment an economic appraisal tool (EAT) was developed which has now been provided to RMBC to facilitate the assessment of low carbon and renewable energy technologies on a site by site basis.

Consultation Event

A stakeholder Consultation Event was held on the 30th of September 2011 at Rotherham Town Hall. The primary objectives were to inform stakeholders about the draft results of the study in terms of the enhanced evidence base and also to solicit comments on the options for low carbon and renewable energy targets and the planning policies being developed.

Although there was some polarisation between the attendees, private sector versus public/voluntary sector, there was no clear steer towards pragmatic or pioneering targets/policies.

Renewable Energy Targets

The outcomes of this study and the accompanying consultation have identified that the following targets would offer both a pragmatic and pioneering approach to achieving increased levels of renewable energy deployment within RMB.

Borough Wide Targets	
Renewable energy sources should provide 10% of predicted energy use within the whole Borough plus a notional 1% uplift per annum up to 2020.	
Development Year*	Renewable energy target
2012	10%
2013	11%
2014	12%
2015	13%
2016	14%
2017	15%
2018	16%
2019	17%
2020	18%**

**Subject to Core Strategy adoption date*
***Maximum currently available renewable energy resource within RMB*

It should be noted that from a practical perspective the currently available renewable energy resource within RMB equates to only 18% of the current energy demand.

Local Development Targets

For new housing developments targets should be adopted in line with current proposals for zero carbon homes and new Building Regulations as shown below.

Residential Carbon Compliance Levels			
Carbon Compliance levels for 44% CO₂ reduction from 2013	All dwellings	14	kgCO ₂ /m ² /yr
	Detached houses	10	
Carbon Compliance levels for Zero Carbon Homes from 2016	Attached houses	11	kgCO ₂ /m ² /yr
	Low rise apartment blocks	14	

These compliance levels are only applicable to residential properties. Non-residential developments should adopt the Borough wide targets above and generate further renewable or low carbon energy or incorporate appropriate design measures to reduce the development's overall predicted carbon dioxide emissions by 20% until appropriate carbon compliance targets are introduced via the Buildings Regulations.

Post 2016 CO₂ emissions up to the relevant compliance level are expected to be met by allowable solutions.

Policy

There is a clear framework through EU, national and local legislation for the inclusion of planning policies designed to encourage the implementation of suitable renewable energy schemes to help achieve European and national targets on CO₂ emissions and climate change.

This evidence base study has shown that the largest potential for renewable energy delivery lies with large scale and particularly medium scale wind. In essence, they offer over half the potential resource across all technologies. Solar PV and thermal can also offer a substantial opportunity, however the successful deployment of this technology tends to be linked to government incentives which tends to introduce constraints in terms of the timing of applications. Existing stock retro-fit tends to be somewhat at the behest of Governmental intervention but should be offered serious consideration, in particular any district heating opportunities.

Rotherham MBC's Local Development Framework (LDF) has the critical role in ensuring future development is delivered in a sustainable manner. The Council's Core Strategy is the primary document within the LDF.

Draft policy CS27 contained within the Core Strategy, as it currently stands, is in line with national guidance, primarily laid out in PS22: Renewable energy. Although this type of policy is adequate, the evidence set out in this study suggests that Rotherham MBC could improve its local distinctiveness by incorporating specific technologies identified in the Energy Opportunities Plan and targets.

It is considered that the policy could be improved by seeking consistency with the energy hierarchy and by encouraging development to incorporate specific suitable technologies identified as energy opportunities to provide sufficient renewable energy generation to offset 10% plus 1% uplift per annum of predicted energy requirements and where appropriate achieve carbon compliance targets. The draft Core Strategy Policy below sets out the strategic targets discussed above.

Core Strategy Policy – Low Carbon and Renewable Energy Generation

Developments that generate renewable and low carbon energy

Proposals for the development of renewable and low carbon sources of energy, particularly from community-owned projects, will be encouraged provided that there are no unacceptable adverse effects on:

- a) Residential living conditions, amenity and quality of life;
- b) Character and appearance of the landscape and surrounding area;
- c) Biodiversity, geodiversity and water quality;
- d) Historical, archaeological and cultural heritage assets;
- e) Highway safety and infrastructure.

Any proposals will be accompanied by supporting information to clearly show how the surrounding environment will be protected and how site restoration will be carried out when production ends.

Energy Hierarchy

Developments should seek to reduce carbon dioxide emissions through the inclusion of mitigation measures in accordance with the following energy hierarchy:

1. Minimising energy requirements through sustainable design and construction;
2. Incorporating renewable energy sources;
3. Using low-carbon energy sources.

Overall Borough Wide Targets

Renewable energy sources should provide 10% of predicted energy use within the whole Borough from 2012 plus a notional 1% uplift per annum up to 2020.

Residential Carbon Compliance Level

All residential developments will be required, unless this can be shown not to be feasible or viable, to achieve the following carbon compliance targets:

- a) From 2011 – All dwellings to achieve at least 20 kgCO₂/m²/yr
- b) From 2013 - All dwellings to achieve at least 14 kgCO₂/m²/yr
- c) From 2016 - Detached houses to achieve at least 10 kgCO₂/m²/yr
 - Attached houses to achieve at least 11 kgCO₂/m²/yr
 - Low rise apartment blocks to achieve at least 14 kgCO₂/m²/yr

Carbon compliance levels are applicable to the development as a whole and may be offset by allowable solutions. The developer may make a payment to an allowable solutions provider, who will take the responsibility and liability for ensuring that allowable solutions, which may be small, medium or large scale carbon-saving projects, deliver the required emissions reductions.

Non-Residential

All significant non-residential developments of more than 1000m² will be required, unless this can be shown not to be feasible or viable, to:

- a) provide a minimum of 10% plus 1% uplift per annum of their predicted energy needs on-site from renewable energy sources, in accordance with Table 7.2; and
- b) generate further renewable or low carbon energy, or incorporate appropriate design measures, to reduce the development's overall predicted carbon dioxide emissions by 20% [including requirements to satisfy (a)]

Where it is not appropriate to incorporate such provisions within the development, an off-site scheme, or contribution to such may be acceptable.

Recommendations

It is recommended that Rotherham Metropolitan Borough Council adopt the suggested low carbon and renewable energy targets and policies in their forthcoming LDF.

Rotherham Metropolitan Borough Council should maximise the implementation of low carbon and renewable energy resources on their own estate.

1 INTRODUCTION

1.1 This report relates to a Renewable and Low Carbon Energy Evidence Base Study commissioned by Rotherham Metropolitan Borough Council (RMBC) in July 2011 to facilitate the formulation and justification of Local Development Framework (LDF) policies relating to renewable and low carbon energy.

1.2 The key objectives of this study included:

- An enhanced evidence base for Rotherham's LDF to meet national planning policy requirements whose preparation is based upon understanding of the local feasibility and potential for renewable and low carbon technologies.
- Robust and justified Core Strategy and supporting Development Management Policy on low carbon and renewable energy including recommendations for policy wording and supporting justification.
- A critical assessment and response, where considered appropriate, to the recommendations of the AECOM (2011) study.
- Refinement of the AECOM (2011) Energy Opportunity Plan for Rotherham Borough to provide robust data on the economically viable resource for low carbon and renewable energy:
- Provision of a method for assessing the economic feasibility of development schemes that include, or could include, low carbon and renewable energy provision, either proposed as part of the Local Development Framework or via individual planning applications.
- Identifying economically feasible and viable opportunities for maximising low carbon and renewable energy as part of the identification and implementation of the Local Development Framework's broad and site allocations for new housing and employment. This could occur via the provision of new or extension of existing schemes. Assessment of economic viability should be scenario based to show performance against varying levels of Borough economic activity.
- A robust examination of whether Rotherham should set its own local target for decentralised energy production and if so, at what level(s) and for what

kind(s) of development and area(s). Full justification, including assessment of impact upon economic viability of development, should be provided.

- A robust examination whether there are any development area or site specific targets justifying higher targets where there are particular and demonstrable opportunities. (This should be undertaken irrespective of conclusion on whether a local authority wide target should be identified.)
- Information to guide subsequent decision on whether to include a requirement for low carbon and renewable energy (as “allowable solutions”) as part of the Council’s development of a Community Infrastructure Levy.

1.3 This report is designed to follow on from the regional study, undertaken by AECOM, entitled ‘[Low carbon and renewable energy capacity in Yorkshire and Humber](#)’.

2 REVIEW OF THE AECOM (2011) STUDY RECOMMENDATIONS FOR ROTHERHAM

2.1 Local Government Yorkshire and Humber commissioned AECOM in January 2010 to produce an evidence base of the potential for low carbon and renewable energy generation in the Yorkshire and Humber region.

2.2 The AECOM study utilised the ‘*Renewable and Low Carbon Energy Capacity Methodology for the English Regions*’ published by the Department of Energy and Climate Change (DECC) in January 2010, to inform the evidence base assessment.

2.3 The technologies included in the regional study included:

- District heating and Combined Heat and Power (CHP)
- Commercial scale wind energy
- Hydro energy
- Biomass
- Energy from Waste
- Microgeneration

2.4 One of the key outputs of the AECOM study was the Energy Opportunity Plan (EOP) for each local authority within the region. This provides a description of the renewable energy resource potential in each local authority within the region. The current capacity and potential renewable energy resource for Rotherham Metropolitan Borough (RMB) identified in the AECOM study is shown in

2.5 Table 2.1.

2.6 For the purposes of the AECOM report “current” refers to facilities that are either operational or have secured planning consent. The complete energy opportunity plan for RMB can be found in Appendix B.15 of the AECOM report.

Table 2.1: Current Capacity and Renewable Energy Resource in Rotherham Borough
Extracted from AECOM Report

Rotherham	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	26	69	0	91	239	0	0%
Small scale wind	0	0	0	1	1	0	5%
Hydro	0	0	0	1	3	0	0%
Solar PV	1	1	0	12	9	0	0%
Solar thermal	0	0	18	0	11	1220	5%
Air source heat pumps	0	0	10	0	15	643	4%
Ground source heat pumps	0	0	6	0	11	390	4%
Biomass energy crops	0	0	7	4	59	476	1%
Biomass woodfuel	1	2	14	0	36	908	4%
Biomass agricultural arisings (straw)	0	0	5	2	38	320	2%
Biomass waste wood	0	0	2	1	14	116	3%
Energy from waste wet	0	0	1	1	11	84	1%
Energy from waste poultry litter	0	0	0	0	0	0	0%
Energy from waste MSW	0	0	2	1	20	166	3%
Energy from waste C&I	0	0	4	2	35	297	3%
Energy from waste landfill gas	1	6	0	0	0	0	0%
Energy from waste sewage gas	0	2	0	0	6	0	0%
Total	29	79	86	117	582	5,757	

2.7 The conclusions of the AECOM report relating specifically to Rotherham were:

“Rotherham town centre has sufficient heat density to support heat networks, and there are several small scale networks covering estates throughout the borough.

Beyond the town centre and away from the Don Valley, Rotherham is largely (about 52%) rural. The borough has significant potential for commercial scale wind

and also some potential for hydro; Jordan Dam has been identified as a potential site.”

2.8 An objective of this study was to review the AECOM recommendations for Rotherham and comment on them where appropriate. The report made three generic recommendations for all local authorities to undertake further work in specific areas, i.e.

- Local authority targets for renewable energy
- Developing the EOP for policy and corporate use
- Using the more detailed EOP

2.9 The recommendations are set out in more detail below along with Wardell Armstrong’s comments.

AECOM Recommendation	Wardell Armstrong Comments
9.2 Local authority targets for renewable energy	
Individual local authorities, or sub-regional groups of authorities, may wish to set area wide targets for renewable energy generation. These targets may take the form of installed capacity in MW, or annual energy generation in MWh or a proportion of energy demand in %. There could be separate targets for renewable electricity and heat, or an overall target.	With the abolition of regional spatial strategies, region wide targets are now a moot point. There may be still a case for area wide sub-regional targets if they are realistic, achievable and stimulate implementation. However, current thinking within DECC is that <u>not</u> having an explicit area wide target may result in more renewable energy projects being implemented. Also the focus has changed from MW, MWh and % demand to CO ₂ reduction targets, particularly in the case of the built environment and a carbon budget for RMB and individual developments may be a better alternative. The need for targets, their scope (borough wide or specific to the new development areas identified in RMBC’s developing LDF) and their timing was a topic considered at the Consultation Event as part of this study (see Chapter 7 for details).
Such targets can provide a useful benchmark for an area of the scale of deployment that will be required to make a meaningful contribution to the UK renewable energy targets by 2020.	All local authorities aspire to making a meaningful contribution to the UK 2020 RE targets. However, any local targets must be set in the context of the locally available and practically exploitable RE resource. A

<p>It also can act as a stimulus for corporate and wider stakeholder action to assist in increasing the deployment of renewable energy.</p>	<p>primary objective of this study has been to provide a robust and detailed evidence base to support the development of these targets.</p> <p>Targets are a two edged sword, authorities where there is a large gap between the target and actual levels can be interpreted by some developers as an easy win. Conversely others will think that the reason for the gap is that planning permissions will be difficult to achieve. What is on the ground is a much better measure of the contribution to UK renewable energy targets.</p>
<p>In order to develop the renewable energy potential figures that have been supplied as part of this study into a target, the further work that would be required at a local authority level is likely to consist of the following:</p>	
<ul style="list-style-type: none"> Engage with relevant local stakeholders to explore how much of the potential for each resource set out in this study is likely to be realised, given more detailed local information on constraints, proposals and plans. This study sets out some examples of scenarios that could be used. 	<p>This is essential to maximise the realisation of the renewable energy potential in Rotherham. This study has engaged with local stakeholders through a Consultation Event, conversations with developers, planners and other stakeholders and Wardell Armstrong's wider contacts through its membership of South Yorkshire business and environmental forums.</p>
<ul style="list-style-type: none"> Consider issues of resource allocation between local authorities. One issue with trying to develop targets at a local authority level is that resources such as biomass and energy from waste do not respect boundaries. Therefore, one local authority may contain an energy recovery facility that takes waste from a neighbouring local authority. The first local authority would see a contribution to its renewable energy generation target whilst the second wouldn't. Therefore, if you know that there are plans or proposals for these sort of facilities in neighbouring authorities, you should discount any contribution from this resource towards your own target. Conversely, if your area is to host such a facility, then this could enable a higher target. 	<p>This is sound reasoning and should be taken into account if area wide targets are implemented. A case in point is the proposed Anaerobic Digestion plant identified by the study in Doncaster. This plant is likely to take waste from RMB and much of the surrounding area. Any target for Energy from Waste (EfW) for RMB needs to be reduced accordingly.</p>
<ul style="list-style-type: none"> Once suitable possible targets or target ranges have been agreed, these would then need to be taken through local authority political approval process 	<p>Any potential targets would need to be embodied in the Core Strategy of Rotherham's LDF and would therefore be required to be passed by an Inspector at an Examination in Public (EiP). An objective of this project has been to ensure that any policies that are derived from it are robust enough to pass EiP and gain</p>

	approval from the Inspector. A key element of this is ensuring that these policies have “local distinctiveness”.
9.3 Developing the EOP for policy and corporate use	
<p>By its nature, this study has been restricted to using regional and national datasets. However, there is additional data available at local authority level that can be superimposed (in GIS format) to the EOPs to add more value, particularly in relation to potential heat loads, and we recommend that local authorities should do this. This could then be used to inform planning policy, development management and wider corporate and strategic action. The additional data could include:</p> <ul style="list-style-type: none"> • Candidate sites for new developments • Strategic new development sites • Preferred sites for locating energy recovery facilities • Public sector buildings • Local authority or public land ownership • Fuel poverty data • Social housing • Local knowledge of potential renewable heat customers • Local environmental or landscape constraints, such as Local Nature Reserves, or greenbelt <p>The local authority will have many of these datasets available in house, or could engage with local public sector or other stakeholders to obtain them.</p>	<p>This study has utilised a number of more detailed local GIS datasets in enhancing the evidence base for RMB. These will form part of the EOP and include:</p> <ul style="list-style-type: none"> • preferred candidate sites for new developments identified in the LDF • local authority owned social housing • existing district heating systems • landscape sensitivity assessment • radar clearance mapping based on local topography
<p>Specifically in relation to wind power, this regional study has used the OS Strategi dataset to identify the location of existing dwellings. A disadvantage of this dataset is that it assumes that there are no (commercial scale) wind power opportunities in urban areas. If a local authority wanted to have a picture of the potential for brownfield wind development in their urban areas, then they may wish to commission a more detailed wind assessment that would make use of Address Point data or OS MasterMap data.</p>	<p>Sound advice from AECOM. The use of Addresspoint data forms the basis for the more detailed commercial and medium scale wind assessments in the enhanced evidence base developed by this study. In addition, the deviation from DECC’s wind methodology, which only considered roof top and very large scale turbines, has allowed a hidden but significant resource of Feed in Tariff (medium) scale turbines to be identified.</p>
9.4 Using the more detailed EOP	
<p>This enhanced EOP can then be used to facilitate the deployment of renewable and low carbon energy. These include:</p> <ul style="list-style-type: none"> • Informing the setting of renewable energy or carbon 	<p>All of these points are salient to RMB and if not already being should be followed up.</p> <p>This study addresses many of them by:</p> <ul style="list-style-type: none"> • Setting RE or carbon reduction targets

<p>reduction targets for new development sites or areas;</p> <ul style="list-style-type: none"> • Assist in identifying strategic areas for renewable energy deployment, as part of Area Action Plans or Core Strategy development. This may require more detailed viability assessment; • Assisting development management in terms of developing site briefs, or discussion with developers around incorporating renewable energy into new developments; • Assist in identifying locations for energy from waste facilities to deal with residual MSW, and identify potential heat loads; • Identifying areas of potential for district heating networks, as a starting point for more detailed viability assessment; • Informing corporate action to facilitate the deployment of low carbon and renewable energy. This could involve action in any number of the following roles: <ul style="list-style-type: none"> o Land owner, o Procurement of energy services o Financing and delivery vehicles o Property developer o Transport infrastructure o Waste management o Leadership 	<ul style="list-style-type: none"> • Identifying potential areas for the deployment of CHP/district heating systems or extending existing ones • Identifying areas for commercial and FIT scale wind development • Providing an Economic Assessment Tool (EAT) to assist planners in managing the deployment of LC&RE in new developments <p>Also, RMBC, in addition to installing solar PV on its own buildings, should consider developing FIT scale wind on any of its landholdings that are suitable.</p>
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3 ENHANCEMENTS TO THE EVIDENCE BASE FOR ROTHERHAM MBC

3.1 The review of the AECOM study identified a number of areas where the original EOP could be improved. WA has sought to make these improvements by enhancing the original study whilst avoiding any unnecessary repetition.

3.2 The following areas were selected for enhancement:

- Heat and power mapping
- Large scale wind resource
- Medium scale wind (Feed in Tariff) resource
- Biomass (specifically dedicated energy crops and woodlands)

3.3 WA was satisfied with the remaining low carbon and renewable energy potential as identified in the AECOM study. This data has therefore been carried forward into this study.

Extracted Data from the Regional Dataset

3.4 The original datasets used and produced by AECOM was provided by Local Government Yorkshire and Humber to inform this study. This included:

- Current and proposed low carbon and renewable energy generation
- Commercial scale wind resource

3.5 The regional biomass resource mapping produced by AECOM was not available and therefore WA has reproduced this data for Rotherham in line with DECC's methodology.

Current Energy Sources

Current Renewable Generation

3.6 Current installed renewable energy generating capacity within Rotherham Metropolitan Borough (RMB) has been obtained from the RESTATs database as

published by DECC. This database lists planning applications for renewable generation and classifies these developments according to the type of technology they use. The database also contains details of the installed capacity of the device along with other details about the application.

3.7 There are six schemes listed in the current RESTATs database that fall within the RMB boundary. These are:

- Advanced Manufacturing Research Centre's wind turbines (2.6MW)
- Alterpower Ltd's Thrybergh Weir Hydro Scheme (0.2MW)
- Banks Renewables' "Penny Hill Windfarm" (20.4MW), awaiting construction
- Bioflame Ltd's "Kiveton Heat and Power Plant" (2.5MW), which was consented at appeal in 2010 but is not yet believed to be operational
- REG Windpower's "Loscar Windfarm" (4.5MW)
- Waste Recycling Group's "Meadow Hall Power Landfill Gas Plant" (1.11MW)

All the projects above are identified in Figure 3.3.

3.8 There are a number of projects that are consented but not yet operational and also some small scale installations that may not have been picked up in the RESTATs database. A list of consented projects is shown below. There are also a number of projects awaiting determination.

2011

RB2011/0801 - Erection of solar farm - GRANTED CONDITIONALLY 05/09/11

RB2011/0046 - Erection of 100m high wind turbine with variation to Condition 04 imposed by RB2010/0649 to extend the maximum diameter of the blades from 52m to 56m - GRANTED CONDITIONALLY 25/02/11

2010

RB2010/1577 - Retrospective application for installation of solar panels on roof at front - GRANTED 08/02/11

RB2010/1521 - Installation of 104 solar panels to roof - GRANTED CONDITIONALLY 05/01/11

- RB2010/1520 - Installation of 161 solar panels to roof - GRANTED CONDITIONALLY 24/01/11
- RB2010/1518 - Installation of 157 solar panels to roof - GRANTED CONDITIONALLY 11/01/11
- RB2010/1517 - Installation of 76 solar panels to roof - GRANTED CONDITIONALLY 28/01/11
- RB2010/1516 - Installation of 157 solar panels - GRANTED CONDITIONALLY 05/01/11
- RB2010/1515 - Installation of 157 solar panels to roof - GRANTED CONDITIONALLY 21/12/10
- RB2010/1511 - Installation of 123 solar panels to roof - GRANTED CONDITIONALLY 05/01/11
- RB2010/0756 - Installation of solar panels to existing roof - GRANTED 28/07/10
- RB2010/0649 - Erection of 100m high wind turbine - GRANTED CONDITIONALLY 17/08/10

2009

- RB2009/0969 - Erection of 15m high wind turbine - GRANTED CONDITIONALLY 24/09/09
- RB2009/0824 - Erection of 6 No.132m high wind turbines and associated 80m high anemometer mast, access roads, crane pads, control building, substation and temporary construction compound GRANTED CONDITIONALLY 16/12/10
- RB2009/0226 - Erection of 12m wind turbine - GRANTED 09/04/09

2008

- RB2008/1400 - Installation of wind turbine on roof - GRANTED CONDITIONALLY 10/10/08
- RB2008/0272 - Erection of 10.6m high wind turbine - GRANTED CONDITIONALLY 03/04/08
- RB2008/0107 - Installation of 24no. solar panels to roof of main hall - GRANTED CONDITIONALLY 06/03/08

Current Low Carbon Generation

- 3.9 For the purpose of this report 'low carbon' energy generation refers to fossil fuelled Combined Heat and Power (CHP) plant and non-renewably driven heat pumps.

- 3.10 Non-renewable CHP plant generates electrical power through conventional turbines driven by the combustion of fossil fuel (predominantly gas) but also harnesses the by-product heat energy produced by the process for useful application elsewhere. In a well-designed system this results in the overall efficiency of the process being substantially greater than conventional generation where the heat energy is dumped. There are no known installations of gas-fired CHP within RMB.
- 3.11 It is very difficult to obtain information about existing heat pump installations as most of these will be domestic scale and there are no easily accessible records identifying where these are. All heat pumps use electricity to power the pumps and drive the compressor however, a well-designed system generates 3-4 times more heat energy than the electrical energy it consumes by absorbing heat from the surroundings. If the electrical power is provided by renewable generation the whole process is carbon neutral but it is most common for the heat pump to be grid connected and therefore it should be considered low carbon. Heat pumps can be ground-sourced, air-sourced or water-sourced depending on the heat source used to generate the temperature difference needed in the refrigeration cycle. It may be practical to deploy all three variants within RMB but little is known about the existing installed capacity or the source of electricity used to power any such installations.

Current Non-Renewable Energy

- 3.12 There are no large scale fossil fuel power stations within Rotherham Metropolitan Borough. This has been ascertained by consulting the YEDL's Long Term Development Plan (2010) which includes schematic maps of the region's electrical grid networks. Existing electrical power is generated outside of the Borough and imported via the national grid.

Detailed Heat and Power Mapping

Approach

- 3.13 Heat and power mapping has been undertaken across the Borough which should be used as a guideline for indicating areas of high energy consumption. In essence this involves assessing the heating and electricity requirements of every residential

building (based on established averages or '*benchmarks*' for particular housing types), every commercial building (based on benchmarks for each category of business undertaken) and every industrial building (based on assumptions about the type of industrial processes undertaken) within RMB. Through necessity this is a high level assessment which does not focus on individual properties per se but instead applies a selection of algorithms to various geographical databases to attribute the energy characteristics as best possible.

- 3.14 The purpose of the heat and power mapping is to identify where areas of high demand/consumption are located. Due to the high level approach these may require 'on the ground' corroboration, but the mapping should provide a starting point for identifying suitable locations for potential district heating schemes and for combined heat and power (CHP) schemes.
- 3.15 For CHP identification of an existing process that generates surplus heat as a by-product (as in many industrial situations) which is also in close proximity to another high heat demand, be it commercial, industrial or residential, is an ideal situation. For heat in particular, as opposed to power which can be transmitted through the grid, the consumer needs to be located close to the source of generation. If looking to setting up district heating networks it is important to identify areas where high quantities of heat are being consumed (as in the case of densely packed housing) to minimise on infrastructure costs.
- 3.16 The data collected for the AECOM study is relatively coarse with a resolution based on the Office of National Statistics Middle Layer Super Output Areas. In order to achieve a higher definition, data has been presented in this study based on postcode areas. Figure 3.1 shows the aggregated modelled residential, commercial and industrial heat loads from this study cropped to the Borough boundary. Figure 3.2 shows the combined domestic and non-domestic electrical demand across the Borough. The physical dimensions of each postcode zone vary depending on the intensity of development in the vicinity and therefore all data has been normalised on a "per hectare" basis to enable direct comparison across the various sized areas.
- 3.17 It may be noted from these figures that there are some areas within the Borough boundary which appear uncoloured on the map. There are several reasons why this

occurs. Some of the uncoloured areas are correctly attributed, for example, where the land included covers parks and gardens or empty brownfield sites but some is obviously incorrect. A number of the postcode zones around the Borough boundary itself have been left unallocated as they straddle two districts and consequently insufficient data has been available to accurately classify them.

3.18 There are also a few areas where the data available has not been sufficiently detailed to characterise the zone correctly. For example, if a company has its main office in one postcode area and a factory in another, it may have all of its energy demand mapped to the office rather than the factory. Furthermore, industrial heat and power consumption is highly variable and very site-specific so the industrial heat components should be viewed only as indicative.

3.19 As may have been expected the ‘hotspots’ for heat and electricity demand are the urban areas of the Borough. On this basis further detailed investigations have focussed on Rotherham (population: 117,262), Rawmarsh (pop: 18,210), Maltby (pop: 17,247), Wath Upon Dearne (pop: 16,787), Swinton (pop: 14,643) and Dinnington (pop: 9161)¹. It should be noted that there are some other significant densities of heat and power demand in locations throughout the Borough, as can be seen in Figures 3.1 and 3.2. These include Aston (pop: 11,000) and Bramley (pop: 8,194). Focussed assessment and detailed map preparation of these locations has not been completed as it is beyond the remit of this report. However, it is clear that an orchestrated carbon reduction strategy should be applied to all areas in the Borough, not just the principal areas mentioned above.

Heat Mapping

3.20 The heat and power mapping of Rotherham has proved to be a difficult exercise with much of the necessary data not being readily available and therefore a number of approximations have been required to achieve the results presented below. Due to these difficulties the results should be seen to be indicative of the real demand rather than taken as absolute. The maps accompanying this report present the energy demand, primarily based on postcode areas, to indicate overall demand for each of the above towns. Results are presented individually for residential,

¹ Population figures taken from 2001 census data

commercial and industrial sectors, as well as in aggregation. Residential heat demand is displayed on a higher resolution 100m grid to enhance the detail. It was not possible to model the commercial and industrial loads at this resolution. An aggregated electrical demand is also shown.

- 3.21 The current housing stock in Rotherham is a mixture of detached, semi-detached, terraced and flats. A number of other types of housing do exist in the Borough but for the purposes of this exercise all housing has been allocated to one of these four categories. The UK housing stock has been built up over many years and consequently has been constructed to a wide variety of standards. The heat mapping is necessarily based on average consumption and for the purposes of this exercise the benchmarks for each of the housing types has been assumed. Furthermore the benchmarks have been scaled for each Middle Layer Super Output Area (MLSOA) as defined by the National Statistic Office, for gas and electric consumption as listed in DECC's Sub-National Energy Consumption Statistics. This estimates average heating requirements in the Borough to be 15,363kWh/yr per dwelling².
- 3.22 The methodology used in the heat mapping exercise is outlined in Appendix 1. Figures 3.4-3.29 show the maps produced detailing current heat demand, focussing on the six largest urban areas; Rotherham, Rawmarsh, Maltby, Wath upon Dearne, Swinton and Dinnington. Data is presented for each location displaying residential, commercial, industrial and combined heat demands. It should be noted that the combined heat demand map aggregates the data by postcode area so the gridded residential data has not been used. Instead the original postcode-based residential dataset has been amalgamated with the commercial and industrial data to create the combined maps.
- 3.23 A significant limitation of the exercise has been the lack of information available on the heat and electrical demands of several potentially large heat and electricity consumers. These include steel works, sewage and water treatment works and mining and quarrying activities. Educated estimates of likely demand have been made in these cases. Furthermore, as explained in the methodology, the mapping of non-residential heat loads has been necessarily conducted on a postcode basis.

² Average gas usage from "Middle Layer Super Output Area (MLSOA) domestic gas estimates 2009: Great Britain" published by DECC, Mar 2011.

Where a business address has a postcode in one zone but an operational area stretching across another zone, the full heat load has been assigned to the postal address, potentially underestimating the latter zone. Corrections have been made for those businesses identified as using PO boxes after abnormally high heat loads were identified in Royal Mail sorting offices.

Conclusions

- 3.24 On the basis of the heat modelling conducted for this analysis total residential heat demand in RMB is estimated to be 1,788GWh/yr, commercial demand is expected to be 488GWh/yr and industrial demand is expected to be 284GWh/yr. Total aggregated heat demand within the Borough is expected to be 2,560GWh/yr. To put these figures in context, the UK's largest power station, Drax, near Selby generated 25,400GWh during 2008, while a typical 2MW wind turbine with a 35% capacity factor would generate 6.2GWh/yr.
- 3.25 The heat mapping shows that, as might be expected the major heat loads are concentrated around the built up areas.
- 3.26 Some of the highest heat loads that have been modelled are located around the hospitals and leisure centres and these facilities are potentially very suitable for inclusion in district heating schemes, particularly if coupled with CHP. In the residential dataset some of the highest heat demands are centred upon densely packed terraced dwellings. Some examples of candidate sites for CHP are given in Paragraph 3.31.
- 3.27 The existing district heating networks dataset obtained from AECOM identifies 16 district heating installations in RMB. These installations are of various sizes and are scattered across the Borough near urban areas.
- 3.28 Cross referencing the existing district heating networks with the dataset of RMB council housing shows that many of the installations are either in or near to housing owned by the council.

3.29 Retrofitting district heating schemes to existing dwellings is an expensive and disruptive exercise, especially if existing heating systems in those dwellings are not nearing the end of their useful life. Consequently district heating is most likely to be appropriate for either commercial/industrial users with high heat demands or new housing developments with associated commercial services.

3.30 Notwithstanding this, the heat mapping exercise has identified several high density heat loads that are potentially exploitable for retrofitting district heating/CHP schemes. Although from high level observation these sites appear to have some potential, it is important that detailed investigation and financial analysis be completed on each site to ascertain its true viability as this work has not been done.

3.31 Some potential candidate sites include:

- Wath Upon Dearne – area around Beech Road, Avenue Road and Sandymount Road.
- Holmes, Rotherham – area around Hartington Road, Cavendish Road, Josephine Road and Belmont Street
- St Ann’s, Rotherham - RMBC Leisure Centre and housing to the east (*it is understood that a 500kW biomass boiler was installed nearby at Shaftsbury House in 2007 but has yet to be fired. Furthermore, it is not clear that the leisure centre is serviced by this and so there is some potential for expansion*).
- Moorgate, Rotherham - Rotherham District General Hospital and adjacent housing
- Rawmarsh – Goosebutt Street, Netherfield Lane and Spalton Road.
- Wickersley School & Sports college and several commercial hubs along Bawtry Road, Bramley, Rotherham

3.32 It should be noted that this is not a definitive or exhaustive list but reflects areas identified on a ‘first pass’ visual inspection of the modelled map data. Further review of the maps produced may enable the selection of additional areas with potential but in all cases, once target areas have been identified, it is recommended that detailed feasibility assessments be carried out to verify that the potential can be realised in practice.

- 3.33 RMBC have been keen to include Dinnington, as one of the Draft Core Strategy's 'Broad Locations for Growth', in the heat mapping exercise. The analysis indicates that there is no significant density of heat demand in the locality, with the highest demand coming from retail businesses on Laughton Road. As a potential development area it is likely that district heating at Dinnington would be most effectively incorporated into this development rather than attempting to retrospectively install a system in the existing urban area.
- 3.34 Domestic heating is rarely required throughout the whole year whereas electrical demand, despite some seasonal variation, is always present. It follows that a CHP scheme is likely to perform better if there is a large commercial or industrial practice in the vicinity that requires a heat resource year round.
- 3.35 The economics of CHP mean that whilst gas is a potential fuel option for district heating/CHP schemes, in order for them to be financially viable any electricity generated would need to be exported on a private wire to a local high-end user, rather than being exported to the national grid. The rationale behind this is that exporting electricity to the grid will attract revenues of around 5p/kWh whilst selling directly to an end-user will achieve 10-12p/kWh. Biomass fuelled systems fare better since 'good quality' schemes will be eligible for additional incentivisation through either double ROC³ support or one ROC and the RHI⁴. If these schemes are coupled with private wire arrangements for the exportation of electricity then the package as a whole can be quite attractive to investors.
- 3.36 From the point of view of carbon savings, the implementation of gas CHP schemes will offer some reduction in overall emissions since combining the processes gives a reduction in CO₂ compared to conventional centralised electricity generation and transmission and separate heat production. Biomass CHP potentially offers a greater reduction in emissions, provided the fuel is sustainably and locally grown avoiding overly-intensive agricultural practices. Although combusting biomass releases CO₂, it is CO₂ that is within the current carbon cycle and therefore there is no net carbon

³ ROC – Renewable Obligation Certificate – The principle UK Government incentive for large-scale renewable generation (for further information see Paragraph 4.11)

⁴ RHI - Renewable Heat Incentive – The new incentive proposed for renewable heat generation (see Paragraph 4.14)

release beyond the harvesting of the fuel. Given its economic advantage and its carbon reduction potential, biomass CHP is likely to be one of the preferred choices of technology for meeting the emissions targets. However it is recognised that many existing developers will, rightly or wrongly, still favour gas technology. Since both will potentially offer savings neither should be discouraged.

Electricity Mapping

- 3.37 Current electrical demand arises from both residential and commercial/industrial sources. Electrical energy is imported into the Borough to meet most of this demand but as the population increases and development is built to house, support and employ that population it will be important to ensure that adequate energy resources are available to facilitate it.
- 3.38 As previously mentioned, there is a mix of housing stock within Rotherham. The energy benchmarks applied to this housing stock have been scaled using the current average electrical usage per dwelling for the Borough, as estimated by DECC. This figure is 3574kWh/yr⁵. The methodology used to map the electrical demand is described fully in Appendix 1.
- 3.39 As a result of the modelling of the total electrical demand in residential properties in RMB is estimated to be around 416GWh/yr. Commercial demand is estimated at 304GWh/yr and industrial demand at 68GWh/yr. Total overall electrical demand has been modelled to be 788GWh/yr.
- 3.40 The methodology used in the electricity mapping exercise is outlined in Appendix 1. Figures 3.8, 3.13, 3.18, 3.23 & 3.28 show the maps produced detailing current electrical consumption, focussing on the six largest urban areas: Rotherham, Rawmarsh, Maltby, Wath upon Dearne, Swinton and Dinnington. The data presented in these maps combines residential, commercial and industrial consumption.

⁵ Average electricity usage from "Middle Layer Super Output Area (MLSOA) domestic electricity estimates 2009: Great Britain" published by DECC, Mar 2011.

Review of Heat and Power Modelling

- 3.41 The 2009 MLSOA values provided by DECC identified gas consumption as being 2,477GWh/yr and electricity consumption as being 563GWh/yr. These came to an overall total value of 3,040GWh/yr.
- 3.42 A benchmarking exercise (where typical loads were ascribed to particular house/business types) was undertaken. This predicted the Borough's heat load to be 2,560GWh/yr and the electrical load to be 788GWh/yr. This resulted in a total energy requirement of 3,349GWh/yr.
- 3.43 The benchmarking data that was undertaken used a number of assumptions which is attributable to the discrepancy of 309GWh/yr between the DECC value and our own. The value given is close to the DECC value, being approximately 10% different, therefore we can conclude that the benchmark data was reasonably accurate despite the necessary assumptions.
- 3.44 Most of the discrepancy in the figures is likely to have been introduced in the modelling of the industrial loads as it was not possible to obtain accurate benchmarks for many of these figures.
- 3.45 The assumptions are explained in more detail within the Energy Demand Assessment Methodology, contained in Appendix 1.

CO₂ Emissions

- 3.46 Off gas grid dwellings will typically rely on night storage heaters, oil or LPG fired central heating or wood burning stoves to provide space heating. With the exception of wood burning stoves these methods of heating produce high levels of CO₂ emissions.

- 3.47 The domestic electricity consumption figures from DECC indicate that 4,339 households within RMB are on economy 7 tariffs. This suggests that at least this number of people heat their homes by night storage heaters or some other form of electrical heating system, for example ground source heat pumps (GSHP).
- 3.48 Official figures from the UK's Department for the Environment, Farming and Rural Affairs (DEFRA)⁶ indicate a carbon content for domestic heating oil (kerosene) of 0.259kg CO₂ per kWh, compared to figures of 0.311kg CO₂ per kWh for coal (used domestically) and 0.204kg CO₂ per kWh for Natural Gas. Based on 2009 rolling average figures including transmission/distribution losses, the CO₂ produced by using electricity generated on the UK's National Grid is 0.521kg CO₂ per kWh.
- 3.49 In order to apply these figures to the residential dwellings it has been necessary to make some assumptions about the use of heating fuel. Of the 116,309 dwellings in the LLPG dataset, 107,967 are understood to be connected to the mains gas network for heating. This equates to about 93% of RMB's dwellings. It has been assumed that half of the remaining 8,342 households have night storage heating (economy 7 tariffs) and the other half use oil. Modelled CO₂ emissions have been scaled proportionally. No information is available as to how many wood burning stoves or LPG fired heating systems are installed but these would have the effect of slightly reducing CO₂ emissions as they are effectively carbon neutral. The average CO₂ emissions for a residential dwelling's heating requirements have therefore been assumed to be 0.217kg CO₂ per kWh. Emissions associated with electrical consumption are assumed to be 0.521kg CO₂ per kWh. Although not strictly accurate, for convenience the same figures have been applied to the commercial and industrial sectors.
- 3.50 Total annual CO₂ emission figures for RMB, excluding those associated with transport, are estimated to be 983,000 tonnes, with 622,000 tonnes coming from residential properties, 264,000 tonnes from the commercial sector and 97,000 tonnes from the industrial sector.

⁶ DEFRA 2011 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting v1.1 (08/08/2011)
(<http://archive.defra.gov.uk/environment/business/reporting/pdf/110807-guidelines-ghg-conversion-factors.pdf>)

Wind

- 3.51 The following sections contain the wind resource assessments for large scale (commercial) and medium scale (based on 500kW turbines under the Feed in Tariff). The assessment methodology applied is given in detail in Appendix 2.
- 3.52 The wind resource layers associated with each scale of wind resource are also available in GIS format.

Large Scale Wind Opportunities

- 3.53 Table 3.1 below shows the potential large scale wind resource for Rotherham once all the relevant constraints have been applied. The large scale wind resource is shown in Figure 3.29.

Table 3.1: Potential Large Scale Wind Resource in Rotherham						
Area (ha)	Number of Turbines	Capacity (MW)	Energy (GWh/yr)	CO ₂ Savings (t/yr)	Electricity Demand	Total Energy Demand
282	15	30	98	49,333	17%	3%

- 3.54 In comparison the AECOM report identified a resource of over 90MW for commercial wind. There are a number of reasons for this discrepancy. Firstly the methodology used by AECOM utilised 3MW turbines with 90m rotors as specified by DECC. These are Class I turbines suitable for areas with annual mean wind speeds (AMWS) greater than 7.7m/s. The AMWSs for RBM are significantly lower than this which means that in practice a Class II turbine with reduced capacity would be the developer's preferred choice. Hence, a 2MW 90m rotor turbine was used in this study. This immediately reduces the AECOM estimate to 60MW but still does not account for all of the difference.
- 3.55 More detailed examination of the constrained areas showed that two wind farms, one already constructed (Loscar, 4.5MW) and one with planning permission (Penny Hill, 20.4MW) had been excluded. In the case of Loscar, it was because it was within 5km of an aerodrome and in the case of Penny Hill, it was due to proximity to high voltage power lines. The developers of these sites, REG Windpower and H J Banks

respectively, were contacted with a view to understanding why these projects were able to proceed in the presence of these constraints.

- 3.56 There had been an aviation objection to Loscar but following protracted negotiations with the airfield operator, the objection was removed and planning permission subsequently granted. Remarkably at Penny Hill there were no objections from the National Grid or the local Distribution Network Operator, YEDL, during the planning process and permission was granted in 2009. Subsequently, H J Banks were contacted by YEDL and concerns raised about the effect of the turbine wakes on YEDL's 66kV line. This has now been resolved by H J Banks agreeing to fund a section of the line being replaced by underground cables. The proximity of the scheme to the M1 and M18 also meant that noise constraints were less arduous.
- 3.57 These issues demonstrate the limitations of desk based GIS estimates of any renewable resource. There will always be local conditions that allow developments to proceed where the generic constraints suggest they should not and vice versa.
- 3.58 Adding the two projects above back into the resource estimates increases the potential to 55MW as shown in Table 3.2 below.

Table 3.2: Revised Potential Large Scale Wind Resource in Rotherham

Area (ha)	Number of Turbines	Capacity (MW)	Energy (GWh/yr)	CO ₂ Savings (t/yr)	Electricity Demand	Total Energy Demand
517	27*	55	180	90,444	31%	6%

*equivalent number of 2MW wind turbines.

- 3.59 Although it is possible that some of the smaller potential sites have been subsumed into the medium scale wind opportunities identified below, the remaining 5MW reduction is thought to be primarily due to the use of Addresspoint data to accurately identify dwellings and their associated noise buffers. As suggested by AECOM, this may have increased the available resource within urban areas (most likely now within the medium scale dataset) but it will also have resulted in a reduction in rural areas due to the additional constraints imposed by isolated dwellings and hamlets. Nevertheless large scale commercial wind remains a significant renewable energy resource in Rotherham with some 30MW of potential still to be exploited.

Medium Scale (Feed in Tariff) Wind Opportunities

3.60 Table 3.3 below shows the potential medium scale wind resource for Rotherham once all the relevant constraints have been applied. The medium scale wind resource can be found in Figure 3.30.

Table 3.3: Potential Medium Scale Wind Resource in Rotherham						
Area (ha)	Number of Turbines	Capacity (MW)	Energy (GWh/yr)	CO ₂ Savings (t/yr)	Electricity Demand	Total Energy Demand
304.5	133	66.5	219	97,877	39%	7%

Other Considerations

3.61 A Landscaper Character Assessment was recently undertaken on behalf of Rotherham MBC. The main consideration of this report was landscape sensitivity in relation to urban expansion and development and there is no specific mention of wind turbines. However, landscape and visual impact can be a key concern for many planning authorities when dealing with windfarm applications. Although the resource study has not excluded potential wind farm areas which fall in areas of high landscape sensitivity, the LCA has been considered and Figure 3.316 shows the identified sites in relation to the landscape sensitivity study.

3.62 Wind turbine developments are often prone to objections arising from concerns regarding radar interference. Such objections can be difficult and costly to resolve, especially for medium scale wind projects and can render this scale of project uneconomic. As part of this study WA has produced a GIS layer which identifies the level of radar clearance across Rotherham from surrounding military and civil aviation radar. A map showing the radar clearance can be found in Figure 3.32. This GIS coverage is purely indicative and the resource assessment has not discounted sites based on the clearance areas, however it is likely to reduce the size of the resource if only by requiring smaller lower capacity turbines to be employed. Notwithstanding this, the coverage shows the areas that should be free of radar constraints and thus easier to develop. It is suggested that this map be used in conjunction with the wind resource assessment to provide developers with an idea of the most easily developable sites in terms of radar clearance. It should be noted

however, that consultation should always be sought with the relevant airport/radar operator when developing a wind project.

Biomass

- 3.63 WA has assessed the potential for energy crops and forest residues as a biomass resource in Rotherham according to the methodology given in Appendix 3.
- 3.64 A GIS was used to estimate the total resource potential. All tonnages are given in oven dried tonnes, i.e. as if all the moisture had been removed from the biomass fuel. This allows the energy content of fuels with different moisture levels to be directly compared.
- 3.65 Figure 3.28 shows the biomass resource distribution over Rotherham.

Forest Residues

- 3.66 There are currently 2,380 ha of woodland in Rotherham. The total resource is based on a long term average sustainable yield (primarily thinnings and brashings) and not that available when the woodland is clear felled as it is assumed that most of this will be used for timber or remain in-situ (e.g. ancient woodland). This could theoretically provide some 4,761 odt/yr of wood fuel if utilised as a biomass resource. This is equivalent to 17 GWh/yr.

Energy Crops

- 3.67 Two types of energy crop were considered in the resource assessment, Miscanthus, a fast growing C4 rhizomatous grass, and Short Rotation Coppice (SRC), eg willow. Miscanthus is the preferred option. However, it does not do well in locations prone to high winds, so SRC has been substituted in all areas where the annual mean wind speed at 10m above ground level exceeds 6m/s.
- 3.68 Approximately 15,883 ha within Rotherham would be suitable for growing Miscanthus which would potentially yield 295,112 odt/yr. However, this is the technically available resource which does not account for the current land use of

these areas. In reality, much of this area will be used for agricultural crops and therefore it has been assumed that only 10% of the resource area would actually be utilised for energy crops. This translates to 29,511 odt/yr or 106 GWh/yr.

- 3.69 Approximately 157 ha would be suitable for growing SRC in Rotherham. This would yield 1,718 odt/yr. Once the 10% utilisation factor is applied the anticipated yield is 171 odt/yr or 0.61 GWh/yr.

Biomass Energy Conversion

- 3.70 The resource assessment results above provide the total energy available from biomass resources. However, this will need to be passed through a conversion plant to transform this into electricity or heat energy and this will ultimately incur some losses reducing the energy available. The type of plant used and the primary energy output required (e.g. electricity or heat) will dictate the losses in the conversion.
- 3.71 If the biomass resource is passed through a boiler solely for heating an efficiency of approximately 85-90% is likely. A combined heat and power plant will provide electricity as the primary energy output and heat as a secondary output. The efficiency of these plants vary again depending on the type of plant, however the overall efficiency will be lower than that of a boiler.
- 3.72 There are two basic technology options for producing electricity from biomass: boilers and steam turbines or gasification/pyrolysis systems coupled to gas engines or gas turbines. Boilers and steam turbines are a well proven bankable technology but are relatively inefficient (e.g. 20% electrical efficiency) at small scale, i.e. up to 10MW. This may not be an issue if heat demand is the critical factor. They also have a critical mass of around 2-3MW_e below which the generation revenue will not warrant the cost of the plant and heat network, as they do not have very good economies of scale at this size, eg a 1MW_e plant will have similar costs to a 3MW plant but much lower revenue. The waste heat they produce is at relatively low temperatures circa 90°C and therefore not suitable for some process heat applications but is ideal for district heating. Finally they are much more tolerant of feedstock quality variations and moisture content making operations and maintenance less of a problem.

- 3.73 Modern gasification and pyrolysis technologies are now available that could make biomass CHP clean, more efficient and sustainable even at relatively small scales. The most common gasification systems are wood fuelled and coupled to a spark ignition (gas) engine. This technology typically has an electrical efficiency of around 30%, implying some 70% of the energy in the fuel would be available as waste heat. It is not possible to recover all of this heat and there will be losses in the heat distribution systems, however, 50%-60% could be made available for heating purposes. CHP can supply high grade heat for industrial use (circa 450°C) or low grade heat for domestic use. Whilst gasification technology is more efficient than traditional steam turbines, they have yet to gain a commercial track record.
- 3.74 For the purpose of this resource assessment it is assumed that the biomass resource will be utilised by a combined heat and power plant operating a boiler and steam turbine. Based on this and the assumption that the plant will run at 8000 hours per year the energy generation have calculated, as shown in Table 3.4.

Table 3.4: Revised Current Capacity and Potential Biomass Resource in Rotherham					
Renewable Energy Resource	Current Capacity MW	Current Capacity GWh	Potential Resource - heat (MW)	Potential Resource - electricity (MW)	Potential resource GWh
Energy crops	0	0	7.4	3.7	88.8
Forest residues	1	2	1.2	0.6	14.4

- 3.75 Table 3.4 shows the total energy resource for heat and power combined, which is 103.2 GWh/yr from energy crops and forest residues. The potential heat output from the biomass resource is 68.8 GWh/yr and the electricity output 34.4 GWh/yr, equivalent to the 6% of the total electricity demand of Rotherham.
- 3.76 In comparison the AECOM report identified a resource of 95 GWh/yr with 59GWh/yr from energy crops and 36GWh/yr from forest residues. In terms of energy crops both studies have identified a similar installed capacity based on generation from combined heat and power plants However, the biomass resource assessment undertaken in this study has used more specific crop yields based on the agricultural

land classification which has produced higher yields than identified in the AECOM study. This means there is a greater amount of wood fuel available increasing the overall generation potential.

- 3.77 AECOM have based the generation potential for forest residues on a biomass boiler providing heat only. These boilers are more efficient than the biomass CHP plants as the primary energy output is heat and therefore the AECOM study identifies a greater resource potential. This revised study assesses forest residues for CHP as a comparative. The potential installed capacity for wood-fired CHP alone is below 1MW_e which is considered below the critical mass for a biomass CHP plant. The wood would need to be co-fired with energy crops to meet this otherwise biomass boilers would be the best option for the forest residues.
- 3.78 This has identified that biomass resource in Rotherham Borough could meet 6% of its electricity needs through biomass CHP. To increase this additional biomass resource will need to be imported from outside the Rotherham boundary.

4 KEY OPPORTUNITIES FROM THE REVISED EVIDENCE BASE

Site Identification

- 4.1 Rotherham MBC is currently preparing a Local Development Framework to identify key areas for development over the next 15 years. These areas will provide new homes and employment land and offer an excellent opportunity to encourage the development of low and zero carbon technologies.
- 4.2 The current Core Strategy requires that around 850 homes per year and 235 hectares of employment areas be built in these areas. Although the current LDF is under preparation and on going consultation it is likely that three key areas will be developed with smaller, scattered developments making up the rest of the requirement. These key areas (broad locations for growth) are:
- Waverley
 - Bassingthorpe Farm
 - Dinnington
- 4.3 These developments may have a large enough energy demand to warrant the inclusion of district heating scheme in the development. Smaller developments are likely to be scattered across the Borough and would not be able to benefit from a district heating scheme, however, building integrated solutions such as solar panels and heat pumps could be installed in these buildings. Furthermore non-residential properties such as schools, offices and community buildings built as part of these developments could incorporate biomass boilers to meet the space and water heating needs of their users.
- 4.4 In addition to the LDF sites, the more detailed heat mapping identified a number of high heat load areas in the existing housing stock where district heating systems could be installed or existing ones extended. However, it should be noted that because of the high costs of the heat network, only the options with circa 1000+ dwellings and some element of biomass CHP were found to be financially viable in the economic assessment below.

- 4.5 The revised evidence base found 11 potential sites and 3 existing/consented sites that would be suitable for large scale wind development and 101 additional potential sites that would be suitable for medium scale wind development, based on the criteria discussed in the methodology in Appendix 3. These areas are shown in Figure 3.29 and Figure 3.30 respectively. It should be noted that whilst technical and environmental constraints have been considered in this study further constraints to development may arise for specific projects in these areas. These may include aviation constraints, access limitations, landscape and visual impact objections etc.
- 4.6 The biomass resource was also included in the revised evidence base and identifies large areas that would be suited to growing energy crops (Miscanthus or Short Rotation Coppice) or contain existing forestry residues. It would not be practical to turn all this land over to energy crops however the resource assessment, shown in Figure 3.33, helps to identify suitable land where this could be developed.

Economic Appraisal

- 4.7 An economic appraisal was undertaken to assess the viability of low and zero carbon technologies for the preferred development sites identified in the Rotherham LDF. The economic model produced by Wardell Armstrong has also been provided to RMBC for use as a generic tool to undertake initial assessments of any future low and zero carbon development opportunities that may come forward.
- 4.8 The economic appraisal tool (EAT) addresses the following issues:
- Estimated energy demand
 - Low and zero carbon options
 - CO₂ savings
 - Costs and investment returns
- 4.9 The proposed LDF has a target of 12,750 homes by 2027 and 235ha of employment land. It is likely that this will be achieved through the development of key sites at Waverley, Basingthorpe Farm and Dinnington with more scattered sites providing a smaller contribution. Large mixed-use developments may be able to benefit from district heating and combined heat and power plants or wind turbines. Smaller

developments may not have high enough energy demand or the land area to accommodate these technologies however; building integrated renewable technologies could provide significant CO₂ savings for these buildings. The EAT assesses both building integrated and whole site solutions for low and zero carbon technologies for the key development areas and the LDF as a whole.

- 4.10 The EAT assesses the cost of different low and zero carbon technologies for these sites. A standard discounted cash flow (DCF) technique has been used to appraise the financial viability of each of the low and zero carbon options eligible for current financial incentives. There are currently three financial incentives in the UK to support renewable electricity and heat generators – the Renewables Obligation (RO), Feed in Tariff (FIT) and the Renewable Heat Incentive (RHI).
- 4.11 Introduced in 2002, the Renewable Obligation (RO) provides a competitive market to promote the uptake of renewable electricity generators. The RO requires electricity supply companies to source a growing proportion of electricity from renewable sources. Electricity suppliers meet the RO by purchasing Renewable Obligation Certificates (ROCs) from accredited renewable electricity generators, thus providing an extra stream of revenue. Each ROC represents 1MWh of renewable electricity generated. The value of a ROC is dependent on supply and demand. Currently there are not enough ROCs available to meet targets, so prices are high. This trend will likely continue at least until the near future with the contribution to electricity in 2010 from renewable sources at only 7%. Electricity supply companies that do not meet their quota must pay a fine set at the ROC buyout value. This is then shared proportionally between companies that do meet their quota based on their quantity of ROCs obtained. Currently each ROC is valued at ~£47/MWh.
- 4.12 In April 2009 the ROC mechanism was “banded” to allow greater support for emerging technologies. Each technology was placed in a ROC band depending on their level of development. Less developed and emerging technologies achieve greater numbers of ROCs per unit of electricity, known as ‘uplift’, as illustrated in Table 4.1 below.

Table 4.1: ROC Banding of Technologies				
0.25ROCs/MWh	0.5ROCs/MWh	1ROCs/MWh	1.5ROCs/MWh	2ROCs/MWh
Landfill Gas	Sewage Gas Co-firing of Biomass	Hydro-Electric Onshore Wind Geopressure EfW CHP Gasification Pyrolysis Co-firing of Energy Crops	Offshore Wind Co-firing of Energy Crops CHP Dedicated Biomass	Wave & Tidal Solar Photovoltaic Adv. Gasification Adv. Pyrolysis Dedicated Energy Crops Biomass CHP Energy Crop CHP

4.13 In April 2010 a Feed in Tariff (FIT) was introduced for renewable energy generators up to 5MW. The FIT runs alongside the RO and is aimed at promoting small scale renewable electricity generation. Generators below 5MW can choose to opt for either the FIT or the RO. The FIT allows accredited renewable electricity generators to obtain a FIT payment for every kWh of electricity generated, whether this is used on site or exported to the grid. FIT payments are banded to allow greater support for certain (emerging) technologies. The levels of support for each technology will be reviewed periodically. However, support for some technologies will reduce after the first two years of the scheme. Electricity supply companies must also offer a minimum of 3.1p/kWh for electricity exported to the grid. The levels of support are given in Table 4.2 below.

Table 4.2: Feed in Tariff Generation Rates

Technology	Scale	FIT Year in which the Eligibility Date of an Eligible Installation falls p/kWh			
		2011/12	2012/13	2013/14	2014/15
Anaerobic digestion	<250kW	14	14	14	14
	>250kW - 500kW	13	13	13	13
	>500kW	9.4	9.4	9.4	9.4
Hydro	<15kW	20.9	20.9	20.9	20.9
	>15-100kW	18.7	18.7	18.7	18.7
	>100kW - 2MW	11.5	11.5	11.5	11.5
	>2MW - 5MW	4.7	4.7	4.7	4.7
MicroCHP pilot	<2kW	10.5	10.5	10.5	10.5
PV	<4 kW (new build)	37.8	34.6	31.6	29
	<4 kW (retrofit)	43.3	39.6	36.3	33.2
	>4 - 10 kW	37.8	34.6	31.6	29
	>10 - 50 kW	32.9	30.1	27.5	25.2
	>50kW - 100kW	19	17.4	15.9	14.6
	>100kW - 150kW	19	17.4	15.9	14.6
	>150kW - 250kW	15	13.7	12.6	11.5
	>250KW	8.5	8.5	8.5	8.5
	Stand alone system	8.5	8.5	8.5	8.5
Wind	<1.5 kw	36.2	34.2	32.3	30.5
	>1.5 - 15 kW	28	26.7	25.5	24.4
	>15 - 100 kW	25.3	24.2	23.1	22
	>100 - 500 kW	19.7	19.7	19.7	19.7
	>500kW - 1.5MW	9.9	9.9	9.9	9.9
	1.5 - 5MW	4.7	4.7	4.7	4.7
Existing microgenerators transferred from the RO		0.094	9.4	9.4	9.4
Export Tariff		3.1	3.1	3.1	3.1

4.14 The Renewable Heat Incentive was recently introduced to support renewable heat technologies. The mechanism provides a tariff for each kWh of heat generated. At present only non-domestic installations are eligible for the RHI and the technologies covered and the associated tariffs are shown in Table 4.3. A metering system is required to ensure generators do not receive the payment for excess heat. It is anticipated that the RHI will extend to domestic installations in the future.

Table 4.3: Renewable Heat Incentive Support Levels					
Tariff name	Eligible technology	Eligible sizes	Tariff rate (p/kWh)	Tariff duration (Years)	Support Calculation
Small Biomass	Solid biomass; Municipal Solid Waste (incl. CHP)	< 200 kWth	Tier 1: 7.6	20	Metering. Tier 1 applies annually up to the Tier Break, Tier 2 above the Tier Break. The Tier Break is: installed capacity x 1,314 peak load hours, i.e.: kWth x 1,314
			Tier 2: 1.9		
Medium biomass		>200kWth <1000kWth	Tier 1: 4.7		
			Tier 2: 1.9		
Large biomass		<1000kWth	2.6		Metering
Small ground source	Ground source heat pumps; Water source heat pumps; Deep geothermal	<100kWth	4.3	20	Metering
Large ground source		>100kWth	3		
Solar thermal	Solar thermal	<200kWth	8.5	20	Metering
Biomethane	Biomethane injection and biogas combustion, except from landfill gas	Biomethane all scales, biogas combustion less than 200kWth	6.5	20	Metering

4.15 Domestic renewable heat technologies, such as solar thermal and heat pumps are not eligible for the RHI. Therefore a discounted cash flow has not been undertaken for these technologies as they will not receive enhanced revenue above the saving on energy bills in the household.

4.16 The EAT also incorporates a capital saving and annual saving based on the costs displaced by using a renewable heat source over a conventional boiler. This assumes that if ground source heat pumps and biomass boilers were not installed then a conventional gas boiler would be needed and therefore a cost incurred. This cost is removed from the capital and running costs of the renewable heat alternative.

4.17 The full methodology for the EAT is given in Appendix 4.

All LDF Sites

4.18 The LDF has a target for both housing and employment land to be developed up to 2027. This corresponds to an annual target of 850 homes and approximately 16ha of employment land per year. The EAT models this annual target and assesses the low and zero carbon technology options assuming that these buildings could be developed anywhere.

4.19 Although it is likely that the development target will be met by developing key areas, this assessment of the target as a whole provides RBMC with an idea of the scale and suitability for different renewable energy technologies. It is also designed to show how smaller developments outside of the key areas could be serviced by renewable energy technologies.

4.20 At this stage the type and nature of the building is not known, therefore for modelling purposes it has been assumed that there will be an equal split across the different dwelling types and non-residential buildings.

4.21 Table 4.4 shows all the building integrated solutions for the LDF sites.

Table 4.4: Building Integrated Solutions for All LDF sites

Technology Option	Building Type	Per Building Type					Total		
		Generation MWh/yr	Installed Costs	NPV	IRR	Simple Payback	Generation Mwh/yr	Installed Costs	CO ₂ Saving
Roof Mounted Wind Turbines	Flat	223	£680,000	-£294.89	11%	9 years	1116.90	£5,100,000	3.9%
	Mid-terrace	223	£680,000	-£294.89	11%	9 years			
	End-terrace	223	£680,000	-£294.89	11%	9 years			
	Semi-detached	223	£680,000	-£294.89	11%	9 years			
	Detached	223	£680,000	-£294.89	11%	9 years			
Solar PV	Flat	441	£1,598,000	-£1,181	10%	9 years	2203.20	£7,990,000	7.8%
	Mid-terrace	441	£1,598,000	-£1,181	10%	9 years			
	End-terrace	441	£1,598,000	-£1,181	10%	9 years			
	Semi-detached	441	£1,598,000	-£1,181	10%	9 years			
	Detached	441	£1,598,000	-£1,181	10%	9 years			
	Commercial Offices	55	£200,000	-£51,705	8%	11 years	606.64	£2,200,000	3.1%
	Communications and Transport	55	£200,000	-£51,705	8%	11 years			
	Education	55	£200,000	-£51,705	8%	11 years			
	Government	55	£200,000	-£51,705	8%	11 years			
	Health	55	£200,000	-£51,705	8%	11 years			
	Hotel	55	£200,000	-£51,705	8%	11 years			
	Retail	55	£200,000	-£51,705	8%	11 years			
	Sports and Leisure	55	£200,000	-£51,705	8%	11 years			
	Warehouses	55	£200,000	-£51,705	8%	11 years			
	Other Services	55	£200,000	-£51,705	8%	11 years			
Industrial	55	£200,000	-£51,705	8%	11 years				
Solar Thermal	Flat	275	£255,000	0.00	0%	0.00	1652.40	£2,677,500	5.8%
	Mid-terrace	275	£255,000	0.00	0%	0.00			
	End-terrace	275	£255,000	0.00	0%	0.00			
	Semi-detached	275	£255,000	0.00	0%	0.00			
	Detached	551	£510,000	0.00	0%	0.00			
Ground Source Heat Pumps	Flat	289	£877,200	0.00	0%	0.00	1947	£5,848,000	1.2%
	Mid-terrace	285	£1,169,600	0.00	0%	0.00			
	End-terrace	369	£1,169,600	0.00	0%	0.00			
	Semi-detached	436	£1,169,600	0.00	0%	0.00			
	Detached	568	£1,462,000	0.00	0%	0.00			
	Commercial Offices	750	£1,105,455	-£899,784	-8%	#N/A	5627	£11,636,364	3.4%
	Communications and Transport	600	£1,105,455	-£787,800	-9%	#N/A			
	Education	487	£1,105,455	-£835,348	-11%	#N/A			
	Government	825	£1,105,455	-£817,550	-7%	#N/A			
	Health	510	£1,105,455	-£878,507	-10%	#N/A			
	Hotel	585	£1,105,455	-£737,657	-10%	#N/A			
	Retail	495	£1,105,455	-£737,657	-11%	#N/A			
	Sports and Leisure	0.00	£0	0.00	0%	0.00			
	Warehouses	892	£1,105,455	-£578,695	-7%	#N/A			
Other Services	439	£1,105,455	-£813,261	-11%	#N/A				
Industrial	45	£1,105,455	-£1,016,810	-22%	#N/A				
Biomass Boilers	Commercial Offices	806	£254,832	£78,939	18%	6 years	10313	£2,803,150	13.9%
	Communications and Transport	715	£254,832	£15,320	13%	8 years			
	Education	702	£254,832	£12,277	13%	8 years			
	Government	874	£254,832	£51,071	15%	7 years			
	Health	854	£254,832	£46,507	15%	7 years			
	Hotel	1893	£254,832	£280,792	28%	4 years			
	Retail	445	£254,832	-£45,534	9%	10 years			
	Sports and Leisure	1360	£254,832	£160,607	21%	5 years			
	Warehouses	803	£254,832	£35,097	14%	7 years			
	Other Services	790	£254,832	£32,054	14%	7 years			
Industrial	40	£254,832	-£136,814	2%	17 years				

4.22 As shown in the table above, building integrated technologies may not provide sufficiently high CO₂ savings and the costs for installing single units on individual

dwellings can be expensive thus making these options less attractive to a developer who will need to pass the cost on to the house buyer.

- 4.23 For the occupier however, these options can be very appealing – providing a secure, independent, low/zero carbon energy supply and, if the technology receives a financial incentive, an additional income. For planning policy where the objective is to achieve high CO₂ reductions then building integrated solutions may only offer a limited contribution. However, it has also been shown that installing low and zero carbon technologies within buildings and dwellings can influence the occupiers’ energy use and outlook on energy consumption.
- 4.24 For the LDF target considered as a whole, domestic solar PV and non-domestic biomass boilers would achieve the highest CO₂ savings and prove most cost effective. Roof mounted wind turbines offer a minimal CO₂ reduction, although the returns on investment are acceptable. Ground source heat pumps (GSHP) do not perform as well due the electricity required to operate the pump and the high installation cost. Renewable heating technologies installed in domestic properties do not currently receive any financial incentives, although this is expected to change when the 2nd phase of the RHI is introduced in 2012. It should be noted that the results of the modelling are dependent on the development mix and could therefore change once the specific development plans come forward.
- 4.25 Alternatively the energy demands could be met by a single windfarm. Table 4.5 shows the different wind turbine options modelled and the resulting costs and CO₂ savings.

Table 4.5: Wind Turbines for All LDF sites

Wind Turbines									
System	Number of Turbines	Installed Capacity	Demand Met	CO ₂ Saving	Installed Costs	Running Costs	Net Revenue	NPV	IRR
Endurance E3120	1	0.05	0.5%	0.6%	£286,667	£4,300	£45,457	£52,870	15%
EWT DW52	1	0.5	3.8%	4.3%	£1,066,667	£16,000	£283,592	£4,605,173	26%
Vestas V90	4	12	90.4%	102.9%	£14,250,000	£213,750	£2,993,461	£45,619,224	21%

- 4.26 As shown in the table a small turbine such as the Endurance E3120 would hardly meet the energy demand of the annual LDF target. In order to attain a 100% CO₂ reduction 200 of these turbines would be needed, this is both impractical and

uneconomic. Some 25 medium scale turbines would be needed to meet a 100% CO₂ saving, which could be achieved by development in the medium scale wind areas identified in the LDF. Alternatively 4 large scale wind turbines could meet 100% reduction. This could be developed as a single windfarm in one of the areas identified in the evidence base study and would be an attractive investment opportunity.

Bassingthorpe Farm

- 4.27 Bassingthorpe Farm is a preferred development site that forms an urban extension to Rotherham. The current target for the site is 2400 houses and 11ha of employment land. Once again the type and nature of the buildings is not known at this stage, therefore for modelling purposes it has been assumed that there will be an equal split across the different dwelling types and non-residential buildings.
- 4.28 Table 4.6 shows all the building integrated solutions considered for the Bassingthorpe Farm development.

Table 4.6: Building Integrated Solutions for Bassingthorpe Farm

Technology Option	Building Type	Per Building Type					Total					
		Generation MWh/yr	Installed Costs	NPV	IRR	Simple Payback	Generation Mwh/yr	Installed Costs	CO ₂ Saving			
Roof Mounted Wind Turbines	Flat	631	£1,920,000	£-294.89	11%	9 years	3153.60	£14,400,000	10.9%			
	Mid-terrace	631	£1,920,000	£-294.89	11%	9 years						
	End-terrace	631	£1,920,000	£-294.89	11%	9 years						
	Semi-detached	631	£1,920,000	£-294.89	11%	9 years						
	Detached	631	£1,920,000	£-294.89	11%	9 years						
Solar PV	Flat	1244	£4,512,000	£-1,181	10%	9 years	6220.80	£22,560,000	21.6%			
	Mid-terrace	1244	£4,512,000	£-1,181	10%	9 years						
	End-terrace	1244	£4,512,000	£-1,181	10%	9 years						
	Semi-detached	1244	£4,512,000	£-1,181	10%	9 years						
	Detached	1244	£4,512,000	£-1,181	10%	9 years						
	Commercial Offices	55	£200,000	£-51,705	8%	11 years	606.64	£2,200,000	3.0%			
	Communications and Transport	55	£200,000	£-51,705	8%	11 years						
	Education	55	£200,000	£-51,705	8%	11 years						
	Government	55	£200,000	£-51,705	8%	11 years						
	Health	55	£200,000	£-51,705	8%	11 years						
Hotel	55	£200,000	£-51,705	8%	11 years							
Retail	55	£200,000	£-51,705	8%	11 years							
Sports and Leisure	55	£200,000	£-51,705	8%	11 years							
Warehouses	55	£200,000	£-51,705	8%	11 years							
Other Services	55	£200,000	£-51,705	8%	11 years							
Industrial	55	£200,000	£-51,705	8%	11 years							
Solar Thermal	Flat	778	£720,000	£0	0%	N/A	4665.60	£7,560,000	16.2%			
	Mid-terrace	778	£720,000	£0	0%	N/A						
	End-terrace	778	£720,000	£0	0%	N/A						
	Semi-detached	778	£720,000	£0	0%	N/A						
	Detached	1555	£1,440,000	£0	0%	N/A						
Ground Source Heat Pumps	Flat	817	£2,476,800	£0	0%	N/A	5497	£16,512,000	3.3%			
	Mid-terrace	804	£3,302,400	£0	0%	N/A						
	End-terrace	1041	£3,302,400	£0	0%	N/A						
	Semi-detached	1232	£3,302,400	£0	0%	N/A						
	Detached	1602	£4,128,000	£0	0%	N/A						
	Commercial Offices	515	£760,000	£-617,761	-8%	N/A	3869	£8,000,000	2.3%			
	Communications and Transport	412	£760,000	£-539,773	-9%	N/A						
	Education	335	£760,000	£-572,462	-11%	N/A						
	Government	567	£760,000	£-560,874	-7%	N/A						
	Health	351	£760,000	£-602,571	-10%	N/A						
	Hotel	402	£760,000	£-504,889	-9%	N/A						
	Retail	340	£760,000	£-504,889	-11%	N/A						
	Sports and Leisure	0	£0	£0	0%	0.00						
	Warehouses	613	£760,000	£-395,603	-7%	N/A						
Other Services	302	£760,000	£-556,867	-11%	N/A							
Industrial	31	£760,000	£-696,807	-22%	N/A							
Biomass Boilers	Commercial Offices	554	£188,500	£37,306	16%	6 years				7090	£2,073,500	9.4%
	Communications and Transport	492	£188,500	£-6,392	11%	8 years						
	Education	482	£188,500	£-8,484	11%	8 years						
	Government	601	£188,500	£18,187	14%	7 years						
	Health	587	£188,500	£15,049	13%	7 years						
	Hotel	1301	£188,500	£176,120	26%	4 years						
	Retail	306	£188,500	£-48,229	8%	11 years						
	Sports and Leisure	935	£188,500	£93,492	19%	5 years						
	Warehouses	552	£188,500	£7,204	13%	8 years						
	Other Services	543	£188,500	£5,113	12%	8 years						
Industrial	28	£188,500	£-110,984	1%	19 years							

4.29 Table 4.6 shows that domestic solar PV would provide the highest CO₂ savings and a relative good payback for the investment, however the capital cost is high and it is likely that this will be passed on to the house buyer. Solar thermal also offers a significant CO₂ saving, however there are no current financial incentives for this technology, although if present in the house once the occupier moves in it effectively

offers free hot water. Roof mounted wind turbines offer the next best alternative in terms of CO₂ reduction and payback; however it should be noted that installing these device on every property would produce excessive noise and reduce the overall power generated due to wind loss from shading. Biomass boilers could provide a small contribution to the CO₂ saving and offer a good investment opportunity for some non-domestic buildings, such as sports and leisure and commercial offices.

- 4.30 Installing all the building integrated solutions assessed in Table 4.6 would result in just 66% reduction in CO₂ as well as being impractical and costly. Whole site solutions can offer higher CO₂ savings and prove more economic. Table 4.7 and Table 4.8 show the opportunities for wind and district heating respectively.

Table 4.7: District Heating for Bassingthorpe Farm

District Heating								
System	Installed Capacity	Demand Met	CO ₂ Saving	Installed Costs	Running Costs	Net Revenue	NPV	IRR
Biomass Boiler and Gas Boiler for Peak Demand	6.2 MWth	48%	33%	£5,421,800	£672,220	£879,275	£1,145,899	15%
Base Load Biomass CHP with Gas Boiler for Peak	2.10 MWe	94%	120%	£9,807,200	£2,487,811	£1,087,435	-£1,684,663	9%
Peak Load Biomass CHP	3.1 MWe	116%	164%	£12,667,200	£3,019,462	£4,545,158	£21,282,601	36%
Peak Load Gas CHP	10.00 MWe	265%	427%	£10,867,200	£3,564,712	£1,510,615	£416,251	13%
Base Load Biomass CHP with Gas CHP for Peak	6.00 MWe	102%	141%	£12,367,200	£1,811,573	£1,704,154	£361,880	12%

- 4.31 Table 4.7 identifies the different district heating options and demonstrated how these technologies compare with one another. A biomass CHP to meet all the demand would achieve the highest reduction in CO₂ and the best investment opportunity. However, it will exceed the demand and probably result in excess heat production and require a significant area for fuel storage. Gas CHP would exceed the demand requirements and receive a good return on investment despite not receiving a financial incentive, however 77% of heat generated by the plant will be excess heat. A base load biomass CHP coupled with a gas CHP would provide the best match to the demand and ensure sufficient CO₂ reduction and a good return on investment.

Table 4.8: Wind Turbines for Bassingthorpe Farm

Wind									
System	Number of Turbines	Installed Capacity	Demand Met	CO ₂ Saving	Installed Costs	Running Costs	Net Revenue	NPV	IRR
Endurance E3120	1	0.05	0.5%	0.6%	£286,667	£4,300	£45,457	£52,870	15%
EWT DW52	1	0.5	3.4%	4.2%	£1,066,667	£16,000	£283,592	£4,605,173	26%
Vestas V90	4	12	82.4%	101.3%	£14,250,000	£213,750	£2,993,461	£45,619,224	21%

4.32 Small and medium scale wind turbines would not provide significant CO₂ reduction unless installed in large quantities. 4 large scale wind turbines would provide a 100% reduction in CO₂ with a good return on investment. The operation of a wind farm will be simpler compared to the CHP plant and district heating as there is no requirement to store and handle fuel.

Dinnington

4.33 The Dinnington, Anston and Laughton Common LDF area is located in and around Dinnington. There is currently a plan for 1100 homes in the area with the final target at 1100 homes and 12ha of employment land. The economic appraisal was undertaken for the 1100 homes currently planned. Once again the type and nature of the buildings is not known at this stage therefore for modelling purposes it has been assumed that there will be an equal split across the different dwelling types.

4.34 Table 4.9 shows the technologies modelled for Dinnington. Solar PV performed the best in terms of CO₂ reduction and investment returns. Solar thermal would provide additional CO₂ reduction however it is unlikely that enough roof space will be available on every dwelling to hold both PV and thermal panels. Roof mounted wind turbines perform well in the model but should be subject to the considerations discussed above.

Table 4.9: Building Integrated Solutions for Dinnington

Technology Option	Building Type	Per Building Type					Total		
		Generation MWh/yr	Installed Costs	NPV	IRR	Simple Payback	Generation Mwh/yr	Installed Costs	CO ₂ Saving
Roof Mounted Wind Turbines	Flat	289	£880,000	-£294.89	11%	9 years	1445.40	£6,600,000	25.6%
	Mid-terrace	289	£880,000	-£294.89	11%	9 years			
	End-terrace	289	£880,000	-£294.89	11%	9 years			
	Semi-detached	289	£880,000	-£294.89	11%	9 years			
	Detached	289	£880,000	-£294.89	11%	9 years			
Solar PV	Flat	570	£2,068,000	-£1,181	10%	9 years	2851.20	£10,340,000	50.6%
	Mid-terrace	570	£2,068,000	-£1,181	10%	9 years			
	End-terrace	570	£2,068,000	-£1,181	10%	9 years			
	Semi-detached	570	£2,068,000	-£1,181	10%	9 years			
	Detached	570	£2,068,000	-£1,181	10%	9 years			
Solar Thermal	Flat	356	£330,000	n/a	n/a	n/a	2138.40	£3,465,000	37.9%
	Mid-terrace	356	£330,000	n/a	n/a	n/a			
	End-terrace	356	£330,000	n/a	n/a	n/a			
	Semi-detached	356	£330,000	n/a	n/a	n/a			
	Detached	713	£660,000	n/a	n/a	n/a			
Ground Source Heat Pumps	Flat	375	£1,135,200	n/a	n/a	n/a	2519	£7,568,000	7.8%
	Mid-terrace	368	£1,513,600	n/a	n/a	n/a			
	End-terrace	477	£1,513,600	n/a	n/a	n/a			
	Semi-detached	565	£1,513,600	n/a	n/a	n/a			
	Detached	734	£1,892,000	n/a	n/a	n/a			

4.35 Whole site solutions for district heating and wind turbines are considered in Table 4.10 and Table 4.11.

Table 4.10: District Heating for Dinnington

District Heating								
System	Installed Capacity	Demand Met	CO ₂ Saving	Installed Costs	Running Costs	Net Revenue	NPV	IRR
Biomass Boiler and Gas Boiler	1.8 MWth	60%	48%	£2,213,300	£217,770	£219,898	-£570,784	8%
Base Load Biomass CHP with Gas	0.60 MWe	118%	171%	£3,383,300	£1,074,813	-£56,069	-£3,802,107	8%
Peak Load Biomass CHP	1 MWe	156%	257%	£4,543,300	£974,020	£1,466,180	£6,408,249	32%
Peak Load Gas CHP	3.00 MWe	348%	646%	£3,793,300	£1,061,591	£445,033	-£469,152	10%
Base Load Biomass CHP with Gas	1.60 MWe	130%	203%	£3,350,535	£540,874	£487,870	£293,580	13%

4.36 The size of the development at Dinnington is relatively small and therefore the energy demand does not warrant a CHP plant due to the cost of the plant and heat network comparative to the revenue received. In addition the current proposal only includes residential properties which will have a high heat demand in the winter dropping away substantially in the summer. Biomass CHP plants work best when allowed to run at a constant load throughout the year and are therefore better suited to commercial and industrial processes which have constant heat demand. Despite providing a return on investment the peak load biomass significantly exceeds demand, whilst electricity can be exported to the grid any excessive heat generation will need to be discarded. Although the base load biomass CHP coupled with gas CHP appears to be the best option, matching the demand and providing a good return on investment as well as exceeding 100% CO₂ reduction, the actual biomass plant will need to be 400kW, this is a sub critical level for the operation of a biomass boiler and steam plant and therefore this option is not possible. In order for this to be viable the heat load would need to increase, which could be achieved by including some commercial or industrial development. Alternatively a gasifier is suitable for small heat loads, however they are not currently bankable and may be considered a risky investment. This technology is discussed in the methodology, Appendix 4.

Table 4.11: Wind Turbines for Dinnington

Wind									
System	Number of Turbines	Installed Capacity	Demand Met	CO ₂ Saving	Installed Costs	Running Costs	Net Revenue	NPV	IRR
Endurance E3120	1	0.05	2.0%	2.9%	£286,667	£4,300	£45,457	£52,870	15%
EWT DW52	1	0.5	15.2%	21.6%	£1,866,667	£28,000	£271,592	£3,565,173	13%
Vestas V90	1	3	91.1%	129.4%	£5,250,000	£78,750	£723,053	£9,211,056	12%

4.37 A single medium scale turbine would provide a significant contribution to the CO₂ reduction and installing a 1.5MW turbine, rather than 500kW turbine modelled, would provide 100% CO₂ saving, although additional modelling will be need to understand the financial performance of this option.

Waverley

4.38 Planning permission has been granted for a development at the Waverley site and an energy strategy has been produced by the applicant. It has been included in the economic appraisal for this report by way of a comparison. There is an anomaly in the energy demand data produced in the model and the energy strategy undertaken by the applicant. It is likely that this has arisen due to the benchmark data used to calculate the energy consumption of the development. Unfortunately WA was unable to attain the specific data used to model the energy demand at Waverley in the original energy strategy and therefore the national benchmarks have been applied, resulting in an underestimate of the consumption compared with the applicant's energy strategy.

4.39 The current proposal is for 3890 houses and approximately 2ha of employment land. The breakdown of housing types was not available and therefore an equal split has been assumed. The non-residential buildings have been broken in the relevant types based on the information in the planning application.

4.40 Table 4.12 shows all the building integrated solutions considered for the Waverley development. Figures 4.13 and 4.14 show the corresponding results for district heating and wind.

Table 4.12: Building Integrated Solutions for Waverley

Technology Option	Building Type	Per Building Type					Total		
		Generation MWh/yr	Installed Costs	NPV	IRR	Simple Payback	Generation Mwh/yr	Installed Costs	CO ₂ Saving
Roof Mounted Wind Turbines	Flat	1022	£3,112,000	£-294.89	11%	9 years	5111.46	£23,340,000	22.2%
	Mid-terrace	1022	£3,112,000	£-294.89	11%	9 years			
	End-terrace	1022	£3,112,000	£-294.89	11%	9 years			
	Semi-detached	1022	£3,112,000	£-294.89	11%	9 years			
	Detached	1022	£3,112,000	£-294.89	11%	9 years			
Solar PV	Flat	2017	£7,313,200	£-1,181	10%	9 years	10082.88	£36,566,000	43.7%
	Mid-terrace	2017	£7,313,200	£-1,181	10%	9 years			
	End-terrace	2017	£7,313,200	£-1,181	10%	9 years			
	Semi-detached	2017	£7,313,200	£-1,181	10%	9 years			
	Detached	2017	£7,313,200	£-1,181	10%	9 years			
	Commercial Offices	55	£200,000	£-51,705	8%	11 years	386.04	£1,400,000	2.4%
	Communications and Transport	0	£0	£0	#N/A	#N/A			
	Education	55	£200,000	£-51,705	8%	11 years			
	Government	0	£0	£0	#N/A	#N/A			
	Health	55	£200,000	£-51,705	8%	11 years			
	Hotel	55	£200,000	£-51,705	8%	11 years			
	Retail	55	£200,000	£-51,705	8%	11 years			
	Sports and Leisure	55	£200,000	£-51,705	8%	11 years			
	Warehouses	0	£0	£0	#N/A	#N/A			
Other Services	55	£200,000	£-51,705	8%	11 years				
Industrial	0	£0	£0	#N/A	#N/A				
Solar Thermal	Flat	1260	£1,167,000	£0	#N/A	#N/A	7562.16	£12,253,500	32.8%
	Mid-terrace	1260	£1,167,000	£0	#N/A	#N/A			
	End-terrace	1260	£1,167,000	£0	#N/A	#N/A			
	Semi-detached	1260	£1,167,000	£0	#N/A	#N/A			
	Detached	2521	£2,334,000	£0	#N/A	#N/A			
Ground Source Heat Pumps	Flat	1325	£4,014,480	£0	#N/A	#N/A	8909	£26,763,200	6.7%
	Mid-terrace	1302	£5,352,640	£0	#N/A	#N/A			
	End-terrace	1688	£5,352,640	£0	#N/A	#N/A			
	Semi-detached	1997	£5,352,640	£0	#N/A	#N/A			
	Detached	2597	£6,690,800	£0	#N/A	#N/A			
	Commercial Offices	26	£38,608	£-28,804	-5%	#N/A	643	£1,451,520	0.5%
	Communications and Transport	0	£0	£0	#N/A	#N/A			
	Education	157	£356,896	£-265,706	-10%	#N/A			
	Government	0	£0	£0	#N/A	#N/A			
	Health	46	£98,800	£-74,357	-9%	#N/A			
	Hotel	225	£425,600	£-279,570	-9%	#N/A			
	Retail	61	£136,800	£-279,570	-9%	#N/A			
	Sports and Leisure	0	£0	£0	0%	0.00			
	Warehouses	0	£0	£0	#N/A	#N/A			
Other Services	128	£322,240	£-231,964	-11%	#N/A				
Industrial	0	£0	£0	#N/A	#N/A				
Biomass Boilers	Commercial Offices	28	£8,752	£-3,105	4%	14 years	1762	£473,871.00	2.9%
	Communications and Transport	0	£0	£0	#N/A	#N/A			
	Education	227	£119,599	£-840	12%	8 years			
	Government	0	£0	£0	#N/A	#N/A			
	Health	76	£21,580	£6,234	16%	6 years			
	Hotel	729	£142,520	£104,555	23%	5 years			
	Retail	55	£29,880	£1,551	13%	8 years			
	Sports and Leisure	241	£43,060	£43,641	27%	4 years			
	Warehouses	0	£0	£0	#N/A	#N/A			
	Other Services	230	£108,480	£3,811	13%	8 years			
Industrial	0	£0	£0	#N/A	#N/A				

4.41 Domestic solar PV performs best again, with solar thermal offering the next highest reduction in CO₂ reductions. Biomass boilers offer a good investment opportunity, however the contribution to the CO₂ reduction is low as they will only service the non-residential buildings, which make up a smaller proportion of the development mix.

Table 4.13: District Heating for Waverley

District Heating								
System	Installed Capacity	Demand Met	CO ₂ Saving	Installed Costs	Running Costs	Net Revenue	NPV	IRR
Biomass Boiler and Gas Boiler for	6.8 MWth	58%	45%	£7,712,070	£1,492,237	£207,967	-£6,158,670	-5%
Base Load Biomass CHP with Gas	2.30 MWe	113%	161%	£12,512,670	£2,677,364	£1,239,889	-£3,251,390	8%
Peak Load Biomass CHP	4 MWe	154%	250%	£17,457,670	£3,896,080	£5,864,720	£26,348,525	33%
Peak Load Gas CHP	10.00 MWe	297%	536%	£12,957,670	£3,552,758	£1,610,534	-£927,875	11%
Base Load Biomass CHP with Gas	6.00 MWe	118%	178%	£14,457,670	£1,820,369	£1,783,323	-£1,137,237	11%

4.42 A peak load biomass CHP would offer the best investment opportunity and significant CO₂ savings, however, the plant will far exceed the heating requirements making this plant impractical unless a large heat user is connected to the network. This is also the gas CHP plant. A base load biomass CHP plant coupled with gas CHP would offer the best district heating option, matching the demand well and providing significant reduction in CO₂. The return on investment for this option is not as good as hoped, but should be considered acceptable. The mix of commercial and residential development should provide a constant heat load for the biomass plant, avoiding excess heat being wasted.

Table 4.14: Wind Turbines for Waverley

Wind									
System	Number of Turbines	Installed Capacity	Demand Met	CO ₂ Saving	Installed Costs	Running Costs	Net Revenue	NPV	IRR
Endurance E3120	1	0.05	0.5%	0.7%	£286,667	£4,300	£45,457	£52,870	15%
EWT DW52	1	0.5	3.8%	5.3%	£1,066,667	£16,000	£283,592	£4,605,173	26%
Vestas V90	3	9	68.1%	94.9%	£11,250,000	£168,750	£2,236,658	£33,483,168	19%

4.43 3 large scale wind turbines would meet a substantial amount of the energy demand and provide a 95% reduction in CO₂ as well as good investment opportunity. A large number of small or medium scale turbines would be needed to match this reduction.

4.44 The energy strategy submitted by the applicant proposes integrating solar thermal panels for the first phase of the development. Later phases will be connected to decentralised power network consisting of a gas fired CHP plant, gas and biomass boiler plant and a bio fuel and biomass boiler plant. These systems will allow the energy needs of the different phases to be met and the development progress and therefore avoid production of excess energy. However, these technologies will not provide the same level of CO₂ reduction as the options discussed above. The highlights the difficulty between assessing the energy use and technology options in

the preliminary stages of development and ensuring the most practical solution for built performance.

Conclusions

- 4.45 Low and zero carbon technologies should be encouraged, if not enforced, in new developments. The range of technologies available provides a number of options for all size and type of development.
- 4.46 Building integrated solutions are best suited to smaller developments where the energy demand is low and variable. The best of these technologies would be either solar PV or solar thermal, both of which provide a good reduction in CO₂ in comparison with other technologies and even with the reduction in the Feed in Tariff, solar PV still gives a reasonable return on investment. In addition, biomass boilers can offer a good solution for schools, hospitals and commercial offices.
- 4.47 The installed cost of building integrated solutions can be relatively high in terms of the capacity installed. It is likely that this cost will be added to the house price to ensure the developers redeem their costs.
- 4.48 For larger mixed use developments whole site solutions offer the best option in terms of CO₂ reduction and investment opportunities. District heating can meet both heat and power demand when coupled with a CHP plant. A base load CHP plant coupled with a gas CHP offers the best solution for matching the demand of most developments whilst still providing a significant reduction in CO₂. The investment opportunities for these plants are good as the generation from the biomass plant will receive a financial incentive in addition to the heat and electricity sales. In order for a biomass CHP plant to operate efficiently it should be run at a constant load throughout the year. This makes CHP most suited to mixed use developments where energy demand will continue all year round despite a reduction residential heating.
- 4.49 A biomass plant will require fuel storage alongside the boiler and turbine house. Typically a biomass fuelled steam turbine will require at least 5 days fuel stored at any given time. The plant will also need to allow turning space for articulated delivery Lorries. These requirements mean that the footprint of a biomass CHP plant

will be substantially bigger than a gas boiler or gas CHP plant for example 5000m² for a biomass plant compared to 500m² for a gas plant. There will need to be constant management and staffing to oversee the delivery and handling of the fuel as well the general operation of the plant.

- 4.50 Commercial wind turbines offer a whole site solution with less operation requirements. For the developments assessed, 3-4 large scale wind turbines could adequately meet the demand of a development, providing significant CO₂ reduction. A windfarm can also prove a good investment opportunity and all electricity generated can be exported to the grid, ensuring no energy is wasted. However, there are a number of issues which often restrict locations in which large scale wind turbines may be deployed. These include but are not limited to: the proximity of residential dwellings, the perceived visual impact, noise, electromagnetic interference (EMI) and accessibility of the site. There are also associated exclusion zones for protected areas and airports. Typically, building integrated technologies need to be deployed in or around urban centres and therefore several of these restrictions may apply, however the turbines could be located off site in the areas identified as suitable by the large scale wind resource study.
- 4.51 In order for a developer or company, or indeed local authority, to benefit from the investment opportunities available from the whole site solutions it may be necessary for the company to form an Energy Service Company (ESCO) to manage the plant and heat network and/or windfarm. From experience, developers are not keen to undertake this commitment and it may be beneficial to encourage community owned or local authority ESCOs to take on the management and operation of these plants once constructed.
- 4.52 Energy Strategies/Statements are a key document for supporting planning applications as they can provide the specific project information to best assess the energy demands of a development and the suitable low or zero carbon technologies.

5 REVISED ENERGY OPPORTUNITY PLAN

5.1 Table 5.1 below gives the revised renewable energy evidence base for Rotherham and the corresponding revised Energy Opportunity Plan is shown in Figure 5.1.

Renewable Energy Resource	Current Capacity MW	Current Capacity GWh	Potential Resource - heat (MW)	Potential Resource - electricity (MW)	Potential resource GWh
Large scale wind	26	69	0	55	179.7
Medium scale wind	0	0	0	66.5	219
Small scale wind	0	0	0	1	1
Hydro	0	0	0	1	3
Solar PV	1	1	0	12	9
Solar Thermal	0	0	18	0	11
Air source heat pumps	0	0	10	0	15
Ground source heat pumps	0	0	6	0	11
Biomass energy crops	0	2	7.4	3.7	88.8
Biomass woodfuel	1	0	1.2	0.6	14.4
Biomass agricultural arisings	0	0	5	2	38
Biomass waste wood	0	0	2	1	14
Energy from waste wet	0	0	1	1	11
Energy from waste poultry litter	0	0	0	0	0
Energy from waste MSW	0	0	2	1	20
Energy from waste C&I	0	0	4	2	35
Energy from waste landfill gas	1	6	0	0	0
Energy from waste sewage gas	0	2	0	0	6
Total	29	80	56.6	146.8	572.7

Wardell Armstrong Revisions	
AECOM study	

6 FEEDBACK FROM THE CONSULTATION EVENT

6.1 As part of this study a Consultation Event was held on the 30th of September at Rotherham Town Hall. The primary objectives were to inform stakeholders about the results of the study in terms of the enhanced evidence base and also solicit comments on the options for low carbon and renewable energy targets and planning

policies being developed. Some 35 people attended from a variety of public, voluntary and private sector organisations. The programme is shown below.

Table 6.1: Consultation Programme	
Time	Activity
09:00 – 09:30	Registration & Coffee
09:30 – 09:35	Introduction & welcome – Nick Tovey, Regional Director Wardell Armstrong
09:35 – 09:45	Opening Address - Councillor Ken Wyatt (RMBC)
09:45 - 10:15	The Low Carbon and Renewable Energy Evidence Base – Haydn Scholes (WA)
10:15 – 10:45	Potential Targets and Policies – Steve Stoney (WA)
10:45 – 11:15	Low Carbon & Renewable Energy in Practice – Rotherham Case Studies
11:15 – 11:35	Coffee Break
11:35 – 12:15	Breakout Workshops (see details on topics below)
12:15 – 12:30	Plenary - Responses from Workshops and Wrap-up Session

Workshop 1

- The role of planning policy – guide, shape and encourage development
- What targets should be applied? Is there a case for local targets? Borough wide or for individual developments?
- Is a level playing field across the region important? Should there be a common set of targets for South Yorkshire?
- Money talks – What LC&RE technologies make economic sense to the private sector
- Timing isn't everything but its right up there with oxygen! Could businesses keep up if RMBC takes a pioneering approach

Workshop 2

- The role of planning policy – guide, shape and encourage development
- Pioneering v Pragmatic policy setting
- Short/medium/long term policy
- Targeting strategic developments
- What mechanisms are required to help communities with LC&RE?

6.2 Workshop 1 was primarily targeted at the private sector and Workshop 2 at the public sector, although there was a certain amount of crossover between the two. Their objective was to identify, on a scale of pragmatic to pioneering, where the targets and policies for RMB should lie. The discussions in the workshops were recorded and are summarised in Appendix 5.

6.3 As can be seen from the discussions, although there was some polarisation between the attendees, private sector versus public/voluntary sector, there was no clear steer towards pragmatic or pioneering targets/policies. Some key points, if somewhat contradictory, that emerged from the discussions were:

- From Sheffield's experience (who followed the Merton lead) they suggested that the 10% figure could be too low.
- Avoid mistake of regional target which set in place a minimum which has scope for misinterpretation.
- Notwithstanding any local targets, the 2020 energy target was felt to be challenging.
- Apply a general borough target but opportunities could be explored for enhanced targets within particular development schemes.
- Targets should be locally derived and driven by capacity and availability of renewable resources.
- Should the targets be based on renewables (*ie a percentage of energy used on site*) or CO₂ reductions? A low carbon element allows for flexibility to be incorporated.
- Should avoid setting targets too high as this will impact on viability.
- Pioneering targets may also encourage investment elsewhere where the demands are less pressing.
- What role could Building Regulations play given that they often move in advance of planning policy?
- General consensus that there should not be separate borough-wide targets for individual technologies.
- Phased implementation was suggested to avoid a situation of looking to achieve too much in the short term.

- Pragmatic approach advocated to avoid potential for backtracking on policy stance if it was not proving to be achievable.
- CPRE believe that Council should be taking positive and proactive approach to renewable energy.
- South Yorkshire Climate Network – Chief Executives decision has been made to decide common priorities across South Yorkshire and to encourage all local authorities to be pioneering.

6.4 These comments and those made on the consultation version of Core Strategy Policy CS27 have been taken on board when producing the suggested targets and policies detailed below in Chapters 7 and 8.

7 TARGETS FOR LOW CARBON AND RENEWABLE ENERGY IN RMB

Discussion on the Usefulness of Targets

- 7.1 There is some thinking currently within DECC that not setting explicit targets would result in more LC&RE technologies being implemented on the ground. In the authors' opinion, this would leave a dangerous vacuum and lead to greater uncertainty within the commercial sector. The primary driver for LC&RE technologies would be the push of financial incentives (which could be short lived) and not the pull of targets from planning authorities. Most planners and developers would prefer explicit targets, be they high or low, pragmatic or pioneering (and in many cases defined areas of search as well). So it is suggested that not setting LC&RE targets is not an option for RMB.
- 7.2 As can be seen from the comments raised at the Consultation Event, targets for Low Carbon and Renewable Energy can be a two edged sword. High targets will be a strong driver for the uptake of LC&RE technologies but can also deter property developers who will simply redirect their activities to nearby authorities with lower targets. Part of the problem is that unfortunately most property developers still see LC&RE targets as an additional cost and not as added value or an opportunity which could provide a better return on investment than the buildings themselves. This is vividly demonstrated in some of the responses to the CS27 consultation where several seek a de minimus size of development which is exempt from the targets. Conversely, low targets will attract property developers but can limit the deployment of commercial scale LC&RE technologies. Although PPS22 states that any targets should be a minimum and exceeding them should not be a reason for refusing planning permission, this sort of thinking has been seen in many planning committees throughout the UK, particularly where wind farms are involved. The dilemma is how to set targets that get buy in from property developers whilst simultaneously not capping the development of borough-wide commercial renewable energy projects.
- 7.3 From a practical perspective the currently available renewable energy resource within RMB equates to only 18% of the current energy demand. There are a number of reasons for this including the urban nature of parts of RMB and any municipal

waste arisings are likely to be exploited by energy from waste plants outside the borough. Consequently, any targets set must take into account these limitations.

- 7.4 Several of the Consultation Event responses suggested a phased implementation of targets. Clearly there is merit in setting targets that start relatively low (pragmatic) but ratchet up year by year to pioneering ones. This approach would be in line with the UK's commitment to increasing renewable energy targets up to 2020 and 2050 and would allow developers an easy entry into the target regime. However, this approach may have already been superseded by events, see below.
- 7.5 Another question raised at the Consultation Event was "Should the targets be based on renewables (*ie a percentage of energy used on site*) or CO₂ reductions?" In July 2007 the previous government published '*Building a Greener Future: Policy Statement*' which announced that all new homes will be carbon zero from 2016 onwards. Plans to reduce CO₂ emissions from new developments were originally detailed in the '*Definition of Zero Carbon Homes and Non-domestic Buildings*' consultation paper. The policy largely focused on a reduction of regulated CO₂ emissions from the 2006 Building Regulations (Part L) in line with the Code for Sustainable Homes (CfSH), a mandatory assessment standard for the sustainability of all new dwellings since 2008. This was introduced in the 2010 building regulations which stipulated all new domestic developments need to achieve a 25% reduction on 2006 CO₂ emissions, in line with Code 3 of the CfSH.
- 7.6 However, although the Coalition Government have expressed commitment to honour this policy no clear legislation and guidance has yet been approved despite a number of recommendations having been put forward since the original *Definition of Zero Carbon Homes and Non-domestic Buildings*' consultation paper.
- 7.7 The latest recommendations have come from the Zero Carbon Hub, a task force given lead responsibility by the Government for achieving zero carbon standards by 2016. The latest report⁷ published by the Hub recommends a carbon compliance level for all new dwellings from 2016 depending on the house type, rather than a reduction on previous emissions levels. This compliance is expressed as kgCO₂/m² and is the amount of CO₂ a dwelling can produce. Anything above this must be offset

⁷ Zero Carbon Hub (Feb 2011). Carbon Compliance: Setting an Appropriate Limit for Zero Carbon New Homes

on site through improved energy efficiency measures or renewable energy. The Figure 7.1 shows the recommended carbon compliance levels and the progression from current regulations to the zero carbon standard.

7.8 It should be noted that this carbon compliance does not have to be met by individual houses as long as the limit is achieved by the development as a whole. The recommendations then suggest that the emissions within the carbon compliance levels are offset by 'allowable solutions'⁸ which could take any number of forms from investment in community windfarms to development of low carbon public transport services.

7.9 Figure 7.1 shows the anticipated 2013 review of the building regulations which is expected to require a 44% reduction in CO₂ over the 2006 regulations. The Hub has equated this to a 14kgCO₂/m²/yr carbon compliance level.

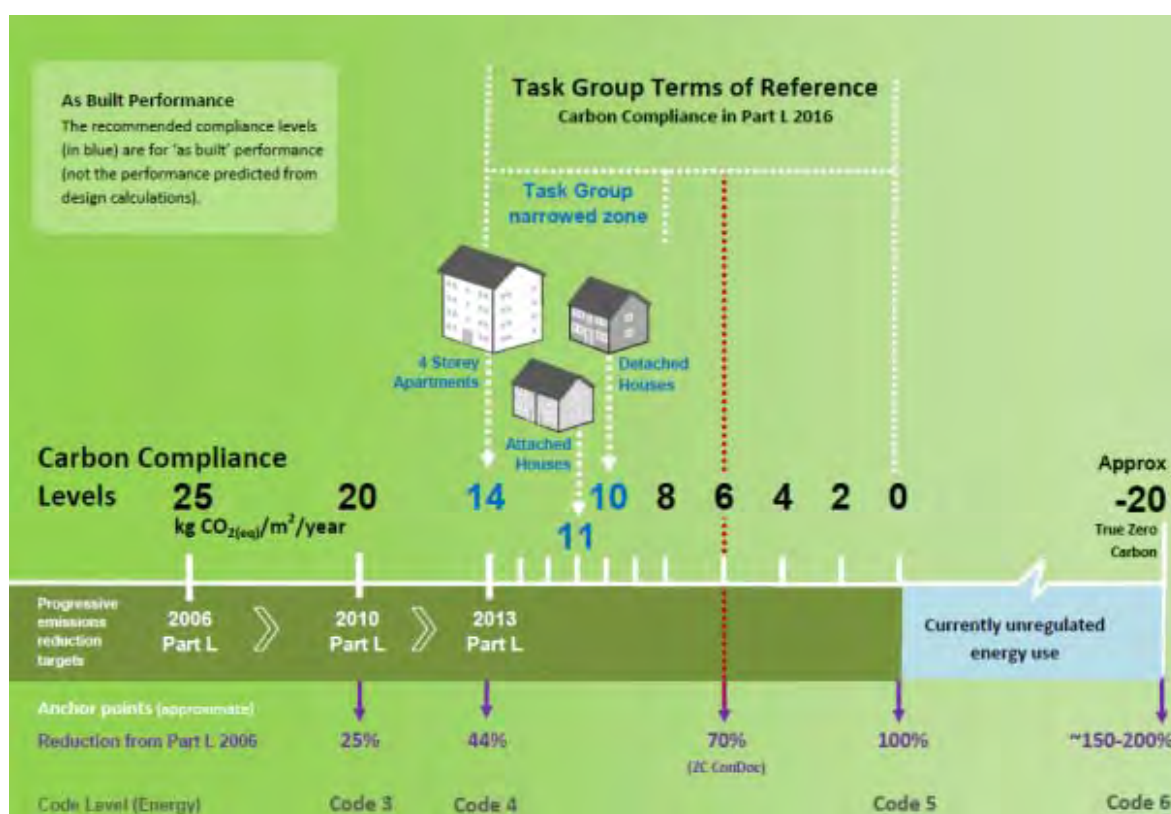


Figure 7.1: Recommended Carbon Compliance Level

Source: Zero Carbon Hub (Feb 2011)

⁸ Zero Carbon Hub (Nov 2009). Defining a Fabric Energy Efficiency Standard

7.10 The Zero Carbon Hub has also published recommendations for an energy efficiency standard⁹ which will provide high yet practical energy efficiency performance for all new homes. The Fabric Energy Efficiency Standard puts forward a minimum energy efficiency for space heating and cooling expressed as kWh/m²/year, as shown in Table 7.1.

Apartment blocks & mid terrace	39	kWh/m ² /yr
End terrace & detached houses	46	kWh/m ² /yr

7.11 At present these publications are only recommendations and there remains no clear policy detailing what will be required for new dwellings from 2016 onwards. No recommendations have been put forward regarding non-residential buildings but the assumption is that they will follow suit albeit in a longer time frame.

7.12 Finally there was a clear steer from the Consultation Event that targets for specific technologies were not a good idea. This would also tie in with the Zero Carbon Homes approach of leaving the decision on whether to utilise enhanced fabric efficiency or specific LC&RE technologies to the developer.

Target Options – Pragmatic v Pioneering

7.13 It is clear that to avoid some of the dilemmas outlined above that separate targets are required for the built environment and for commercial scale renewable projects, eg windfarms. This would also allow the forthcoming CO₂ targets or compliance levels, which are more appropriate to the built environment, to co-exist with a more general escalating percentage of energy use from renewable sources for other projects and RMB as a whole.

7.14 The former option should be more acceptable to property developers as it will ultimately be embedded in building regulations, thus providing a level playing field throughout the UK, and also leaves the choice of enhancing fabric efficiency or using LC&RE technologies to the developer. The latter option would also cover the gap whilst CO₂ compliance levels are put in place for non-residential buildings.

⁹ Zero Carbon Hub (July 2011). Allowable Solutions for Tomorrow's New Homes

7.15 This approach will hopefully be both pragmatic in that it starts from a relatively low but known baseline and at the same time pioneering in that it brings forward the latest recommendations from the Low Carbon Hub. The suggested target levels are given in the following paragraphs.

Overall Borough Targets

Table 7.2: Minimum Renewable Energy Provision for RMB	
Renewable energy should provide 10% of predicted energy use within the Borough plus a notional 1% uplift per annum up to 2020	
Development Year*	Renewable energy target
2012	10%
2013	11%
2014	12%
2015	13%
2016	14%
2017	15%
2018	16%
2019	17%
2020	18%**

**Subject to Core Strategy adoption date*
***Maximum currently available renewable energy resource within RMB*

Local Development Targets

7.16 For new housing developments targets should be adopted in line with current proposals for zero carbon homes and new Building Regulations as shown below.

Table 7.3: Residential Carbon Compliance Levels			
Carbon Compliance levels for 44% CO₂ reduction from 2013	All dwellings	14	kgCO ₂ /m ² /yr
	Detached houses	10	
Carbon Compliance levels for Zero Carbon Homes from 2016	Attached houses	11	kgCO ₂ /m ² /yr
	Low rise apartment blocks	14	

7.17 These compliance levels are only applicable to residential properties. Non-residential developments should adopt the Borough wide targets in Table 7.2 above and generate further renewable or low carbon energy or incorporate appropriate design

measures to reduce the development's overall predicted carbon dioxide emissions by 20% until appropriate carbon compliance targets are introduced via the Buildings Regulations.

8 LOCAL DEVELOPMENT FRAMEWORK/RENEWABLE ENERGY POLICY DEVELOPMENT

Policy Review

8.1 There is a clear framework through EU, national and local legislation for the inclusion of planning policies designed to encourage the implementation of suitable renewable energy schemes to help achieve European and national targets on CO₂ emissions and Climate Change. Below is a summary of national through to local spatial scale policies which will help inform renewable energy policy development in Rotherham.

National Policy/Legislation

8.2 The Government has set challenging targets to mitigate and adapt to the impacts of climate change. The strategy to achieve these challenging targets is set out in the UK Low Carbon Transition Plan and the Renewable Energy Strategy. These national targets alone provide sufficient justification for setting stringent energy policies in development plan documents.

UK Low Carbon Transition Plan (2009)

8.3 The UK Low Carbon Transition Plan is an overarching document which plots how the UK will cut emissions by 18% on 2008 levels by 2020. In addition it sets out how the UK will generate 30% of electricity from renewable energy by 2020. The Plan also illustrates how CO₂ emission reductions in key sectors including power and heavy industry; transport; homes and communities; workplaces and jobs; and farming, land and waste could enable 'carbon budgets' to 2022 to be achieved. A number of additional, more detailed, documents were published alongside the Plan including a Greener Future (DfT), the UK Low Carbon Industrial Strategy (BIS and DECC), and the UK Renewable Energy Strategy (DECC).

Renewable Energy Strategy (2009)

8.4 As part of EU-wide action to increase the use of renewable energy, the UK has committed to sourcing 15% of its energy from renewable sources by 2020. This

document published in 2009 sets out the comprehensive action plan required to deliver this increase in renewable energy sources. The three main elements of the plan revolve around the following strategic points:

- Achieving a balance of fuels and technologies.
- The Government's strategic role in leading delivery of renewables targets.
- The opportunities for individuals, communities and businesses to harness.
- Renewable energy and contribute to action against climate change.

The Energy Act 2008

8.5 The aim of the Energy Act 2008 is to implement the legislative aspects of the Energy White Paper 2007: 'Meeting the Energy Challenge'. The important contributions of the act are detailed below.

8.6 **Renewable Obligation:** The act strengthens the Renewables Obligation (RO) to increase the diversity of electricity supplies, improve the reliability of energy supplies and help lower carbon emissions from the electricity sector. The RO works by placing an obligation on licensed electricity suppliers to source a specified and annually increasing proportion of their electricity sales from renewable sources, or pay a penalty.

8.7 **Feed-in tariffs:** Feed-in tariffs (FITs) enable the Government to offer financial support for low-carbon electricity generation in projects up to 5 megawatts (MW). The aim is for generators to receive a guaranteed payment for generating low-carbon electricity. FIT schemes were introduced through changes to electricity supply licences. The Feed-in Tariffs (Specified Maximum Capacity and Functions) Order 2010 ("the FITs Order") came into effect on 1 April 2010. However, following a fast track review by the coalition Government revised tariffs came into effect on the 1st August 2011. These changes effectively reduced the fiscal associated with large scale solar projects but enhanced the incentives for small scale Energy from Waste (EfW) Anaerobic Digestion facilities.

8.8 **Renewable Heat Incentive:** RHI is a proposed financial support programme for renewable heat generated from a range of sources, from large industrial sites to

individual households. Heat generated from renewable sources accounts for approximately 1% of total heat demand although this may need to rise to 12% to meet EU regulations. In March 2011 the Coalition Government announced the RHI tariffs for the industrial and commercial sector; the public sector; not-for-profit organisations and communities however, tariffs may still be subject to review.

Climate Change Act 2008

8.9 The UK has passed legislation which introduces the world's first long-term legally binding framework to address the impacts of climate change.

8.10 The Climate Change Act creates a new approach to managing and responding to climate change in the UK, by:

- Setting ambitious, legally binding targets.
- Taking powers to help meet those targets.
- Strengthening the institutional framework.
- Enhancing the UK's ability to adapt to the impact of climate change.
- Establishing clear and regular accountability to the UK Parliament and to the devolved legislatures.

The Local Government (Miscellaneous Provisions) Act 1976 as amended by the Electricity Act 1989

8.11 Following an extensive consultation period the Government has seen fit to make the necessary legislative changes to section 11(3) of the Local Government (Miscellaneous Provisions) Act 1976 for England and section 170A(3) thereby enabling Local Authorities to sell electricity generated from renewable sources as of the 18 August 2010 in England, Wales and Scotland.

- 8.12 These legislative changes will give Local Authorities a greater opportunity to generate additional revenue whilst continuing to meet their Climate Change targets. The changes could also serve to encourage the use of technologies such as solar power which otherwise may not have been economically viable; improve energy efficiency and promote innovative solutions to meet current energy issues.

National Policy Statements (NPS) for Energy

- 8.13 On 18th July 2011 six National Policy Statements for Energy (NPS) were approved and designated under the Planning Act 2008. The energy NPSs set out national policy against which proposals for major energy projects will be assessed and decided on by the Infrastructure Planning Commission. It is considered that the following NPSs are of particular relevance:

EN-1 Overarching Energy NPS

- 8.14 This NPS sets out the high level objectives, policy and regulatory framework for new nationally significant infrastructure that are covered by the suite of energy NPSs and any associated development. The guidance highlights the need and urgency for new energy infrastructure to be consented and built with the objective of contributing to a secure, diverse and affordable energy supply and supporting Government policies on sustainable development, in particular by mitigating and adapting to climate change. It also addresses the need for specific technologies (including renewable and nuclear power) and infrastructure.
- 8.15 One of the key principles contained in EN-1 Overarching Energy, is the process to be followed by the IPC in the examination and determination of major energy applications. In addition to this it sets out assessment criteria, including EIA, of applications for particular technologies.

EN-3 Renewable Energy NPS

- 8.16 This NPS is one of suite of documents which come under the umbrella of EN-1 and sets out specific advice in relation to major renewable energy applications. EN-3

Renewable Energy covers the following types of nationally significant renewable energy infrastructure:

- Energy from Biomass and/or waste (>50 megawatts (MW))
- Offshore wind (>10 0MW)
- Onshore wind (>50 MW)

8.17 The guidance does not cover other types of renewable energy generation that are not at present technically viable over 50 MW onshore or over 100 MW.

8.18 The guidance establishes the process to be followed by the IPC in the examination and determination of major renewable energy applications. In addition to this it sets out assessment criteria, including EIA, of applications for particular technologies.

National Planning Policy

PPS1: Sustainable development (2005)

8.19 Planning Policy Statement 1: Delivering Sustainable Development (PPS1) (2005) places an emphasis on promoting more sustainable development, with a supplement to PPS1 on climate change published in December 2007. It advises planning authorities to provide a framework to encourage low carbon and renewable energy generation in their local development documents and confirms that there are situations where it is appropriate for LPA to expect higher standards than building regulations. However, care must be taken to demonstrate that requirements are viable, will not have a negative effect on housing development and will not inhibit the provision of affordable housing.

PPS12: Local Spatial Planning (2008)

8.20 Planning Policy Statement 12 (PPS12) published on the 4th June 2008 explains the basis of local spatial planning, and how the planning framework it introduces benefits communities. The guidance sets out what the key elements of local spatial plans are and government policies on how they should be prepared. PPS12 should be

taken into account by local planning authorities in the preparation of development plan documents and other local development documents.

- 8.21 The production of core strategies of core strategies should follow the Government's principles for community engagement in planning. The production of 'sound' and 'locally distinctive' policies must be 'justifiable'; therefore founded on a robust and credible evidence base and be the most appropriate strategy when considered against reasonable alternatives, and also 'effective' meaning that they are deliverable, flexible and able to be monitored.

PPS22: Renewable Energy (2004)

- 8.22 The current Government target for electricity generated through renewable energy is 10% by 2010, increasing to 15% by 2015. Planning Policy Statement 22 (PPS22) published on the 19 August 2004 sets out the Government's national planning policies which it hopes will help deliver its renewable energy targets by encouraging proposals for the use of renewable energy resources such as biomass, onshore wind power, active solar systems, small scale hydro-electricity schemes and energy from waste combustion and landfill gas, subject to an assessment of their impact using criteria-based policies.

".... local development documents should contain policies designed to promote and encourage, rather than restrict, the development of renewable energy resources..."

Planning for Renewable Energy: A Companion Guide to PPS22 (2004)

- 8.23 The Planning for renewable energy companion guide, published on the 19th December 2004, provides practical advice on the best ways to implement renewable energy provisions through LDDs. Key guidance provided includes the identification of broad geographical areas suitable for renewable energy developments; building design and layout; detailed amenity issues; use of renewable in local authority property and through procurement, and guidance on how locally distinctive renewable energy policies should be included in LDDs. The companion guide also presents best practice examples to help inform local policy development.

Emerging National Planning Policy Framework (NPPF)

8.24 The draft National Planning Policy Framework (NPPF) was published in July 2011 for consultation. The NPPF sets out the Government's requirements for:

"...the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities."

8.25 One of the Government's key objectives is to ensure that planning fully supports the transition to a low carbon economy in a changing climate. To achieve this objective, the planning system should aim to:

"secure, consistent with the Government's published objectives, radical reductions in greenhouse gas emissions, through the appropriate location and layout of new development, and active support for energy efficiency improvements to existing buildings and the delivery of renewable and low-carbon energy infrastructure..."

8.26 Local planning authorities should adopt proactive strategies to mitigate and adapt to climate change. In order to support the delivery of renewable low carbon technologies, Local Authorities should:

- Plan for new development in locations and ways which reduce greenhouse gas emissions;
- When setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards;
- Increase the use and supply of renewable and low-carbon energy by recognising the responsibility on all communities to contribute to energy generation from renewable or low-carbon sources;
- •Have a positive strategy to promote energy from renewable and low-carbon sources, including deep geothermal energy;
- Design their policies to maximise renewable and low-carbon energy development while ensuring that adverse impacts are addressed satisfactorily;

- Consider identifying suitable areas for renewable and low-carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources;
- Support community-led initiatives for renewable and low carbon energy, including developments outside such areas being taken forward through neighbourhood planning; and
- Identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

8.27 Although the NPPF is still emerging it does clearly illustrate the ‘direction of travel’. There is a strong commitment to increasing the supply of renewable and low carbon energy as well as a renewed dedication to community –led initiatives. It also encourages Local Authorities to promote suitable areas for renewable energy technologies which could, for example, be set out in an ‘energy opportunities plan’.

National Building Regulations

8.28 Building Regulations set standards for design and construction which apply to most new buildings and many alterations to existing buildings in England and Wales. These standards have an important role to play in improving energy efficiency and reduce CO₂ emissions in the UK.

8.29 Of particular relevance is the introduction of a minimum standard for fabric energy efficiency based on that set out in the recent consultation on the Code for Sustainable Homes. This is due to be taken forward in Part L of the building regulations.

Local Policy

8.30 Rotherham MBC’s Local Development Framework (LDF) has the critical role in ensuring future development is delivered in a sustainable manner. The Council’s Core Strategy is the primary document within the LDF, setting out a long-term vision for a stated period of 15 years, as well as spatial objectives and strategic planning policies to guide development in accordance with the strategic vision and objectives.

Policy CS 27

Renewable Energy Generation

Include renewable energy in developments

All significant developments will be required, unless this can be shown not to be feasible or viable, to

- a. provide a minimum of 10% of their predicted energy needs on-site; and
- b. generate further renewable or low carbon energy, or incorporate appropriate design measures, to reduce the development's overall predicted carbon dioxide emissions by 20% [including the requirements to satisfy (a)]

Where it is not appropriate to incorporate such provisions within the development, an off site scheme, or contribution to such may be acceptable.

Developments that produce renewable energy

We will encourage development that produces renewable energy as long as there are no significant harmful effects on:

- a. Residents living conditions and quality of life
- b. The character and appearance of the landscape / surrounding area
- c. Biodiversity, geodiversity and water quality
- d. Historical and archaeological features
- e. Highway safety and infrastructure

Any proposals will be accompanied by supporting information to clearly show how the surrounding environment will be protected and how site restoration will be carried out when production ends.

- 8.31 Draft policy CS27, as it currently stands, is in line with national guidance, primarily laid out in PS22: Renewable energy. Although this type of policy is adequate the evidence set out in this study suggests that Rotherham MBC could improve its local distinctiveness by incorporating specific technologies identified in the Energy Opportunities Plan and targets.
- 8.32 This report now sets out an evidence base from which to prepare and promote in the way that the Inspector accepted in the City of Stoke-on-Trent and Newcastle Borough LDF process, where Wardell Armstrong advised on local evidence, the development market, draft policy and what was accepted overall as a 'clear local dimension' in promoting specific opportunities for energy development.

Best Practice Examples and how they Relate to Rotherham

8.33 There are various examples of innovative Planning Policy which encourage the use of renewable energy in locally distinctive ways. The London Borough of Merton created the so-called 'Merton Rule' (see below) and has informed Local Authority renewable energy policy nationwide. The following best practice examples have been taken from a range of urban and rural Local Authorities to provide a broad basis for policy development.

London Borough of Merton

8.34 Integrated renewable energy policy (non-residential development) London Borough of Merton UDP (2003):

Policy E.11: Environmental Improvements from Employment Development

"To achieve environmental benefits, employment developments will be expected to be of high quality and layout. All new industrial, warehousing, office and live/work units outside Conservation Areas and above a threshold of 1,000sqm will be expected to incorporate renewable energy production equipment to provide at least 10% of predicted energy requirements..."

"...By expecting the installation of renewable power generation equipment in larger developments, it is ... anticipated that the Council will be helping to generate sufficient levels of demand to enable manufacturers of appropriate renewable energy equipment to exploit economies of scale in the production of such equipment..." (UDP paragraph 3.132)

Stockport Metropolitan Borough

8.35 The Stockport Core Strategy, March 2011 provides comprehensive yet accessible renewable and low carbon Policies. The DPD establishes a clear framework around which renewable energy technologies can be introduced, justifies why and how policies will be implemented and also how outcomes will be measured.

- 8.36 Policy CS1 – *Overarching Principles: Sustainable development – addressing inequalities*, seeks to tackle issues of social, economic and environmental inequalities in coordination with addressing issues of climate change.
- 8.37 Development Management Policy SD-3 establishes how the strategic aims of policy CS1 will be delivered in new developments. Stockport MBC recognises that different energy technologies and CO₂ reduction strategies will suit different parts of the Borough and different types of development. To reflect this the Council have established varying opportunities in their ‘Energy Opportunities Plan’.
- 8.38 The ‘**Energy Opportunities Plan**’ which identifies areas of potential Biomass production, Biocrop growth, medium to large wind energy and district heating within the Borough. A resource like the ‘**Energy Opportunities Plan**’ could potentially be of great benefit to Rotherham in preparation of its Local Development Documents and could inform the production of effective, evidence based, local policy. Recommendations for policy creation are explored in greater depth later in the statement.

London Borough of Southwark

- 8.39 The London Borough of Southwark recently received a commendation in recognition of the quality of its Sustainable Design and Construction SPD from the RTPI. The SPD was widely consulted on for over a year before being adopted by the Council’s Executive and cross-departmental working was vital to its production. Technical knowledge and expertise was needed to understand the issues and find solutions, for example devising templates so that developers provide technical information in a consistent format, helping development management staff to analyse it. The SPD covers the whole range of issues involved in sustainable design and construction, including liveability of housing, the energy hierarchy, adapting to climate change, renewable energy and considerate construction. Minimum standards are required for major developments of more than 10 residential units or 1000sqm of floorspace and developments are also required to connect area wide combined heat and power/combined cooling heat and power (CHP/CCHP) systems where these exist or are being developed.

Bristol City Council

- 8.40 Core Strategy Policy BCS14 sets out the strategic aims of Bristol City Council in relation to renewable energy generation. It establishes the notion that development should be in accordance with the energy hierarchy and is expected to provide sufficient renewable energy generation to reduce carbon dioxide emissions from residual energy use in the buildings by at least 20%.

“Policy BCS14

Proposals for the utilisation, distribution and development of renewable and low carbon sources of energy, including large-scale freestanding installations, will be encouraged. In assessing such proposals the environmental and economic benefits of the proposed development will be afforded significant weight, alongside considerations of public health and safety and impacts on biodiversity, landscape character, the historic environment and the residential amenity of the surrounding area.

Development in Bristol should include measures to reduce carbon dioxide emissions from energy use in accordance with the following energy hierarchy:

- 1. Minimising energy requirements;*
- 2. Incorporating renewable energy sources;*
- 3. Incorporating low-carbon energy sources.*

Consistent with stage two of the above energy hierarchy, development will be expected to provide sufficient renewable energy generation to reduce carbon dioxide emissions from residual energy use in the buildings by at least 20%. An exception will only be made in the case where a development is appropriate and necessary but where it is demonstrated that meeting the required standard would not be feasible or viable.”

- 8.41 There are various other examples of best practice provided by Local Authorities such as Kirklees District Council, Leicester City Council and Woking District Council which may also be useful in successful policy development.

Renewable and Low Carbon Energy Targets

8.42 At this stage of the Core Strategy process Rotherham should aim to achieve minimal targets for renewable energy provision and reduction in CO₂ emissions in line with the following 'best practice' targets.

Energy Hierarchy

8.43 Designing and constructing developments in accordance with the energy hierarchy, set out below, will reduce CO₂ emissions associated with new development and ensure that the most appropriate constructions methods and technologies are implemented:

- Energy Efficiency (Sustainable Construction)
- Renewable Energy Generation
- Low Carbon Energy Generation

Code for Sustainable Homes (CfSH)/BREEAM

8.44 Implementing BREEAM/CfSH regulations will improve the sustainability of all new developments which in the long term will reduce CO₂ emissions, save energy and ultimately save the occupant(s) money. The implementation of high quality design features will not extensively impact developer expenditure and will increasingly make new developments more attractive to potential buyers.

8.45 All new residential developments should adhere to code 3 of the CfSH which requires 25% improvements over the Target Emission Rate (TER) in accordance with Circular 02/2010: The Building Act 1984, The Building Regulations 2000: Amendments relating to Approved Documents B and L 2006 Editions.

Renewable Energy

8.46 Rotherham MBC should aim to reflect 'Best Practice' policy examples provided in the companion guide to PPS22 and also carbon compliance recommendations provided by Zero Carbon Hub.

- 8.47 The Council should encourage an overall borough wide renewable energy target of **10% of predicted energy use within the whole Borough from 2012 plus a notional 1% uplift per annum up to 2020.**
- 8.48 Renewable energy policy should also be individually tailored to non-residential and residential developments.
- 8.49 The Council could encourage the incorporation of renewable energy in residential developments by requiring proposals to meet the following carbon compliance levels (shown in **Error! Reference source not found.**), pre-empting their possible introduction in future building regulations:
- From 2012 – **All dwellings** to achieve **20 kgCO₂/m²/yr**
 - From 2013 – **All dwellings** to achieve **14 kgCO₂/m²/yr**
 - From 2016 –
 - Detached houses to achieve 10 kgCO₂/m²/yr
 - Attached houses to achieve 11 kgCO₂/m²/yr
 - Low rise apartment blocks to achieve 14 kgCO₂/m²/yr
- 8.50 Carbon compliance levels should be achieved by the development as a whole and may be offset by allowable solutions. The developer may make a payment to an allowable solutions provider, who will take the responsibility and liability for ensuring that allowable solutions, which may be small, medium or large scale carbon-saving projects, deliver the required emissions reductions.
- 8.51 In terms of non-residential development, the Council could encourage the incorporation of renewable energy by requiring proposals for non-residential developments exceeding **1,000** square metres gross floor space, to incorporate renewable energy production equipment to off-set at least **10% of predicted carbon emissions plus a notional 1% uplift per annum** (as shown in Table 7.2), in accordance with Borough targets, except where:
- i) The technology would be inappropriate;

- ii) It would have an adverse visual or amenity impact that would clearly outweigh the benefits of the technology; and
- iii) Renewable energy cannot be incorporated to achieve the full target.

8.52 The Council could also encourage the incorporation of renewable energy by requiring proposals for non-residential developments to generate further renewable or low carbon energy, or incorporate appropriate design measures, to reduce the development's overall predicted carbon dioxide emissions by 20% [including requirements to satisfy 8.51 above].

8.53 Where the full requirement cannot be achieved on major / strategic developments, a planning obligation could be sought to secure savings through the implementation of other 'offsite' local renewable energy schemes. These targets could be readjusted incrementally to take account of success levels and renewable technology developments.

8.54 Wardell Armstrong broadly supports the form of draft Policy CS27 and this report will form a stronger evidence base than the AECOM draft report 'Low carbon and renewable energy capacity in Yorkshire and Humber'. However, it is considered that the policy could be further improved by seeking consistency with the energy hierarchy and by encouraging development to incorporate specific suitable technologies identified as energy opportunities to provide sufficient renewable energy generation to offset 10% plus 1% uplift per annum of predicted energy requirements and where appropriate achieve carbon compliance targets. The draft Core Strategy Policy below sets out the strategic targets discussed above.

Core Strategy Policy – Low Carbon and Renewable Energy Generation

Developments that generate renewable and low carbon energy

Proposals for the development of renewable and low carbon sources of energy, particularly from community-owned projects, will be encouraged provided that there are no unacceptable adverse effects on:

- a) Residential living conditions, amenity and quality of life;
- b) Character and appearance of the landscape and surrounding area;
- c) Biodiversity, geodiversity and water quality;
- d) Historical, archaeological and cultural heritage assets;
- e) Highway safety and infrastructure.

Any proposals will be accompanied by supporting information to clearly show how the surrounding environment will be protected and how site restoration will be carried out when production ends.

Energy Hierarchy

Developments should seek to reduce carbon dioxide emissions through the inclusion of mitigation measures in accordance with the following energy hierarchy:

1. Minimising energy requirements through sustainable design and construction;
2. Incorporating renewable energy sources;
3. Using low-carbon energy sources.

Overall Borough Wide Targets

Renewable energy sources should provide 10% of predicted energy use within the whole Borough from 2012 plus a notional 1% uplift per annum up to 2020.

Residential Carbon Compliance Level

All residential developments will be required, unless this can be shown not to be feasible or viable, to achieve the following carbon compliance targets:

- a) From 2011 – All dwellings to achieve at least 20 kgCO₂/m²/yr
- b) From 2013 - All dwellings to achieve at least 14 kgCO₂/m²/yr

- c) From 2016 - Detached houses to achieve at least 10 kgCO₂/m²/yr
- Attached houses to achieve at least 11 kgCO₂/m²/yr
 - Low rise apartment blocks to achieve at least 14 kgCO₂/m²/yr

Carbon compliance levels are applicable to the development as a whole and may be offset by allowable solutions. The developer may make a payment to an allowable solutions provider, who will take the responsibility and liability for ensuring that allowable solutions, which may be small, medium or large scale carbon-saving projects, deliver the required emissions reductions.

Non-Residential

All significant non-residential developments of more than 1000m² will be required, unless this can be shown not to be feasible or viable, to:

- a) provide a minimum of 10% plus 1% uplift per annum of their predicted energy needs on-site from renewable energy sources, in accordance with Table 7.2; and
- b) generate further renewable or low carbon energy, or incorporate appropriate design measures, to reduce the development's overall predicted carbon dioxide emissions by 20% [including requirements to satisfy (a)]

Where it is not appropriate to incorporate such provisions within the development, an off-site scheme, or contribution to such may be acceptable.

8.55 The following section sets out a number of proposed policies and supporting justification.

Renewable and Low Carbon Energy Policy Proposals

Spatial Distribution of Renewable Energy

8.56 Due to the particular nature of the Rotherham Borough area development tends to be 'Zoned' in a quite distinctive way between industrial, commercial and residential uses with little integrated or 'mixed use' development. Therefore a bespoke

approach is required to promote a balanced mix of renewable energy techniques in a variety of locations. The Rotherham LDF is quite clear and distinctive in that it promotes strategic development in key locations, for example Bassingthorpe Farm, and is in a position to be ambitious with its renewable energy targets and exhibit a forward looking approach. The key principle is in development and redevelopment to promote mixed use and complementarity e.g. heat sharing potential between development types.

8.57 To promote renewables in a meaningful manner it is appropriate to draw from the economic modelling work, particularly the following assumptions from the draft LDF Core Strategy (June 2011).

- Development will be achieved at a predicted rate of 850 homes and 16 hectares of employment land per annum, split equally against the different dwelling/building types.
- Bassingthorpe Farm – assuming 2400 homes and 11 hectares of employment land, again split equally against the potential different dwelling and building types. Master Planning is understood to be being discussed.
- Dinnington – assuming 700 dwellings, split equally amongst the potential different dwelling and building types.
- Waverley – working to the current Energy Strategy approved in principle under outline permission and subject to detailed condition discharge / approval of reserved matters: 2500 homes (within LDF Core Strategy Plan Period) equally split – and 2ha of employment land, where specific target figures have been employed.

8.58 The Current Capacity and Potential renewable resource in Rotherham work draws the following broad conclusions:

- By far the largest potential for delivery lies with large scale and particularly medium scale wind. In essence, they offer over half the potential resource across all technologies. Medium scale wind in particular can easily become part of operational life and integrated satisfactorily in to most farms, warehouse and mixed business sites including commercial operations like office parks and supermarkets, even schools.

- Solar PV and Thermal can also offer substantial opportunity, but tend to be linked to the incentive element which tends to introduce constraints in terms of the timing of applications. Existing stock retro-fit tends to be somewhat at the behest of Governmental intervention, but should be offered serious consideration, in particular any district heating opportunities.
 - Many other technologies are very much Renewable Heat Incentive (RHI) dependent.
 - Landscape sensitivity is a major consideration (see paragraph 3.61) and an appropriate promotive policy based on local designations and knowledge could ensure security of delivery.
 - Wardell Armstrong's advice is that pioneering policy drives more effective delivery, whereas pragmatic policy simply harnesses delivery. Bespoke targets above CS27 LDF Policy should become the norm as that policy is a minimum.
 - Policy needs to promote at a local level as well as national guidance, the value of renewable energy developments integrated within development and the need to consider then undertake energy audits at the outset and form an integral part of processes like masterplanning.
- 8.59 The Renewables EAT described in Chapter 4 has been produced to guide and assist the setting of appropriate policies and targets and are designed for application to projects. This can take policy and target setting to the heart of delivery process.
- 8.60 The Borough also has the potential to have levels of community/co-operative owned energy which could generate levels of additional revenue/ employment to boost the local economy.
- 8.61 It is important to ensure that the distinctive character of the Borough is maintained and where possible enhanced. Renewable energy technologies must not harm the fabric of the green or built environments. An example of this provided by the cultivation of Miscanthus, or maize, energy crops for biofuel which have the potential to produce large volumes of low carbon energy, however this must be balanced against supporting the production of agricultural crops and maintaining land for grazing.

Overview of Technologies

Large Scale Wind Energy

8.62 Rotherham with its relatively diverse geographical range has the potential to harness good levels of wind energy. Levels of practically accessible wind resources is 98 GWh/yr and equates to approximately 15 2MW turbines after unsuitable areas for large wind farm development have been identified and ruled out. This is significantly less than the potential identified by AECOM (69MW) for the reasons explained in Chapter 3 although some of this may now be manifesting itself as medium scale wind. With some 26MW already installed, this potentially makes large scale wind energy a good but limited short to medium term priority in relation to planning policy as the technology is already proven and it can be implemented readily. However, the impact that large wind turbines can have on visual amenity must be acknowledged in robust Planning Policy to prevent inappropriate development.

Medium Scale Wind Energy

8.63 The level of practically accessible wind resources is 219 GWh/yr and equates to approximately 4133 500kW turbines after unsuitable areas for large wind farm development have been identified and ruled out. This makes medium scale wind energy a very high priority in the short, medium and long term in relation to planning policy as the technology is already proven; it is a good vehicle for community owned energy as it has good fiscal returns, and it can be implemented readily. Again, but to a lesser extent, the impact that wind turbines can have on visual amenity must be acknowledged in Planning Policy to prevent inappropriate development.

Small Scale Wind Energy

8.64 The level of practically accessible small scale wind resources is 1000 MWh/yr as identified in the AECOM report. There may be some opportunities for small scale residential wind turbines which are likely under new relaxations to constitute permitted development but also may require the relaxation of GPDO through specific Area Action Plans (AAP) or a Supplementary Planning Document (SPD) as

appropriate. Small scale wind energy should be a high priority in the short, medium and long term in relation to planning policy as the technology is already proven; Feed in Tariffs offer reasonable returns, and can be implemented readily. However, small scale wind energy is not always appropriate, especially in built up urban areas and can impact upon visual amenity in conservation areas. Equally, they deliver a very small potential resource in quantum terms compared to the large and medium scale wind proposition.

WIND PLANNING POLICY OPTIONS

Planning Policy Option 1: Pioneering

Encourage large, medium and small scale wind farms in **Wind Priority Areas** which have been identified through locally distinctive, ward level and evidence based Area Action Plans or a Borough wide SPD which cross references environmental sensitivities and offers a promotive role in clearly setting out appropriate locations for wind at relevant scales, involving local communities. Promote community/ co-operative owned wind farms/turbines and maximise Council owned assets to harness wind energy.

Planning Policy Option 2: Pragmatic

Encourage wind energy as a means of achieving renewable energy targets. Development will be decided on a case by case basis with strong emphasis on community involvement.

Hydro

8.65 The AECOM study identified 1 GWh/yr of potential resource from hydro power. The total installed capacity available was estimated at 1MW and there is currently planning permission for an 80kW hydro plant at the Jordan dam on the Rotherham/Sheffield border. This makes hydro schemes a medium priority in the short, medium and long term in relation to planning policy as the technology is already proven; it is a good vehicle for community owned energy, and it can be implemented readily. However, it is important to note that further feasibility studies are required to determine environmental sensitivity issues. The impact on river based ecosystems must be comprehensively researched to prevent any species decline or loss, however it is clear that hydro-electric energy has the potential to contribute to a low level within the renewable portfolio.

HYDRO PLANNING POLICY OPTIONS

Planning Policy Option 1: Pioneering

Encourage hydro schemes in **Hydro Priority Areas** through locally distinctive, ward level and evidence based Area Action Plans or a Borough wide SPD, involving local communities. Promote community/co-operative owned hydro schemes and maximise Council owned assets to harness hydro energy.

Planning Policy Option 2: Pragmatic

Encourage hydro energy as a means of achieving renewable energy targets. Development will be decided on a case by case basis with strong emphasis on community involvement.

Biomass

Wood Fuel/ Waste Wood

8.66 There are currently 2,380ha of woodland opportunity in the locality of Rotherham. This could provide some 4,761odt/ yr of wood fuel if utilised as a biomass resource and is equivalent to 17 GWh/ yr. It will not be practicable to utilise the entire woodland coverage. However, there is potential for forest residues to become a significant resource as part of an integrated biomass heating programme. This should have high priority in the medium to long term and subject of further assessment of resource.

Energy Crops

8.67 Two types of energy crops have been considered Miscanthus and Short Rotation Coppice (SRC). Approximately 15,883ha within Rotherham would be suitable for growing Miscanthus which would potentially yield 295,112 odt/yr. An additional 157 ha would be suitable for growing SRC yielding 1,718 odt/yr. However, a practical yield for both crops is approximately 10% of this as the majority of this land will be used for agricultural output. There is potential that energy crops can become a significant resource as part of an integrated biomass energy programme. This should have high priority in the medium to long term. However, a balance must be achieved between the cultivation of crops for energy and cultivation of crops for food/ livestock due to the importance of agricultural output.

8.68 *Agricultural arisings.* Rotherham may well be well placed to utilise domestic, agricultural and forestry waste for small scale AD plants and biomass units. However, the use of biomass CHP in urban developments is not considered viable given the enormous volume of material required for a CHP plant and one already being developed in Doncaster. There may be opportunities for small scale on-farm development, however, because of the limited resource available, this should have low priority in the medium to long term.

8.69 The woody biomass energy sources all have significant potential to become a significant resource as part of integrated biomass energy and recycling programmes. Biomass using the following fuel types should have high priority in the medium to long term.

BIOMASS PLANNING POLICY OPTIONS

Planning Policy Option 1: Pioneering

Encourage investment in energy supply infrastructure which enables increased use of biomass. Develop an **Integrated Biomass Plan** which will create a framework of biomass options for use in Rotherham but also for export. Promote co-operative owned biomass facilities capable of meeting local energy demands, especially in rural locations.

Planning Policy Option 2: Pragmatic

Encourage biomass facilities as a means of achieving renewable energy targets. Development will be decided on a case by case basis with strong emphasis on community involvement.

Solar Energy

8.70 With the introduction of FITs, solar energy has the capacity to generate reasonable yields with relatively high return rates on investment – subject to changing Governmental consideration. This technology could be encouraged on significant new developments and industrial units throughout the Borough and will make a reasonable contribution to the Council's renewable target. Consideration would need to be made to visual amenity of solar panels, especially in conservation areas. The AECOM study suggested solar power has the potential to generate 12,000 MWh/yr. This technology should have a high priority in the short, medium and long term.

SOLAR PLANNING POLICY OPTIONS

Planning Policy Options 1: Pioneering

Promote appropriate buildings to install photovoltaics on significant roof space. Retrofit Council buildings to harness solar energy and reduce consumption of mains energy or alternatively rent roof space to co-operatives/ communities interested in installing solar photovoltaic's where the technology is not appropriate.

Planning Policy Option 2: Pragmatic

Encourage solar energy as a means of achieving renewable energy targets. Development will be decided on a case by case basis with strong emphasis on community involvement.

Combined Heat and Power (District Heating)

8.71 CHP requires certain levels of density to be cost effective. The residential growth points as identified in Rotherham would appear to have some scope for CHP. For CHP to succeed in the Borough, a mixed use strategy is advised. By incorporating commercial and high energy use developments in sub critical mass new residential and mixed use developments like Bassingthorpe Farm it may be possible to develop a feasible CHP district heating network. An alternative option is provided by the development of new CHP powered Eco-parks on a commercial scale, something which may warrant consideration for the long term. This assessment suggests that CHP should have low priority to begin with then increase to high priority in the medium to long term. In the long term this technology may be able to utilise the emerging biofuel/ biomass resources being developed to create more sustainable heating networks.

CHP PLANNING POLICY OPTIONS

Planning Policy Options 1: Pioneering

Develop a long term strategy to implement an extensive CHP district heating network in tier 1 (strategic) and 2 (large) settlements which uses locally produced biomass/ biofuels developed through the Integrated Biomass Plan. Encourage the development of biomass powered CHP plants in areas with higher population densities or higher heating demands such as hospitals and schools.

Planning Policy Option 2: Pragmatic

Encourage all new developments to incorporate infrastructure that could connect to any existing or future planned CHP district heating networks.

Heat Pumps

8.72 Heat Pumps have the potential to be implemented in all new residential buildings at a relatively low cost to the developer. AECOM identified the potential energy to be gained from ground source heat pumps in existing and new domestic building as 11,000MWh/yr and 15,000MWh/yr from air source heat pumps. This combined figure of 26,000 MWh/yr would significantly contribute to reducing CO₂ emissions. This technology is not location dependant however, it may not be as economically viable in existing buildings or established settlements as groundwork will be required for ground source heat pumps. Heat pumps should be high priority in the medium to long term.

GROUND SOURCE / AIR SOURCE HEAT PUMP PLANNING POLICY OPTIONS

Planning Policy Options 1: Pioneering

Ground (and air) Source Heat Pumps should be encouraged as appropriate in new development to offset energy consumption. The Council could also introduce a fiscal scheme to retrofit existing buildings with ground source technology as payback would eventually outweigh initial investment.

Planning Policy Option 2: Pragmatic

Encourage heat pumps as a means of achieving renewable energy targets. Development will be decided on a case by case basis.

Permitted Development Rights

8.73 Rotherham MBC could consider offering an increased relaxation of domestic or commercial Permitted Development rights in relation to renewable energy in areas of development to encourage their uptake. Central Government relaxed General Permitted Development Orders in relation to renewable energy technologies in 2008 and in September 2011. Nevertheless additional flexibility could be introduced

at a local level through a bespoke Local Development Order for strategic developments to promote renewable energy.

Policy Recommendations

8.74 The policy options provided in this report are based on the assumption that current Government energy schemes remain in place namely ROCs, FITs and the RHI, with the understanding that these are reviewed and changed by Government. The following policy options are based on current planning policy as it stands at the time of writing.

8.75 The production of 'sound' and 'locally distinctive' policies must be 'justifiable'; therefore founded on a robust and credible evidence base and be the most appropriate strategy when considered against reasonable alternatives, and also 'effective' meaning that they are deliverable, flexible and able to be monitored.

8.76 Key recommendations are as follows:

- Develop an energy opportunities plan in accordance with PPS22: Companion guide to identify key areas of renewable energy supply and also communities/co-operatives who could be interested in developing community owned energy.
- Develop cross cutting renewable energy policies/themes which empower rural communities to harness the diverse mix of renewables open to them.
- Promote Master Planning of strategic developments linked to energy audits, opportunities plans and energy delivery plans.
- Ensure appropriate delivery by employing a criteria based approach, to include appropriate criteria such as impact and environmental safeguards.

'Model' Policies

8.77 The following 'Model' Policies are in accordance with national policy guidance on Local Spatial Planning, Sustainability and Renewable Energy. The following policies are based on robust evidence from a range of quantitative and qualitative sources and are locally distinctive to the Borough of Rotherham.

Core Strategy Policy – Low Carbon and Renewable Energy Generation

Developments that generate renewable and low carbon energy

Proposals for the development of renewable and low carbon sources of energy, particularly from community-owned projects, will be encouraged provided that there are no unacceptable adverse effects on:

- a) Residential living conditions, amenity and quality of life;
- b) Character and appearance of the landscape and surrounding area;
- c) Biodiversity, geodiversity and water quality;
- d) Historical, archaeological and cultural heritage assets;
- e) Highway safety and infrastructure.

Any proposals will be accompanied by supporting information to clearly show how the surrounding environment will be protected and how site restoration will be carried out when production ends.

Energy Hierarchy

Developments should seek to reduce carbon dioxide emissions through the inclusion of mitigation measures in accordance with the following energy hierarchy:

1. Minimising energy requirements through sustainable design and construction;
2. Incorporating renewable energy sources;
3. Using low-carbon energy sources.

Overall Borough Wide Targets

Renewable energy sources should provide 10% of predicted energy use within the whole Borough from 2012 plus a notional 1% uplift per annum up to 2020.

Residential Carbon Compliance Level

All residential developments will be required, unless this can be shown not to be feasible or viable, to achieve the following carbon compliance targets:

- a) From 2011 – All dwellings to achieve at least 20 kgCO₂/m²/yr

- b) From 2013 - All dwellings to achieve at least 14 kgCO₂/m²/yr
- c) From 2016 - Detached houses to achieve at least 10 kgCO₂/m²/yr
 - Attached houses to achieve at least 11 kgCO₂/m²/yr
 - Low rise apartment blocks to achieve at least 14 kgCO₂/m²/yr

Carbon compliance levels are applicable to the development as a whole and may be offset by allowable solutions. The developer may make a payment to an allowable solutions provider, who will take the responsibility and liability for ensuring that allowable solutions, which may be small, medium or large scale carbon-saving projects, deliver the required emissions reductions.

Non-Residential

All significant non-residential developments of more than 1000m² will be required, unless this can be shown not to be feasible or viable, to:

- a) provide a minimum of 10% plus 1% uplift per annum of their predicted energy needs on-site from renewable energy sources, in accordance with Table 7.2; and
- b) generate further renewable or low carbon energy, or incorporate appropriate design measures, to reduce the development's overall predicted carbon dioxide emissions by 20% [including requirements to satisfy (a)]

Where it is not appropriate to incorporate such provisions within the development, an off-site scheme, or contribution to such may be acceptable.

Development Management Policy – Medium Scale Wind

Medium Scale wind energy (based on 500kW turbines under the Feed in Tariff) has been identified in the renewable energy report as a significant potential source of renewable energy in Rotherham Borough.

Criteria Based Approach

Opportunities for medium scale wind opportunities have been identified. To achieve deliverability a criteria based approach is required to assess and give favourable context to development proposals.

Medium Scale Wind projects should be encouraged provided that there are no unacceptable adverse effects on:

- a) Residential amenity and quality of life;
- b) Character and appearance of the landscape and surrounding area;
- c) Biodiversity, geodiversity and water quality;
- d) Historical, archaeological and cultural heritage assets;
- e) Highway safety and infrastructure.

Community Led Projects

Community owned energy generation, including medium scale wind, has an important role to play in reducing CO₂ emissions and increasing total installed renewable and low carbon energy capacity. Proposals from standalone or 'onsite' community-led medium scale wind projects will be viewed favourably provided the above factors are suitably addressed.

Development Management Policy – Building Integrated Renewable and Low Carbon Technologies

There is significant potential in Rotherham Metropolitan Borough to exploit building integrated renewable and low carbon energy technologies. The council encourages the installation of the following suitable technologies on new and existing developments in order to off-set CO₂ emissions and mitigate the impacts of climate change.

Feasibility

As identified in the renewable energy report the following installed technologies would be suitable for deployment in Rotherham Borough:

Solar Thermal;

Solar Photovoltaic;

Biomass Boilers;

Ground Source Heat Pump; and

Roof mounted wind turbines

In all cases where development of listed buildings, development within conservation areas, or development involving other heritage assets, particular regard should be given to visual impact.

Policy Justification

8.78 Renewable energy generation technologies offer an effective means of mitigating climate change. The main sources of renewable energy are wind, solar, moving water, and heat extracted from the air, ground or water. These are all sources that are continuously replenished by nature. The Climate Change Act has committed the government to reducing gas emissions by at least 80% by 2050, and reducing CO₂ emissions by at least 26% by 2020, set against a 1990 baseline.

8.79 The Rotherham renewable and low carbon energy study prepared by Wardell Armstrong provides a resource assessment for various technologies in Rotherham and provides the evidence base to inform the production of this policy. The low carbon and renewable energy technologies that have been considered in the study included:

- Wind (medium and large scale);
- Solar;
- Hydro-energy;
- Biomass (forest residues and energy crops);
- District Heating and Combined Heat and Power; and
- Ground Source Heat Pumps/ Air Source Heat Pumps

8.80 The suggested carbon emission target reduction on new non-residential developments of 20% is to be partly achieved by a 10% renewable energy generation, which reflects national policy and the Regional Strategy (RS). However, given the capacity of the Borough to produce significant levels of large and medium scale wind it is considered that a target of 10% plus 1% uplift per annum would be achievable and illustrates a commitment to mitigating CO₂ emissions.

8.81 The suggested carbon compliance levels for new residential developments reflect a shift in targets from proportion of energy used on site to CO₂ reductions that can be achieved. The carbon compliance targets are progressive and preempt anticipated amendments to building regulations. This approach provides flexibility in the approach used by the developer to meet targets whilst also creating a clear framework by which CO₂ emissions can be reduced.

8.82 Increased development of renewable energy resources is vital to facilitating the delivery of international and national commitments on both greenhouse gas emissions and renewable energy. It will also assist in greater diversity and security of energy supply. Renewable energy can also deliver substantial economic, social and environmental benefits at the local and regional level, by creating jobs, through the manufacture, installation, operation and maintenance of renewable energy as well as providing a new impetus for rural diversification and regeneration. The council

will therefore support renewable energy proposals unless they would have unacceptable adverse effects which are not outweighed by the local and wider environmental, economic and social benefits of the development. This includes wider benefits arising from a clean, secure energy supply; reductions in greenhouse gases and other polluting emissions; and contributions towards meeting Rotherham's target for use of renewable energy sources.

- 8.83 The RSS has set targets for renewable energy generation for individual local authorities in Yorkshire and the Humber. The target for Rotherham, and these are minimum targets, are 11MW by 2010 and 36MW by 2021. These figures refer to "installed grid-connected capacity" and not actual energy generation since that would be impossible to monitor with any accuracy. This policy is intended to apply to all renewable energy technologies. Such technologies can be used at different scales ranging from those which contribute to the national grid, to micro-generation schemes which serve one property. Renewable resources can be used to supply Combined Heat and Power Schemes (CHP) to serve groups of properties, existing or new, including housing schemes.
- 8.84 These policies also recognise that different character areas and development types will have different opportunities for achieving CO₂ reductions. Where strategic renewable energy opportunities are identified that might be brought about by development they will be detailed as far as possible in separate Allocations DPD.
- 8.85 Consideration may be given to achieving additional flexibility by the introduction at a local level, of bespoke Local Development Order(s) for strategic developments to promote renewable and low carbon energy.
- 8.86 Rotherham has a landscape with abundant natural resources, which clearly lend themselves toward wind and solar opportunities. These resources provide an excellent opportunity to deploy a good range of Renewable and Low Carbon Energy Technologies to deliver significant outputs.
- 8.87 The Borough of Rotherham is set to see significant growth promoted by an LDF policy framework. The implementation of carefully thought out policies will enable Rotherham to utilise its natural resources in the most effective and sustainable

manner, and can be achieved through maximisation of opportunity on strategic site proposals.

- 8.88 This Evidence Base Study has shown where the technical resource exists and provides guidance as to how best to develop supporting LDF policies for the deployment of Renewable and Low Carbon Energy Technologies. Rotherham MBC is therefore in a much more knowledgeable position about how to make use of these technologies to meet or potentially exceed their energy obligations and targets.
- 8.89 This is based on the potential resource and deployment strategy for the range of Renewable and Low Carbon Energy Technologies.

9 CONCLUSIONS

- 9.1 On the basis of the heat modelling conducted for this analysis total residential heat demand in RMB is estimated to be 1,788GWh/yr, commercial demand is expected to be 488GWh/yr and industrial demand is expected to be 284GWh/yr. Total aggregated heat demand within the Borough is expected to be 2,560GWh/yr.
- 9.2 As a result of the modelling of the total electrical demand in residential properties in RMB is estimated to be around 416GWh/yr. Commercial demand is estimated at 304GWh/yr and industrial demand at 68GWh/yr. Total overall electrical demand has been modelled to be 788GWh/yr.
- 9.3 The revised evidence base found 13 sites that would be suitable for large scale wind development and 101 sites that would be suitable for medium scale wind development. It should be noted that whilst technical and environmental constraints have been considered in this study further constraints to development may arise for specific projects in these areas. These may include aviation constraints, access limitations, landscape and visual impact objections etc.
- 9.4 The biomass resource was also included in the revised evidence base and identifies large areas that would be suited to growing energy crops (Miscanthus or Short Rotation Coppice) or contain existing forestry residues. It would not be practical to turn all this land over to energy crops however the resource assessment helps to identify suitable land where this could be developed.
- 9.5 The report identified that biomass resource in Rotherham could meet 6% of borough's electricity needs through biomass CHP. To increase this additional biomass resource will need to be imported from outside the Rotherham boundary.
- 9.6 The existing district heating networks dataset obtained from AECOM identifies 16 district heating installations in RMB. These installations are of various sizes and are scattered across the Borough near urban areas.
- 9.7 In addition to this, the heat mapping exercise has identified several high density heat loads that are potentially exploitable for retrofitting district heating/CHP schemes.

Although from high level observation these sites appear to have some potential, it is important that detailed investigation and financial analysis be completed on each site to ascertain its true viability as this work has not been done.

9.8 Some potential candidate sites include:

- Wath Upon Dearne – area around Beech Road, Avenue Road and Sandymount Road.
- Holmes, Rotherham – area around Hartington Road, Cavendish Road, Josephine Road and Belmont Street
- St Ann’s, Rotherham - RMBC Leisure Centre and housing to the east.
- Moorgate, Rotherham - Rotherham District General Hospital and adjacent housing
- Rawmarsh – Goosebutt Street, Netherfield Lane and Spalton Road.
- Bramley, Rotherham

9.9 Rotherham MBC is currently preparing a Local Development Framework to identify key areas for development over the next 15 years. These areas will provide new homes and employment land and offer an excellent opportunity to encourage the development of low and zero carbon technologies.

9.10 The proposed LDF has a target of 12,750 homes by 2027 and 235ha of employment land. It is likely that this will be achieved through the development of key sites at Waverley, Basingthorpe Farm and Dinnington with more scattered sites providing a smaller contribution. Large mixed-use developments may be able to benefit from district heating and combined heat and power plants or wind turbines. Smaller developments may not have high enough energy demand or the land area to accommodate these technologies however; building integrated renewable technologies could provide significant CO₂ savings for these buildings

9.11 Low and zero carbon technologies should be encouraged, if not enforced, in new developments. The range of technologies available provides a number of options for all size and type of development.

- 9.12 Building integrated solutions are best suited to smaller developments where the energy demand is low and variable. The best of these technologies would be either solar PV or solar thermal, both of which provide a good reduction in CO₂ in comparison with other technologies and solar PV also gaining a good return on investment due to the Feed in Tariff. In addition biomass boilers can offer a good solution for schools, hospitals and commercial offices.
- 9.13 The installed cost of building integrated solutions can be relatively high in terms of the capacity installed. It is likely that this cost will be added to the house price to ensure the developers redeem their costs.
- 9.14 For larger mixed use developments whole site solutions offer the best option in terms of CO₂ reduction and investment opportunities. District heating can meet both heat and power demand when coupled with a CHP plant. A base load CHP plant coupled with a gas CHP offers the best solution for matching the demand of most developments whilst still providing a significant reduction in CO₂. The investment opportunities for these plants are good as the generation from the biomass plant will receive a financial incentive in addition to the heat and electricity sales. In order for a biomass CHP plant to operate efficiently it should be run at a constant load throughout the year. This makes CHP most suited to mixed use developments where energy demand will continue all year round despite a reduction residential heating.
- 9.15 A biomass plant will require fuel storage alongside the boiler and turbine house. Typically a biomass fuelled steam turbine will require at least 5 days fuel stored at any given time. The plant will also need to allow turning space for articulated delivery Lorries. These requirements mean that the footprint of a biomass CHP plant will be substantially bigger than a gas boiler or gas CHP plant. There will need to be constant management and staffing to oversee the delivery and handling of the fuel as well the general operation of the plant.
- 9.16 Commercial wind turbines offer a whole site solution with less operation requirements. For the developments assessed, 3-4 large scale wind turbines could adequately meet the demand of a development, providing significant CO₂ reduction. A windfarm can also prove a good investment opportunity and all electricity generated can be exported to the grid, ensuring no energy is wasted. However, there

are a number of issues which often restrict locations in which large scale wind turbines may be deployed. These include but are not limited to: the proximity of residential dwellings, the perceived visual impact, noise, electromagnetic interference (EMI) and accessibility of the site. There are also associated exclusion zones for protected areas and airports. Typically, building integrated technologies need to be deployed in or around urban centres and therefore several of these restrictions may apply, however the turbines could be located off site in the areas identified as suitable by the large scale wind resource study.

- 9.17 In order for a developer or company, or indeed local authority, to benefit from the investment opportunities available from the whole site solutions it may be necessary for the company to form an Energy Service Company (ESCo) to manage the plant and heat network and/or windfarm. From experience, developers are not keen to undertake this commitment and it may be beneficial to encourage community owned or local authority ESCOs to take on the management and operation of these plants once constructed.
- 9.18 Rotherham has a landscape with abundant natural resources, which clearly lend themselves toward wind and solar opportunities. These resources provide an excellent opportunity to deploy a good range of Renewable and Low Carbon Energy Technologies to deliver significant outputs.
- 9.19 The Borough of Rotherham is set to see significant growth promoted by an LDF policy framework. The implementation of carefully thought out policies will enable Rotherham to utilise its natural resources in the most effective and sustainable manner, and can be achieved through maximisation of opportunity on strategic site proposals.
- 9.20 This Evidence Base Study has shown where the technical resource exists and provides guidance as to how best to develop supporting LDF policies for the deployment of Renewable and Low Carbon Energy Technologies. Rotherham MBC is therefore in a much more knowledgeable position about how to make use of these technologies to meet, or potentially exceed, their energy obligations and targets.

9.21 This is based on the potential resource and deployment strategy for the range of Renewable and Low Carbon Energy Technologies.

10 RECOMMENDATIONS

10.1 It is recommended that Rotherham Metropolitan Borough Council adopt the suggested low carbon and renewable energy targets and policies in their forthcoming LDF.

10.2 Rotherham Metropolitan Borough Council should maximise the implementation of low carbon and renewable energy resources on their own estate.

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APPENDIX 1

Energy Demand Assessment Methodology

RESIDENTIAL HEAT MAPPING METHODOLOGY

All residential properties within the Rotherham Metropolitan Borough (RMB) boundary were mapped using the supplied Local Land & Property Gazetteer (Live Extract) data set (LLPG). This data set initially included a mixture of residential, commercial and industrial business addresses. Where the descriptor permitted the data was filtered by type but in instances where insufficient data was available a further filtering procedure was applied by searching for approximately 50 keywords within the addresses such as “unit”, “factory” or “workshop”. The outcome was the creation of two subsets; a residential database and a commercial/industrial database.

Investigation of the residential data showed there were 116,309 records in total. Of these only 7,703 were sub classified by the type of property they referred to. Where present this descriptor was used to ascribe a typical heat consumption (based on space heating and hot water benchmarks that closest resembled the particular property type – see Table 1 below for benchmark allocation).

Code Point Tertiary Description	Heat Consumption Benchmark Allocation
Caravan	Flat
Flats	Flat
Terrace	Terrace
Semi detached	Semi-detached
Detached	Detached
Care Homes	Flat
Bungalow	Detached

This left some 108,621 properties remaining unclassified in the supplied data. In order to properly assess domestic heat demand densities across the region it was necessary to allocate a classification to these properties. This was implemented based on geographical proximity to neighbouring LLPG data points. It was noted that flats within a block tended to be displayed on a coincident geographical point. The data set was queried to identify unclassified points centred on a common location and these were ascribed the status of “Flats”. Terraces were nominally defined as having neighbouring non-coincident LLPG data points within 5m proximity. Semi-detached properties were defined as having at least one neighbouring LLPG data point within a distance of 5m-9m and any properties with no neighbours within 9m were classified as detached. While this approach can never be 100%

accurate, sample visual inspections of the resulting allocations superimposed on to aerial photography suggests a fairly high degree of correlation. On this basis the newly classified points were amalgamated back into the primary residential dataset.

Once each of the properties in the dataset had been classified into a nominal benchmark type, its category was used to attribute a kWh/year heat consumption value based on the appropriate space heating and domestic hot water (DHW) benchmarks. It should be noted that the benchmark figures differentiate between 'mid' and 'end' terrace energy consumptions. To account for this in the heat mapping it has been assumed that an 'average' terrace consists of 8 individual properties i.e. two end terrace properties and six mid terrace properties. An average terrace value based on a 25%/75% end/mid split has been applied to all terraced properties.

The same classification was used to assign an electrical demand to each household based upon cooking, lighting and appliance benchmarks.

It has been necessary to assume that the cooking contribution is based on electrical consumption while the space heating and hot water contribution is based on heat. This assumption is clearly not strictly correct as those on the gas grid will quite likely use gas for cooking and there will be many instances of night storage and immersion heaters providing heat. However, in the absence of a detailed breakdown of individual properties fuel sources this approximation is the best available.

Furthermore, the benchmark figures available for were designed to be applied to buildings built in 2006. Obviously most of the housing stock in Rotherham is a lot older than this and since old buildings vary considerably in build quality and energy efficiency it was necessary to find some way of correcting this discrepancy. Although something of a 'fix', it was decided that the best solution was to analyse the predicted demand of averaged across all dwellings in each Middle Layer Super Output Area and compare this with DECC calculations of average residential heat and power consumption across the same areas. The ratio was used to generate a scaling factor that was linearly applied to all dwellings within that area. The effect was to make the modelled residential figures much more consistent with observed data whilst at the same time maintaining the distribution of demand according to dwelling size, despite the obvious limitations with this system.

To calculate CO₂ emissions the average DEFRA¹ figure of 0.521kg/kWh was applied to the calculated electricity consumption figures for each dwelling, assuming generation to come from the national grid through a typical mix of generation. For space heating it is more complex as although most dwellings in the Borough are connected to the gas grid it is not clear which these are nor whether those that are off the gas grid use oil or some other form of heating. The DEFRA report indicates that natural gas produces 0.204kg of CO₂/kWh (net calorific values), while kerosene produces an average of 0.259kg/kWh and domestic coal produces 0.311kg/kWh. Heating requirements are expected to be fuelled primarily by natural gas with some coal and oil fired heating present as well. 93% of the residential properties in Rotherham are known to be on the gas main and therefore the ratio of the heating types has been assumed to be 93% gas, 3.5% electric and 3.5% oil. CO₂ emissions have been modelled accordingly resulting in an estimated figure of 0.217kg/kWh which has been applied to the heat loads.

Once the correct attributes had been applied to each residence it was intended to amalgamate individual household contributions by postcode area in order to bring the residential dataset in line with the commercial/industrial datasets (see below) which could only be developed on this basis. This would enable the datasets to be superimposed to directly determine the heat and power loads across that postcode area. However, the postcode zones are all different sizes with those in the urban areas being predominantly quite small and some of the rural zones being very large. Normalising the data by calculating the load per unit area did not yield particular intuitive results as a particular feature of the 'OS Codepoint' dataset skewed the mapping. It was decided instead to generate a 100m grid and map residential demand within each grid square. This standardised the resolution of the mapping across the Borough and removed the skewing artefact but it did mean that the resulting dataset was not congruent with the commercial and industrial datasets and that it was not simple to amalgamate the three in a cohesive manner.

The resulting residential dataset was thematically mapped to produce the residential maps (Figures 3.4, 3.9, 3.14 & 3.19). To aid interpretation of potential hotspots to target for future development by RMBC the residential heat maps have been overlaid with the locations of council houses which could be retrofitted with clean technologies to improve emissions. The locations of existing district heating networks have also been identified.

¹ DEFRA 2011 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting v1.1 (08/08/2011) (<http://archive.defra.gov.uk/environment/business/reporting/pdf/110807-guidelines-ghg-conversion-factors.pdf>)

NON-RESIDENTIAL HEAT & POWER MAPPING

For non-residential heat and power loads it was not possible to apply a generic benchmark and so an alternative approach was required. Energy benchmarks for commercial and industrial heat and power uses are prescribed in the Chartered Institution of Building Service Engineers (CIBSE) Guide F document “Energy efficiency in buildings”.

These benchmark figures are given based on unit floor area for various commercial and industrial practices. The guide identifies separate figures for fossil fuel consumption and electrical consumption for each nominal business type and based on whether operations fall within what is termed ‘good practice’ or ‘typical practice’. For the purposes of this exercise it has been assumed that the ‘typical practice’ figure applies to all commercial and industrial premises in Rotherham Metropolitan Borough. Furthermore, it has been necessary to assume that the fossil fuel use corresponds to heat loads and the electrical use corresponds to power consumption. Clearly this is an approximation as some businesses will use electricity to generate heat and some businesses may run diesel generators to supply their electrical needs but it is suggested that this approach will provide as realistic a representation of usage within RMB as possible without conducting a census of businesses to establish actual usage.

In order to apply the CIBSE energy benchmarks, it is necessary to know the floor area of all the industrial and commercial buildings within RMB as well as categorise them by type of business. Determination of these characteristics has proved difficult for a number of technical reasons. The LLPG dataset supplied by RMBC categorises some of the records into commercial and residential subsets, however there were a large number of records in an unclassified state. Furthermore, although business addresses in the LLPG were mappable (i.e. the location of the properties is known and can be geo-referenced) the database did not include floor areas and therefore it was not possible to apply the appropriate energy benchmarks.

It would potentially be possible to cross-reference the LLPG dataset against Ordnance Survey's MasterMap dataset which contains polygon data for all of the buildings within the Borough. This could then be queried to establish the footprint of the polygon that coincided with the commercial listing in the LLPG. The approach was considered at length but ultimately rejected due to the problem associated with a business operating from more than one building. For example a commercial operation, which could have a significant heat

load, may consist of several factory buildings, an office/admin centre and any number of other buildings. If only the office building coincided with the LLPG address location the query would only be able to distinguish a footprint for this when actually the benchmark ought to be applied to the much larger factory area. This omission could lead to a significant underestimate in the actual heat load within a given area. Extensive research concluded that no known data set containing all the relevant detail, available in an appropriate format is available to Rotherham Metropolitan Borough Council.

The only other dataset that has been identified which does include commercial building footprint areas is the Valuation Office Agency's (VOA) "2010 Rating List for Business Properties". This data was acquired for Rotherham and was found to identify 7569 business addresses (7077 once deletions had been removed). Within the dataset floor areas were attributed to 6,369 of these addresses. All of the 708 records that did not contain information on floor areas did have an overall rateable value attributed and this was used to estimate the floor area as described below. The rateable value of a business is set according to a number of factors including the type of business carried out, its location and its 'shop floor' layout.

Where the records excluded the floor area it has been necessary to estimate this from the rateable value of the business. These businesses fall into several categories and where similar businesses types have been identified, the average cost per m² of those businesses has been used to estimate the floor area of the undeclared business by proportionally scaling it using its rateable value.

Furthermore in its native format, the VOA dataset was not mappable - it only contained address strings, not geo-referenced points. In order to create a mappable dataset it would be necessary to geo-code the VOA data. This process would effectively create a join between the LLPG dataset and the VOA dataset based on corresponding addresses. Several attempts were made to do this but it was found to be a non-trivial exercise because the format of the address string itself and the data contained within it was not consistent in the two datasets. Experimentation with conventional geo-coding software failed to achieve satisfactory results as did an attempt to construct a software algorithm to produce a match between the two addresses. The approach resulted in a mappable dataset containing floor areas, however, because of the differing number of records and inconsistent address formats the algorithm necessarily produced 'best-match' results. Consequently the merger

produced numerous errors and duplication. While in theory these could have been manually removed due to the number of records this method was abandoned.

It was decided to use the VOA dataset as it stood and, rather than locating each building precisely, to use the postcode to map it to an area. This would enable the generation of maps based on the heat, power and CO₂ emissions of the businesses although this did limit the resolution of the maps, as described below. The resulting dataset was further combined with the CIBSE benchmarks in order to establish the expected heat and power loads. The benchmarks categorise 98 different types of business activity and specify good practice and typical practice heat and power consumption figures per unit area for each. The VOA dataset contained 335 subgroup business types and it was recognised that some form of amalgamation was necessary in order to assign the benchmarks. Thirteen new categories were formulated summarising 'business sectors' by averaging the benchmarks appropriate for that sector and then each of the 335 subgroups were assigned to one of these new categories. Averaging benchmarks is not an ideal solution as it obviously increases error but it was a necessary step in the timely delivery of the exercise, given the availability of detail on each specific subgroup business classification. 'Typical Practice' benchmarks were assigned rather than 'Good Practice' as it is believed that these give the most representative picture overall.

<i>(kWh/m²/yr)</i>	Typical Practice	
	Fossil Fuels	Electricity
Catering	960.0	810.0
Entertainment	510.0	192.5
Education	149.4	61.2
Hospital	482.8	95.0
Hotel	406.7	136.7
LEA	334.4	66.4
Offices	172.5	180.8
Public	263.7	59.6
Retail	204.3	268.1
Sports & Leisure	640.0	195.0
Warehouses	120.5	18.5
Industrial	-	-
Inapplicable	0	0

These benchmark figures were applied to each of the businesses in the VOA database using the actual or derived floor area for that business, and the resulting heat and power demands were used to calculate the CO₂ emissions. The “Industrial” category was used to separate out those businesses that need to be treated separately and individually due to large and potentially significant variations in heat and power use. The “Inapplicable” dataset was used to classify records within the VOA dataset with no obvious associated heat or power consumption, for example, advertising space, land used for storage and cemeteries. The total heat and power demand for each postcode zone was calculated and then normalised by dividing by its area to give a demand per unit area and this dataset was mapped to produce the commercial heat maps (Figures 3.5, 3.10, 3.15 & 3.20) and the industrial heat maps (Figures 3.6, 3.11, 3.16 & 3.21).

The resulting map had a much coarser resolution than was originally envisaged but it was concluded the result was the best achievable with the available data. Since some of the postcode areas were considerably larger than others, particularly the more rural ones, the data was normalised by dividing the resulting totals by the areas of the postcode zone to which they applied.

Figures 3.7, 3.12, 3.17 & 3.22 were formed by summing the residential and commercial/industrial demands for each postcode area to generate a map of overall demand within the county and specifically within the five target urban areas.

The electrical maps (Figures 3.8, 3.13, 3.18 & 3.22) were formed from the combined residential, commercial and industrial loads as modelled with the relevant benchmarks.

SUMMARY

As can be seen in the individual residential, commercial and industrial heat maps there are some areas where no demand of a particular type has been identified. These ‘empty’ areas appear as uncoloured zones on the maps. . This should be taken into account when viewing the maps.

Care must also be taken when interpreting the heat maps since there is some potential for confusion due to the normalisation process. The normalisation process has been implemented to remove visual anomalies from the mapping but in doing so a different anomaly is introduced. A large heat-load located in a small postcode area would have a very

limited impact on the appearance of the map compared to assigning the same heat load to a much larger postcode zone. The latter scenario gives the impression of a much higher average heat load. To avoid this effect data has been normalised by dividing the heat load by the physical area of the postcode zone. This gives a much more balanced view in general but, where the postcode area is small (i.e. less than one Hectare) and the heat load is large, dividing the load by the area can result in a sharp spike in normalised heat demand. To temper this effect the upper range on the heat maps has been extended to capture all modelled demand.

APPENDIX 2

Wind Resource Assessment Methodology

INTRODUCTION

This report details the methodology used to produce the wind resource areas for Rotherham Metropolitan Borough Council, which forms part of a borough-wide renewable energy resource assessment. The overall resource study has been designed to build upon the region-wide study for Yorkshire and the Humber undertaken by AECOM, however, Wardell Armstrong has taken the decision to revise the large scale wind resource as the original study was based on region-wide data which is relative coarse for undertaking a borough-wide assessment. Furthermore, the medium scale wind was not assessed as an individual resource area in the original study and therefore Wardell Armstrong has implemented the methodology explained below to identify these resource areas.

The medium scale wind resource was included in this study as it has become an expanding market area amongst the renewable energy technologies. This has largely been stimulated by the Feed in Tariff, introduced in April 2010, which offers attractive tariffs for wind turbines with an installed capacity below 1.5MW and particularly those between 100kW and 500kW. Additionally, the development of medium scale wind projects can often be simpler than larger schemes due to the removal/reduction of some technical and environmental constraints. This also allows development in areas that may have been considered unsuitable for large wind turbines.

METHODOLOGY

The resource assessment for medium scale wind was started from a GIS layer comprised of the Rotherham boundary. The polygon was then constrained to identify suitable areas in which medium wind scale turbines could be deployed.

The potential wind resource is expressed in two different features:

- Energy (MWh/yr), based on electricity generation
- The carbon saving (0.499kg of carbon / kilowatt hour of electricity produced - DEFRA).

Medium Scale Wind Resource

The resource assessment for medium scale wind used the following methodology and benchmarks to establish the values described above. A wind speed up log law calculation was used to estimate the wind speed at 40m above ground level from the 45m reference height in the NOABL database. A surface roughness value of 0.03 was used in the calculation. The resultant speed up factor applied to the 45m wind speed values to derive the wind speed at 40m was 0.984.

Low wind speed areas were removed from the outset of the study. Low wind speed areas are defined as less than 5.5m/s at a height of 45m above ground level.

Practically Accessible Wind Resource

The final wind resource areas were identified from the available wind resource (discussed above) after non-accessible areas have been removed. These non-accessible areas were defined by a series of constraints applied to the initial wind resource, including:

- Roads, railways, inland waters, electricity transmission grid etc
- Airports and MOD considerations
- Ancient semi-natural woodland and sites of historic interest
- Environmental designations
- Landscape constraints

The Ordnance Survey 1:50,000 Vector Map dataset was the base mapping used to develop some of the various constraint layers used in the resource assessment, including roads, railways and inland waters. Most features found within this dataset are defined by vectors. To produce the constraint layers these features require offsets to be built around them to define the inaccessible areas.

Table 1: Exclusion Area Offsets	
Feature	Offset
Roads (Motorway, Primary, A & B)	71.5m (turbine topple height +10%)
Railway	71.5m (turbine topple height +10%)
Settlements	500m (mitigation against noise impacts)
Airports	5km (safeguarding mitigation)
Rivers	50m (landowner oversail)
Electricity Transmission Grid – 400kV	400m
Electricity Transmission Grid < 400kV	71.5m (turbine topple +10%)

Historic, environmental and landscape constraints were applied from WA's GIS database including:

- Scheduled Ancient Monuments, Listed Buildings, Registered Historic Battlefields, Registered Parks and Gardens and World Heritage Sites,
- SPAs, SACs, NNRs, SSSIs and Ramsars.
- National Parks and Areas of Outstanding Natural Beauty

Radar and MOD Considerations

Wind turbine developments are often prone to objections arising from concerns regarding radar interference. Such objections can be difficult and costly to resolve, especially for medium scale wind projects and can render this scale of project uneconomic.

In order to understand where radar interference may occur, WA has created a GIS database which provides a method of assessing primary surveillance radar clearance at a given site. This is based on whether the radar is related to civil or military operations, the location of the radar and its height above ground level and the ground terrain. Civil radars are perceived to have coverage of 35km in any given direction whilst military radars cover approximately 65km.

This GIS coverage is purely indicative and consultation should always be sought with the relevant airport/radar operator when developing a wind project. To that effect therefore this GIS layer has not been applied as an additional constraint to the medium scale wind resource. Instead it has been supplied to provide information on where difficulties due to radar interference may arise.

Energy Generation and CO₂ Saving

The number of turbines for each area was estimated based on the land area occupied by a single turbine. This was based on a medium scale turbine occupying 5ha to ensure that turbines are not located too close to each other to cause turbulence or unacceptable wake loss effects. These buffers are 6 rotor diameters down wind and 4 rotor diameters across the wind to ensure optimum wind resource extraction based on wind flow across the site. Any areas greater than 20ha were discarded and were later assessed in the large (commercial) wind resource study.

The installed generating capacity was calculated based on a medium scale wind turbine with a generating capacity of 500kW. An EWT DirectWind 52/54 500kW was subsequently used as the reference turbine for energy calculations, etc. This turbine is representative of the scale of turbine consider for medium scale wind development for the average wind speed values for Rotherham.

Each discrete area falls within a specific 1km grid square with an identified wind speed at a reference height of 45m. The total number of turbines within these discrete areas was then used as a multiplier on the annual energy output for a single EWT 500kW turbine derived from its energy curve at the given wind speed.

The CO₂ savings associated with the generation of electricity from a medium scale wind turbine has been calculated from the average CO₂ emissions arising from UK grid electricity, at the point of generation. This currently stands at 0.4455kgCO₂/kWh as stated in Defra/DECC's GHG Conversion Factors for Company Reporting published August 2011.

Large Scale Wind Resource

The resource assessment for large scale wind used the areas discarded in the medium scale wind methodology, as discussed above. These areas were then reduced by an offset of 50m to account for additional technical and environmental constraints associated with larger turbines.

A wind speed up log law calculation was used to estimate the wind speed at 80m above ground level from the 45m reference height in the NOABL database. A surface roughness

value of 0.03 was used in the calculation. The resultant speed up factor applied to the 45m wind speed values to derive the wind speed at 80m was 1.079.

Energy Generation and CO₂ Saving

The number of turbines for each area was estimated based on the land area occupied by a single turbine. This was based on an installed capacity of 9MW/km². These areas were then manually adjusted to accommodate a Vestas V90 2MW wind turbine. This turbine is representative of the scale of turbine consider for large scale wind development for the average wind speed values for Rotherham.

Each discrete area falls within a specific 1km grid square with an identified wind speed at a reference height of 45m. The total number of turbines within these discrete areas was then used as a multiplier on the annual energy output for a single Vestas V90 turbine derived from its energy curve at the given wind speed.

The CO₂ savings associated with the generation of electricity from a medium scale wind turbine has been calculated from the average CO₂ emissions arising from UK grid electricity, at the point of generation. This currently stands at 0.4455kgCO₂/kWh as stated in Defra/DECC's GHG Conversion Factors for Company Reporting published August 2011.

APPENDIX 3

Biomass Resource Assessment Methodology

INTRODUCTION

The enhanced biomass resource assessment for Rotherham identifies areas suitable for growing energy crops, established woodlands and the potential yields that could be expected.

METHODOLOGY

The methodology for assessing the available biomass resource in Rotherham has been based on the guidance from the SQWenergy report entitled "*Renewable and Low-carbon Energy Capacity Methodology – Methodology for the English Regions*" issued by DECC in January 2010.

The methodology provides parameters for opportunities and constraints for renewable energy technology deployment. These have been modelled for Rotherham however; certain changes and assumptions have been made to improve upon the detail provided by this resource assessment.

Energy Crops and Woodlands

The available energy crop resource has been assessed by applying a series of restrictions and constraints to the natural resource.

The natural resource has been determined as the available energy crop yield. The potential yield for Miscanthus or Short Rotation Crop (SRC) in Rotherham was obtained from DEFRA. This data classifies the potential for energy crops in terms of low, medium and high yields.

The natural resource was then limited to the technically accessible resources. This restricts the natural resource to suitable land dependent on agricultural practices and climatic conditions.

The Agricultural Land Classification (ALC) data, also supplied by DEFRA, was applied to the energy crop yields. The ALC provides a method for assessing the quality of agricultural land to assist informed choices for agricultural development. Land is graded based upon physical or chemical limitations to agricultural use. The most suitable land for agricultural development falls within Grades 1 to 3. For the purpose of this resource assessment energy

crop yields were restricted to agricultural land graded 1 to 3. All other land areas were excluded. Current land use of these areas have not been considered and it should be noted that areas identified as suitable for energy crops will currently be utilised for other agricultural crops.

The technical resource was further restricted by wind speed. Miscanthus crops grow to a significant height and can be affected by high winds, which flatten the crop and impact the final yield. Miscanthus was therefore determined as the dominant energy crop in areas with a wind speed below 6m/s at a height of 10m above ground level. SRC was considered the dominant crop for areas with a wind speed above this. Wind speed data was derived from the UK Wind Atlas available from DECC.

The technical resource was then constrained to the physically accessible and the practically viable resource. This was determined by excluding the following areas from the technical resource:

- Ancient and Natural Woodland
- Road
- Rail
- Rivers
- Lakes
- Settlements
- Sites Special Scientific Interest
- Special Protection Areas
- Special Areas of Conservation
- RAMSAR (protected Wetlands)
- National nature reserves
- Local nature reserves
- Scheduled Ancient Monuments
- Battlefields
- Country Parks
- Parks and Gardens
- Local Authority Conservation Areas
- Countryside Rights of Way
- Existing Habitats (Phase 1)

Areas of Outstanding Natural Beauty (AONB), National Parks and Heritage Coasts were not considered constraints to the biomass yield as crops can still be cultivated in these areas.

The practical resource was assessed to determine the available yield and the potential energy generation achievable from energy crops in Rotherham.

The Natural Woodland Area, obtained from Ordnance survey, was mapped with the miscanthus and SRC resource. This data is already constrained and it was not necessary to restrict the resource in the same manner as energy crops. Please note that the yield value in Table 1 below is a long term average sustainable yield (primarily thinnings and brashings) and not that available when the woodland is clear felled as it is assumed that most of this will be used for timber.

The conversion factors shown in Table 1 were applied to estimate the amount of oven dry tonnes of fuel produced per hectare per annum. These figures were established by sound reasoning based on expected crop yields from varying agricultural land characteristics and climatic changes¹. These figures are more refined than those suggested in the SQWEnergy guidance and should provide an accurate representation of the available yields.

Table.1: Yield				
Yield Category	ALC	Miscanthus odt/ha/yr	SRC odt/ha/yr	Wood odt/ha/yr
Low	1	14	7	2
	2	15	8	
	3	16	9	
Medium	1	16	9	
	2	17	10	
	3	18	11	
High	1	18	11	
	2	19	12	
	3	20	13	

These conversion factors were applied to the practical resource and the natural woodland resource, to obtain the resource in oven dry tonnes per year for each land area. This was then converted into MWh based upon energy conversion factors obtained from the Biomass Energy Centre², as shown in Table.1

¹ Wardell Armstrong: Devon Biomass and Woodfuel Opportunities

² Biomass Energy Centre: Typical calorific values of fuels

http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,20041&_dad=portal&_schema=PORTAL

Table.2: Net Calorific Values	
Fuel	GJ/tonne
Miscanthus	13
SRC	13
Wood	13

The resource assessment produced the following outputs:

- Resource availability (odt/ha/yr)
- Potential Energy Generation (MWh/yr)
- The CO₂ saving (0.499kgCO₂/kilowatt hour of electricity generated - DEFRA).

The resource density in oven dry tonnes per hectare has been mapped using a GIS to provide a map of the borough identifying the suitability for biomass throughout Rotherham. See Figure 3.28

As stated previously, the land areas included in this assessment will currently be utilised for agricultural crops and therefore not all of the resource identified in the study will be accessible. In order to reflect the true contribution from energy crops in Rotherham it has been assumed that only 10% of the areas identified as suitable will be used for energy crops. This is roughly equivalent to the average amount of land previously in set-a-side for the UK.

APPENDIX 4

Economic Appraisal Methodology

INTRODUCTION

The economic appraisal assessed the viability of low and zero carbon technologies for the preferred development sites identified in the Rotherham LDF. The economic model produced by Wardell Armstrong has also been provided to RMBC for use as a generic tool to undertake initial assessments of any future low and zero carbon development opportunities that may come forward.

The economic appraisal tool (EAT) addresses the following issues:

- Estimated energy demand
- Low and zero carbon options
- CO₂ savings
- Costs and investment returns

METHODOLOGY

Energy Demand

The EAT is designed to be applied to different developments of various sizes and uses in the proposal/planning stage. It is impossible to determine the true energy demand of a development at this stage and therefore it is necessary to estimate the potential energy demand based on national or industry benchmarks.

It should be noted that building regulations are due to be revised in 2013 and 2016 and a key element of the changes is a reduction in CO₂ emissions produced by a dwelling or building. By definition this will require a reduction in energy demand. Whilst there has been much discussion, consultation and recommendations regarding these regulations, no definitive policy has yet been finalised. In light of this, energy demands have been based on developments built to the 2010 building regulations, however these should be reviewed once the revised building regulations have been published.

For the purpose of estimating energy demands for the residential sector, the Energy Saving Trust's (EST) guide "*Meeting the 10 Per Cent Target for Renewable Energy in Housing*"¹ has been used. This gives demand reference data for typical types and sizes of dwellings. These

¹ Energy Saving Trust *Meeting the 10 Per Cent Target for Renewable Energy in Housing* 2006

figures have been adjusted to incorporate a 25% CO₂ reduction in line with the changes to Building Regulations introduced in October 2010. The reference data is shown in Table 1.

Dwelling type		Top floor flat	Mid-terraced	End-terraced	Semi-detached	Detached
Total floor area m ²		60.9	78.8	78.8	88.8	104
Energy Requirement kWh/yr	Space Heating	1703	1674	2170	2567	3338
	Water	2110	2421	2421	2559	2822
	L&A	1651	2039	2039	2293	2726
	Cooking	880	948	948	986	1040
	Total	6343	7082	7578	8405	9926

For the non-residential sector, energy benchmarks have been derived from the DCLG 2010 CO₂ reduction targets² as shown in Table 2. This assumes that all buildings will be built to achieve a 25% CO₂ reduction in line with the changes to Building Regulations introduced in October 2010.

Energy Use	Heating	Cooling	Auxilalary	Lighting	Domestic Hot Water	Equipment	Total
Commercial Offices	52	11	9	36	10	55	172
Communications and Transport	41	23	11	36	13	60	184
Education	34	0	4	25	20	32	115
Government	57	11	9	33	10	55	175
Health	35	0	26	38	30	132	261
Hotel	40	0	9	22	104	28	202
Retail	34	93	17	113	0	28	284
Sports and Leisure	0	53	32	36	104	30	256
Warehouses	61	0	0	7	0	11	79
Other Services	30	19	15	45	30	66	205
Industrial	3	0	32	89	0	0	124
Average	37	15	15	46	17	34	164

LOW AND ZERO CARBON TECHNOLOGY OPTIONS

The low and zero carbon technology options have been divided into two sections, building integrated solutions and whole site solutions as shown in Table 3.

² DCLG *Definition of Zero Carbon Homes and Non Domestic Buildings* 2008

Table 4: Low and Zero Carbon Technology Options	
Building Integrated Solutions	Whole Site Solutions
Roof mounted wind turbines	Wind turbines
Solar photovoltaic	District heating
Solar thermal	Combined Heat and Power
Ground source heat pumps	
Biomass boilers	

Hydroelectric and water source heat pumps were not considered as they may not be suitable for every development site. Air source heat pumps were excluded from the study as they are less efficient than the ground source alternative and do not produce significant CO₂ savings.

Building Integrated Solutions

The building integrated solutions have been assessed for residential and non-residential buildings. For residential buildings the EAT provides a breakdown of technology by dwelling type to provide an installed capacity, estimated generation and cost for each dwelling type, i.e. flat, terrace, semi-detached etc. For non-residential buildings the model breaks down the technology by building type based on floor area, i.e. retail, offices, education etc. Although it is recognised that these building may be built in separate units, at this stage of assessment only a floor area is available and this is therefore the best method for assessing the options.

Roof Mounted Wind Turbines

There are currently a range of roof mounted turbines available at different generating capacities. Roof mounted turbines have only been modelled for domestic property as the size and nature of these dwelling make this option suitable. For non-residential buildings larger stand-alone wind turbines are recommended. The EAT for roof mounted turbines models a Swift 1.5kW turbine, which has a rotor diameter of 2m. The annual generation of this turbine is estimated at 1,314kWh/yr based on a 10% capacity factor, however this can be altered by the user. The installed cost of the turbine is estimated at £4,000³.

³ <http://www.swiftwindturbine.com/>

The user can adjust the number of turbines per dwelling. The financial returns and simple payback calculations have been based on the Feed in Tariff, assuming 50% of the electricity generated by the turbine will be used in the dwelling and the remainder will be exported to the grid. The CO₂ saving is based on offsetting grid electricity at the point of consumption.

Solar Photovoltaic

Solar photovoltaic (PV) panels have been modelled for both residential and non-residential buildings. There are currently a range of photovoltaic panels available at different generating capacities and efficiencies. The economic appraisal considers PV panels rated at 235W_p with an area of 2m². The expected annual generation from this panel is 259.2 kWh based on the solar insolation in Rotherham⁴ and a panel efficiency of 12% (which can be altered by the user). The cost of solar PV is estimated at £4,000 per kW_p installed.

For the purpose of this economic appraisal, solar PV has been modelled to meet the total electricity needs per dwelling/building type. The very nature of solar PV means that all electricity will generated during the day. For domestic PV, it is considered that not all the electricity generated by the solar PV will be utilised in the house due to the generation characteristics of PV and the typical demand profile of a dwelling. Therefore the user can estimate how much electricity will be displaced in the home; the remainder will be fed into the national grid network. For non-residential buildings it is assumed that all electricity generated by the PV panels will be utilised by the building.

The financial returns and simple payback calculation have been based on the Feed in Tariff. The CO₂ saving is based on offsetting grid electricity at the point of consumption.

Solar Thermal

Solar thermal panels are best suited to applications that require a constant supply of hot water. Typically solar thermal systems can provide up to 60% - 70% of domestic water heating needs, electric immersion heaters are usually installed to meet the rest of the demand.

Solar thermal has been modelled for residential properties as this is the most suitable application for this technology. The solar thermal collector is sized at 2.5m² which will

⁴ <http://re.jrc.ec.europa.eu/pvgis/>

provide 1620 kWh/yr of thermal energy, based on the solar insolation at Rotherham and a collector efficiency of 60%.

The number solar thermal collectors per dwelling have been sized to meet 60% of the total hot water demand. The remainder will need to be met by an electric immersion heater.

The financial returns and simple payback period have not been calculated for solar thermal collectors as domestic installations are not currently eligible for the Renewable Heat Incentive. The CO₂ saving is based on offsetting natural gas.

Ground Source Heat Pumps

Ground source heat pumps (GSHPs) are probably the most convenient renewable energy technology to use on the new developments as they do not require planning permission, are maintenance free and only require an electrical connection to operate. However, GSHPs will not provide optimum CO₂ reductions due to the associated parasitic electricity requirements. To be considered completely renewable, heat pumps should be coupled with a renewable electricity supply such as wind or PV.

The heat pumps in the EAT have been sized to meet the total space heating demand of each dwelling/building type. A seasonal average Co-efficient of Performance (COP) of 4.0 was assumed to calculate the GSHP electrical loads. This means that for every 4kW of heat produced, 1kW of electricity will be consumed. The installed cost of a ground source heat pump is estimated at £1,800/kW for domestic use and £1,600/kW for larger non-domestic systems.

The financial returns and simple payback period have not been calculated for domestic installations of heat pumps as they are not currently eligible for the Renewable Heat Incentive. The returns and payback for non-domestic installations have been based on a tariff from the Renewable Heat Incentive.

In addition, the economic model takes into account the saving made by **not** installing a gas boiler as this is considered the conventional alternative. The cost of a gas boiler is estimated at £80/kW. An annual saving has also been included to account for the money that would otherwise be spent on purchasing gas.

The CO₂ savings are based on the saving made by displacing the use of gas minus the CO₂ emissions from the electricity consumption of the heat pumps.

Biomass Boilers

Biomass boilers can provide both water and space heating. Boilers range in size from small scale units for single dwellings to large boilers supplying a district heating scheme. For large scale boilers there are three sizing options:

- Base load sizing provides the minimum required heat load with additional requirements being met by a secondary fossil fuel boiler.
- Peak load sizing provides the capability to meet the full heating demand through the biomass boiler.
- Optimum sizing provides a combination of both methods.

Optimum sizing is generally the most common system, providing 80 – 90% of heating demands from the biomass boiler with peak demand met by a conventional fossil fuel boiler. This reduces the capital expenditure and allows the biomass boiler to run constantly, as this is the preferred mode of operation for maximum efficiency.

Biomass boilers have not been modelled for individual domestic properties as residential installations require a significant heat load and space for the boiler and fuel. It is considered that new dwellings will not have sufficiently high heat loads or be designed with the space to incorporate these systems. Non-residential buildings however, lend themselves much more to biomass boilers.

Biomass boilers in the EAT are modelled at optimum sizing and should provide 90% of the total heat demand for the non-residential buildings, the remaining demand will be met by a gas boiler. The cost of both boilers and anticipated fuel costs and operating costs have been estimated from data published by the Carbon Trust⁵

The financial returns and simple payback period have been based on a tariff from the Renewable Heat Incentive. The economic model takes into account the saving made by **not** installing a gas boiler to service the total demand, as with the heat pumps. An annual saving

⁵ Biomass heating: A practical guide for potential users, Carbon Trust 2008

has also been included to account for the cost that would otherwise be incurred by purchasing gas.

The CO₂ savings are based on the saving made by displacing the use of gas with the biomass boiler.

Whole Site Solutions

Whilst building integrated low and zero carbon technologies can offer independent and secure energy supply to single dwellings and/or non-residential units on large developments, this can be costly and not necessary provide the highest CO₂ savings.

Large low and zero carbon projects can, in some cases, meet all the energy needs of a development and provide the economics of scale to ensure a good return on investment.

The EAT considers two whole site solutions. A number of options are explored within these areas.

Wind Turbines

Three scales of wind turbines have been included in the economic model as their suitability can be limited by a number of factors such as environmental constraints, noise/visual impacts etc, rather than just meeting energy demand. The turbines selected for modelling are based on popular, proven and bankable turbines which available in each scale range. These are:

- Endurance E3120 50kW turbine
- EWT DW52 500kW turbine
- Vestas V90 3MW turbine

The EAT is designed to let the operator adjust the number of turbines for each category to determine which option would best be suited to a given development. As the location of a development is not known at this stage, the annual generation of a turbine is based on a capacity factor rather than the wind speed at a given site. The operator can alter the capacity factor for each turbine.

The cost of each turbine has been sourced from the manufacturer and it is assumed that this will account for 75% of the total installation costs. Operating costs are estimated at 1.5% of the total installed costs

The financial returns are based on tariff received from the Feed in Tariff (for projects below 5MW) or the Renewables Obligation (for projects greater than 5MW) and the sale of electricity to the national grid.

District Heating and CHP

District heating can provide an efficient economic method of heating a development, and when coupled with a CHP plant can meet the electrical demand too.

Combined heat and power (CHP) systems achieve high operating efficiencies by identifying uses for recovered heat as well as generating electricity. These systems can be fuelled by fossil fuels or even by waste but if they are fuelled by biomass resources then they are truly renewable. Suitable biomass can be sourced from forest residues, energy crops, poultry litter or any other organic material provided it has sufficiently low moisture content.

There are two basic technology options for producing electricity from biomass: boilers and steam turbines or gasification/pyrolysis systems coupled to gas engines or gas turbines. Boilers and steam turbines are a well proven bankable technology but are relatively inefficient (e.g. 20% electrical efficiency) at small scale, i.e. up to 10MW. This may not be an issue if heat demand is the critical factor. They also do not have very good economies of scale at this size, eg a 1MWe plant will have similar costs to a 3MW plant. The waste heat they produce is at relatively low temperatures circa 90°C and therefore not suitable for some process heat applications but is ideal for district heating. Finally they are much more tolerant of feedstock quality variations and moisture content making operations and maintenance less of a problem.

Modern gasification and pyrolysis technologies are now available that could make biomass CHP clean, more efficient and sustainable even at relatively small scales. The most common gasification systems are wood fuelled and coupled to a spark ignition (gas) engine. This technology typically has an electrical efficiency of around 30%, implying some 70% of the energy in the fuel would be available as waste heat. It is not possible to recover all of this heat and there will be losses in the heat distribution systems, however, 50%-60% could be

made available for heating purposes. CHP can supply high grade heat for industrial use (circa 450°C) or low grade heat for domestic use. Whilst gasification technology is more efficient than traditional steam turbines, they have yet to gain a commercial track record.

The model assesses a number of options for CHP, however, gasification and pyrolysis are not considered as they are not currently considered as bankable as the boiler and steam turbine system. The options considered in the model are:

- Base load biomass boiler with gas boiler for peak demand
- Base load biomass CHP with gas boiler for peak demand
- Peak load biomass CHP
- Peak load gas CHP
- Base load biomass CHP and gas CHP for peak demand

The installed capacity required for the plant is based on the electricity and heating demand of the development. It is assumed that the electricity demand will be required throughout the year. A base load heating capacity has been calculated on an estimated minimum of 3000 heating hours per year, it is anticipated that this will be approximately 68% of the total demand (as specified by BERR).

Biomass Boiler with gas boiler for peak demand

A biomass boiler can provide district heating for developments of a range of sizes. A simple boiler system can be cheaper than a biomass CHP plant and easier to operate. As with all biomass systems, it is best to run the plant at a constant load throughout the year. The model considers a biomass boiler for the base load requirement of 3000 hours, supported by a gas boiler to meet the peak demand, also connected to the district heating network.

The cost for the plant has been based on data supplied by the Carbon Trust. It is assumed that the boiler will be 90% efficient and the wood fuel has a moisture content of 30% when it is combusted. The gas boiler is expected to be 95% efficient and has been sized to meet the remaining demand, required for 1000 hours a year.

Revenue will be generated by the sale of the heat to users of the network and the Renewable Heat Incentive tariff, which is based on the size of the plant.

Base Load Biomass CHP with Gas Boiler for Peak Demand

Sizing the biomass CHP to meet the base load requirements ensures that the plant can be run at a constant load throughout the year without generating too much excess heat. This would be cheaper to build but the site's peak heating requirements would need to be accounted for by either conventional boiler systems or solar hot water panels to reduce the heating requirement. Having back-up conventional boilers may be more suitable as this also ensures that residents have some form of heating during biomass plant downtimes. In this scenario a gas boiler (as above) has been used to meet the peak demand. The CHP plant's net electrical efficiency has been assumed to be 20% with 20% heat losses based on a traditional steam plant. The fuel requirement is based on 8,000 dry tonnes equivalent (DTE) of wood being required per annum per MW of electrical capacity. The costs for a generic 500kW_e biomass CHP plant are shown in Table 5. These have been scaled accordingly to meet the size of the required plant.

Table 5: Generic 500kW_e Biomass CHP Unit		
Electrical Capacity	500	kWe
Electrical Efficiency	20%	
Heat losses	20%	
Cost	£1,500,000	
O&M Costs	£125,000	/yr

The revenue in this model is based on electricity sales to the grid, based on wholesale electricity price and heat sales to the heat network, based on the current price of gas for the end user. Additionally the plant will also receive revenue through the current financial incentives for biomass CHP. At present biomass CHP operators can either opt to receive two ROCs under the Renewables obligation or one ROC and a fixed tariff from the RHI. The model can be adjusted to include either option.

Peak Load Biomass CHP

Biomass CHP built to meet the peak demand benefits from being 100% renewable and therefore achieves the highest CO₂ saving. Also it is not significantly more expensive than the base load CHP and gas boiler plant due to the economies of scale. However, peak sizing will result in excess heat, which can be used to dry the wood fuel, however some heat may still need to be discarded.

The costs for this system are as shown in Table 5 and the revenue is as above.

Peak Load Gas CHP

A gas CHP system could be installed for the development. Despite running on fossil fuel, a gas CHP plant can achieve up to 70% CO₂ savings due to heat recovery. Furthermore, gas plants can be sized to meet peak load but do not have to run continuously through the year and are cheaper than biomass systems. A gas CHP plant can be installed modularly, allowing the installed capacity to be increased as the development is built reducing the initial capital expenditure. Table 6 shows the data used to model the CHP plant.

Electrical Capacity	500	kWe
Electrical Efficiency	35%	
Heat losses	35%	
Cost	£40,000	
O&M Costs	£3	/operational hour

The revenue in this model is based on electricity sales to the grid, based on wholesale electricity price and heat sales to the heat network, based on the current price of gas for the end user.

Base Load Biomass CHP and Gas CHP for Peak Demand

A biomass CHP sized for base load coupled with a gas CHP could be installed to achieve higher CO₂ reductions. This would allow the gas CHP plant to be installed initially for the first stages of the development and the biomass CHP plant to be bought online at a later date when the energy demand is greater.

The details for the biomass and gas plants are the same as Table 5 and Table 6 respectively and have been scaled up to the relevant size. It is assumed that the biomass plant will run constantly throughout the year, except for periods of downtime whilst the gas CHP will be needed for 1000 hours a year.

Revenue will be generated through electricity sales to the grid, based on wholesale electricity price and heat sales to the heat network, based on the current price of gas for the

end user. The heat and power generated by the biomass CHP will also benefit from either two ROCs or one ROC and RHI, as discussed previously.

District Heating Network

A district heating network will be installed to export the heat to the buildings in the development. This will require large distribution pipe along the main trunks of the development and branch pipe work to deliver the heat to individual units. Heat exchangers may be required in the individual buildings to transfer the heat from the network. A cost estimate for installing a district heating network has been included in the model. This is based on the number of dwellings as a reference and has been generated from a previous study undertaken by WA. The details are shown in Table 7.

Distribution Pipe	£420	per meter
Branch Pipe	£200	per meter
Project management costs	10%	
Contingency costs	5%	

Energy Service Company

In order for a developer or company, or indeed local authority, to benefit from the investment opportunities available from the whole site solutions it may be necessary for the company to form an Energy Service Company (ESCo) to manage the plant and heat network and/or windfarm. The cost of running this ESCo has been estimated at 10% of the annual revenue.

Financial Appraisal

The EAT uses a standard discounted cash flow (DCF) technique to appraise the financial viability of each of the low and zero carbon options. A number of financial assumptions have been made based on current market trends and conditions.

The returns on investment will depend on the price that electricity or gas is traded at. The costs of gas and electricity have been estimated based on current market conditions for both wholesale price and the consumer price. These are shown in Table 8.

Table 8: Estimated Energy Prices			
Fuel	Wholesale	Supplied	
<i>Electricity</i>	5	12	p/kWh
<i>Gas</i>	2	4	p/kWh

Whilst it is generally accepted that energy prices will rise it is not possible to predict that rate of inflation and therefore the model assumes that prices remain constant, however these figures can be adjusted by the user. This provides a worst case scenario for the financial assessment. Overall inflation and the time value of money are accounted for in the discount rate.

Additional revenue will be generated through the relevant renewable energy incentive available for different types and scales of technologies. A full breakdown of the Feed in Tariff, Renewables Obligation and Renewable Heat Incentive tariff levels can be found in the EAT.

The Net Present Value (NPV) and Internal Rate of Return (IRR) have been calculated for the relevant technologies to provide comparison figures. To reflect the true value of the investment at the end of the project lifetime a discount rate of 12% has been applied to the cash flow model to allow for depreciation in the current value of money. This is incorporated into the NPV.

APPENDIX 5

Consultation Discussions

APPENDIX 5 – SUMMARIES OF DISCUSSIONS IN CONSULTATION EVENT WORKSHOPS

Workshop 1 (Private Sector)

1. Planning Policy - Guide, Shape & Encourage Development

- The policy approach is fundamental in how we plan for future infrastructure needs – need to fully consider this issue (renewables) within the context of the Infrastructure Delivery Plan & the Community Infrastructure Levy
- Policy needs to be positive in its intent with certainty provided to developers
- The policy should include within it an identification of broad areas of opportunity
- As an extension to policy, further guidance needs to be provided which distils out how best to achieve renewable targets
- The role of pre-application guidance in helping to shape renewable schemes was emphasised with the need for the local authority to take a lead in establishing proactive examples of best practice
- Planning process and the time taken to bring forward schemes was felt to be an obstacle to progression – for significant schemes such as 3x1.5 MW wind turbines at Tata Steel taking account of, for instance, the ecological impacts can be very onerous
- Important for the public to know and understand the benefits of the technologies including both the positive environmental and economic advantages that can be yielded
- From Sheffield's experience (who followed the Merton lead) they suggested that the 10% figure could be too low – may need to investigate this further.
- Could a policy be included on micro-generation or the nature/design of installations that could be acceptable? Potential conflicts with other ambitions of the plan such as preserving historic character of conservation areas or spoiling aesthetics/landscape of countryside needs to be fully considered
- Targets relating to an overall vision - for instance within the Dearne Valley has it proved easier to achieve their ambition because of the vision for the area? Suggests policy needs to be seen in its widest context of what the Development Plan hopes to achieve

2. What targets should be applied? Is there a case for local targets? Borough wide or for individual developments?

- Balance needs to be reached between the planning for renewables & the application of energy efficiency measures
- Avoid mistake of regional target which set in place a minimum which has scope for misinterpretation
- Notwithstanding any local targets, the 2020 energy target was felt to be challenging. The Code for Sustainable Homes will also need to be met for new developments.
- Retrofitting existing developments was felt to be particularly challenging, but still needs to be considered given likely lifespan of these properties
- Apply a general borough target but opportunities could be explored for enhanced targets within particular development schemes
- Targets should be locally derived and driven by capacity and availability of renewable resources
- Should the targets be based on renewables or CO2 reductions? A low carbon element allows for flexibility to be incorporated.
- Requires a behavioural change in the market sector – developers are reluctant to absorb additional upfront costs
- A collective appetite from architects in their designs, planners through creating infrastructure and the benefits message being conveyed by developers will all be necessary to achieve success
- Suggestion that other aspects as well as renewable energy generation need to be considered including funding from utility companies to upgrade networks as well as challenges for these companies as to how they bill for heat as opposed to the traditional gas & oil
- Should avoid setting targets too high as this will impact on viability - it would be unfortunate if this were to prejudice ambitions for new development generally
- Equally setting the local target too low can be a barrier to higher achievement, as once the target is met, the general public may use this to oppose any further developments (e.g. wind farms).
- Pioneering targets may also encourage investment elsewhere where the demands are less pressing
- What role could Building Regulations play given that they often move in advance of planning policy. This extended to talking about Code for Sustainable Homes and

BREEAM standards. Suggestion that Building Regulations seem to be already moving towards allowing the developer to choose which form of technology to use

- General consensus that there should not be separate borough-wide targets for individual technologies - whilst recognising there are differing levels of resource available this needs to be resolved within individual developments & taking account of site specific constraints. Setting targets for different technologies also takes away the choice of technology from the developer.
- The commercial opportunities of energy generation could be explored alongside the actual development itself
- Through the operations of Tata Steel and its obligations under the Carbon Reduction Commitment mean that a failure to achieve this will place substantial financial penalties upon them. The significance of their shift in approach to energy generation will have major consequences for the whole of the Borough and contributions towards any target

3. Is a level playing field across the region important? Should there be a common set of targets for South Yorkshire?

- Discussion was time limited but view was that there should be a consistency of approach whether that be through the sub-region or city-region. Specific areas should not be identified for special attention as this was felt to disproportionately draw energies and investment from elsewhere which was seen to be detrimental to overall ambitions

4. Money talks - What LC&RE technologies make economic sense to the private sector?

- Opportunities from decentralised energy and combined heat & power were felt to be substantial. Waste to energy opportunities could also be exploited

5. Timing isn't everything but its right up there with oxygen! Could businesses keep up if RMBC takes a pioneering approach?

- Phased implementation was suggested to avoid a situation of looking to achieve too much in the short term. Pragmatic approach advocated to avoid potential for backtracking on policy stance if it was not proving to be achievable

- Consider the implications of the Green Deal http://www.decc.gov.uk/en/content/cms/tackling/green_deal/green_deal.aspx
- Suggestion that other aspects as well as renewable energy generation need to be considered including funding from utility companies to upgrade networks as well as challenges for these companies as to how they bill for heat as opposed to the traditional gas & oil
- Delivery overall dependent upon the legal, financial, technology, installation, and on going care arrangements being established and carried out effectively

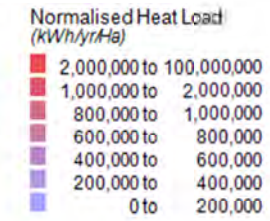
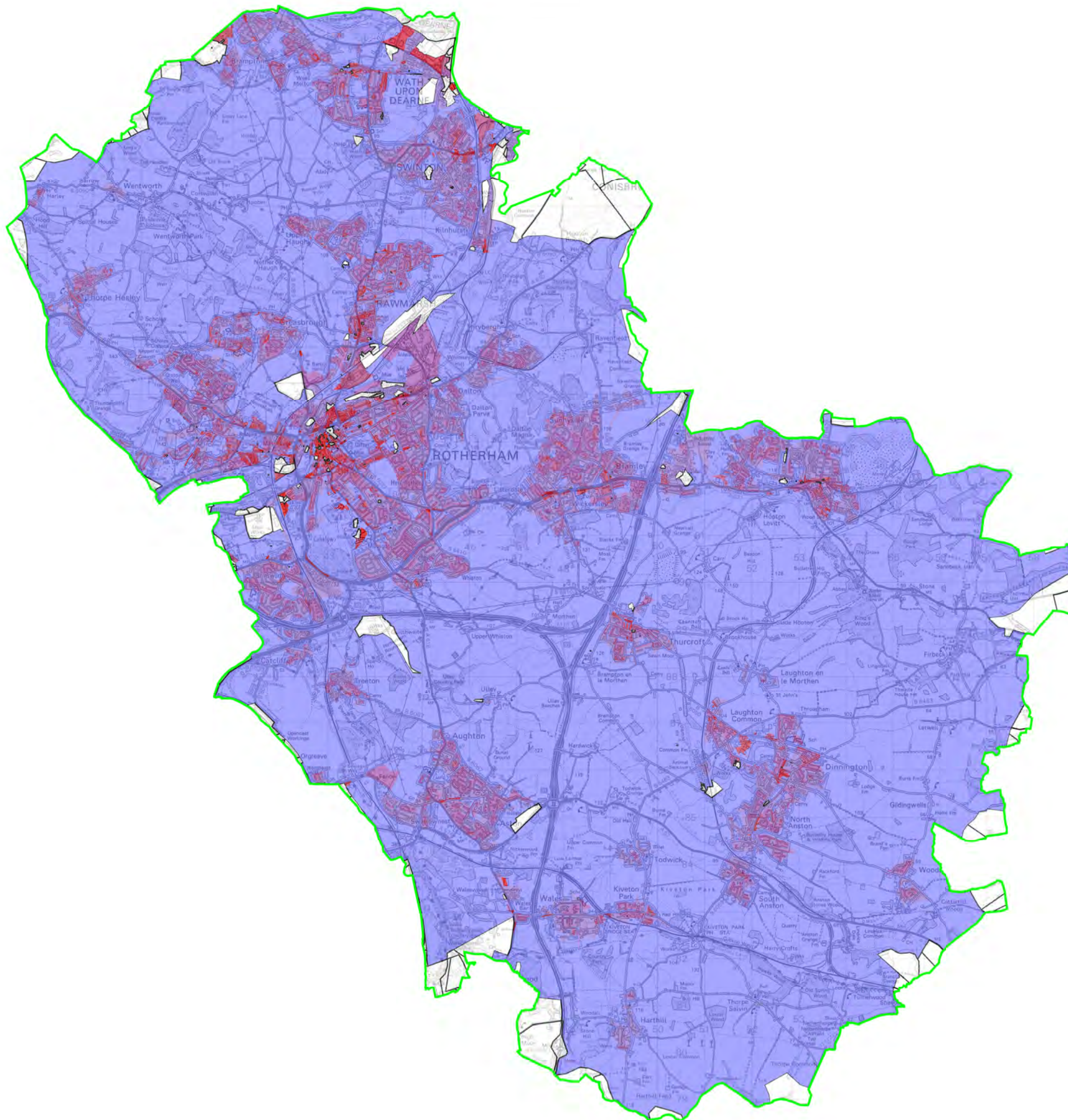
Additional Comments

- We need to have an idea of where we need to be in 2050 to meet our CO2 reduction targets – utilise the Carbon Model as a benchmark of progress.
- There needs to be a combined approach across all the departments and an agreement on how renewables are to be integrated into planning policy.
- Lack of strong policies currently (10% Merton rule aside)
- Where possible, we should aim to integrate renewable projects to make the most of Feed in Tariffs and Renewable Heat Incentives – although it was agreed that long term there needs to be a more sustainable approach.
- Possibility of renewable energy contribution through CIL? Although it was considered this may not be viable.
- There is a need to highlight a direct policy on wind power and for all forthcoming planned developments.
- Case for SY wide discussion on priority areas – potential to discuss sharing renewable energy targets and low carbon initiatives to reduce risk of developers ‘moving elsewhere’
- Stronger promotion of energy efficiency rather than renewables to reduce reliance on using energy. It was suggested this could be a more viable option due to the low demand for housing in the area.
- It was suggested all developments should be considered on a case by case basis in conjunction with the LDF to determine which areas could deliver different types of projects.
- Recommendation & training could be given to members and officers could provide a number of options for elected members to choose from.

Workshop 2 (Public Sector)

This group ran out of time and it is unclear how many of the workshop agenda points it managed to cover.

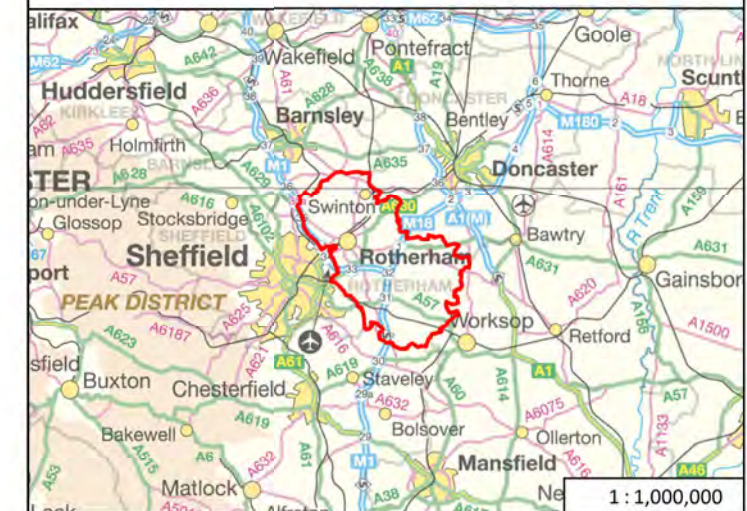
- Core Strategy must be able to demonstrate long term robustness. It can't rely on the existence of current grant schemes, such as Feed in Tariff.
- Could relax standards in order to increase Renewable Energy
- Difficulties of Rotherham securing development due to viability concerns – need to take care not to prevent development
- Should focus on achieving reducing demand for energy and increasing energy efficiency before seeking renewables.
- Need to understand priorities for renewable energy balanced against other priorities such as need for affordable housing.
- Stress need to get steer from Members. Alternative view that officers need to set priorities and gain Member acceptance.
- Need for alignment of approach to Sheffield's approach.
- CPRE believe that Council should be taking positive and proactive approach to renewable energy.
- Consider use of commuted sums to deliver renewables.
- Could provide information on the ranking of renewable technologies in terms of costs and outputs.
- South Yorkshire Climate Network – Chief Executives decision has been made to decide common priorities across South Yorkshire and to encourage all local authorities to be pioneering.



Rotherham Metropolitan Borough Boundary



This heat map shows the aggregation of residential, commercial and industrial heat loads as modelled using standard benchmarks and assumptions based on industry experience.



BNG Ref: 447800 : 389900	OS 100km Grid: SK	Landranger Ref: 111
Long : Lat DD -01.2804° : 53.4037°	Long : Lat DMS -01 16 49.4 : 53 24 13.3	

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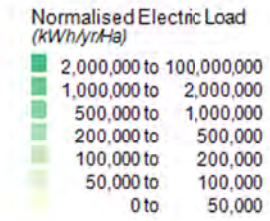
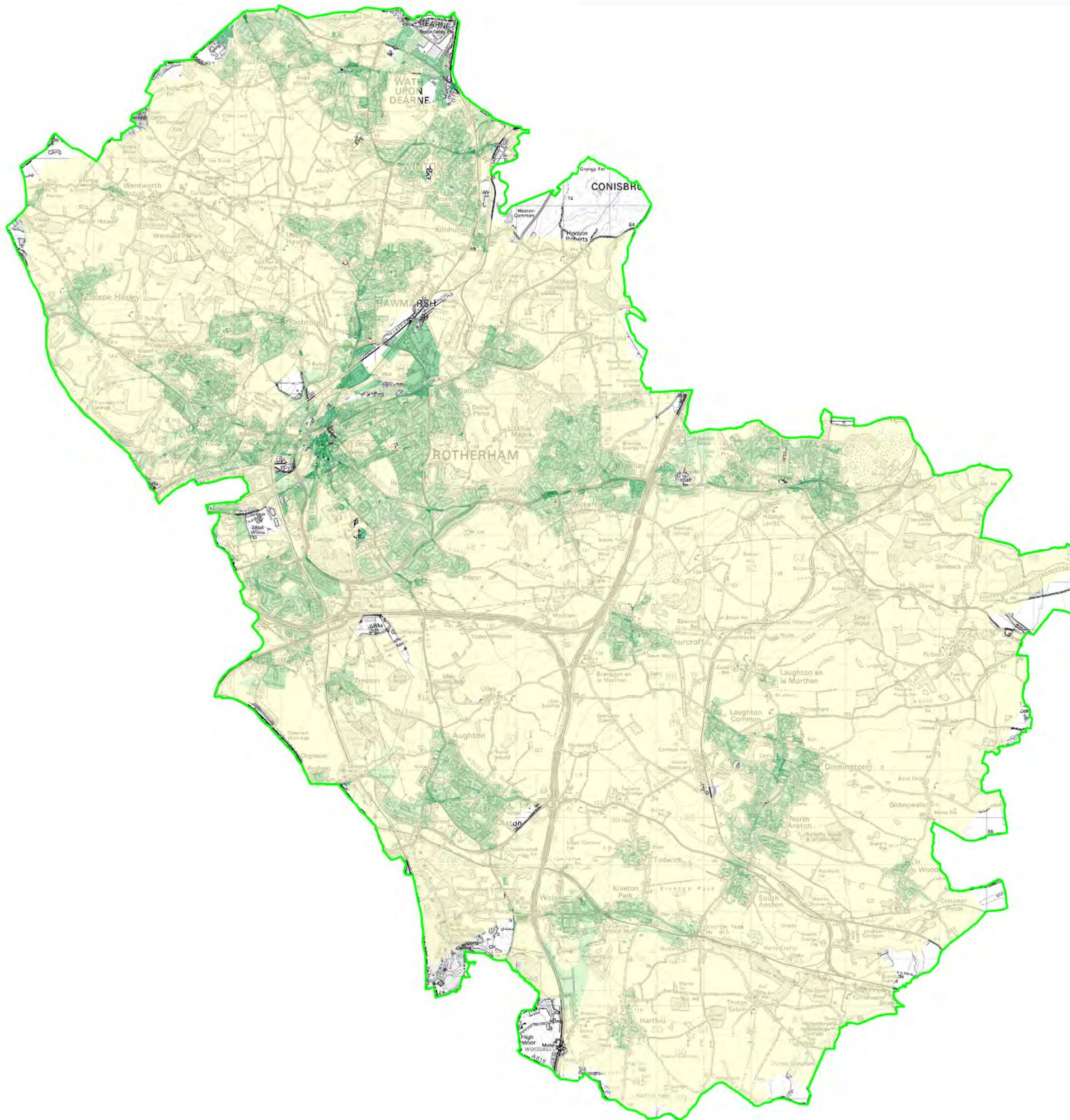
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Drawn By: S.J.Allen	Date: 15/09/2011
Checked By: P.Evans	Date: 16/09/2011

**Borough Combined Heat Use
Local Development Framework
Rotherham Metropolitan Borough**

RMB_HEAT_ALL_ZT420418 Figure 3.1

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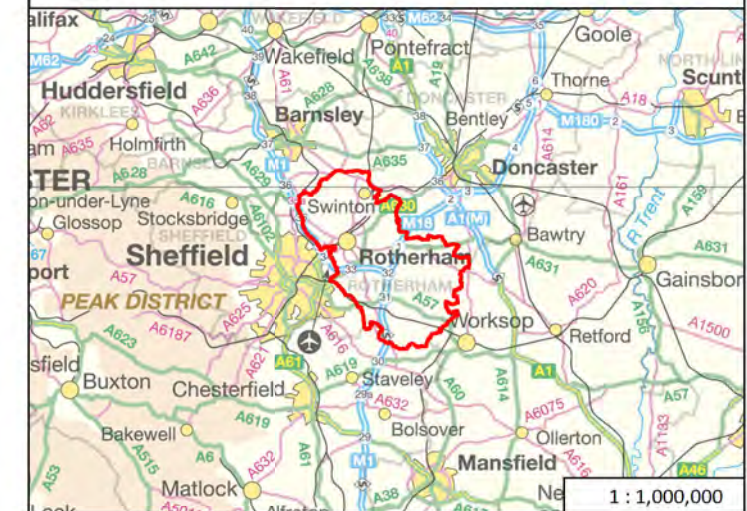


Rotherham Metropolitan Borough Boundary



The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Commercial buildings only are considered here at this stage. No industrial or residential settlements have yet to be factored in.



0 5 10 kilometres		1 : 1,000,000
BNG Ref: 447800 : 389900		OS 100km Grid: SK Landranger Ref: 111
Long : Lat DD -01.2804° : 53.4037°		Long : Lat DMS -01_16_49.4 : 53_24_13.3



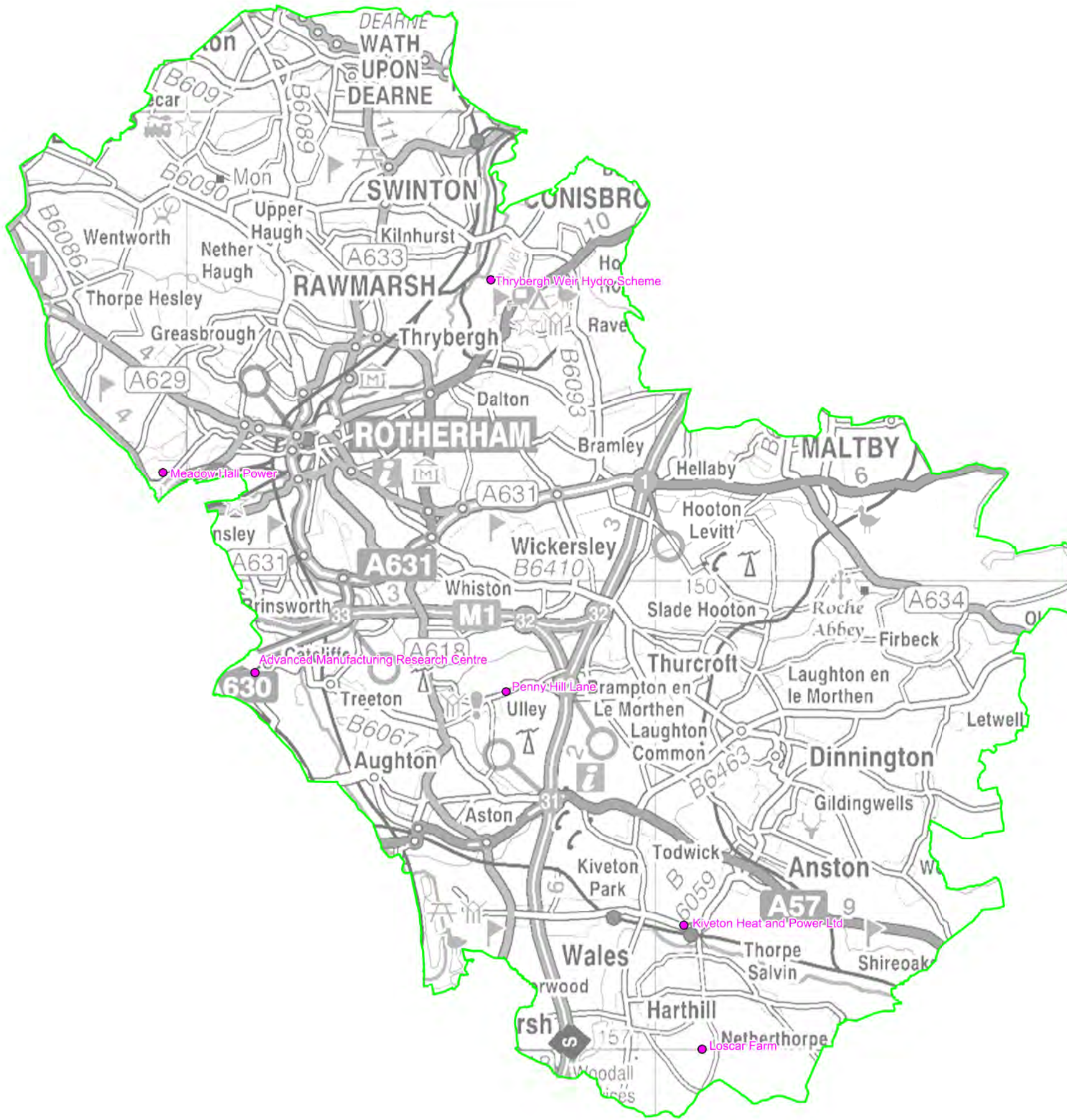
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Drawn By: S.J.Allen	Date: 15/09/2011
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Borough Combined Electricity Use
Local Development Framework
Rotherham Metropolitan Borough

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- Rotherham Metropolitan Borough Boundary
- RESTAT Listed Renewable Scheme



BNG Ref: 447800 : 389900	OS 100km Grid: SK	Landranger Ref: 111
Long : Lat DD -01.2804° : 53.4037°	Long : Lat OMS -01_16_49.4 : 53_24_13.3	

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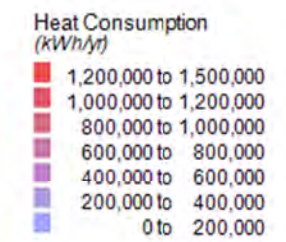
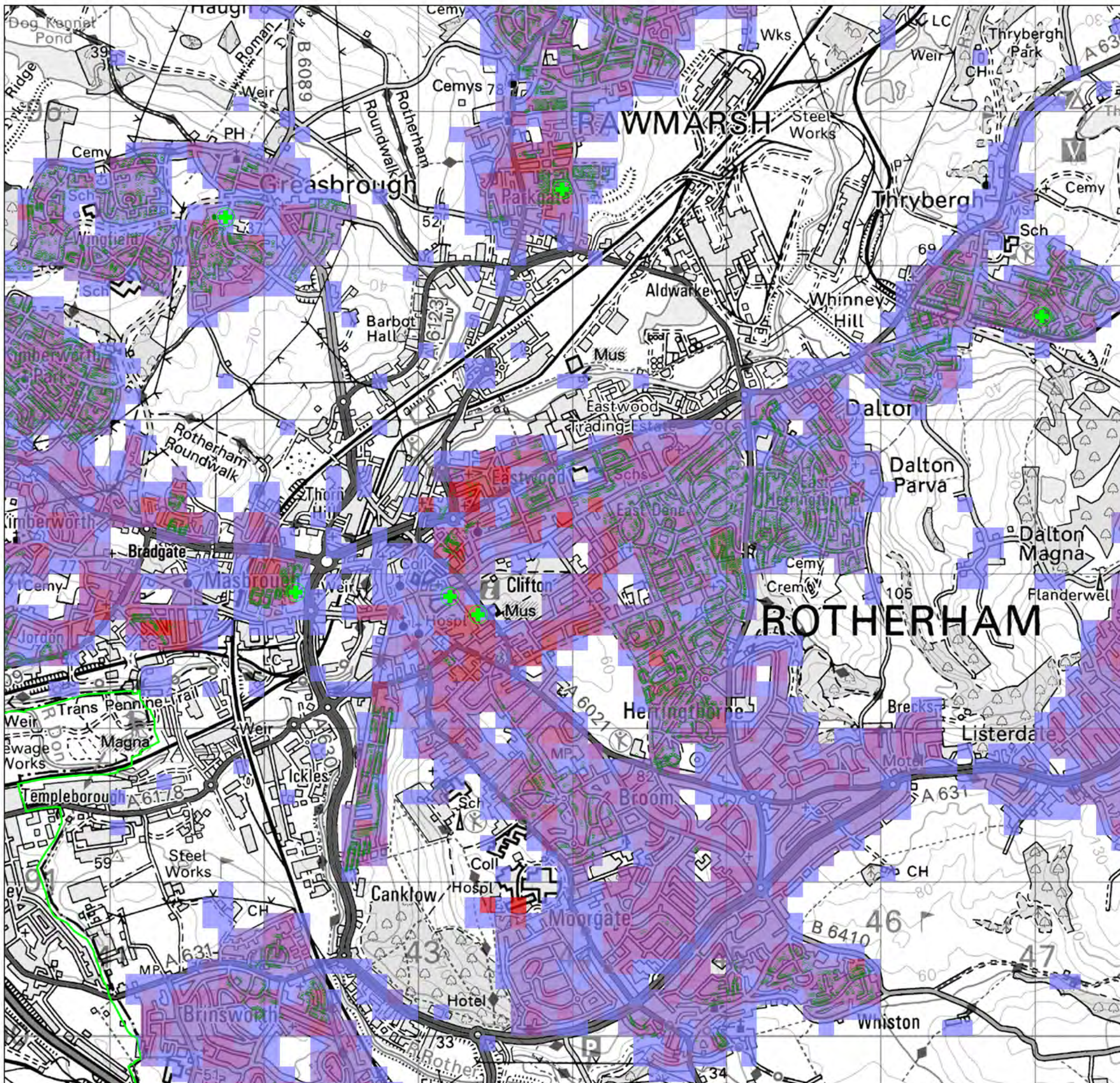
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Drawn By: S.J.Allen	Date: 15/09/2011
Checked By: P.Evans	Date: 16/09/2011

**Existing Renewable Energy Projects
 Local Development Framework
 Rotherham Metropolitan Borough**

RESTAT_V1_ZT420418
Figure 3.3

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- Rotherham Metropolitan Borough Boundary
- + Existing District Heating Networks
- + Existing Council Houses

These heat maps have been generated by estimating building types from the residential subset of the Local Land and Property Gazetteer. Building types (ie flats/terraced/semi-detached/detached) were then attributed energy usage benchmarks and the mapping produced was based on 100m grid.

Residential buildings only are displayed on this map.



Scale: 1:1,000,000 and 1:25,000 @ A3

BNG Ref: 443980 : 393180	OS 100m Grid: SK	Landranger Ref: 111
Long : Lat DD -01.3380° : 53.4333°	Long : Lat DMS -01_20_16.6 : 53_25_59.9	

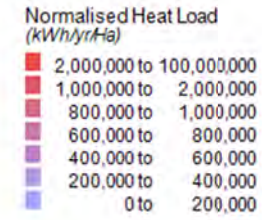
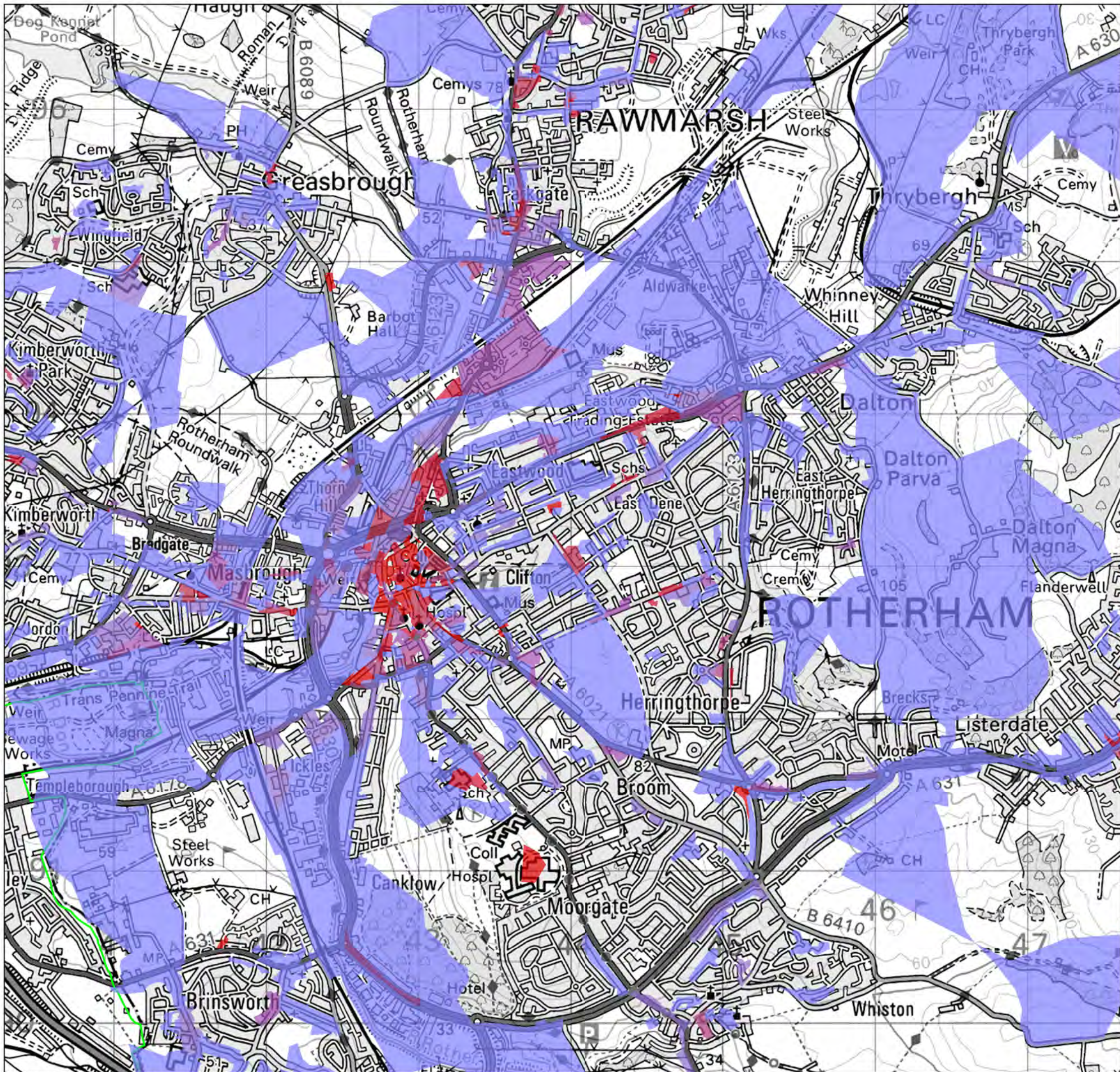
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**Rotherham Residential Heat Use
Local Development Framework
Rotherham**

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 Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Commercial buildings only are displayed on this map.

Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m2).



BNG Ref: 443980 : 393180	OS 100km Grid: SK	Landranger Ref: 111
Long: Lat DD -01.3380° : 53.4333°	Long: Lat DMS -01_20_16.6 : 53_25_59.9	



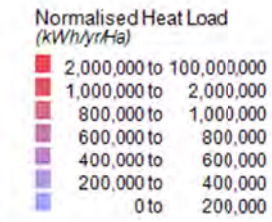
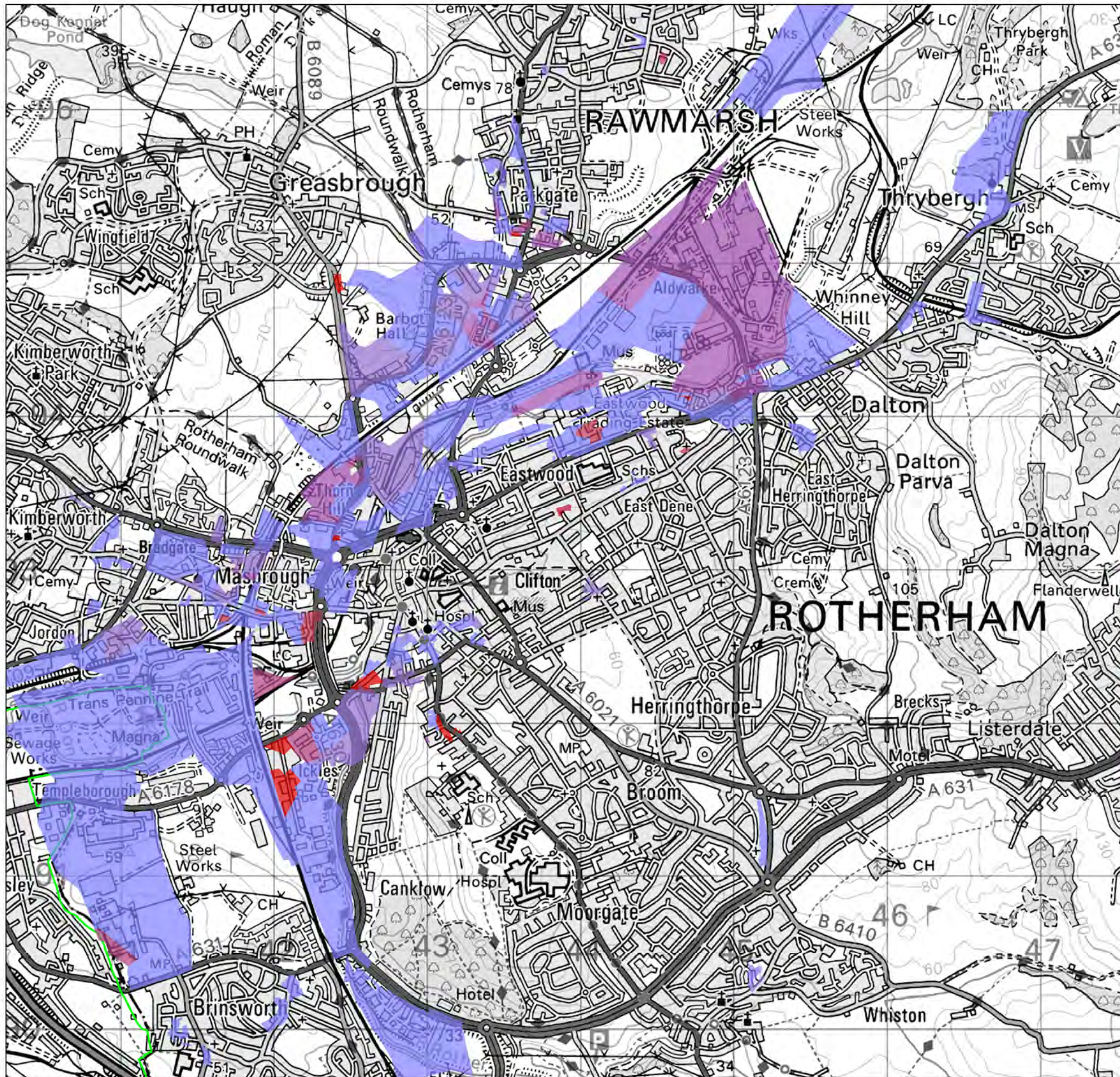
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Rotherham Commercial Heat Use
Local Development Framework
Rotherham

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Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Industrial heat demand only is displayed on this map.

Industrial heat load data for major consumers has not been verified and relevant industrial benchmarks are not known to exist. Industrial heat loads should be verified on a case by case basis before relying on the accuracy of this mapping.

Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m²).



Scale: 1:1,000,000 and 1:25,000 @ A3

BNG Ref: 443980 : 393180	OS 100km Grid: SK	Landranger Ref: 111
Long: Lat DD -01.3380° : 53.4333°	Long: Lat DMS -01_20_16.6 : 53_25_59.9	



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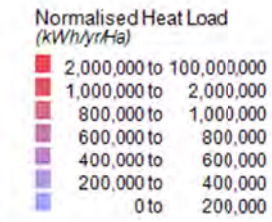
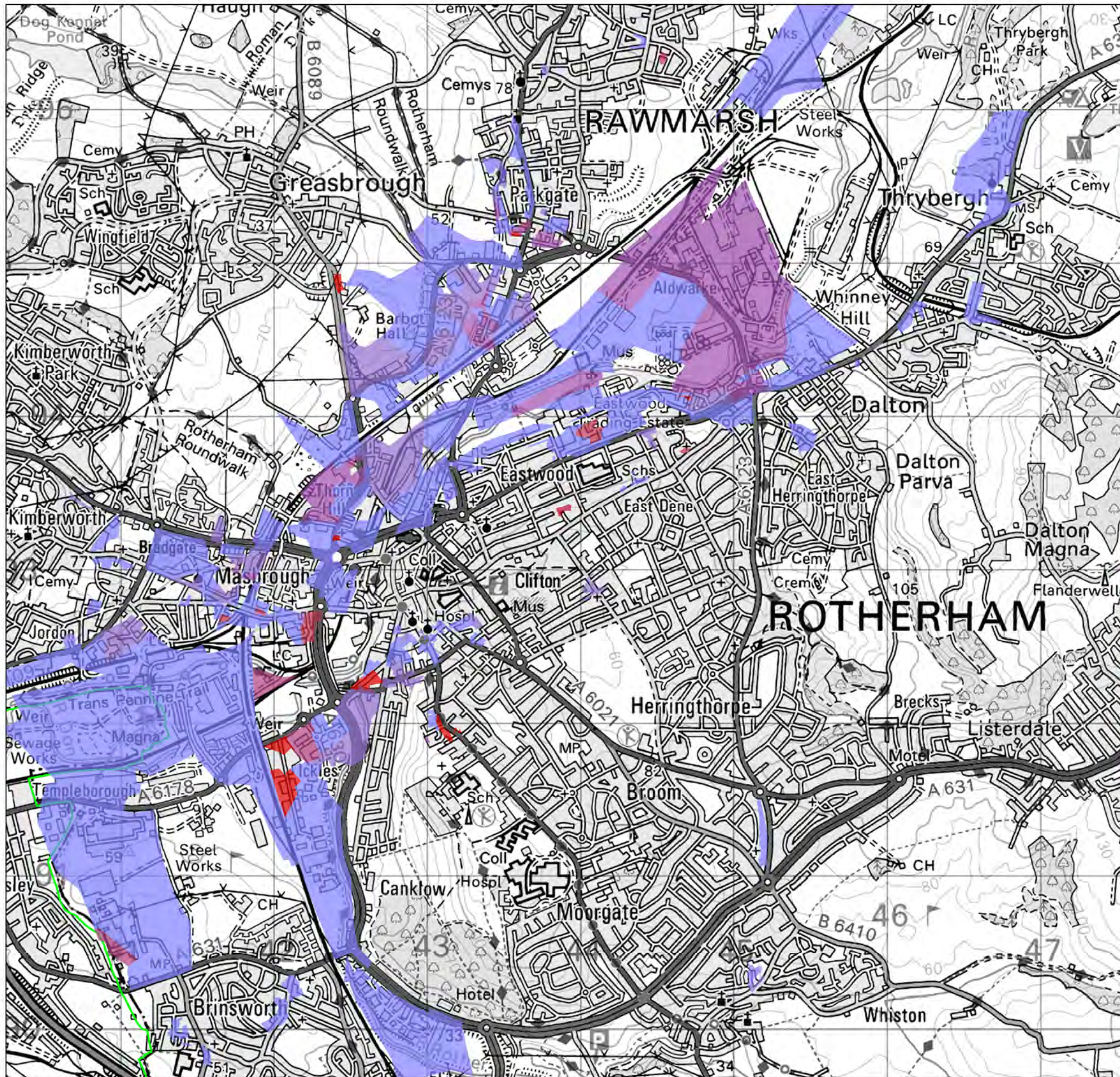
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Rotherham Industrial Heat Use
Local Development Framework
Rotherham

ROTHM_HEAT_IND_ZT420418 Figure 3.6

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Rotherham Metropolitan Borough Boundary

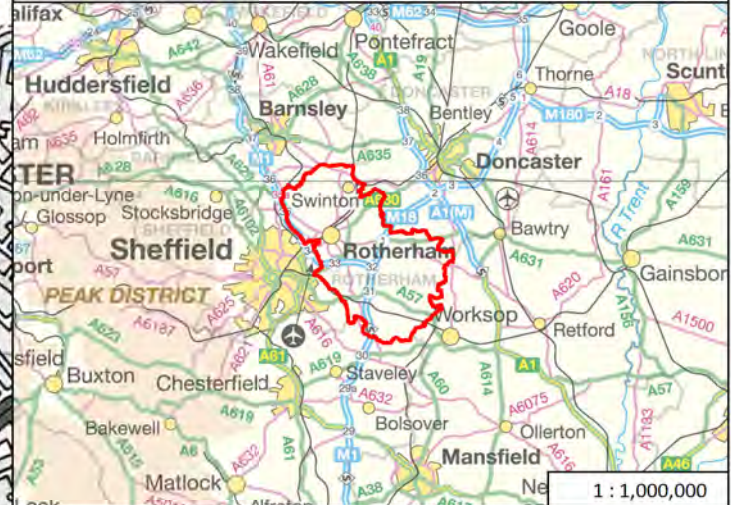


The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Industrial heat demand only is displayed on this map.

Industrial heat load data for major consumers has not been verified and relevant industrial benchmarks are not known to exist. Industrial heat loads should be verified on a case by case basis before relying on the accuracy of this mapping.

Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m²).



Scale: 1:1,000,000 and 1:25,000 @ A3

BNG Ref: 443980 : 393180 OS 100km Grid: SK Landranger Ref: 111
 Long: Lat DD -01.3380° : 53.4333° Long: Lat DMS -01_20_16.6 : 53_25_59.9



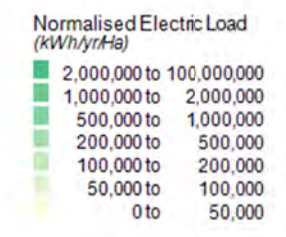
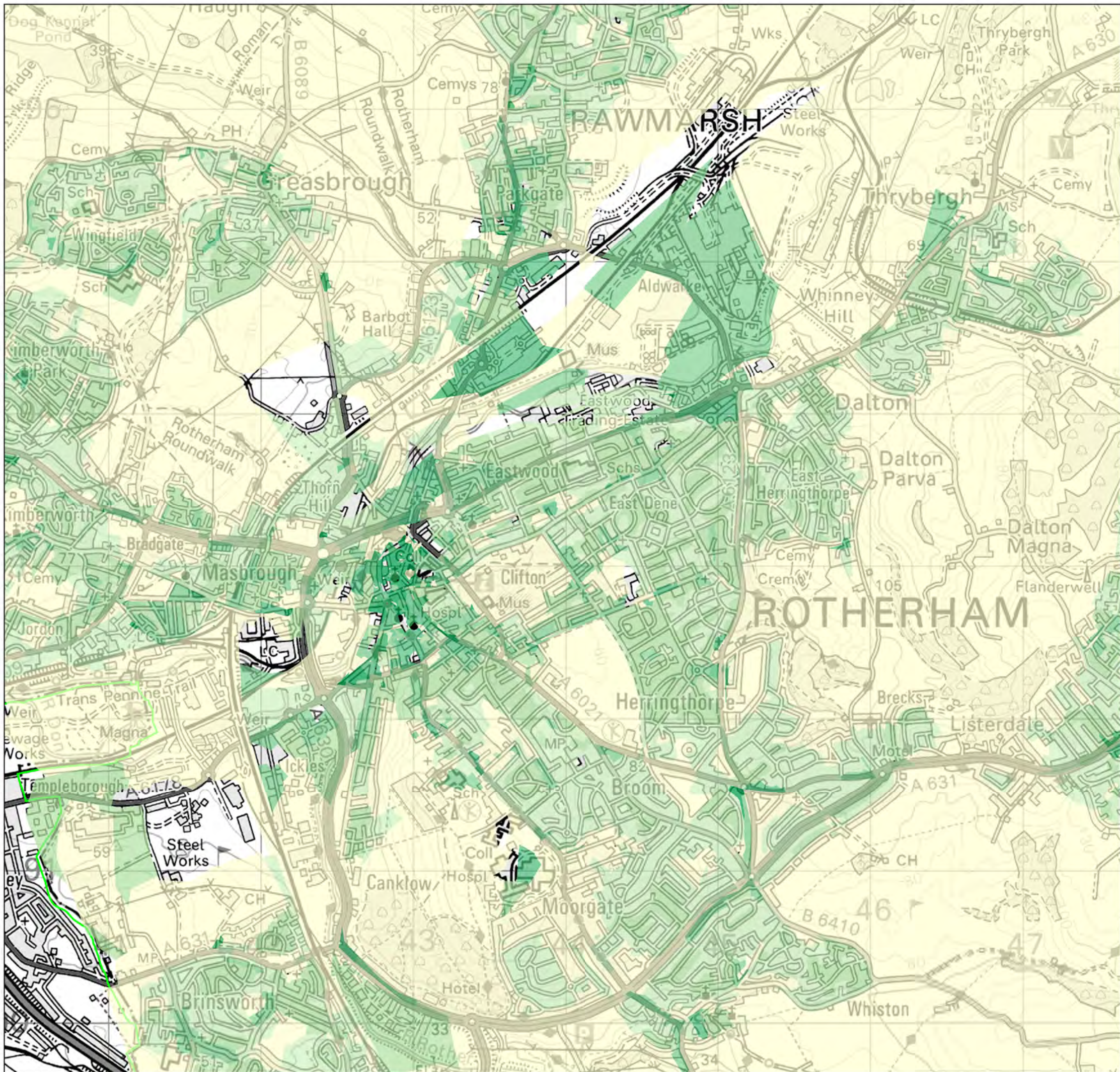
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Rotherham Industrial Heat Use
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ROTHM_HEAT_IND_ZT420418 Figure 3.6

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Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Commercial buildings only are considered here at this stage. No industrial or residential settlements have yet to be factored in.



Scale: 1:1,000,000 (Inset) / 1:25,000 @ A3 (Main)

BNG Ref: 443980 : 393180 OS 100km Grid: SK Landranger Ref: 111
 Long : Lat DD -01.3380° : 53.4333° Long : Lat DMS -01_20_16.6 : 53_25_59.9



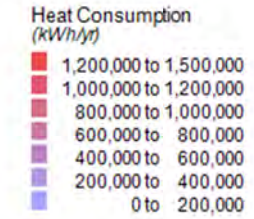
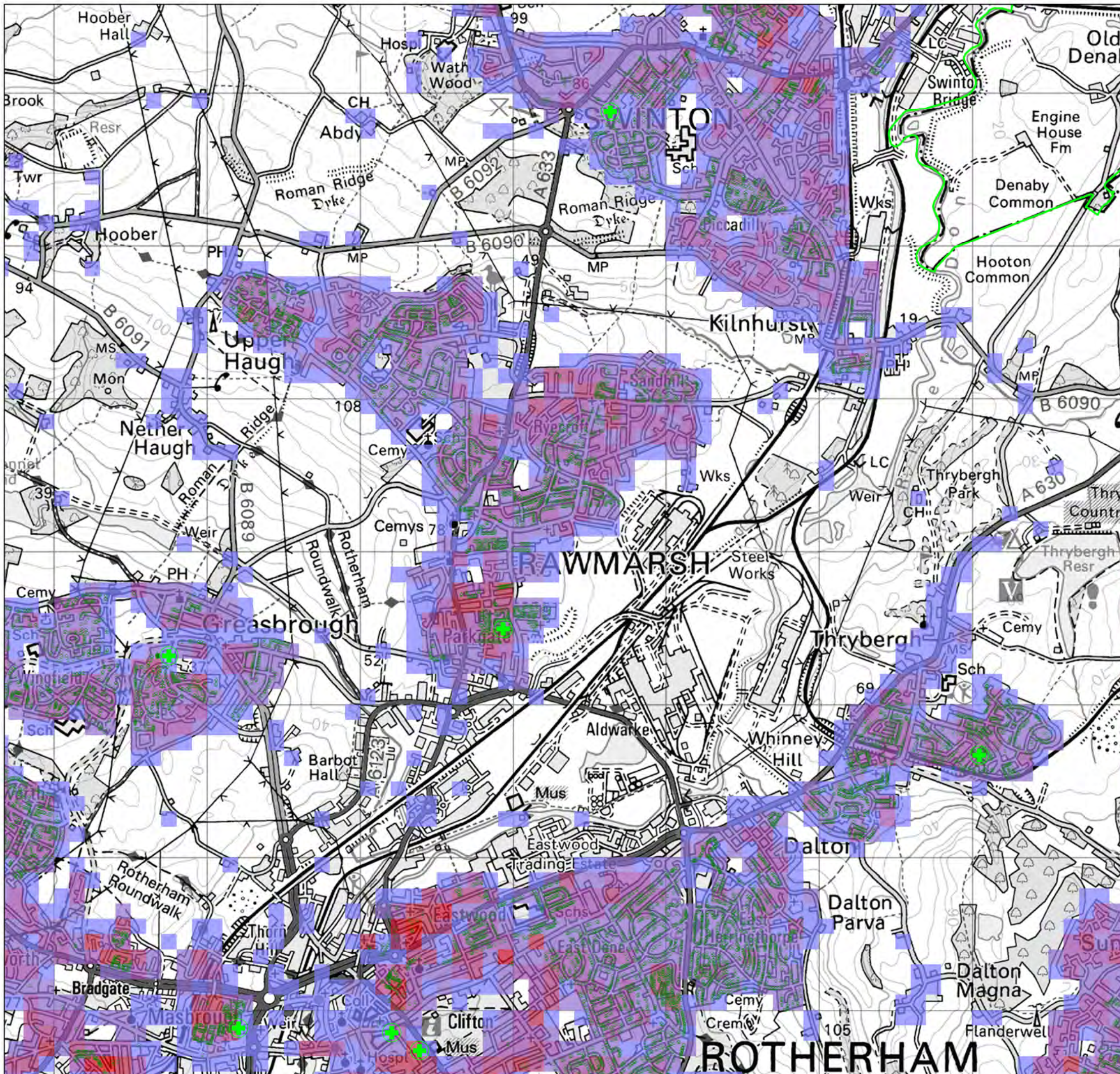
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**Rotherham Combined Electricity Use
 Local Development Framework
 Rotherham**

ROTHM_ELEC_ALL_ZT420418 Figure 3.8

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- Rotherham Metropolitan Borough Boundary
- Existing District Heating Network
- Existing Council Houses

These heat maps have been generated by estimating building types from the residential subset of the Local Land and Property Gazetteer. Building types (ie flats/terraced/semi-detached/detached) were then attributed energy usage benchmarks and the mapping produced was based on 100m grid.

Residential buildings only are displayed on this map.



0 1 2 3 4 5 6 7 8 9 10		1 : 25 000 @ A3
BNG Ref: 444340 : 396070	OS 100km Grid: SK	Landranger Ref: 111
Long: Lat DD -01.3321° : 53.4593°	Long: Lat DMS -01_19_55.6 : 53_27_33.4	



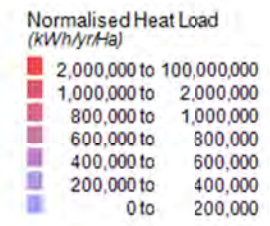
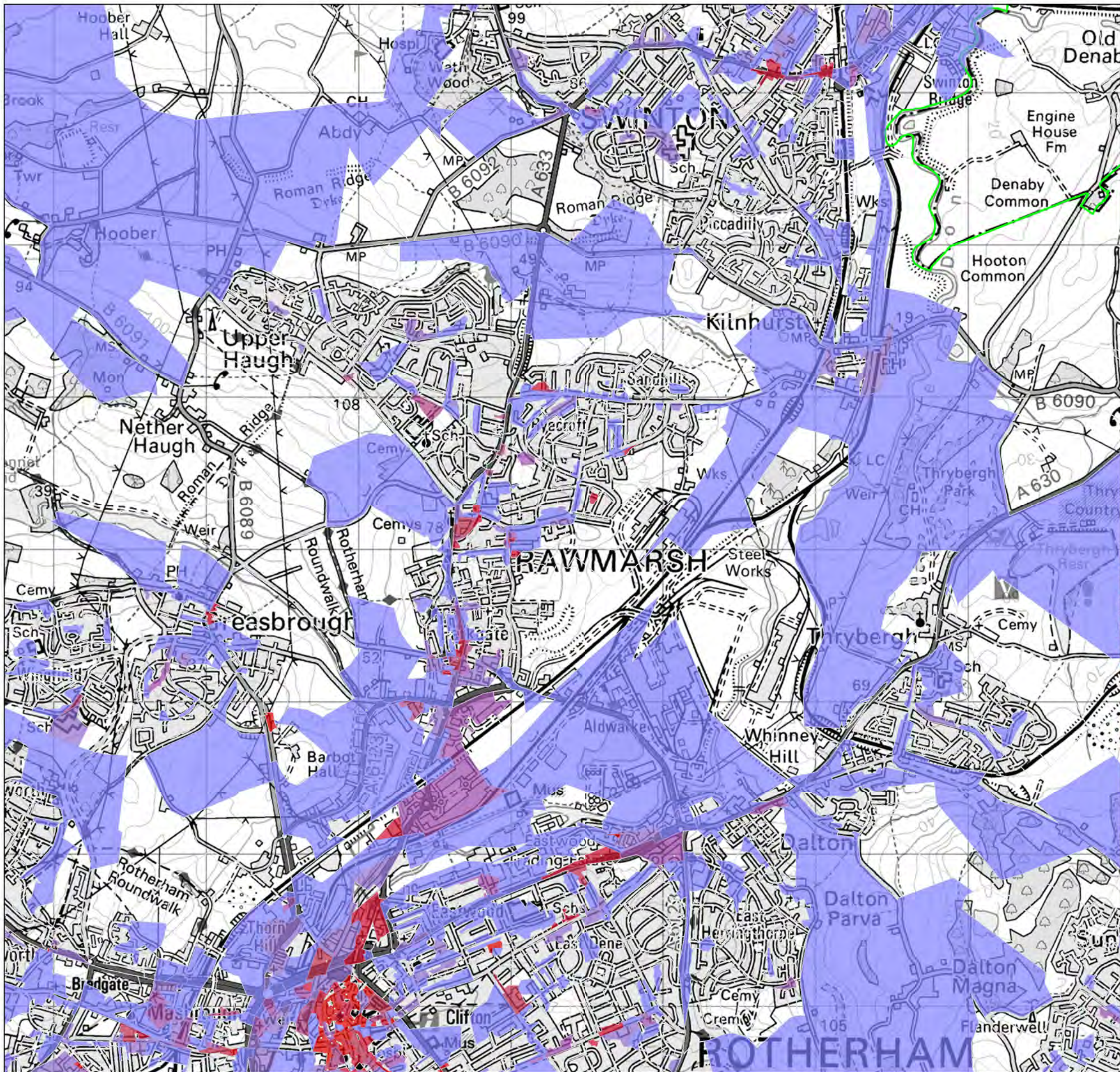
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Rawmarsh Residential Heat Use
Local Development Framework
Rotherham

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Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Commercial buildings only are displayed on this map.

Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m²).



Scale: 1:25,000 @ A3		Scale: 1:1,000,000	
BNG Ref: 444340 : 396070	OS 100km Grid: SK	Landranger Ref: 111	
Long: Lat DD: -01.3321° : 53.4593°	Long: Lat DMS: -01_19_55.6 : 53_27_33.4		



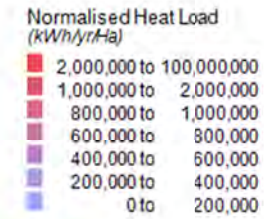
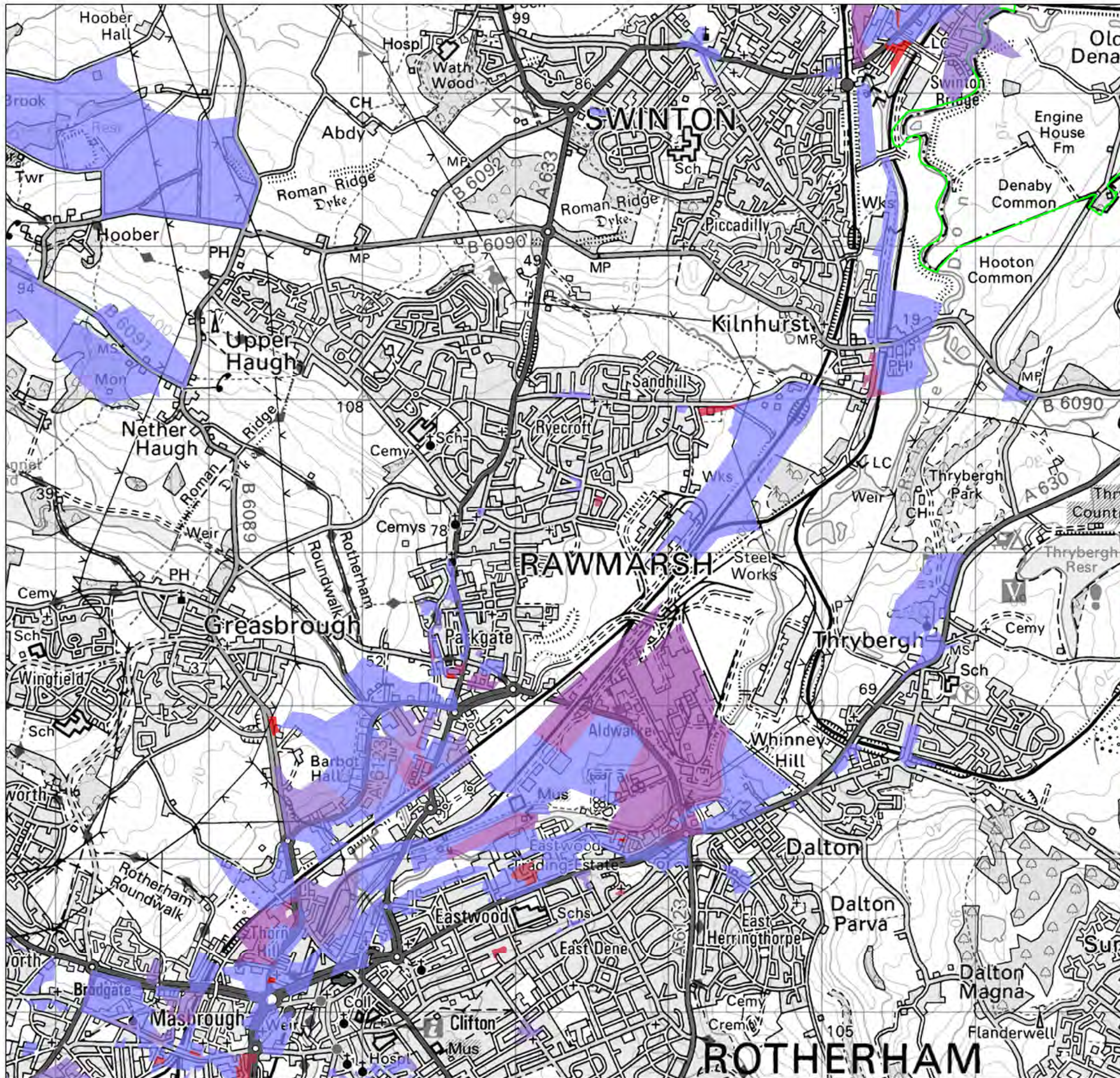
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Rawmarsh Commercial Heat Use
Local Development Framework
Rotherham
RAWMSH_HEAT_COM_ZT420418 Figure 3.10

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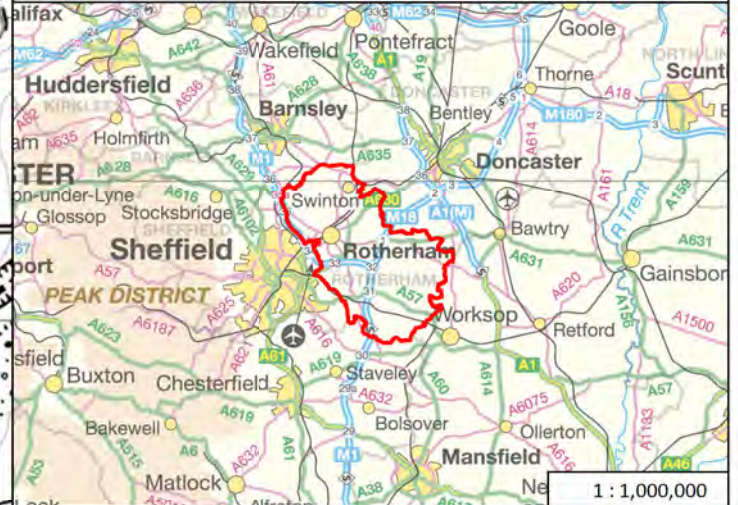
Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Industrial heat demand only is displayed on this map.

Industrial heat load data for major consumers has not been verified and relevant industrial benchmarks are not known to exist. Industrial heat loads should be verified on a case by case basis before relying on the accuracy of this mapping.

Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m²).



BNG Ref: 444340 : 396070	OS 100km Grid: SK	Landranger Ref: 111
Long: Lat DD -01.3321° : 53.4593°	Long: Lat DMS -01_19_55.6 : 53_27_33.4	



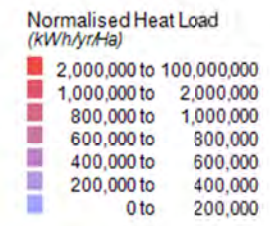
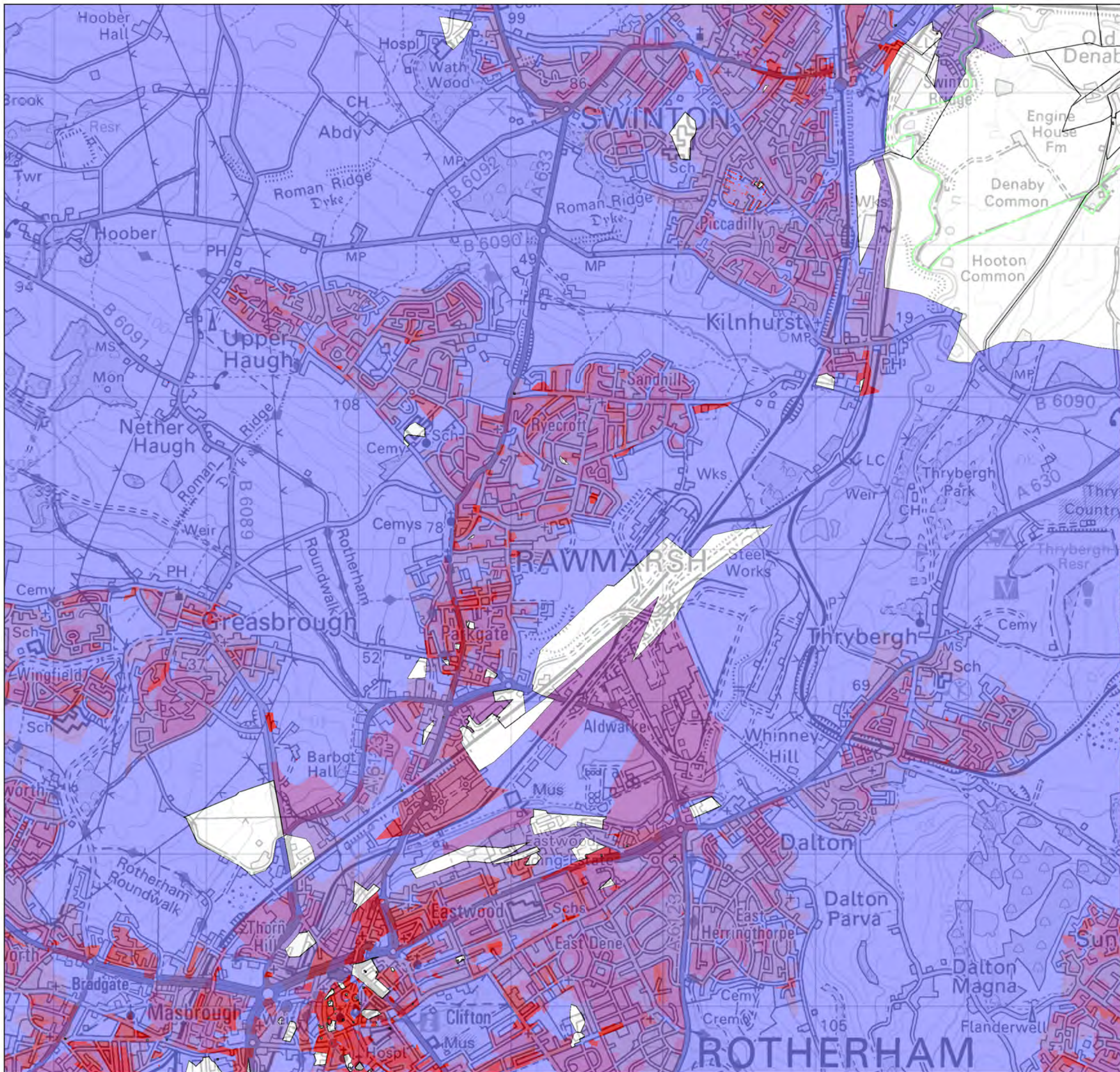
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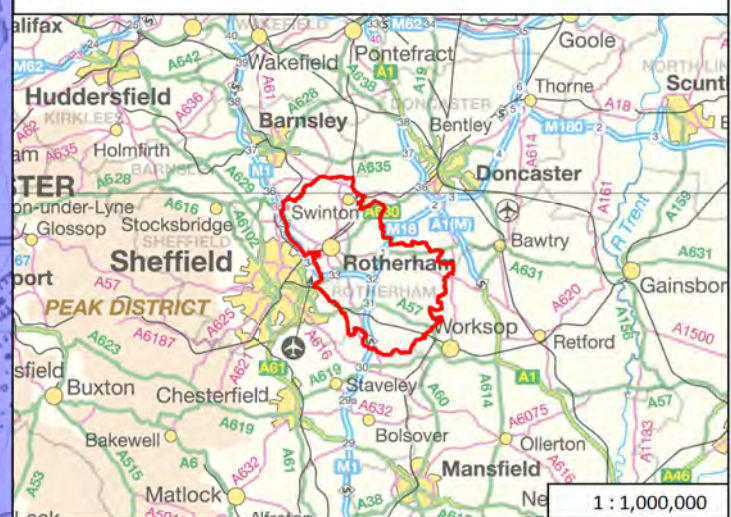
Rawmarsh Industrial Heat Use
Local Development Framework
Rotherham
RAWMSH_HEAT_IND_ZT420418 Figure 3.11

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Rotherham Metropolitan Borough Boundary

This heat map shows the aggregation of residential, commercial and industrial heat loads as modelled using standard benchmarks and assumptions based on industry experience.



Scale: 1:25,000 @ A3

BNG Ref: 444340 : 396070 OS 100km Grid: SK Landranger Ref: 111
 Long: Lat DD -01.3321° : 53.4593° Long: Lat DMS -01_19_55.6 : 53_27_33.4



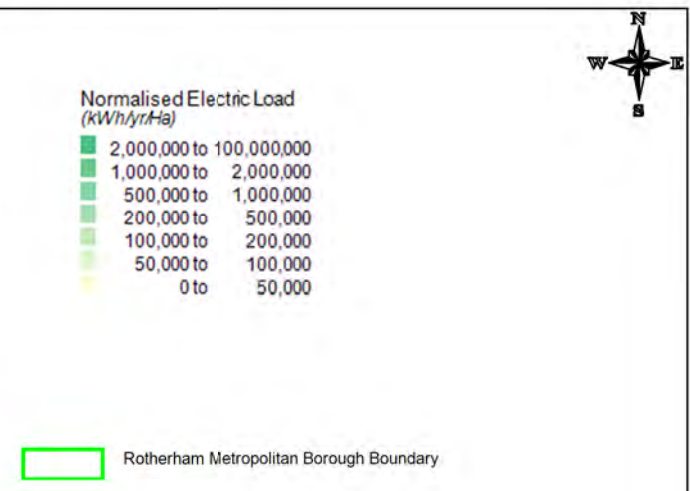
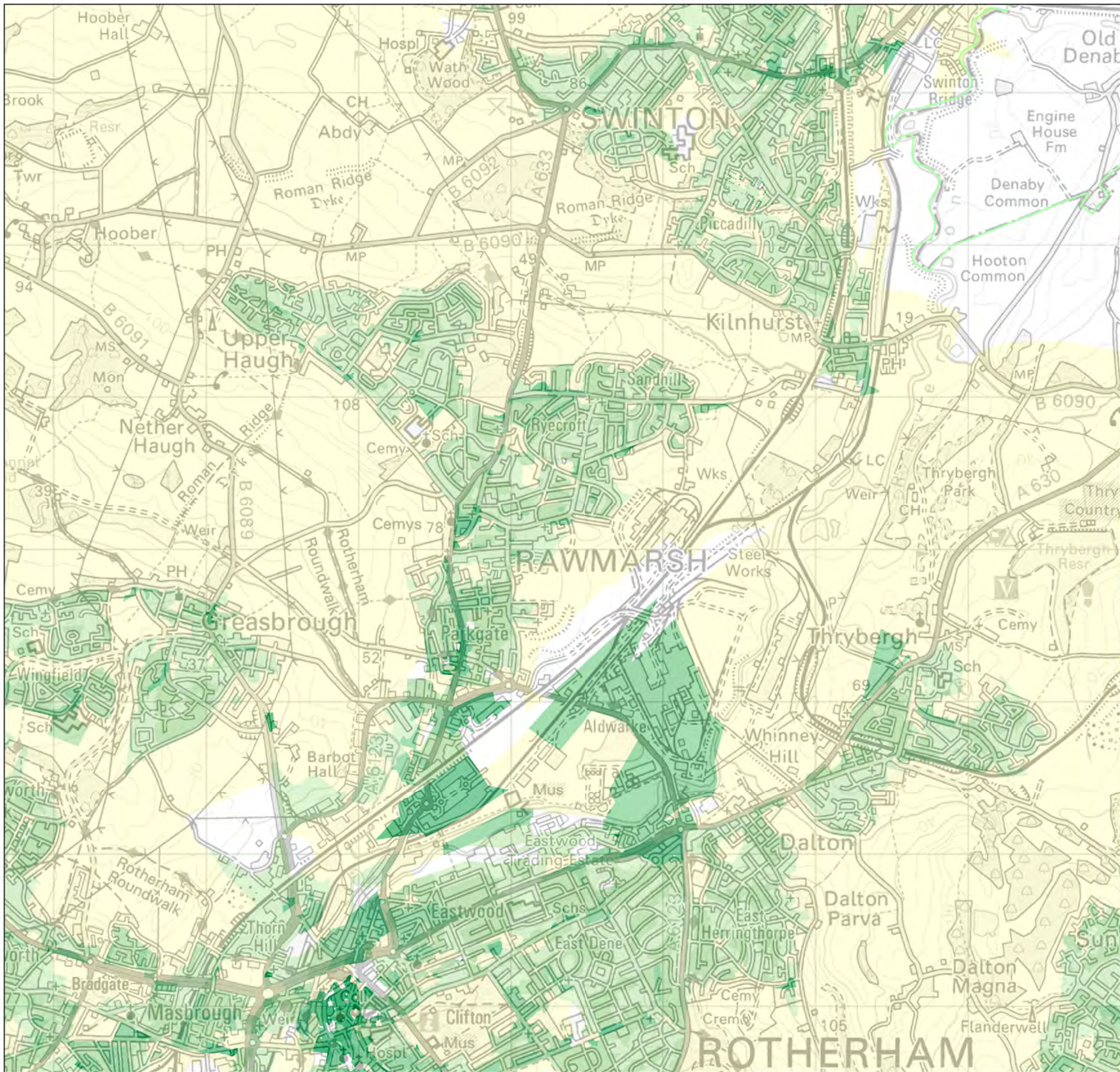
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Rawmarsh Combined Heat Use
 Local Development Framework
 Rotherham

RAWMSH_HEAT_ALL_ZT420418 Figure 3.12

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The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Commercial buildings only are considered here at this stage. No industrial or residential settlements have yet to be factored in.



BNG Ref:	444340 : 396070	OS 100km Grid:	SK	Landranger Ref:	111
Long : Lat DD	-01.3321° : 53.4593°	Long : Lat DMS	-01_19_55.6 : 53_27_33.4		



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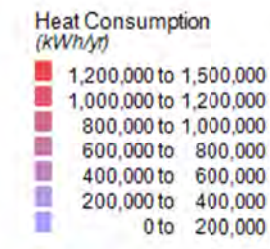
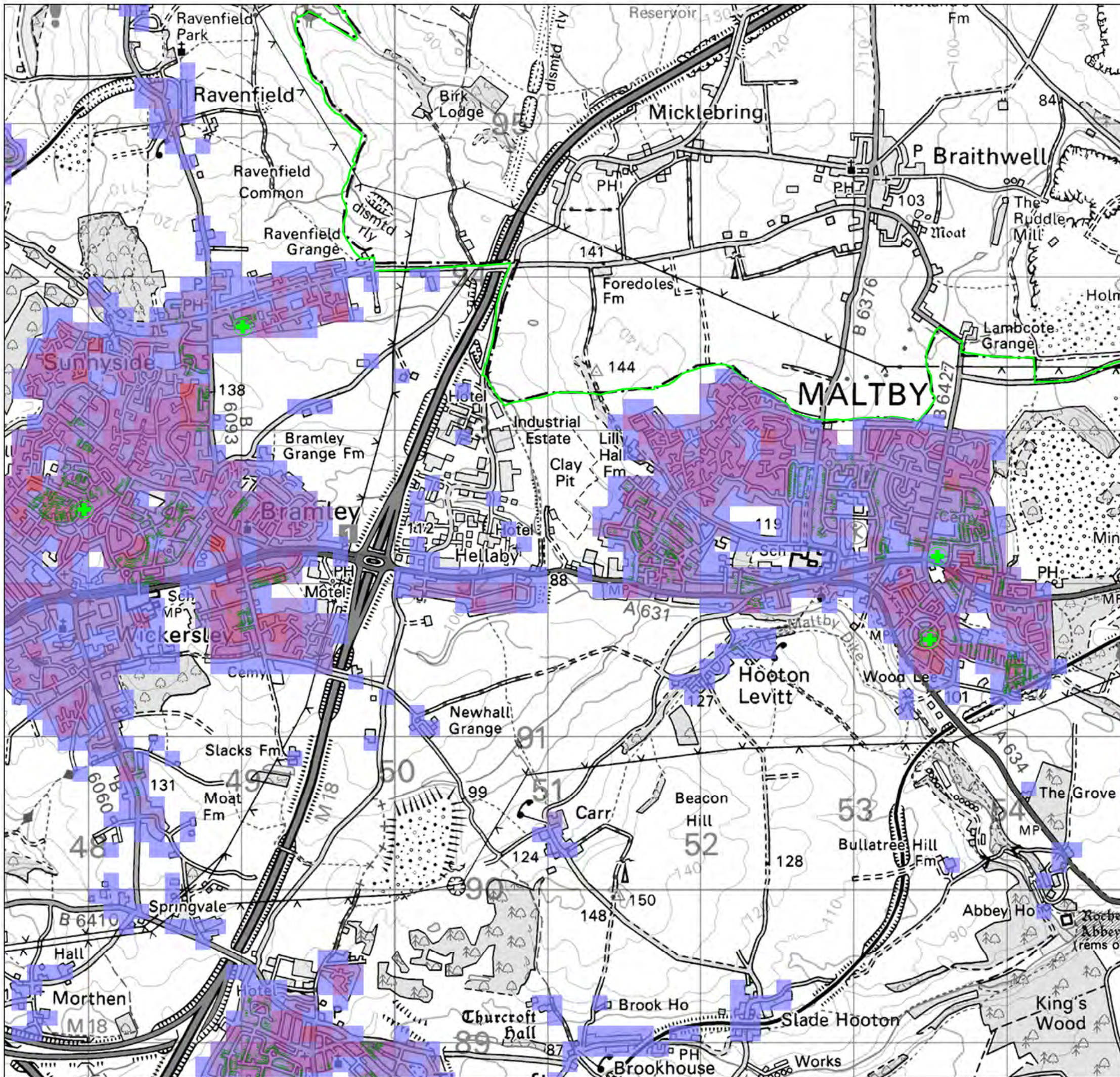
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**Rawmarsh Combined Electrical Use
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Rotherham**

RAWMSH_ELEC_ALL_ZT420418	Figure 3.13
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- Rotherham Metropolitan Borough Boundary
- + Existing District Heating Network
- + Existing Council Houses

These heat maps have been generated by estimating building types from the residential subset of the Local Land and Property Gazetteer. Building types (ie flats/terraced/semi-detached/detached) were then attributed energy usage benchmarks and the mapping produced was based on 100m grid.

Residential buildings only are displayed on this map.



BNG Ref: 451150 : 392270	OS 100km Grid: SK	Landranger Ref: 111
Long : Lat DD -01.2302° : 53.4245°	Long : Lat DMS -01_13_48.7 : 53_25_28.3	

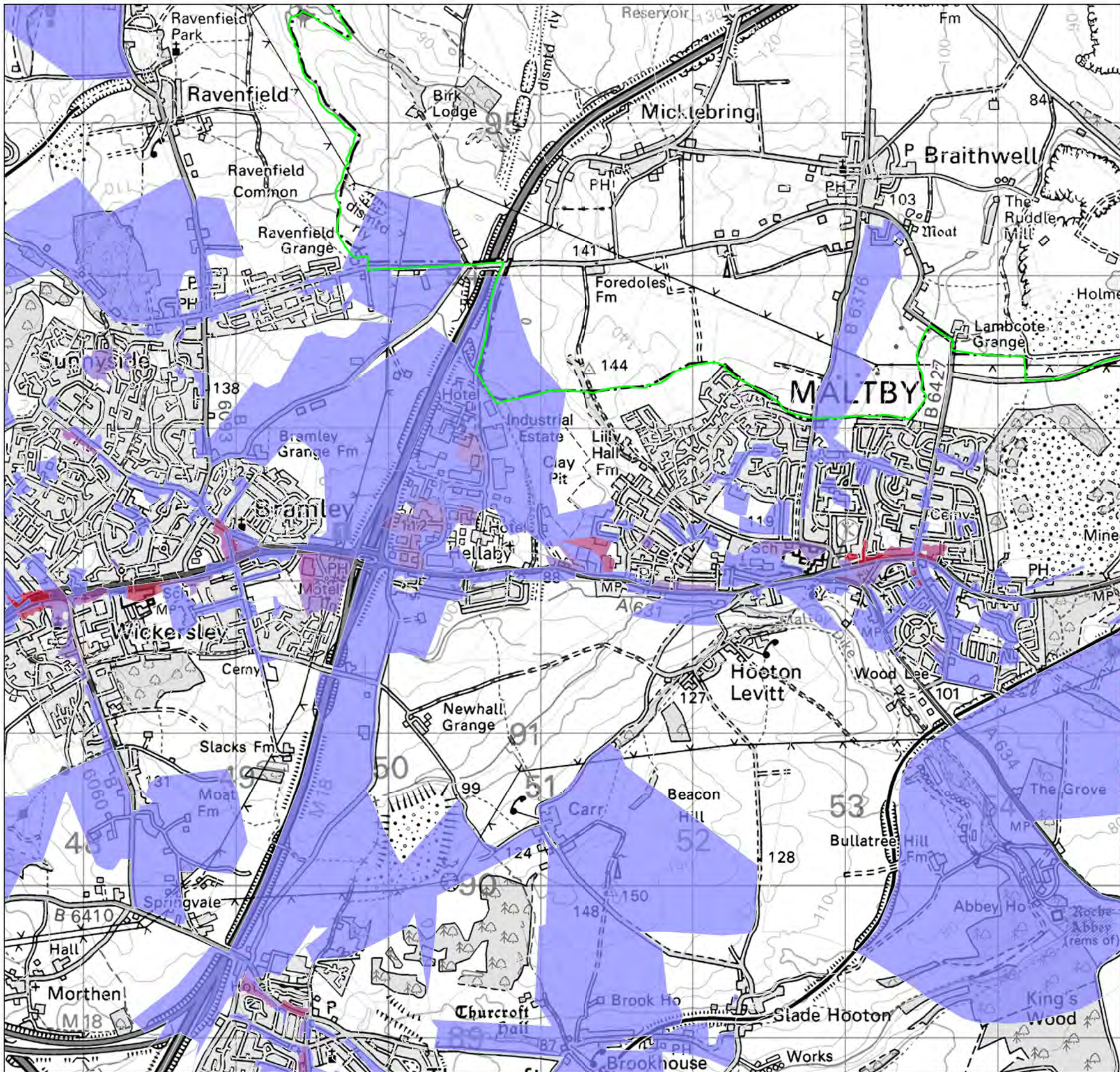
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**Maltby Residential Heat Use
Local Development Framework
Rotherham**


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Normalised Heat Load (kWh/yr/ha)


- 2,000,000 to 100,000,000
- 1,000,000 to 2,000,000
- 800,000 to 1,000,000
- 600,000 to 800,000
- 400,000 to 600,000
- 200,000 to 400,000
- 0 to 200,000

 Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Commercial buildings only are displayed on this map.

Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m²).



1 : 1,000,000
1 : 25,000 @ A3

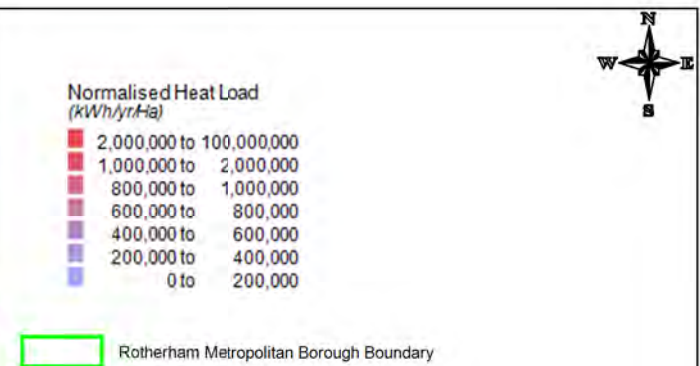
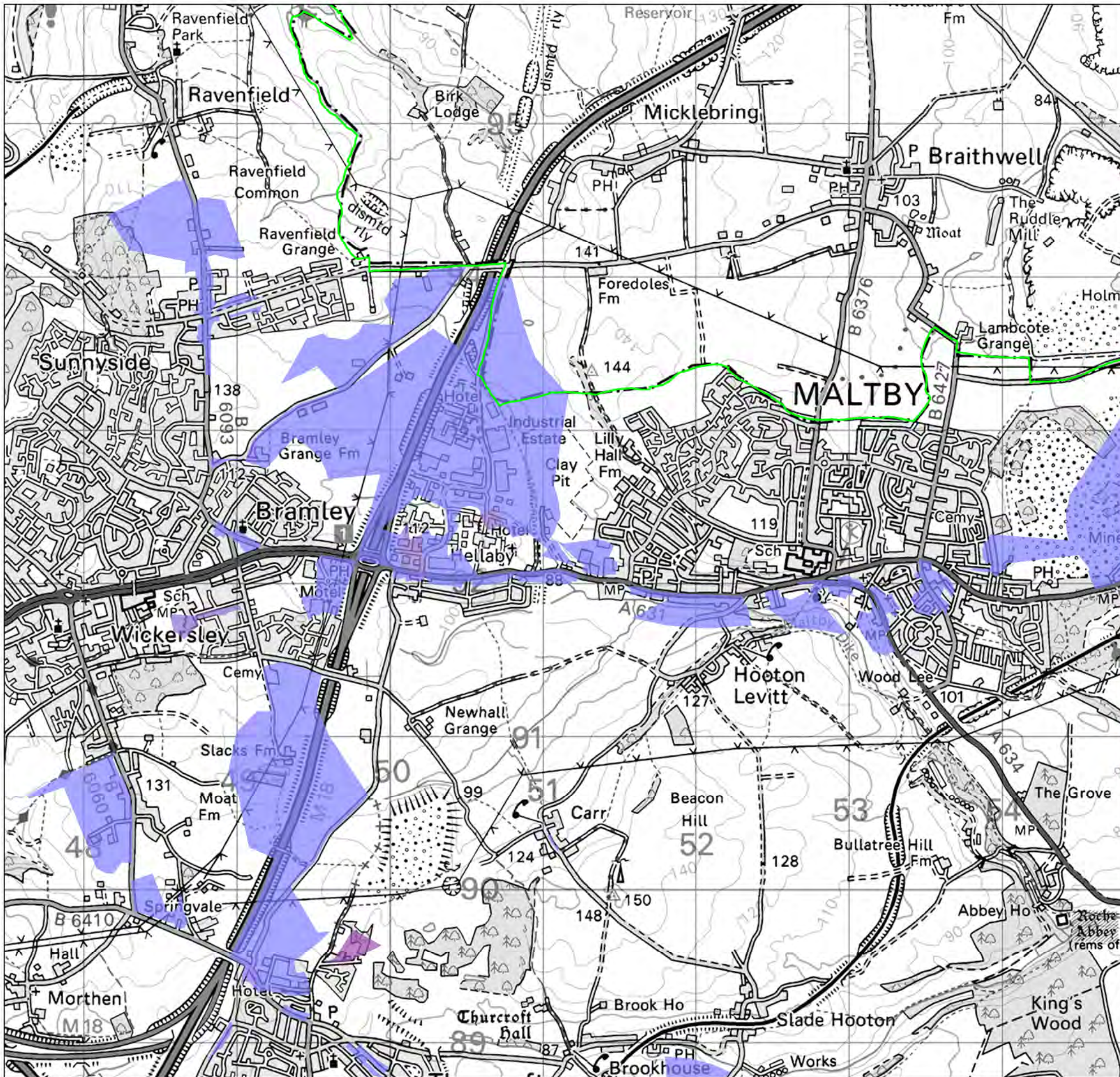
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**Maltby Commercial Heat Use
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MALTBY_HEAT_COM_ZT420418 Figure 3.15

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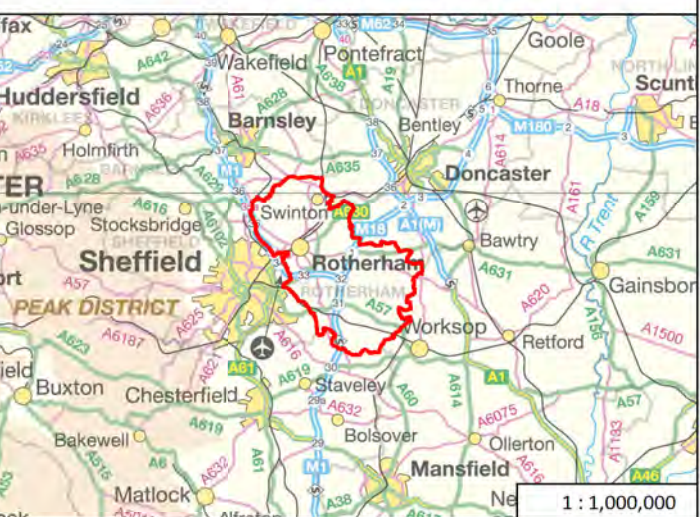


The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Industrial heat demand only is displayed on this map.

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Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m²).



BNG Ref: 451150 : 392270	OS 100km Grid: SK	Landranger Ref: 111
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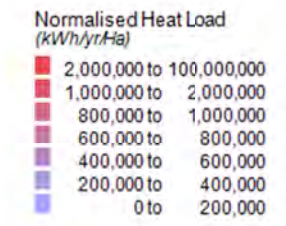
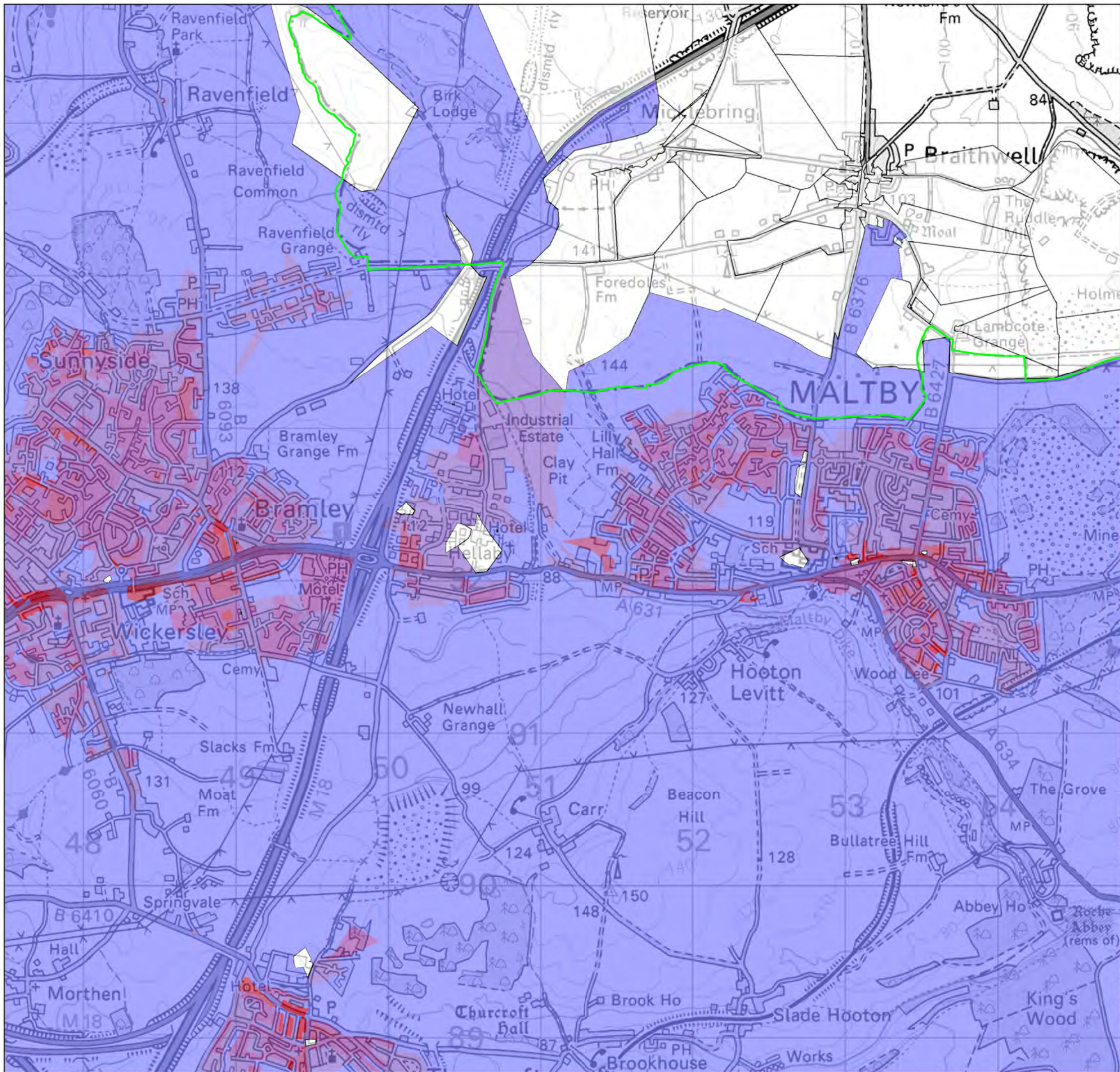
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**Maltby Industrial Heat Use
Local Development Framework
Rotherham**

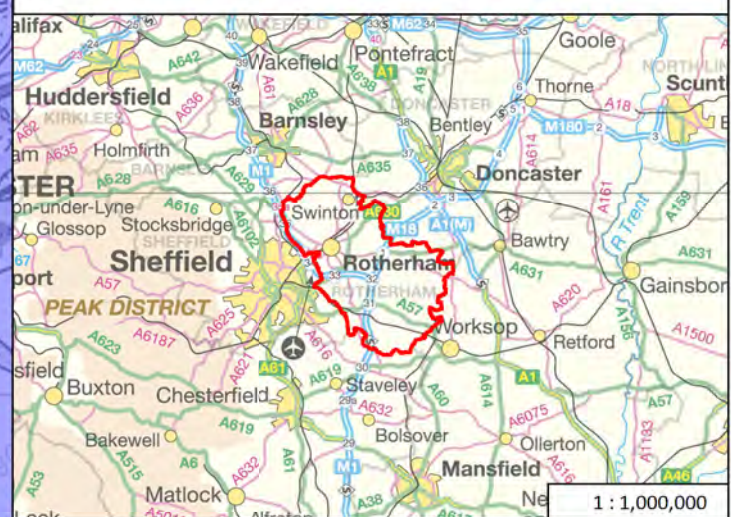
MALTBY_HEAT_IND_ZT420418 Figure 3.16

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Rotherham Metropolitan Borough Boundary

This heat map shows the aggregation of residential, commercial and industrial heat loads as modelled using standard benchmarks and assumptions based on industry experience.



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Long : Lat DD -01.2302° : 53.4245°	Long : Lat DMS -01_13_48.7 : 53_25_28.3	



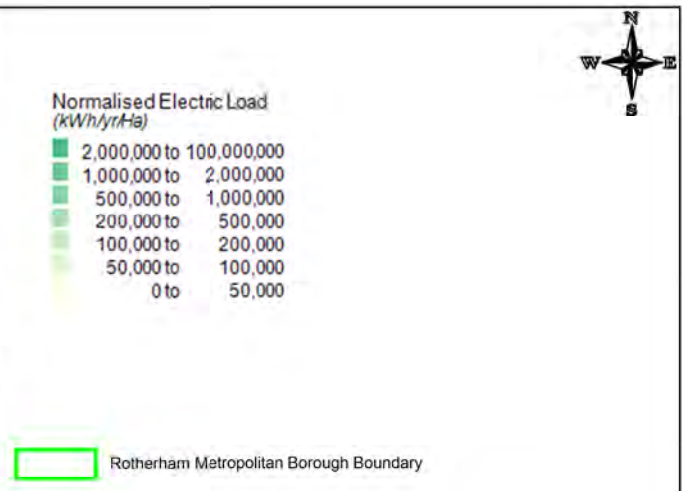
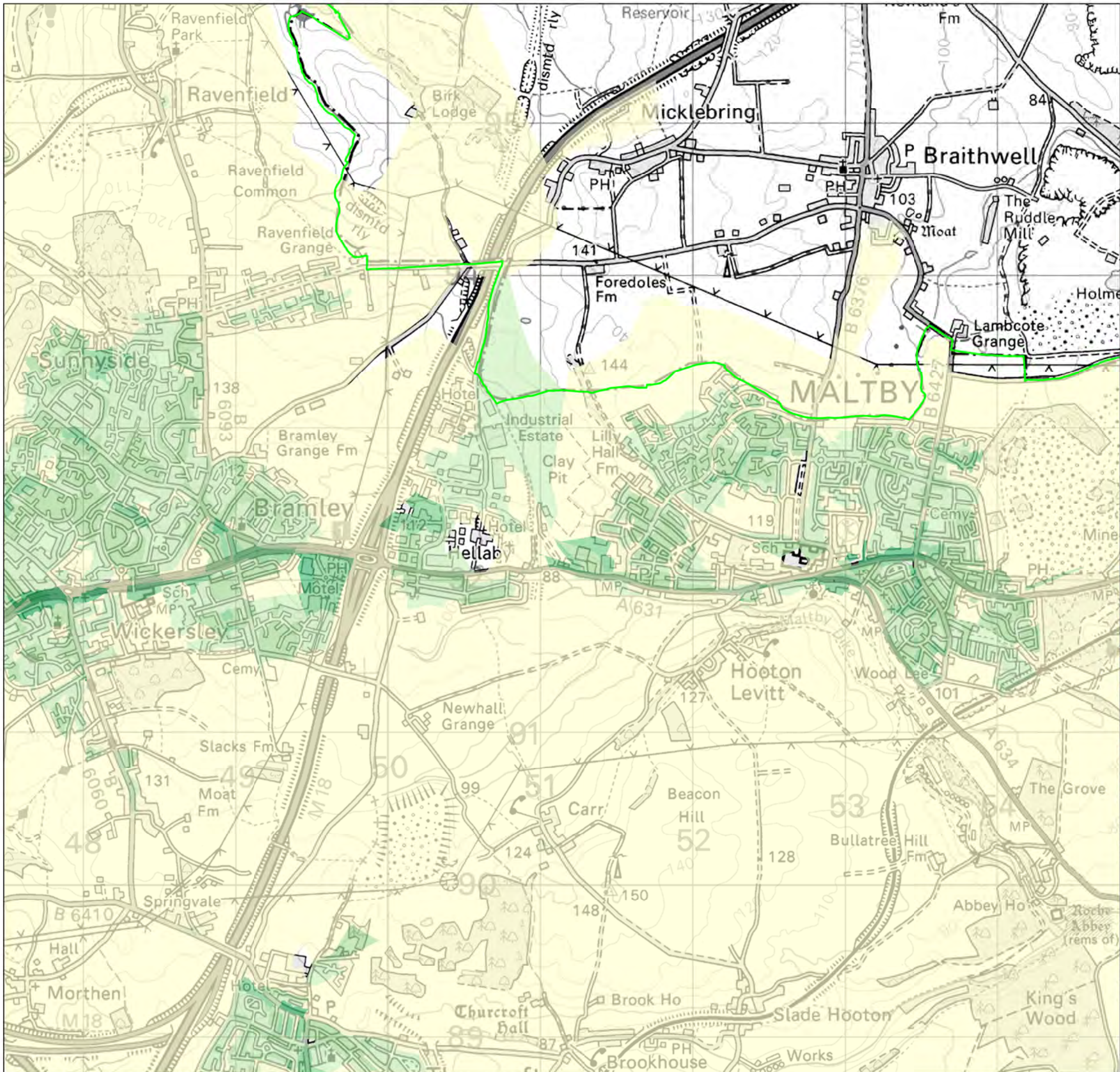
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Maltby Combined Heat Use
Local Development Framework
Rotherham

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Long : Lat DD -01.2302° : 53.4245°	Long : Lat OMS -01_13_48.7 : 53_25_28.3	



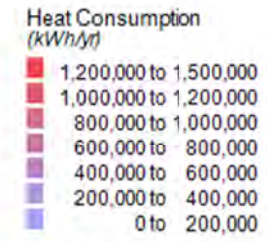
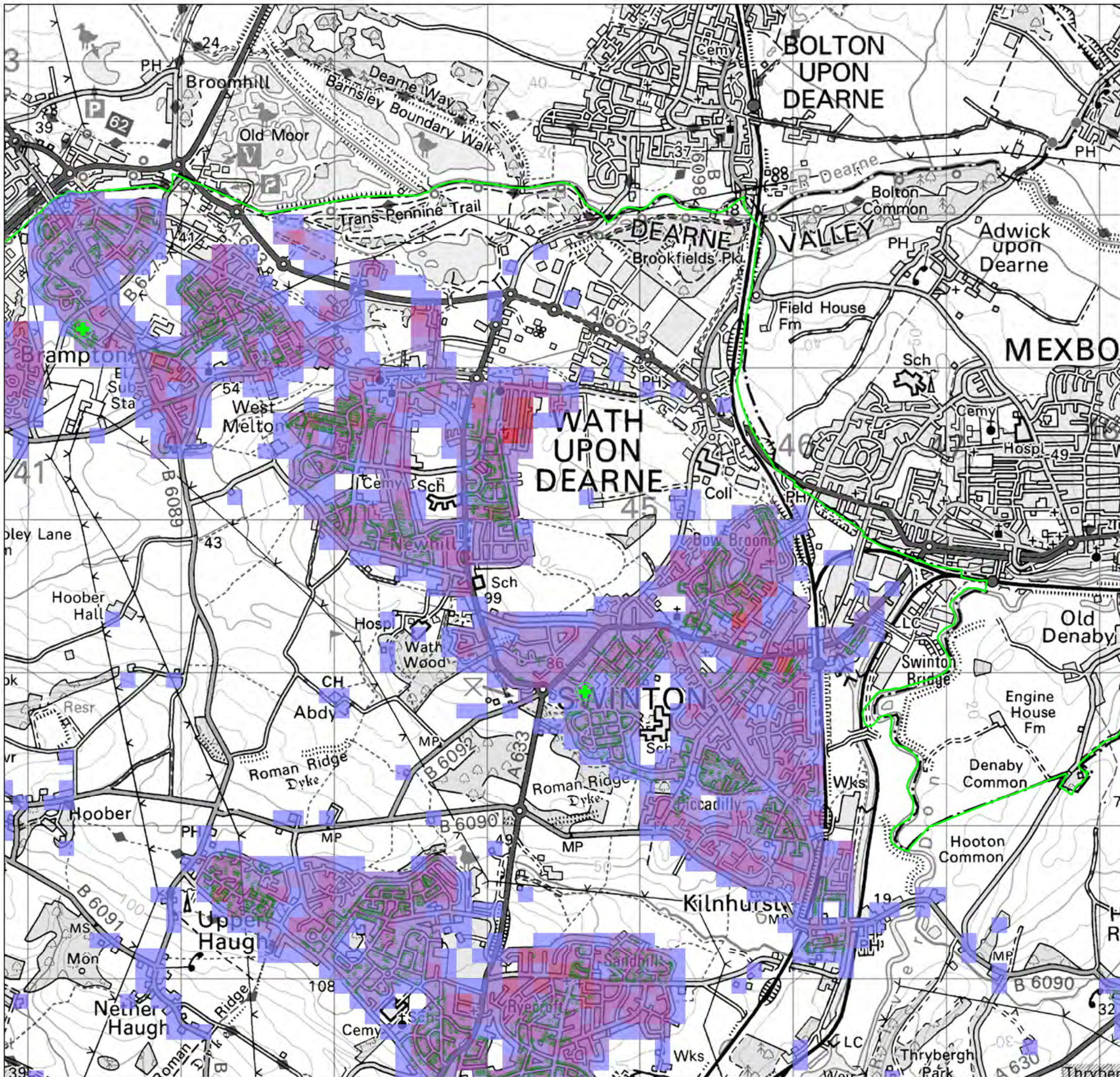
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Checked By: P.Evans	Date: 08/09/2011

Maltby Combined Electrical Use
Local Development Framework
Rotherham

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- Rotherham Metropolitan Borough Boundary
- + Existing District Heating Network
- Existing Council Housing

These heat maps have been generated by estimating building types from the residential subset of the Local Land and Property Gazetteer. Building types (ie flats/terraced/semi-detached/detached) were then attributed energy usage benchmarks and the mapping produced was based on 100m grid.

Residential buildings only are displayed on this map.



BNG Ref: 444510 : 399860	OS 100km Grid: SK	Landranger Ref: 111
Long : Lat DD -01.3291° : 53.4933°	Long : Lat DMS -01_19_44.6 : 53_29_35.8	



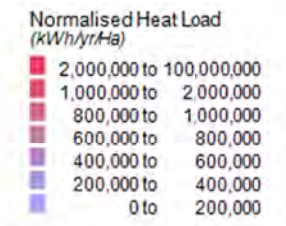
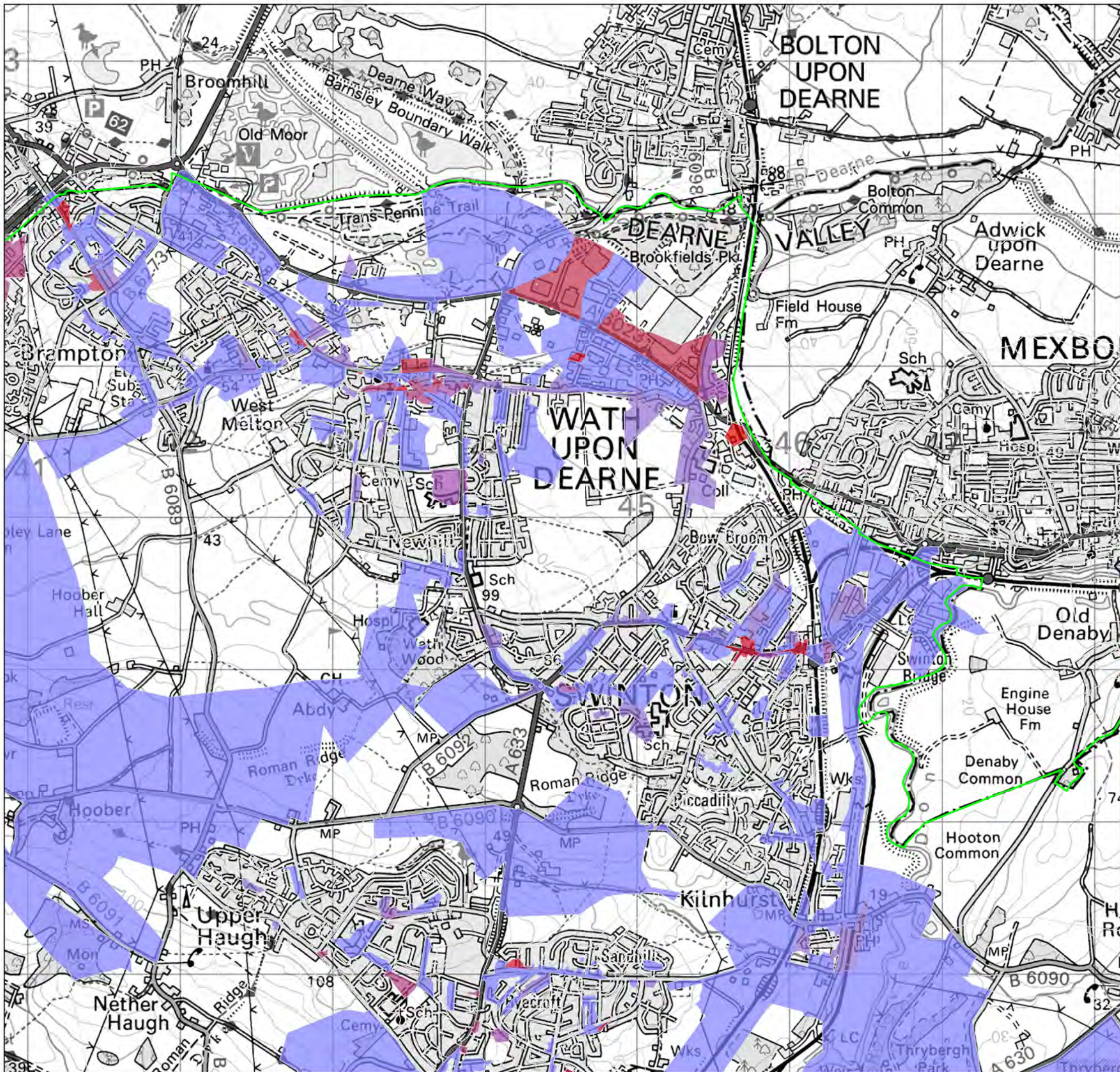
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Drawn By: S.J.Allen	Date: 20/09/2011
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Wath-upon-Dearne & Swinton Residential Heat Use
Local Development Framework
Rotherham

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Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Commercial buildings only are displayed on this map.

Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m²).



BNG Ref: 444510 : 399860	OS 100km Grid: SK	Landranger Ref: 111
Long : Lat DD -01.3291° : 53.4933°	Long : Lat DMS -01_19_44.6 : 53_29_35.8	

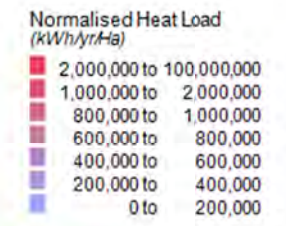
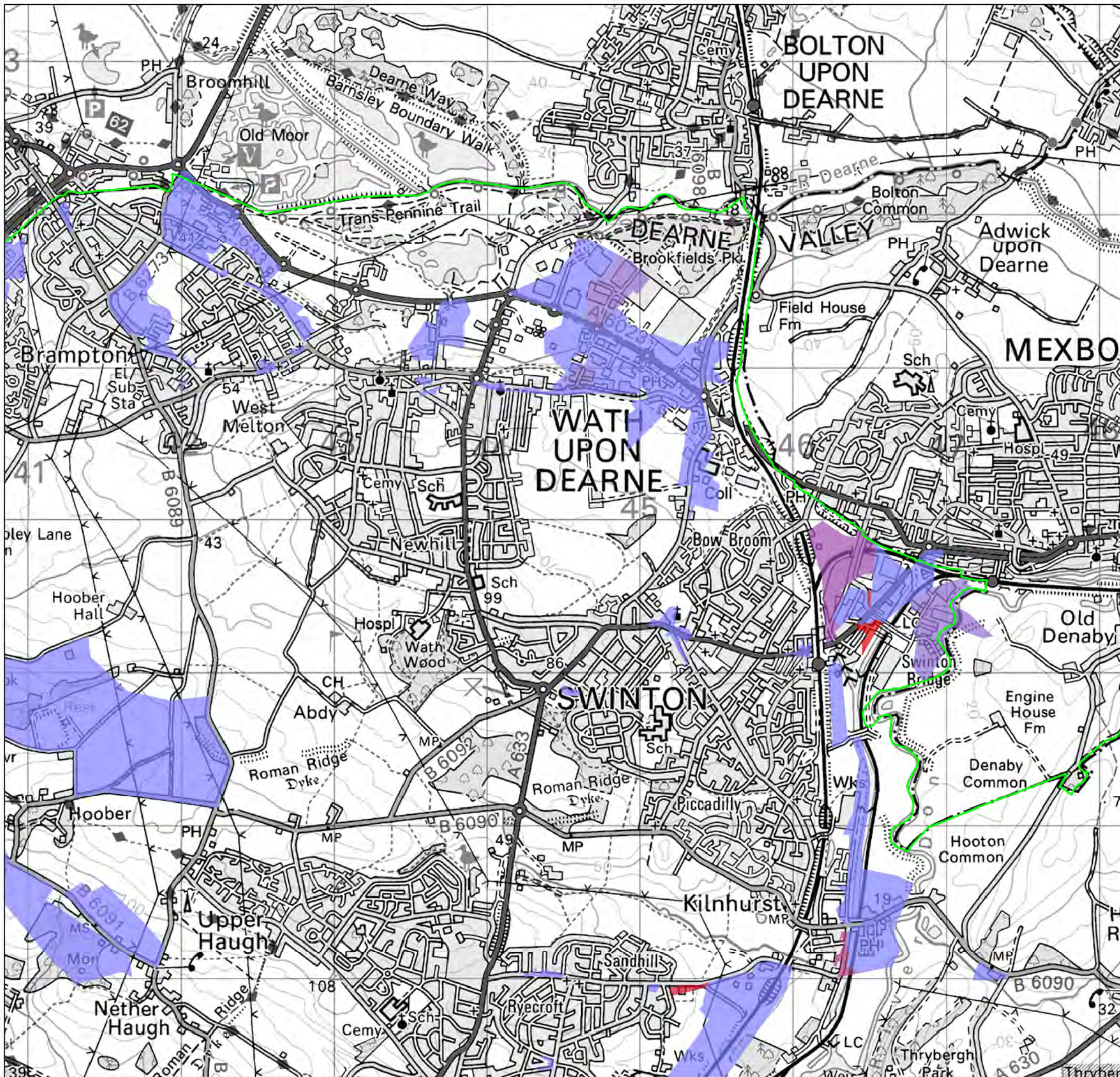
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Checked By: P.Evans	Date: 08/09/2011

**Wath-upon-Dearne & Swinton Commercial Heat Use
Local Development Framework
Rotherham**

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Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Industrial heat demand only is displayed on this map.

Industrial heat load data for major consumers has not been verified and relevant industrial benchmarks are not known to exist. Industrial heat loads should be verified on a case by case basis before relying on the accuracy of this mapping.

Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m²).



BNG Ref: 444510 : 399860	OS 100km Grid: SK	Landranger Ref: 111
Long: Lat DD -01.3291° : 53.4933°	Long: Lat DMS -01_19_44.6 : 53_29_35.8	



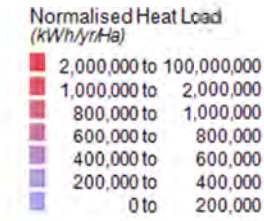
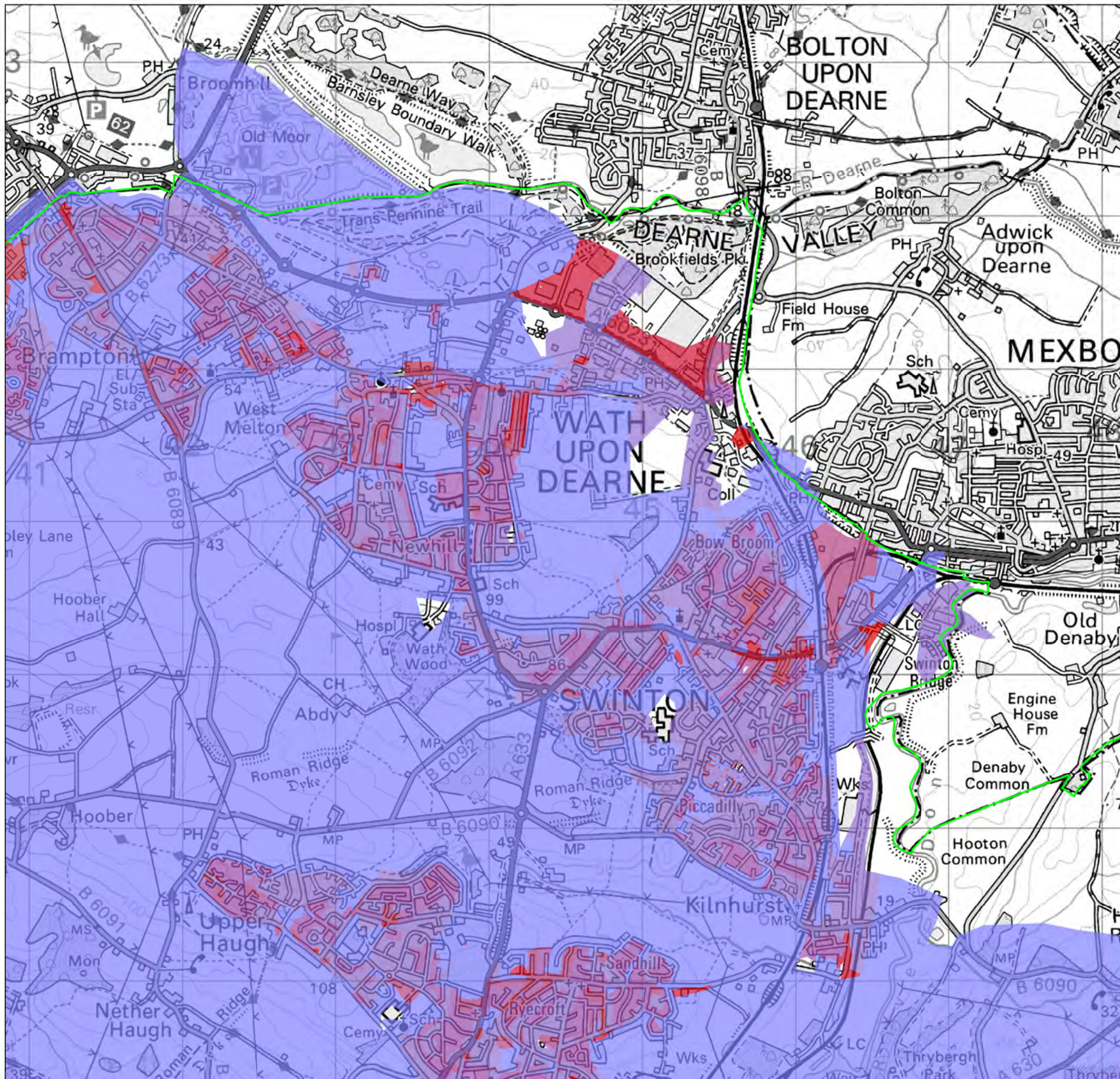
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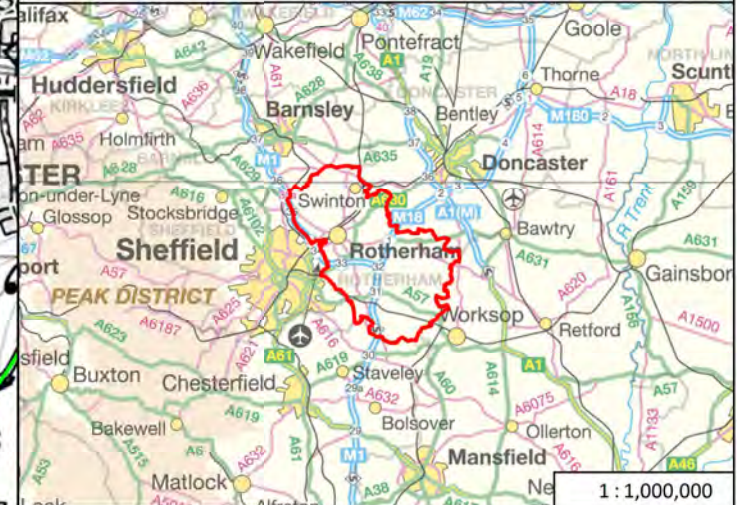
**Wath-upon-Deerne & Swinton Industrial Heat Use
Local Development Framework
Rotherham**

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Rotherham Metropolitan Borough Boundary

This heat map shows the aggregation of residential, commercial and industrial heat loads as modelled using standard benchmarks and assumptions based on industry experience.



Scale: 1:1,000,000
Scale: 1:25,000 @ A3

BNG Ref: 444510 : 399860	OS 100km Grid: SK	Landranger Ref: 111
Long : Lat DD -01.3291° : 53.4933°	Long : Lat OMS -01_19_44.6 : 53_29_35.8	

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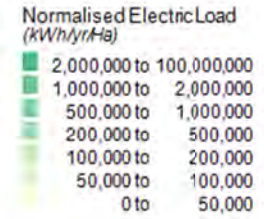
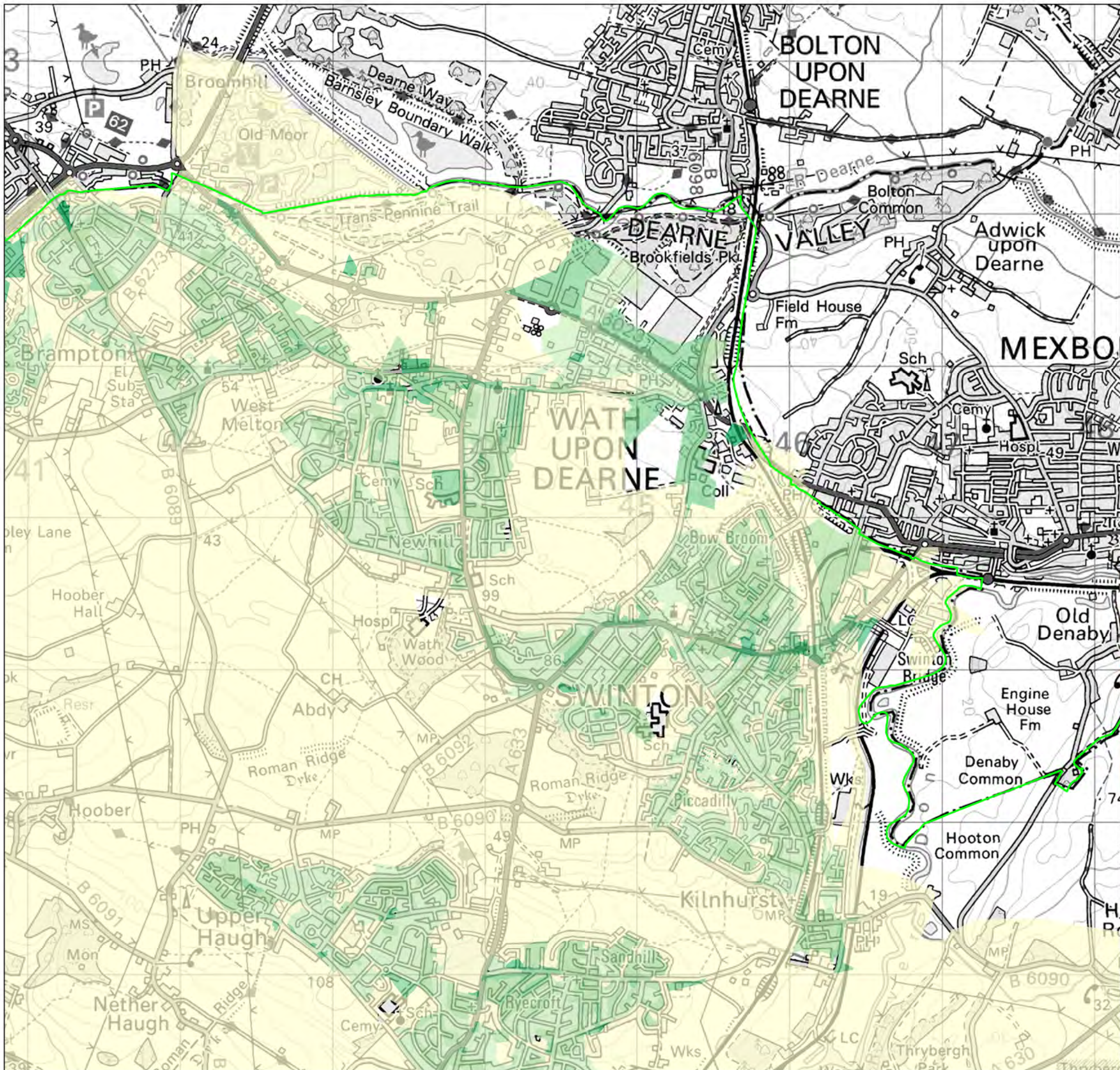
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**Wath-upon-Dearne & Swinton Combined Heat Use
Local Development Framework
Rotherham**

WUD-SWIN_HEAT_ALL_ZT420418 Figure 3.22

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Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Commercial buildings only are considered here at this stage. No industrial or residential settlements have yet to be factored in.



Scale: 1:25,000 @ A3

BNG Ref: 444510 : 399860 OS 100km Grid: SK Landranger Ref: 111
 Long : Lat DD -01.3291° : 53.4933° Long : Lat DMS -01_19_44.6 : 53_29_35.8



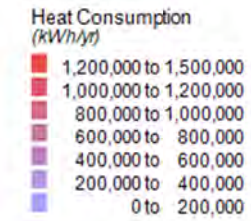
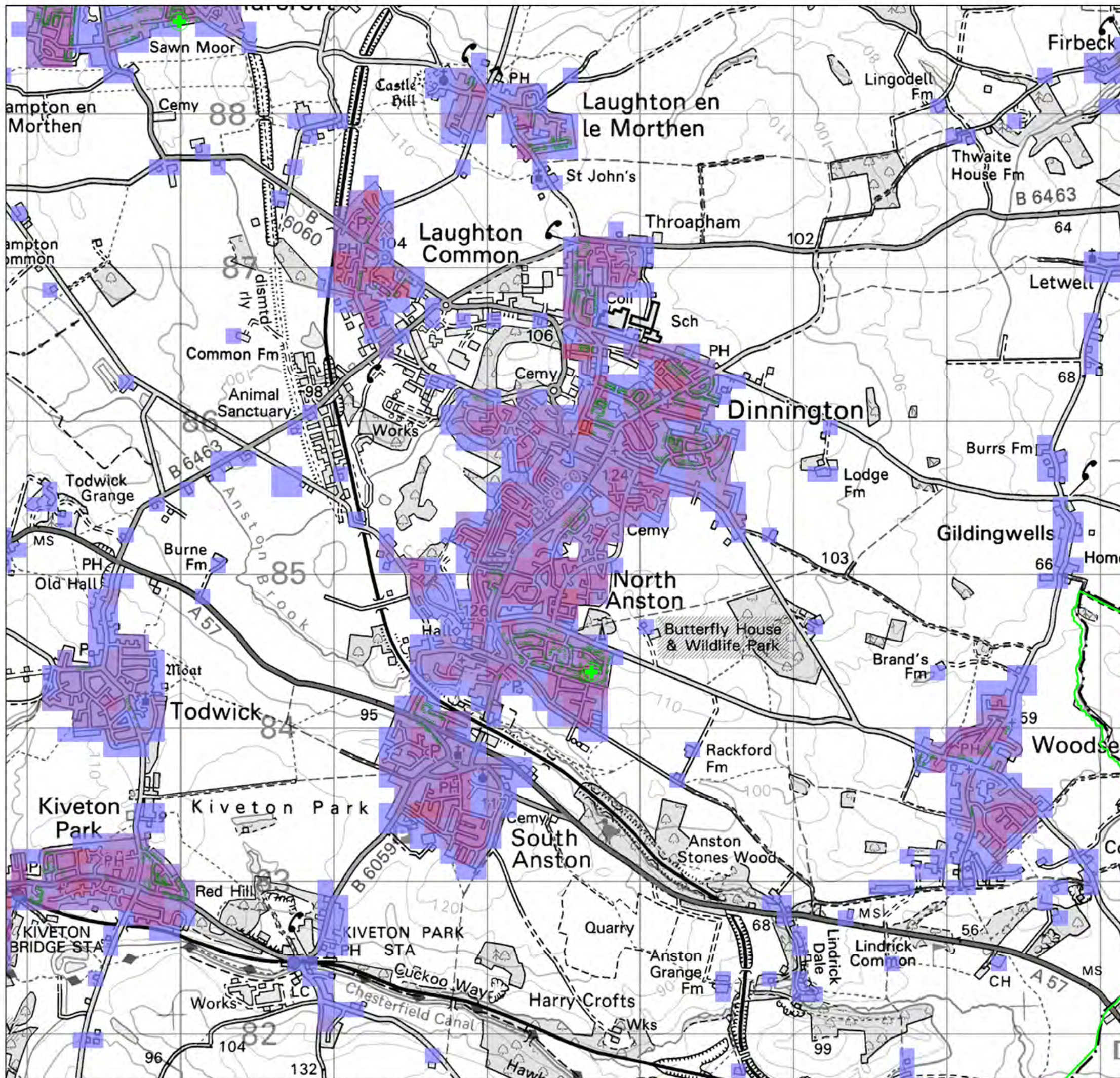
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Drawn By: S.J.Allen Date: 07/09/2011
 Checked By: P.Evans Date: 08/09/2011

Wath-upon-Dearne & Swinton Combined Electrical Use
 Local Development Framework
 Rotherham

WUD_SWIN_ELEC_ALL_ZT420418 Figure 3.23

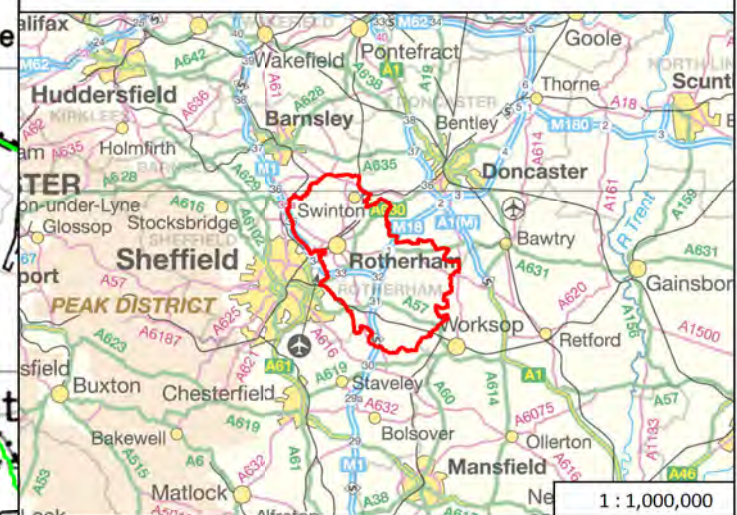
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- Rotherham Metropolitan Borough Boundary
- + Existing District Heating Network
- + Existing Council Houses

These heat maps have been generated by estimating building types from the residential subset of the Local Land and Property Gazetteer. Building types (ie flats/terraced/semi-detached/detached) were then attributed energy usage benchmarks and the mapping produced was based on 100m grid.

Residential buildings only are displayed on this map.



BNG Ref: 452500 : 385200	OS 100km Grid: SK	Landranger Ref: 111
Long: Lat DD -01.2106° : 53.3608°	Long: Lat DMS -01_12_38.2 : 53_21_38.9	

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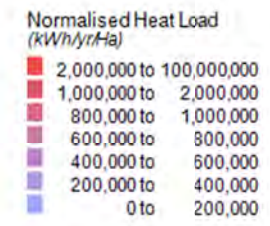
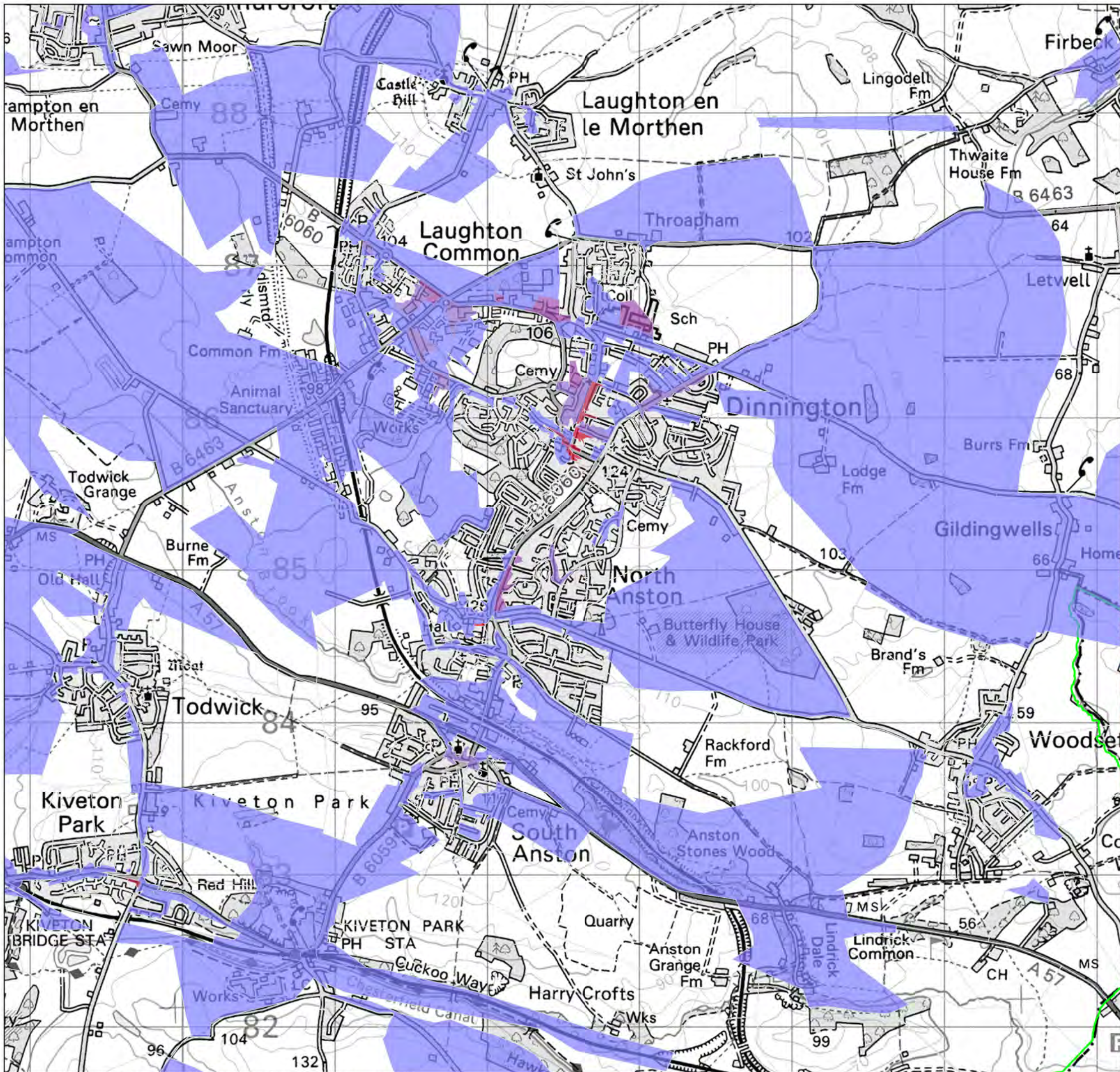
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Checked By: P.Evans	Date: 10/10/2011

**Dinnington Residential Heat Use
Local Development Framework
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Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Commercial buildings only are displayed on this map.

Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m²).



BNG Ref: 452500 : 385200	OS 100km Grid: SK	Landranger Ref: 111
Long : Lat DD -01.2106° : 53.3608°	Long : Lat DMS -01_12_38.2 : 53_21_38.9	

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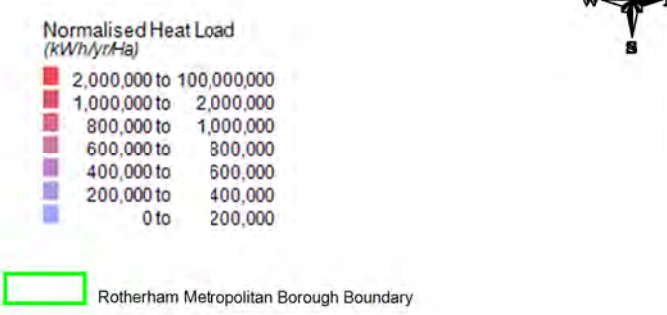
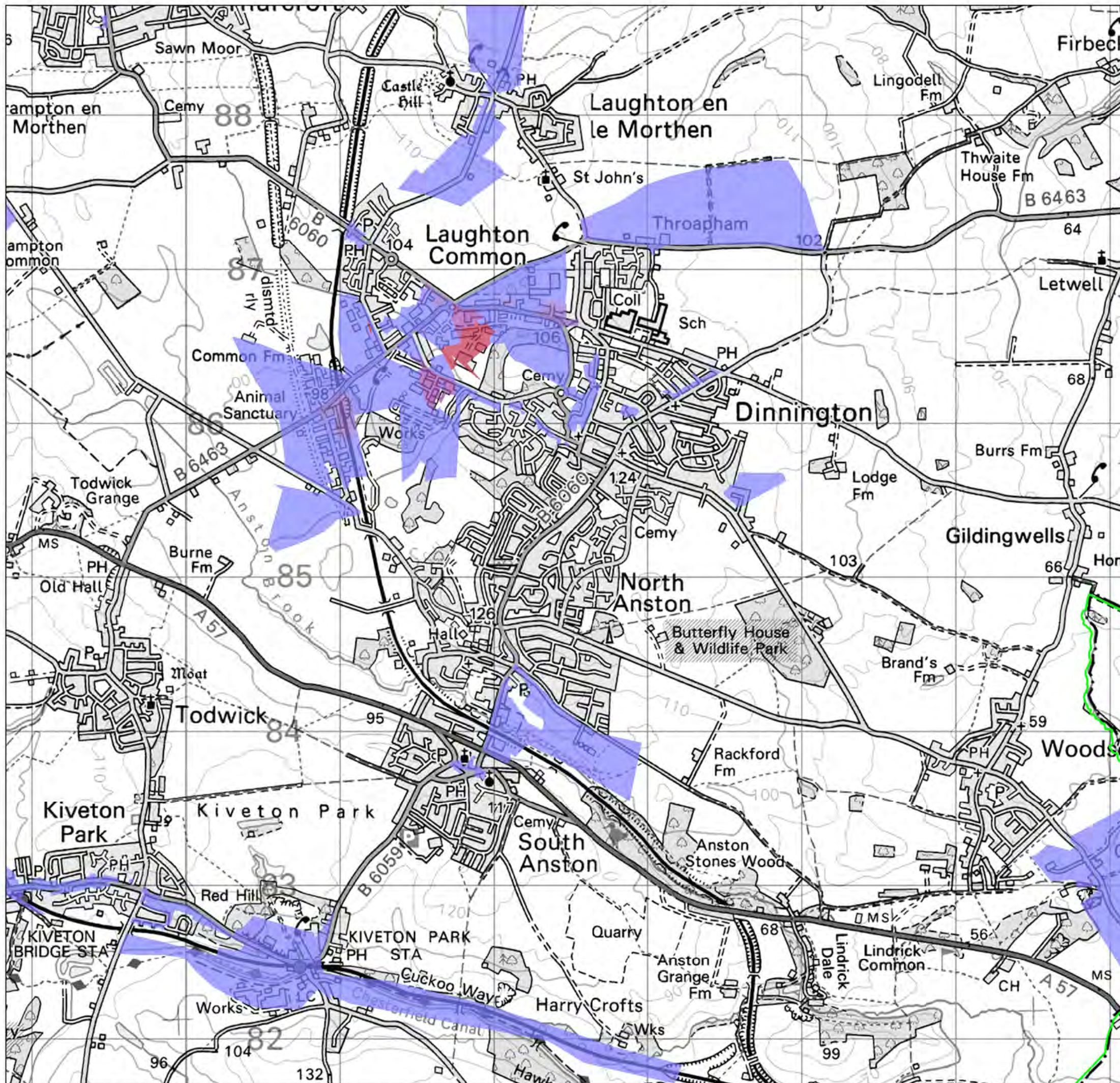
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Drawn By: S.J.Allen Date: 10/10/2011
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**Dinnington Commercial Heat Use
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Rotherham**

DINTON_HEAT_COM_ZT420418 Figure 3.25

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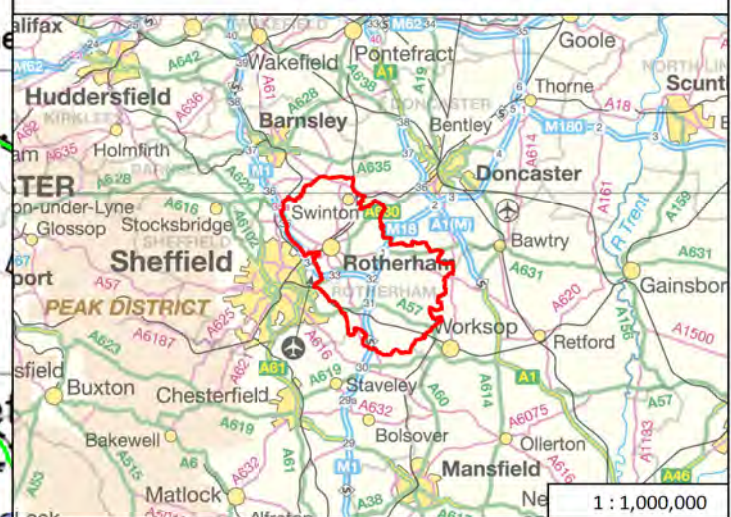


The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

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Heat loads are displayed based on postcode zones and normalised by the area of the zone (the units are kWh/yr/m²).



BNG Ref: 452500 : 385200	OS 100km Grid: SK	Landranger Ref: 111
Long: Lat DD -01.2106° : 53.3608°	Long: Lat DMS -01_12_38.2 : 53_21_38.9	



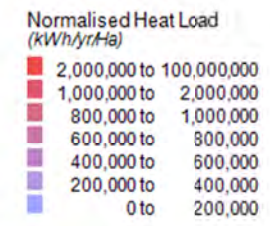
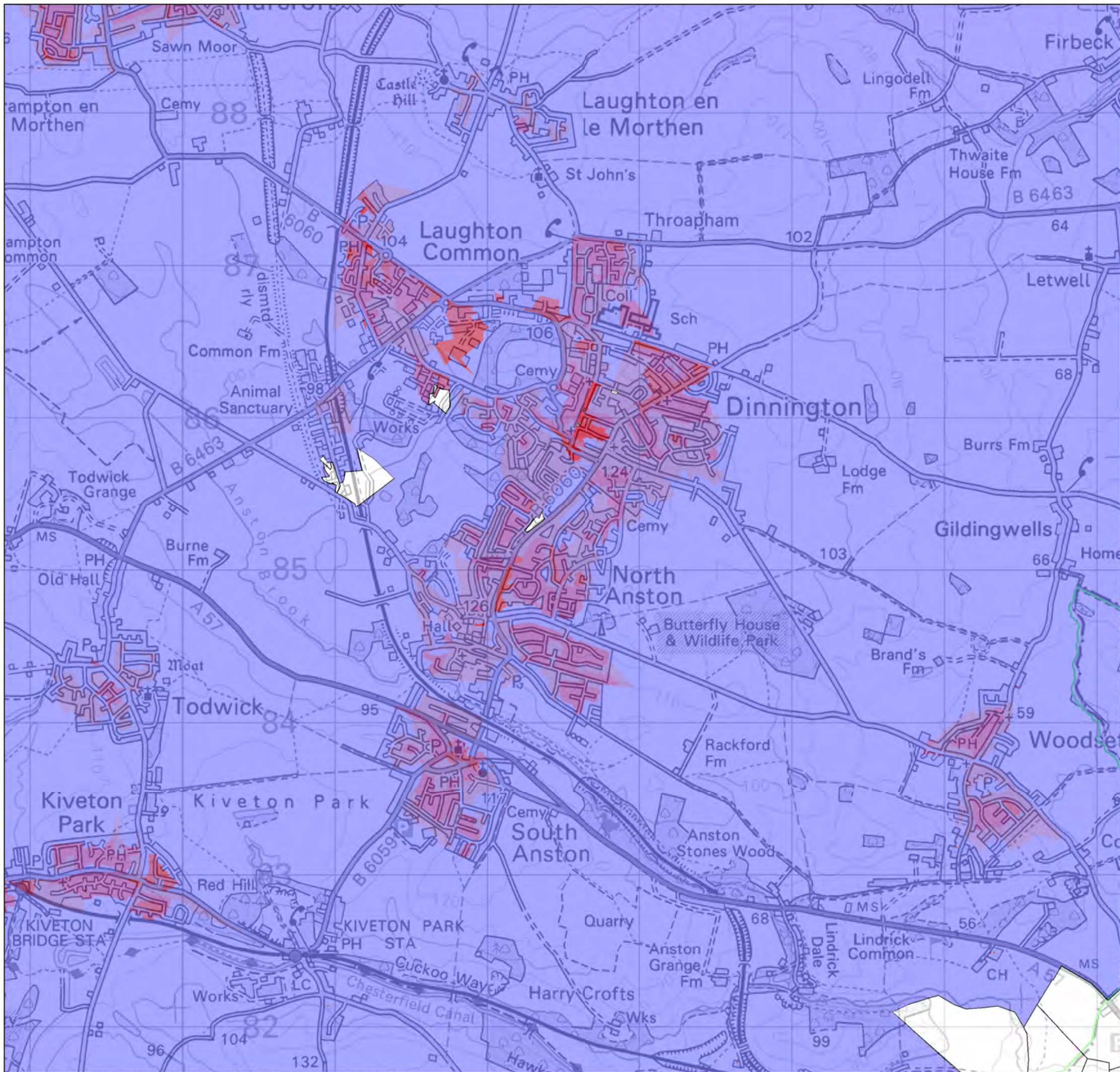
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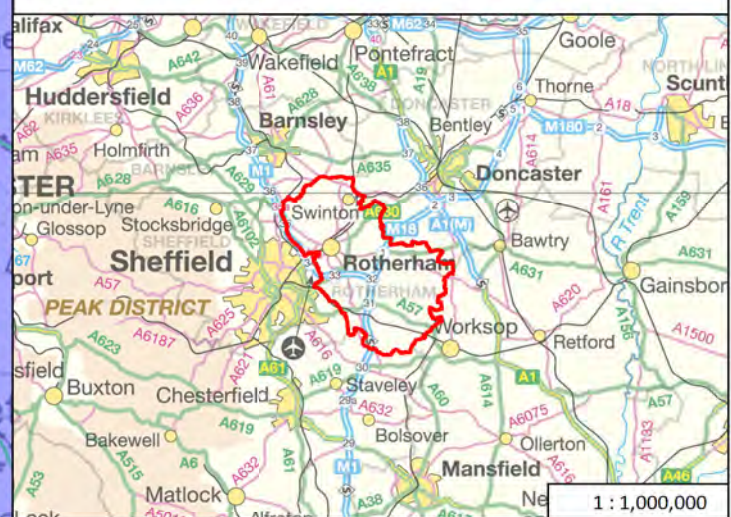
**Dinnington Industrial Heat Use
Local Development Framework
Rotherham**

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Rotherham Metropolitan Borough Boundary

This heat map shows the aggregation of residential, commercial and industrial heat loads as modelled using standard benchmarks and assumptions based on industry experience.



Scale: 1:25,000 @ A3

BNG Ref: 452500 : 385200 OS 100km Grid: SK Landranger Ref: 111
 Long: Lat DD -01.2106° : 53.3608° Long: Lat DMS -01_12_38.2 : 53_21_38.9



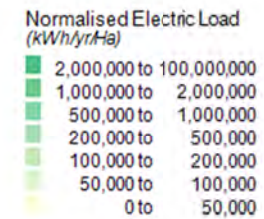
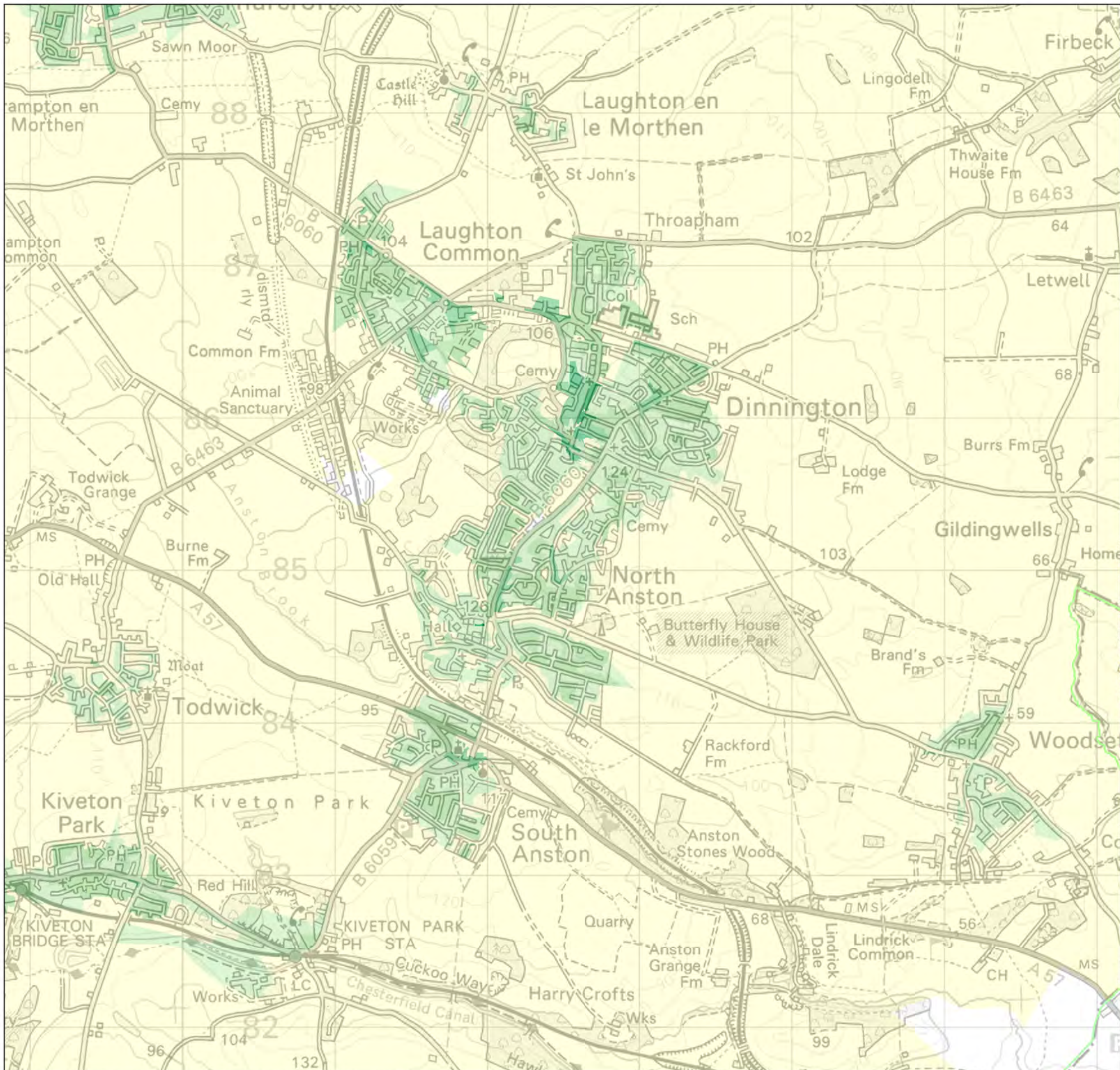
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Dinnington Combined Heat Use
 Local Development Framework
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DINTON_HEAT_ALL_ZT420418 Figure 3.27

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Rotherham Metropolitan Borough Boundary

The heat maps have been calculated by comparing energy usage benchmarks for categories of use with floor areas from the VOA business rate datasets.

Commercial buildings only are considered here at this stage. No industrial or residential settlements have yet to be factored in.



0 1 1:25 000 @ A3		1:1,000,000
BNG Ref: 452500 : 385200	OS 100km Grid: SK	Landranger Ref: 111
Long : Lat DD -01.2106° : 53.3608°	Long : Lat DMS -01 12 38.2 : 53 21 38.9	

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Checked By: P.Evans	Date: 10/10/2011

**Dinnington Combined Electrical Use
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 Large scale wind resource areas

Large Wind Resource	
Area (ha)	282
Number of Turbines	15
Capacity (MW)	30
Energy (GWh/yr)	98.8
CO2 Savings (Tonnes/yr)	44,044

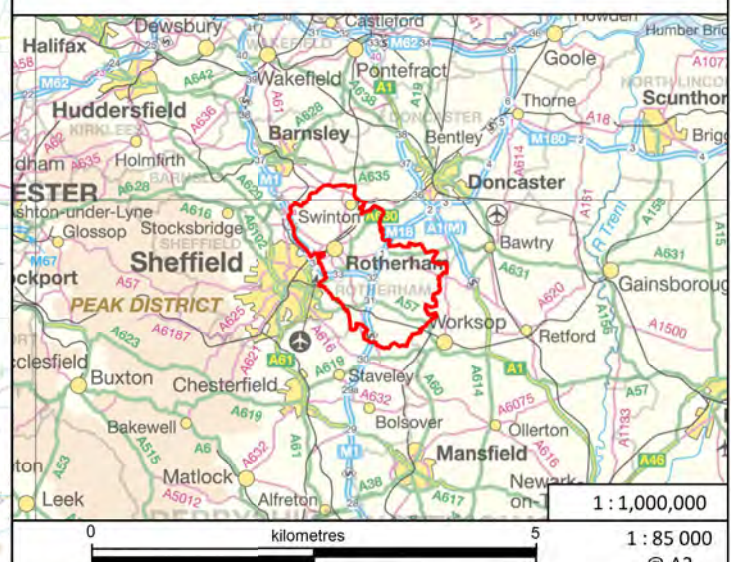
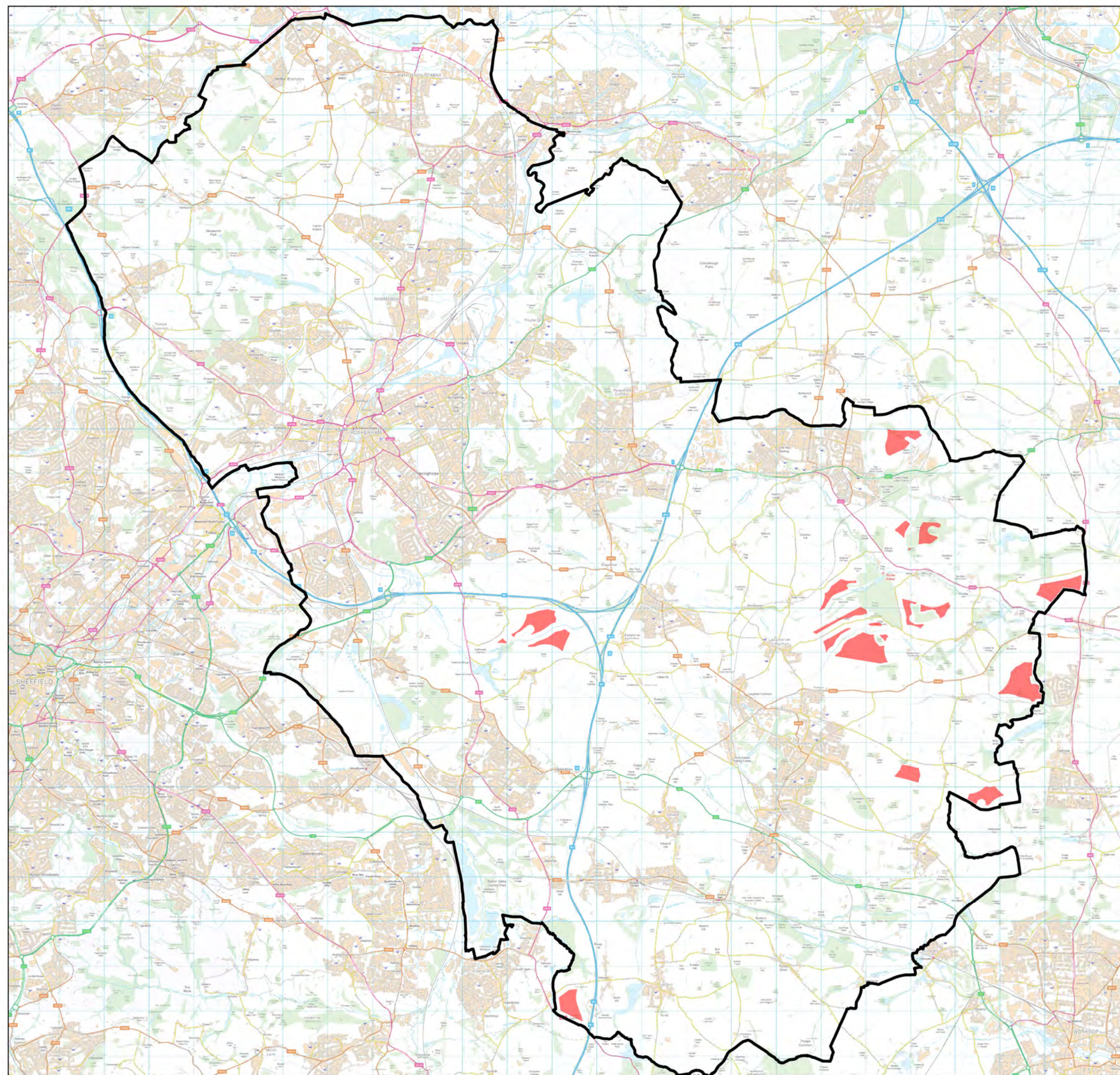
The areas shown give the practical viable wind resource following the removal of landscape designations and other technical constraints.

Wind resource energy values have been based on the following benchmarks:

A wind speed up log law calculation was used to estimate the wind at 80m above the ground level from the 45m reference height in the UK Wind Speed database. A ground roughness value of 0.03 was used in the calculation (x 1.079).

Installed capacity was nominally based on area, set at 9MW/km². These areas were then manually adjusted to accommodate one or more Vestas V90 2MW turbines. Total energy output was then derived from the number of turbines and the energy curve for the Vestas V90 turbine with a hub height of 80m.

The Carbon Saving was calculated based on 0.499kgCO₂/kWh of electricity generated (DEFRA).



BNG Ref: 447543 : 390408 OS 100km Grid: SK Landranger Ref: 111
 Long : Lat DD -1.2847° : 53.4080° Long : Lat DMS -1° 17' 4.9" : 53° 24' 29.1"



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Drawn By: C.Bines Date: 09.08.2011
 Checked By: P.Evans Date: 10.08.2011

Large Scale Wind Resource
 Local Development Framework
 Rotherham

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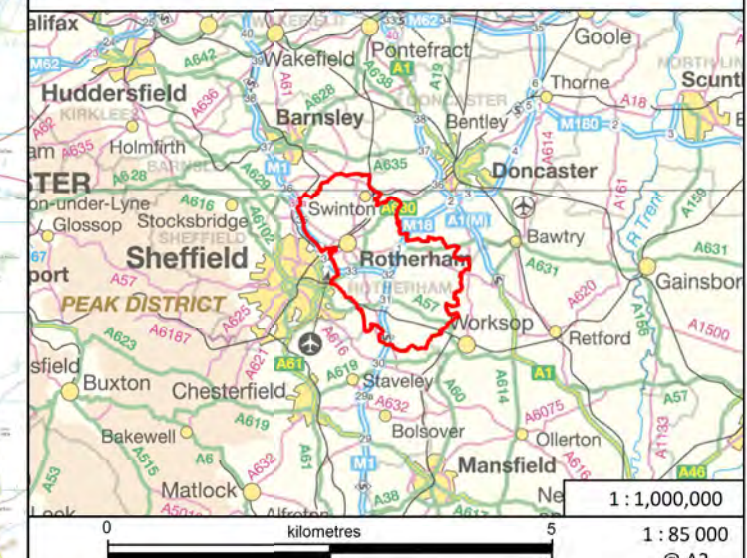
Medium scale wind resource areas

Medium Wind Resource	
Area (ha)	304.5
Number of Turbines	133
Capacity (MW)	66.5
Energy (GWh/yr)	219
CO2 Savings (Tonnes/yr)	97,877

The areas shown give the practical viable wind resource following the removal of landscape designations and other technical constraints.

Wind resource energy values have been based on the following benchmarks:

A wind speed up log law calculation was used to estimate the wind at 40m above the ground level from the 45m reference height in the UK Wind Speed database. A ground roughness value of 0.03 was used in the calculation (x 0.984). Installed capacity was estimated on the assumption that a single turbine occupying 5ha. This is based on EWT 500kW turbine and the expected density for placement of turbines at this scale. Total energy output was then derived from the number of turbines and the energy curve for the EWT 500kW turbine with a hub height of 40m. The Carbon Saving was calculated based on 0.499kgCO₂/kWh of electricity generated (DEFRA).



BNG Ref: 447543 : 390408 OS 100km Grid: SK Landranger Ref: 111
 Long : Lat DD -1.2847° : 53.4080° Long : Lat DMS -1° 17' 4.9" : 53° 24' 29.1"

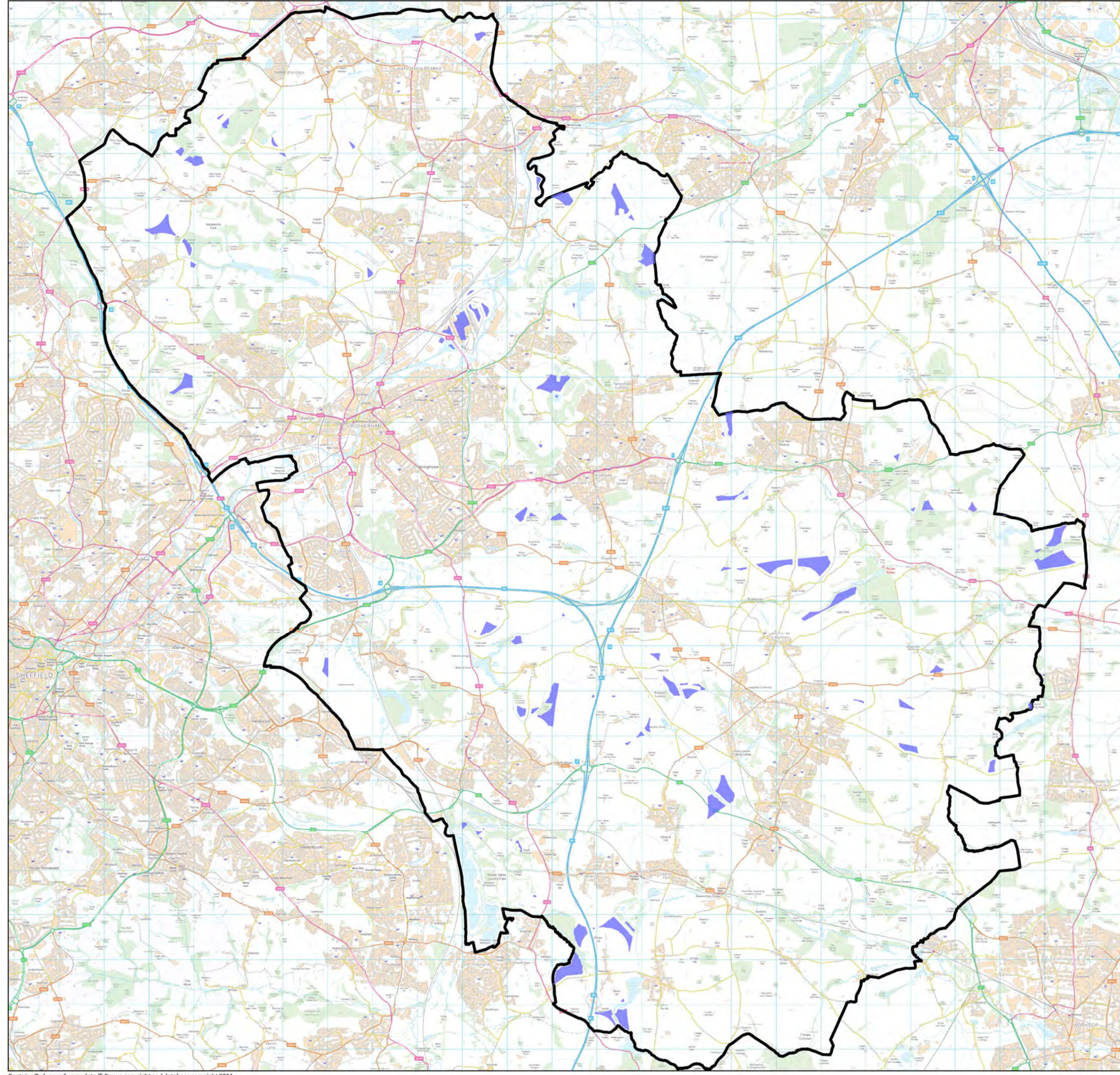


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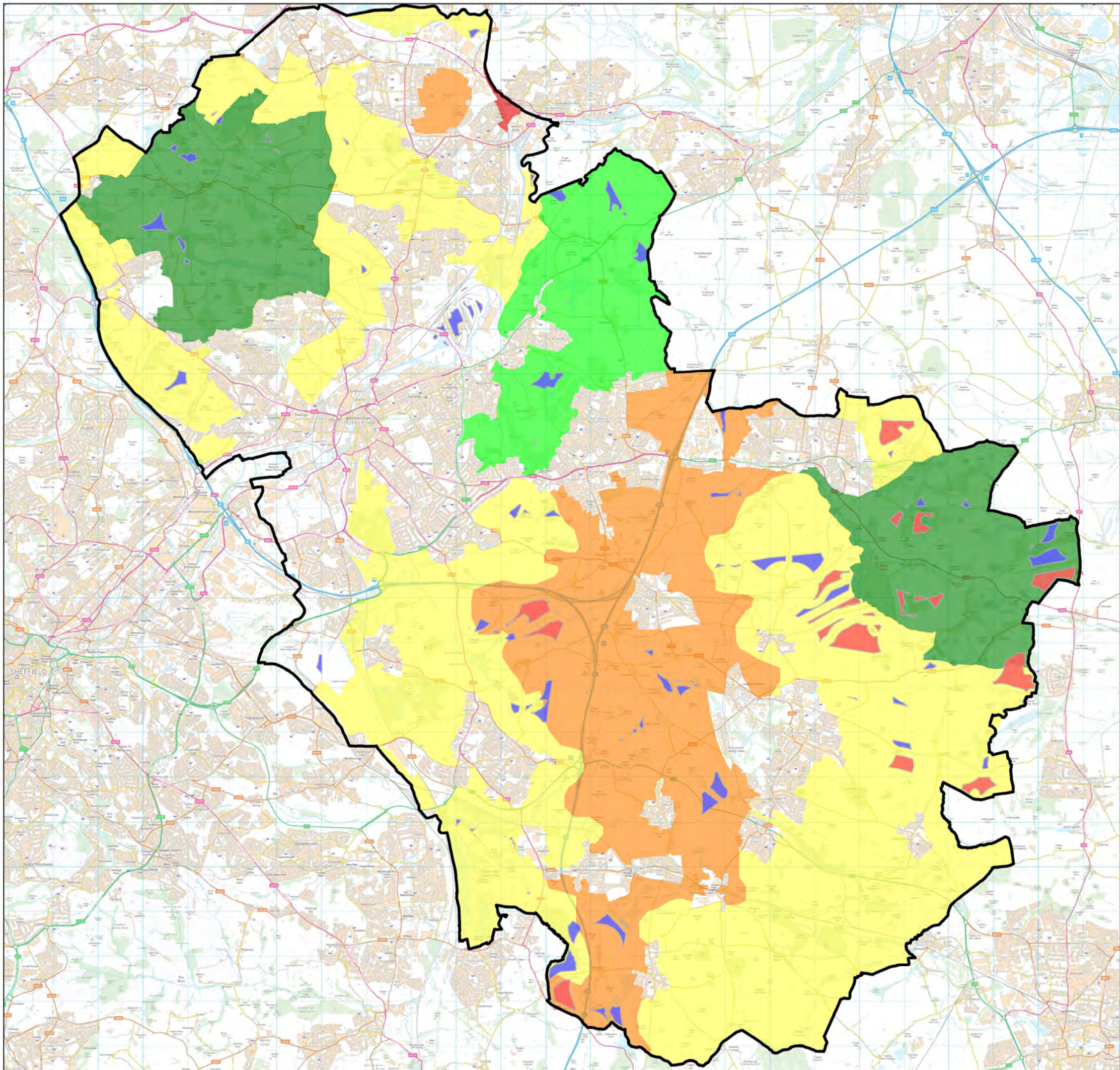
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Medium Scale Wind Resource
 Local Development Framework
 Rotherham

MWDAREAS_V1_ZT420418 Figure 3.30



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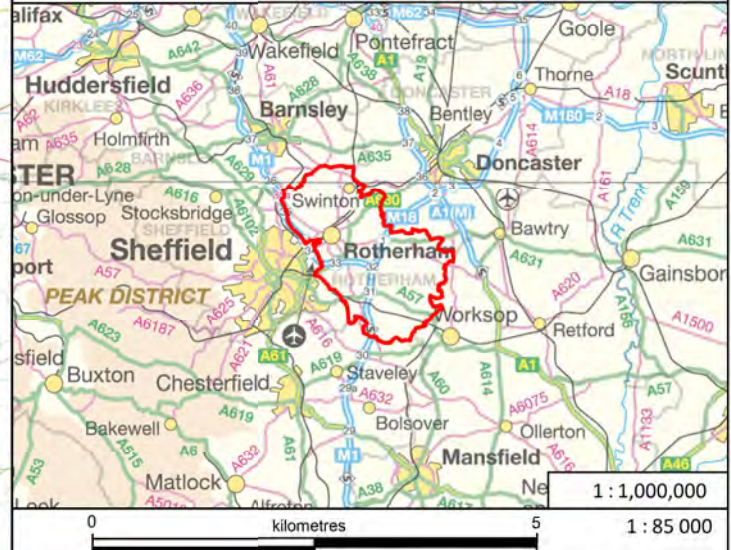
Wind Resource

- Large scale
- Medium scale

Landscape Character Sensitivity

- High
- Moderate-high
- Moderate
- Moderate-low
- Low

Landscape Character Sensitivity data taken from the Rotherham Landscape Character Assessment as supplied by Rotherham Metropolitan Borough Council.
 Wind resource areas shown give the practical viable wind resource following the removal of all landscape and other technical constraints.



BNG Ref: 447543 : 390408	OS 100km Grid: SK	Landranger Ref: 111
Long : Lat DD -1.2847° : 53.4080°	Long : Lat DMS -1° 17' 4.9" : 53° 24' 29.1"	

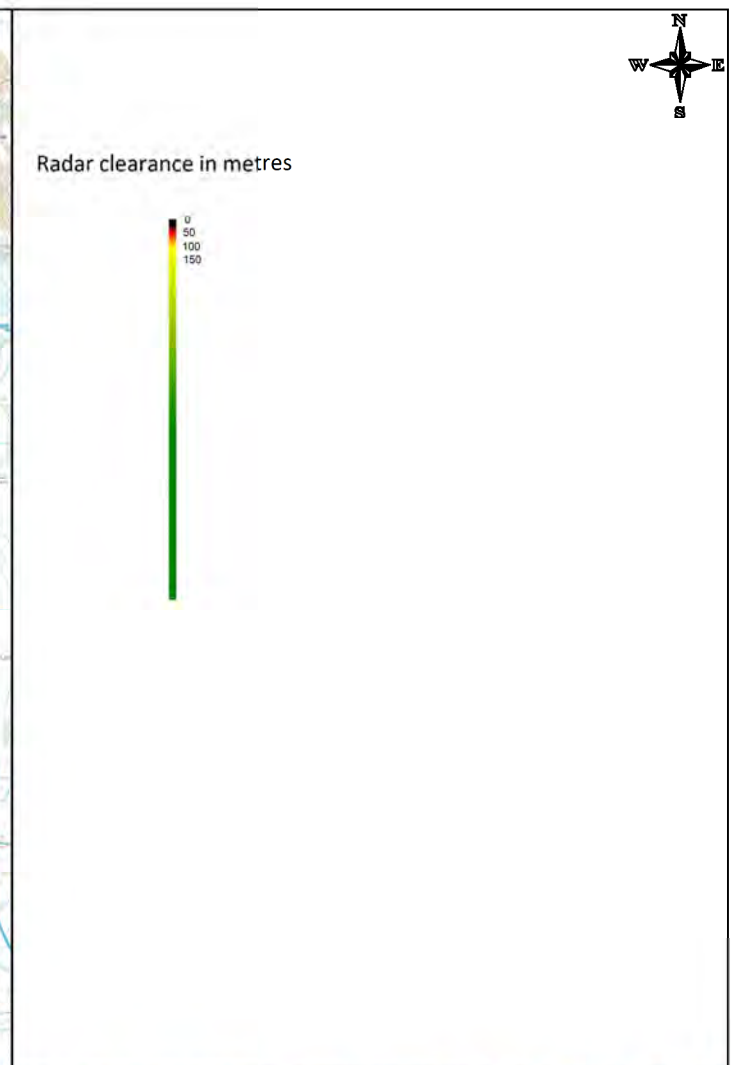
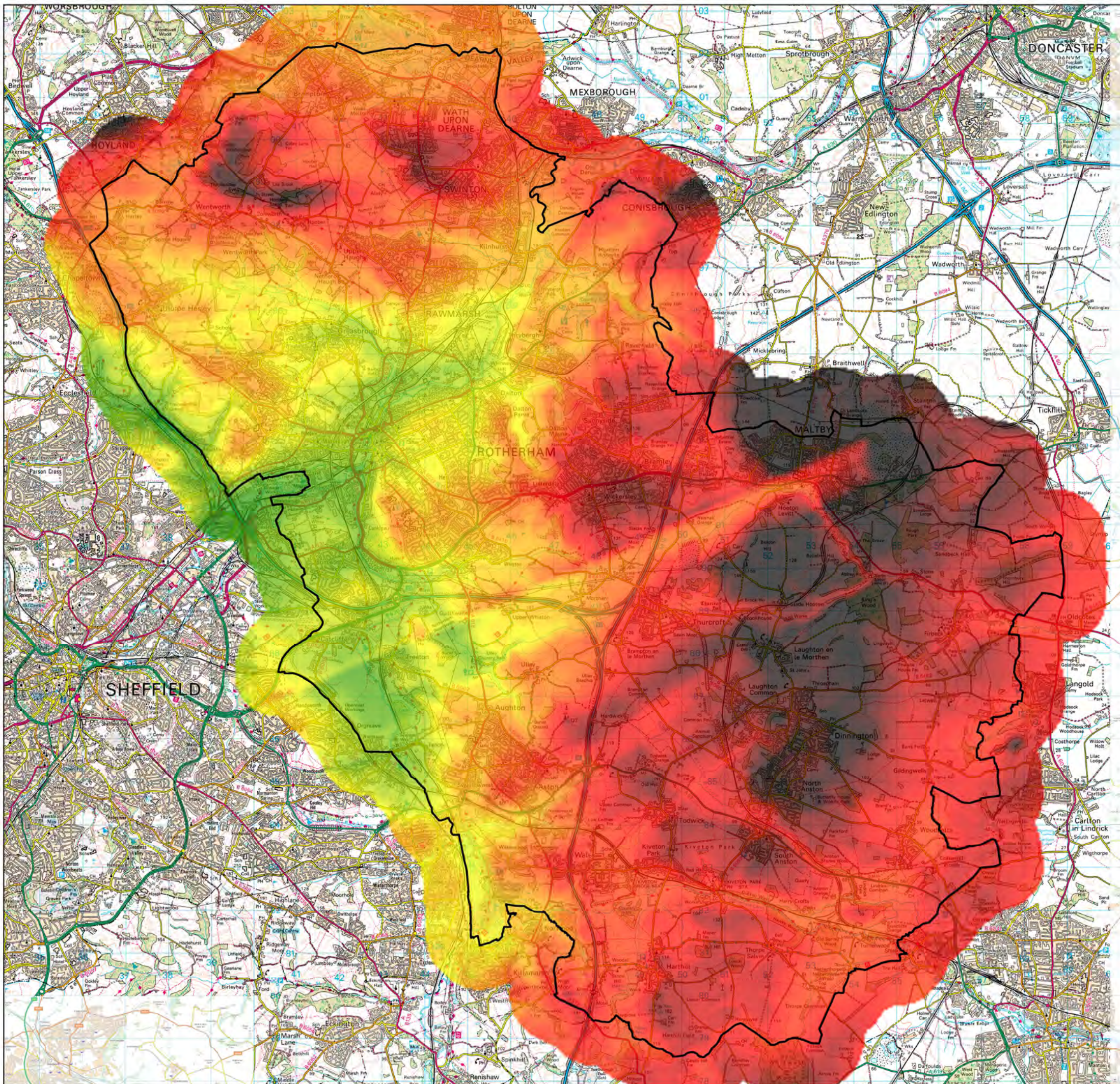


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Checked By: H.Scholes	Date: 09.09.2011

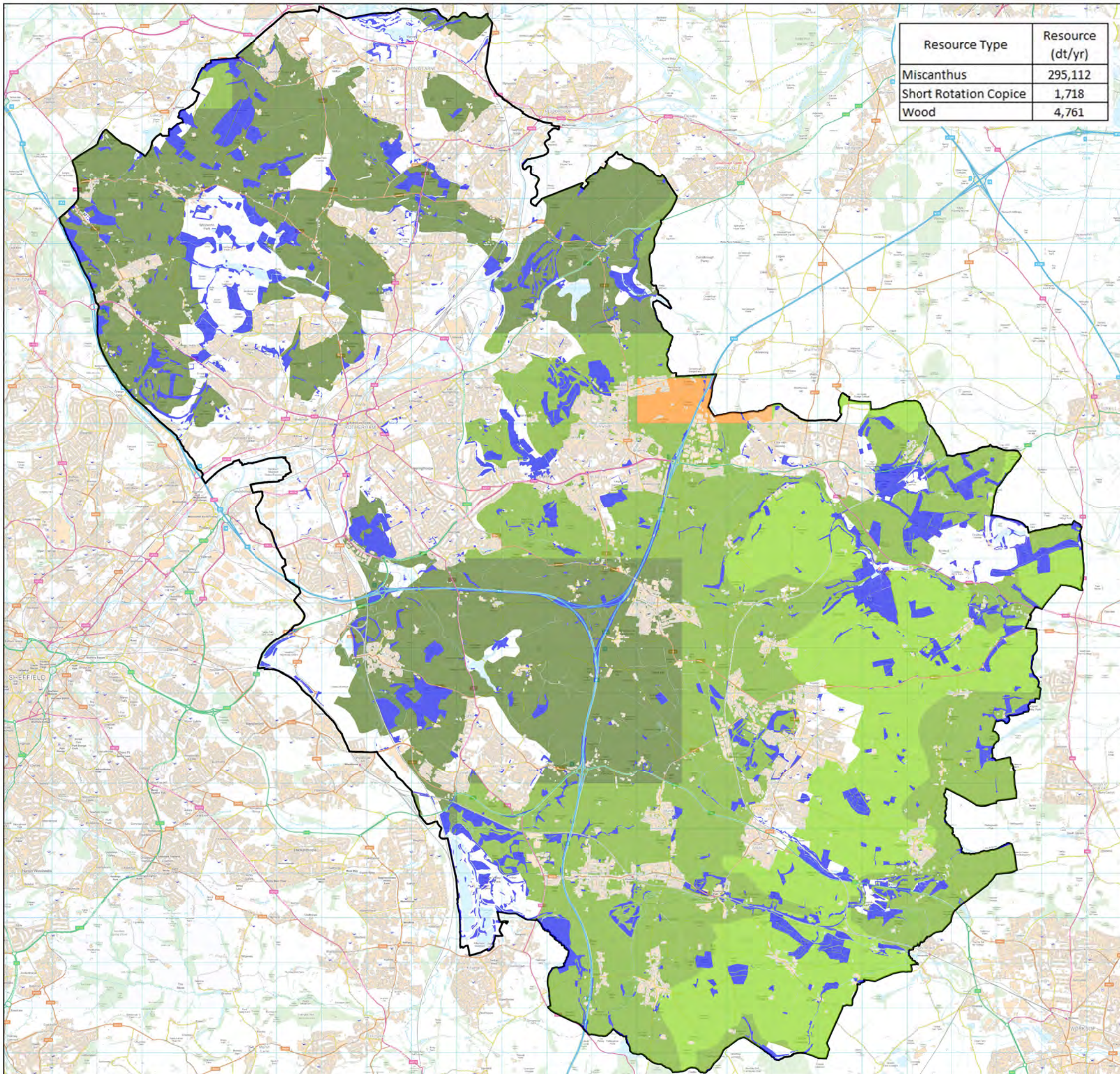
**Wind Resource and Landscape Character Sensitivity
 Local Development Framework
 Rotherham**

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Drawn By:	C.Bines	Date:	05.08.2011		
Checked By:	P.Evans	Date:	05.08.2011		
Combined Radar Constraints Local Development Framework Rotherham					
RADARCON_V1_ZT420418			Figure 3.32		

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Resource Type	Resource (dt/yr)
Miscanthus	295,112
Short Rotation Copice	1,718
Wood	4,761

Biomass Resource (dt/ha/yr)	
2 (Wood)	(8817)
7 (Short Rotation Crops)	(0)
9	(0)
10	(1)
11	(6)
13	(0)
14 (Miscanthus)	(0)
15	(0)
16	(0)
17	(381)
18	(1002)
19	(10)
20	(809)



Biomass resource energy values have been based on the following benchmarks:
 The Miscanthus and SRC yields were classified based on DEFRA data and broken down further by the Agricultural Land Dataset, also supplied by DEFRA.
 Wood yields were based on Ordnance Survey Vector data for Natural Woodland Areas.
 Wind speed was taken from the NOABL database at a reference height of 10m above ground level. This was used to intensify SRC growing areas where wind speed > 6.0 m/s @ 10m AGL
 The resource was derived from the following conversion factors supplied by the Biomass Energy Centre: Miscanthus - 4.8 MWh/dt, SRC - 5.1 MWh/dt, Wood 5.15 MWh/dt
 The thematic map (colouring) represents resource density (dt/ha/yr)
 The Carbon Saving was calculated based on 0.499kgCO₂/kWh of electricity generated (DEFRA).



Scale: 1 : 1,000,000
 0 5 kilometres 1 : 85 000 @ A3

BNG Ref: 447543 : 390408 OS 100km Grid: SK Landranger Ref: 111
 Long : Lat DD -1.2847° : 53.4080° Long : Lat DMS -1° 17' 4.9" : 53° 24' 29.1"



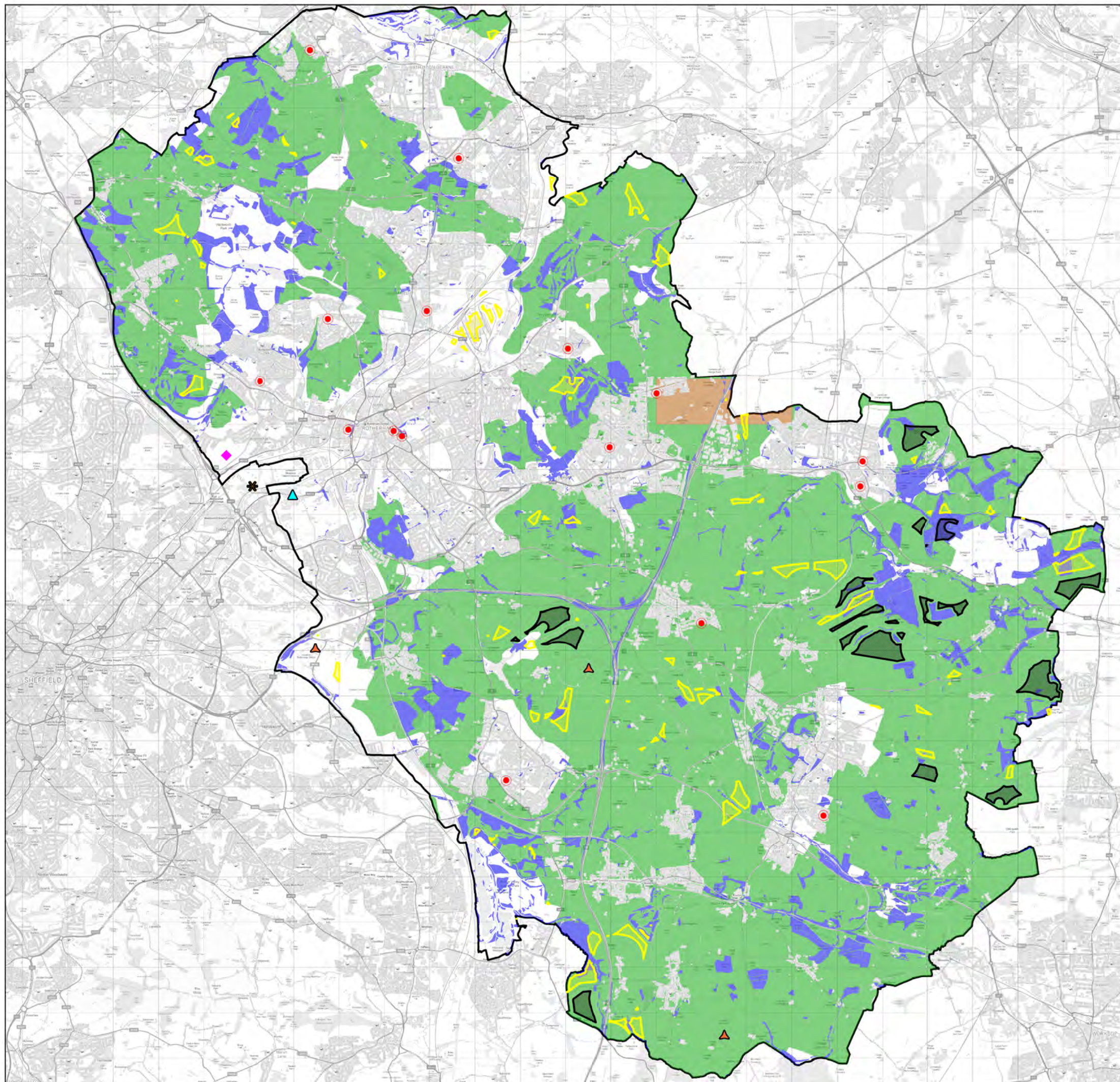
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Drawn By: C.Bines Date: 01/09/2011
 Checked By: S.Clarke Date: 02/09/2011

**Biomass Resource
 Local Development Framework
 Rotherham**

BIORES_V1_ZT420418 Figure 3.33

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- Current district heating networks
 - ▲ Current wind farm
 - ◆ Current landfill
 - ▲ Proposed hydro
 - ✱ Current biomass
 - Medium scale wind turbine resource areas
 - Large scale wind turbine resource areas
- Biomass Resource**
- Miscanthus
 - Short Rotation Coppice
 - Wood



The zoned resource areas are defined as a result of the evidence base study undertaken by Wardell Armstrong. Please see the report for the methodology. All other data is based on the Low Carbon and Renewable Energy Capacity in Yorkshire and Humber published by AECOM. This data was obtained from Rotherham Metropolitan Borough Council.



BNG Ref: 447543 : 390408	OS 100km Grid: SK	Landranger Ref: 111
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Drawn By: C.Bines	Date: 21.09.2011	
Checked By: S.Clarke	Date: 21.09.2011	

**Revised Energy Opportunity Plan
Local Development Framework
Rotherham**

REOP_V1_ZT420418 Figure 5.1

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