Renewable Energy Study

Solar PV and Wind Turbine Potential

Lewes District Council

24 April 2023

Delivering a better world

Quality information

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1. Introduction

Lewes District Council (LDC) declared a climate emergency in July 2019[1]. The council committed to becoming a net zero carbon and fully climate resilient council by 2030.

The Climate Change and Sustainability Strategy 2021 defined the councils baseline emissions profile and set out a pathway to achieving net zero[2]. The baseline is built on LDC's directly controllable consumption of gas, electricity, and fuel; the baseline emissions for 2018/19 financial year was approximately 1,590 tonnes CO2e (tCO2e), with District wide emissions equalling 458,000 tCO2e. For the purpose of this report, district is defined as the area under LDC administrative division.

There was a 10% reduction in District wide emissions between 2019 and 2020; it is noted that the district should be aiming for a year on year reduction of 13.3% reduction to stay within the carbon budget for 2020-2100[3].

One target established in the strategy is to increase solar capacity in the district by 2025 by way of placing solar panels on all suitable buildings, including housing stock. LDC is working with Solar Together to enable and facilitate household access to solar panels and battery storage, at a competitive price, in a group-buying scheme. Further work is also ongoing with community energy companies and East Sussex County Council to put solar panels on schools. Solar generation as of the end of 2021 was 16.7MW.

To support the net zero carbon 2030 transition, LDC have instructed AECOM to quantify renewable energy potential within the Council boundary. This study is intended to help inform the Lewes Core Strategy Local Plan[4], which is an opportunity to shape policies to meet the ambitious decarbonisation target. Technologies investigated include solar photovoltaics (PV) and wind turbine generators (WTGs).

The aim of the study is to identify areas of opportunity for potential developments following a constraints based approach. This study is desktop based and no site visits have been carried out to review the feasibility of any of the opportunities discussed.

1.1 Energy Consumption

To contextualise the renewable generation yield figures discussed herein, details of energy consumption in the Lewes District is provided in Figure 1. In 2019, the total consumption of all fuels (including gas, electricity, coal, petroleum, bioenergy, manufactured fuels) in Lewes equated to 1,833 GWh, of that 322 GWh was delivered as electrical power. It can be assumed that the latter figure will increase as sectors including heating and transport are electrified.

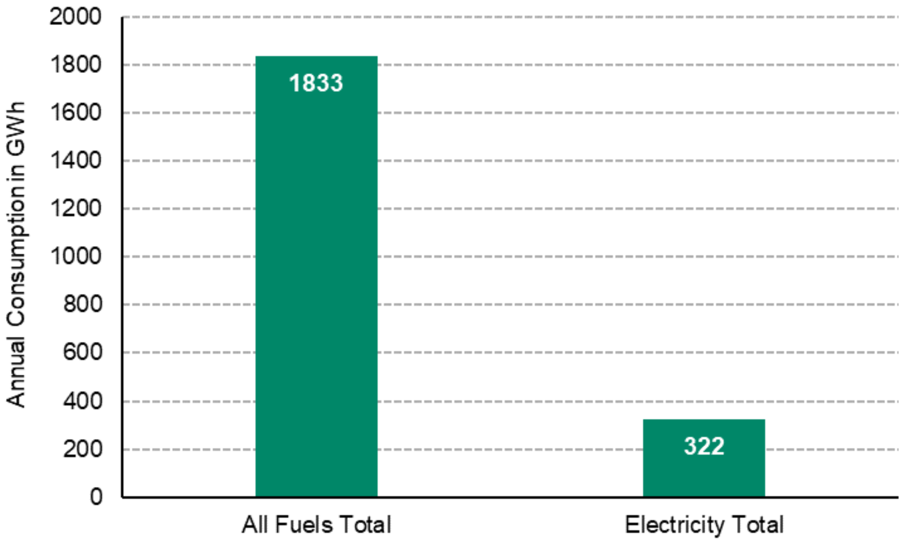


Figure 1. Lewes Total Fuel and Electricity Consumption, 2019[5]

[1] https://www.lewes-eastbourne.gov.uk/community/climate-change/lewes-district-climate-change-and-sustainability/
[2] https://www.lewes-eastbourne.gov.uk/_resources/assets/inline/full/0/310115.pdf
[3] https://www.lewes-eastbourne.gov.uk/_resources/assets/inline/full/0/323256.pdf
[4] https://www.lewes-eastbourne.gov.uk/planning-policy/lewes-core-strategy-local-plan-part-1/
[5] https://www.gov.uk/government/statistics/total-final-energy-consumption-at-regional-and-local-authority-level-2005-to-2019

1.2 Methodology

The renewable energy study was conducted in line with the following methodology:

- Definition of mapping criteria used to build the GIS model. The GIS model was developed using Esri ArcGIS desktop. Datasets were compiled into a file geodatabase, supplied with appropriate metadata. Layers of spatial data include:
  - Planning and environmental constraints.
  - Existing infrastructure (buildings, roads, overhead power lines, railways etc.,).
  - Watercourses and flood risk.
  - Topography.
  - Mean wind speed.
  - Irradiance as Global Horizontal Index (GHI).
- The GIS model was then used to identify areas of constraint and allowed measurement of land areas with opportunity for development of solar PV or WTGs.
- A high-level assessment of generation capacity was carried out for the land areas identified. Solar PV yield was calculated using PV GIS and wind energy yield was simulated using HOMER software.
- Available grid capacity was assessed at a high-level.

The methodology above identified the opportunities for renewable energy in Lewes and provided the estimation of their scale in terms of capacity and energy yield.

1.3 Constraints Overview

This section provides an overview of the LDC boundary area and the main limitations to developing renewable energy. Development of large-scale renewables generally requires extensive open land areas. Figure 2 highlights the main constraints on renewable energy development in Lewes. Various areas of land were identified in the Land Availability Assessment as being either deliverable or undeliverable for strategic housing and economic development, the areas identified as deliverable have been avoided.

The South Downs National Park (SDNP) covers a large area within the LDC boundary, see Figure 3. This was identified as a main limitation, as this designation provides further protection through the 1995 Environmental Act. AECOM carried out a Renewable and Low Carbon Energy Study[6] for the SDNP on behalf of the South Downs National Park Authority (SDNPA). One output from the study has been the inclusion of the following statement and proposed energy policy within the Partnership Management Plan:

> *Policy 55. Support appropriate renewable energy schemes, sustainable resource management and energy efficiency in communities and businesses in the National Park, with the aim of meeting Government climate change targets.*

This is now being used as a basis for development of energy policy within the Local Plan for the SDNP. A Small Scale Renewable Energy Technical Advice Note[7] (TAN) was also published in April 2022 with the purpose to help applicants (householders, community organisations or local businesses) to make successful planning applications for small-scale renewable energy schemes in the National Park as part of the drive to achieve zero carbon emissions. The key considerations that the TAN makes are:

- Sensitively designed schemes for roof top solar panels are likely to be suitable in most areas. Making use of existing roof space is strongly encouraged.
- Other than for domestic use, or at a very small scale, ground mounted solar PV result in a significant change to landscape character which is unlikely to be suitable in most areas.
- Wind resource capacity varies across the National Park. This was evidenced in a high level assessment conducted in 2012 and a more detailed assessment will be undertaken as evidence for the Local Plan

[6] https://www.southdowns.gov.uk/wp-content/uploads/2015/04/SDNP-Low-Carbon-and-Renewable-Energy-Study-Main-Report.pdf
[7] https://www.southdowns.gov.uk/wp-content/uploads/2022/04/Small-Scale-Renewable-Energy-TAN.pdf

Review. Whilst WTG’s may be suitable in some areas this needs to be weighed against visual impact and impacts on tranquillity and a sense of remoteness.

As the above outcomes show that renewable energy developments located within the SDNP are not a hard stop constraint, the potential for development within the LDC boundary has been considered, although separate to the main study analysis. However, it is noted that ground mounted solar PV and WTGs are unlikely to be suitable due to landscape character and visual impact.

Further environmental constraints that have been avoided within the LDC boundary include Tree Preservation Orders (TPO), Local Wildlife Sites (LWS), Ancient Woodland, Country Parks, Sites of Special Scientific Interest (SSSI), Local Nature Reserves (LNR), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Heritage Coast, and Priority Habitat, shown in Figure 4.

Figure 5 shows Source Protection Zones and Flood Zones within the LDC boundary. Source Protection Zones 1 and Zone 2 have been avoided for ground mounted solar PV and WTG potential locations. Flood Zone 2 and Zone 3 were also identified as a constraint, although it is technically possible to develop ground mounted solar PV and WTGs in flood zone areas with suitable engineering solutions. The potential for ground mounted solar PV developments was analysed in addition to the main study.

Agricultural Land Classification (ALC) was another consideration identified, in Figure 6. ALC uses a grading system to enable you to assess and compare the quality of agricultural land; it is graded from 1 to 5 with the best and most versatile (BMV) agricultural land graded 1 to 3a. It is thought that development should avoid unnecessary loss of BMV land. However, it is known that some sites on Grade 2 / 3 land have been granted permission for solar PV. Analysis of potential renewable energy development on Grade 2 and 3 was completed separately to the core opportunities in the area.

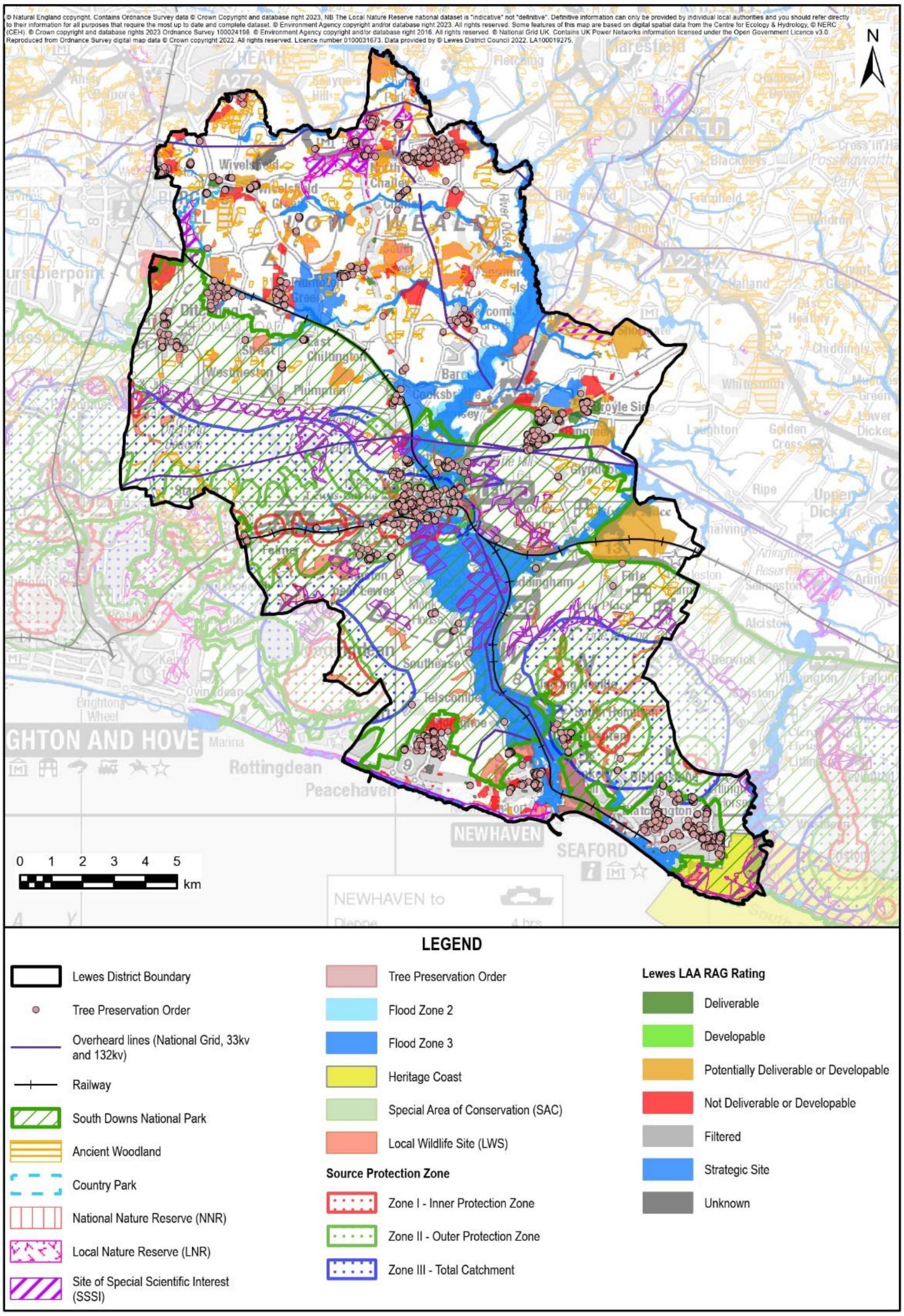


Figure 2. Overview of constraints on renewable energy development in Lewes

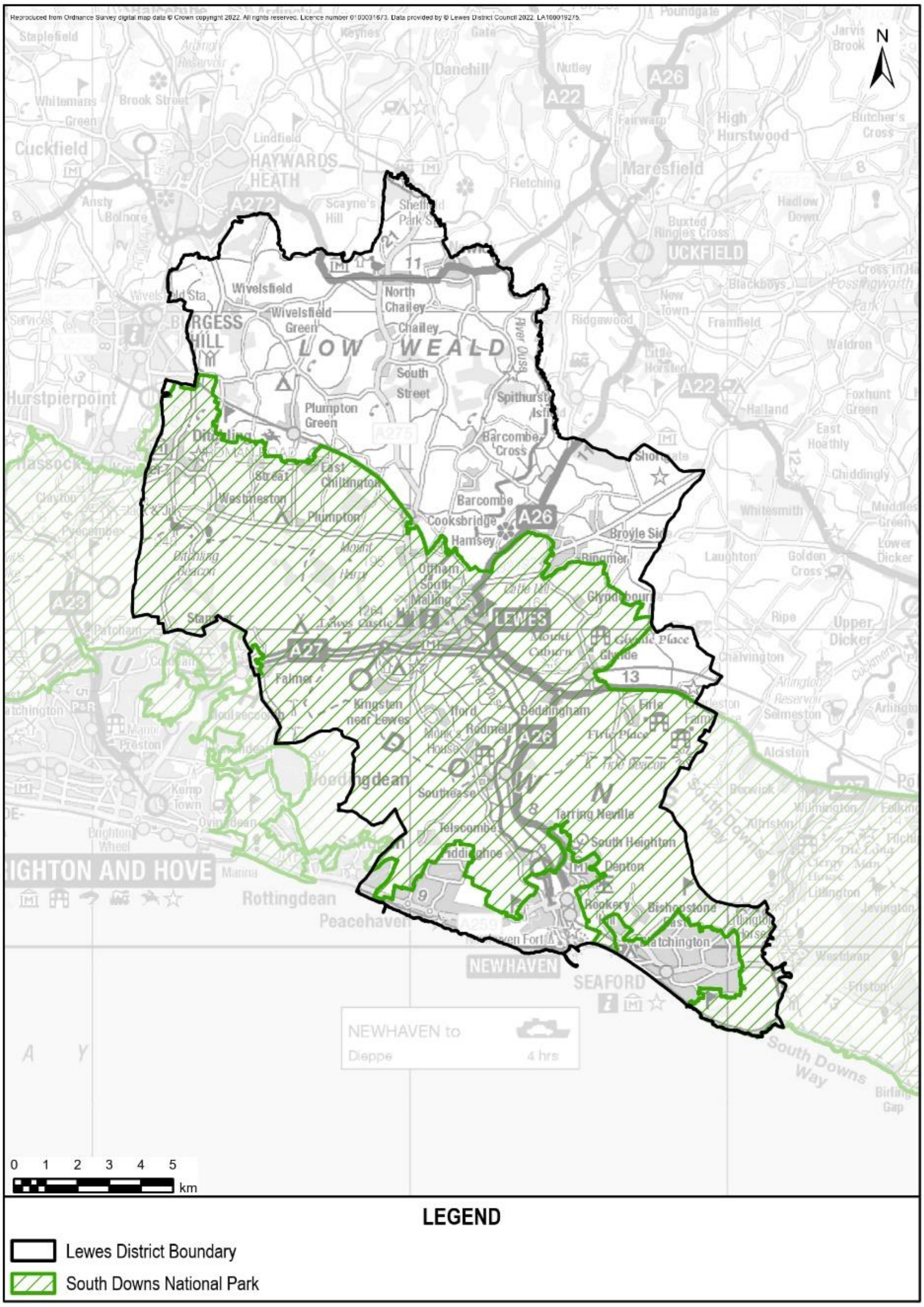


Figure 3. Extent of the SDNP in Lewes

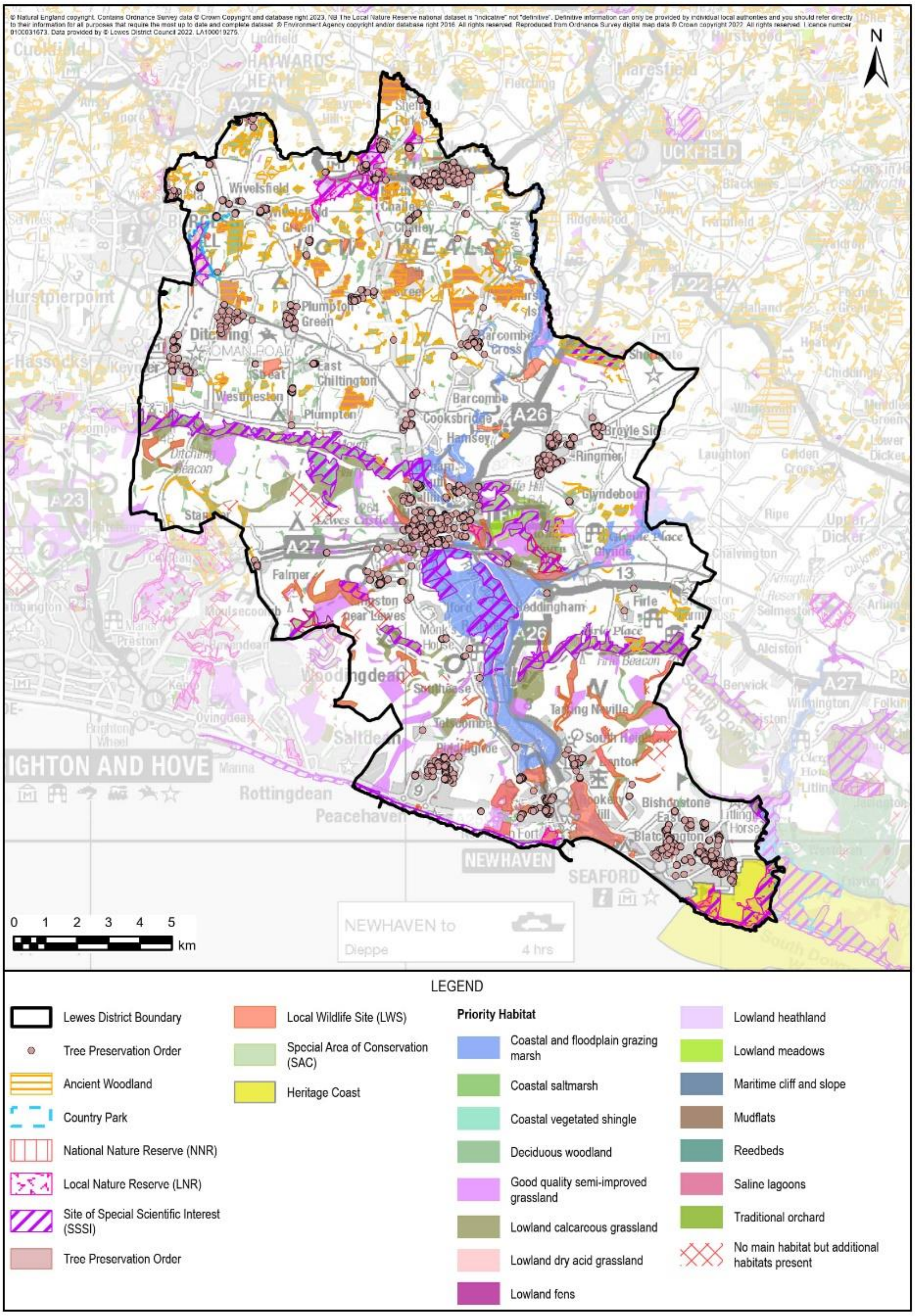


Figure 4. Overview of environmental constraints in Lewes

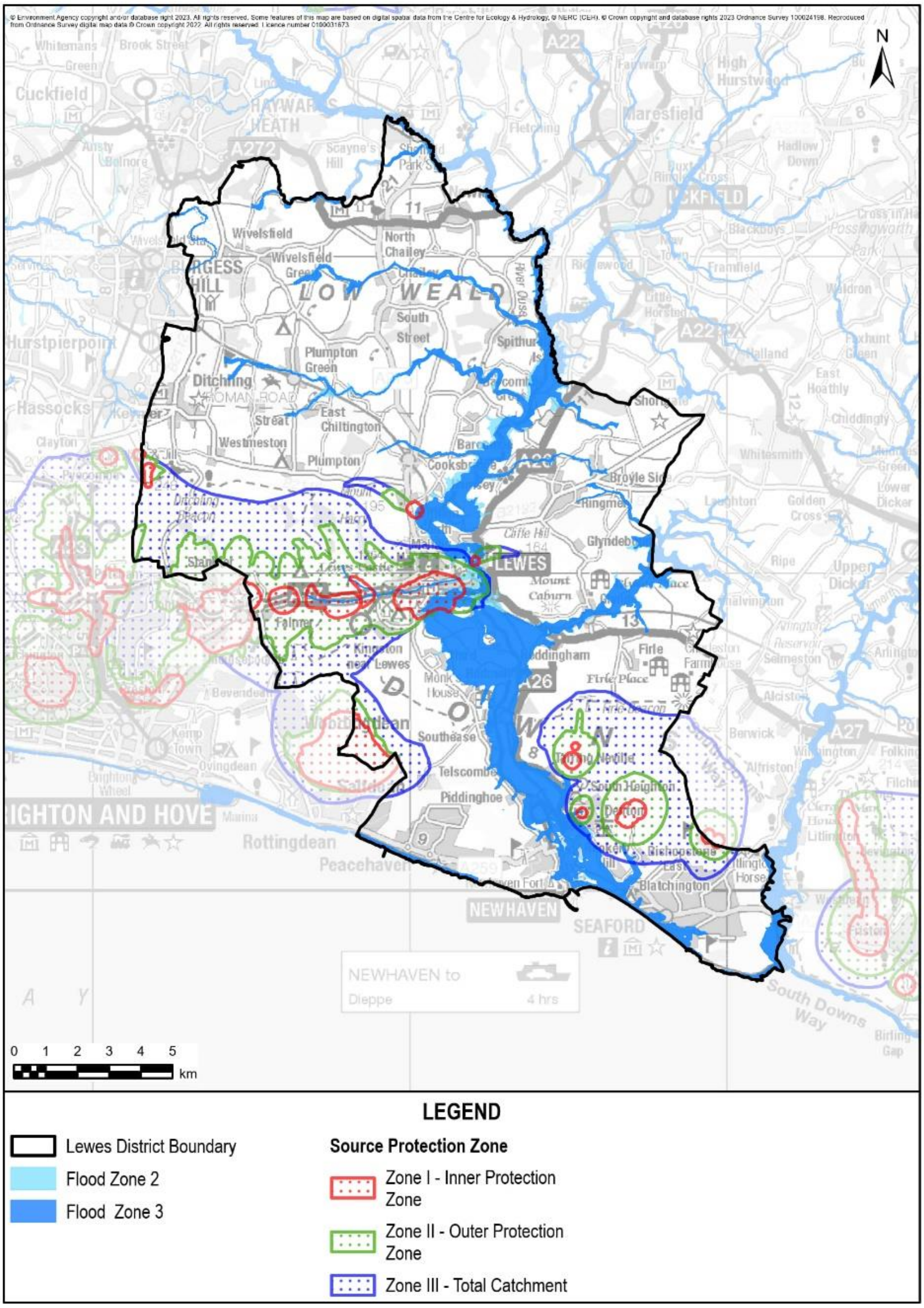


Figure 5. Overview of hydrological constraints in Lewes

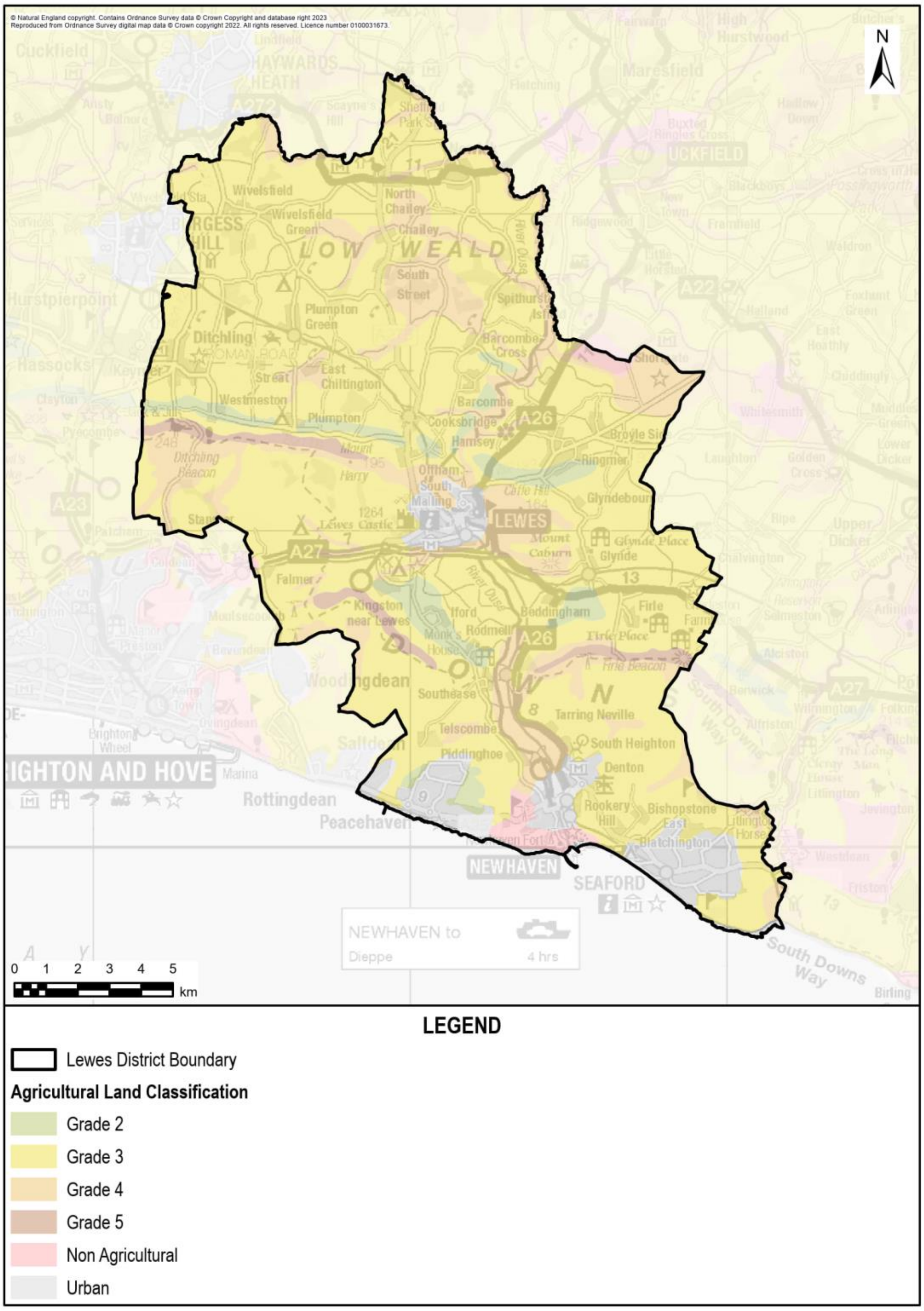


Figure 6. Overview of ALC in Lewes

1.4 Renewable Resource Overview

Initial review shows that Lewes has potential renewable energy resource, however, this is potential is highest to the south of the district.

Figure 7 illustrates that GHI is varied across Lewes, however, annual insolation exceeds 1,060 kWh/m² in most areas. For comparison, Sheffield is the town deemed to represent the average solar resource in the UK with approximately 950 kWh/m². The area south of the A27 experiences higher annual insolation and exceeds 1,105 kWh/m² in most areas, although, this does not apply to areas where the path of sunlight is blocked by shading objects. North of the A27 there is a decreasing trend in annual insolation the further north within the LDC boundary.

Figure 8 shows mean wind speed at 100m above ground; 100m height is used as this would likely be close to the hub height of a large onshore WTGs. Mean wind speed across Lewes varies between 7 m/s and 10 m/s; as a rule of thumb 6 m/s is a minimum requirement for economically viable WTG development. The greater wind speed per m/s is found within the SDNP, due to the areas elevated position. Winds speeds identified here ranged between 8 and 10 m/s. Areas to the north of the SDNP receive wind speeds between 7 and 8.5 m/s on average.

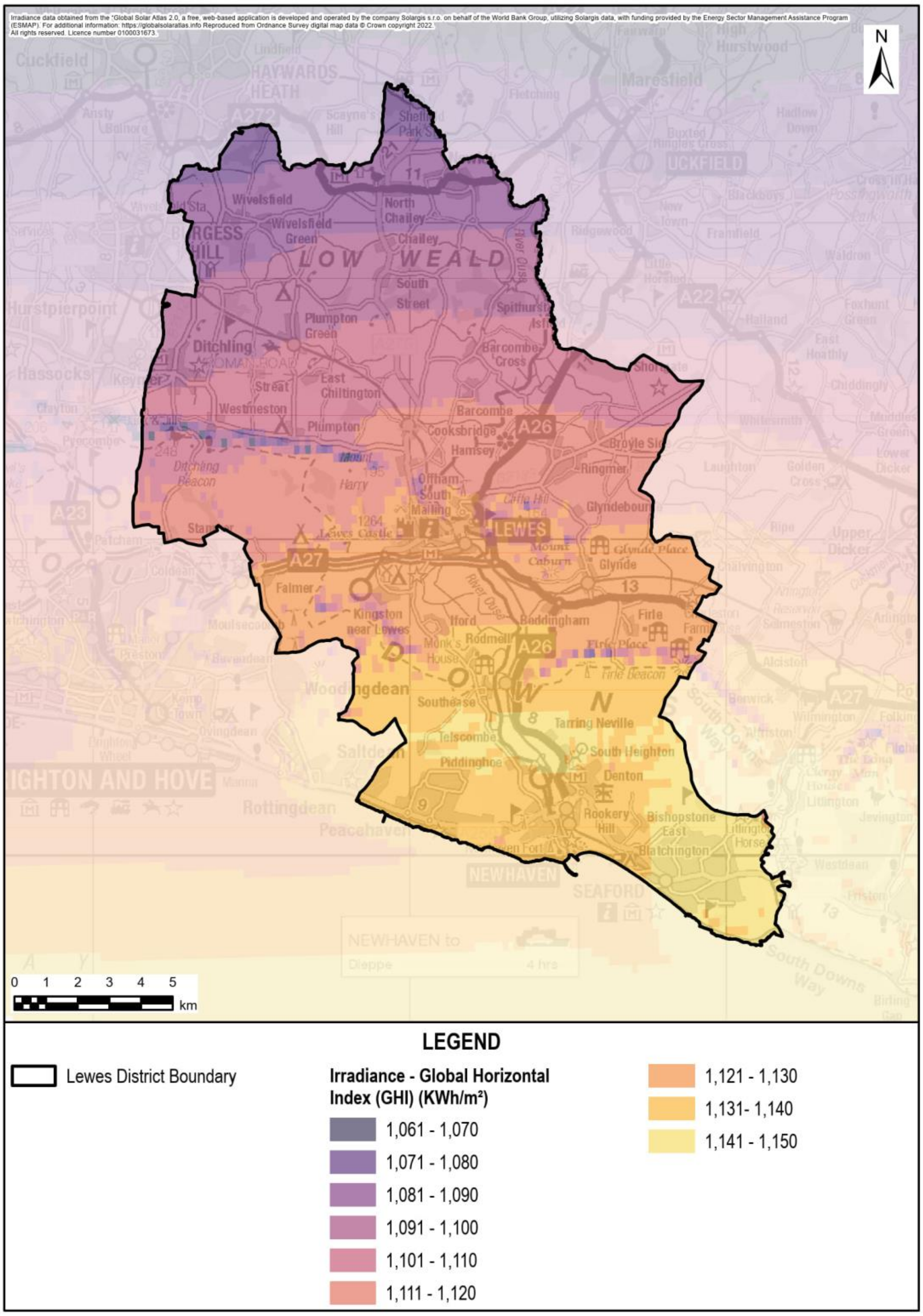


Figure 7. Solar resource across Lewes. GHI measured in kWh/m²

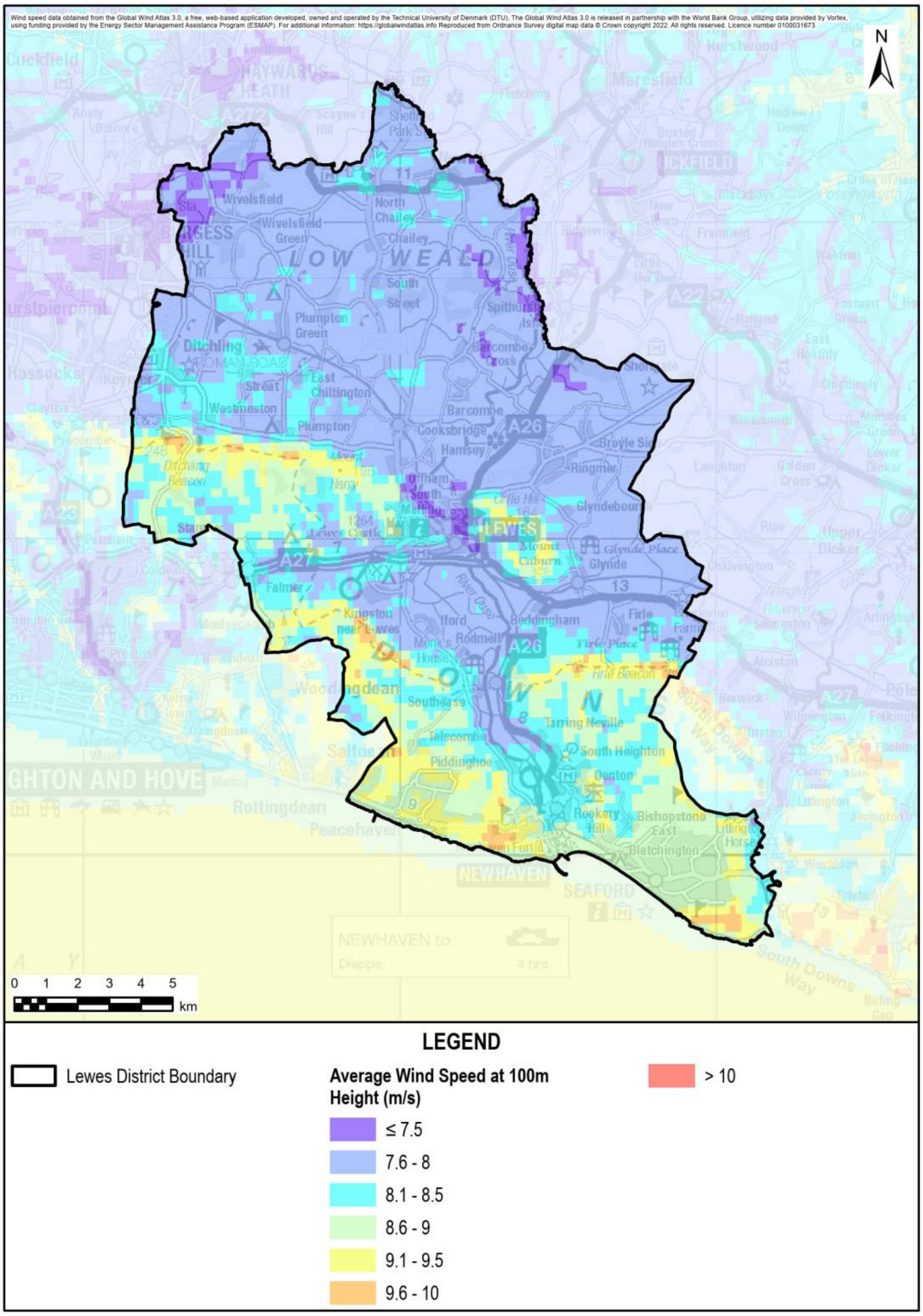


Figure 8. Wind resource across Lewes. Mean wind speed at 100m above ground in m/s

2. Renewable Energy Technology Type

Within the scope of this study the renewable energy technologies include solar PV and WTGs. Options investigated are tailored specifically to the opportunities within the LDC boundary and include ground-mounted PV, carport PV, roof-mounted PV and horizontal axis wind turbines.

2.1 Ground Mounted Solar PV

To locate ground-mounted PV installations, typically large areas of relatively flat open land is required, with few obstructions from trees and structures. PV modules are attached to array tables which are fixed to the ground either with a screw or pile foundation, or ballast where ground conditions do not allow the former option. The layout can be tailored to maximise capacity from individual shapes of land parcels and the approach is modular so can be scaled to almost any size. A clear and preferably short route should be available to connect the PV plant either to grid or to a local off-taker such as a hospital or industrial site.

2.1.1 Potential Ground Mounted PV Locations

The majority of open land areas that are relatively flat within the LDC boundary are either designated national park, flood zone 2 or 3, and / or constrained by other environmental designations. A maximum slope of 11.0 degrees has been assumed for this study, closer to 8.0 degrees would be preferred. Figure 9 shows the locations with solar PV potential within Lewes that are not constrained by these factors.

As discussed in the introduction, while the development of ground mounted solar PV within the national park is unlikely, it is not considered a hard stop constraint. Figure 10 shows the locations that have solar PV potential that are within the SDNP.

Technically, it is possible to develop ground-mounted PV in flood zone 3 areas with suitable engineering solutions. Array tables can be sited on higher mounting structures and electrical equipment and connections raised and designed with appropriate water ingress protection. However, there are potential planning issues around rainwater and ecology. Assuming that these engineering and planning challenges can be overcome, the area available for potential ground mounted PV is increased. Figure 11 shows the potential opportunities in Lewes for Solar PV which are in flood zone 2 and / or 3 areas.

2.1.2 Estimated Ground Mounted PV Generation

Generation potential for the ground-mounted PV category has been broken down into areas that are outside the SDNP, inside the SDNP, and within flood zone 2 and / or 3.

Outside SDNP
Table 1 shows that the total size of the 29 areas identified in Figure 9 is 502 Ha. Assuming a PV density of 0.5 MWp/Ha and a land usability factor of 0.8; to account for hedgerows, shading and access roads; the estimated PV capacity is 201 MWp. The year one yield was simulated in PV GIS which results in an expected annual generation of 226 GWh. Lifetime yield includes expected module degradation over a 30-year period.

Table 1. Generation potential from ground-mounted PV outside SDNP area

Total Area (Ha)	Capacity (MWp)	Year 1 yield (MWh)	Yield estimate over 30-year lifespan (MWh)
502	201	225,947	6,399,544

Inside SDNP
In Table 2 we can see that the area with potential for PV development inside the SDNP area is 645 Ha. This includes all area highlighted in Figure 10. The total potential PV capacity within in this area is 258 MWp, which has a simulated year 1 yield of 290.3 GWh.

Table 2. Generation potential from ground-mounted PV inside SDNP area

Total Area (Ha)	Capacity (MWp)	Year 1 yield (MWh)	Yield estimate over 30-year lifespan (MWh)
645	258	290,307	8,222,430

Within Flood Zone 2 / 3

In Table 3 we can see that the area with potential for PV development inside flood zone 2 and / or 3 area is 68 Ha. This includes all area highlighted in Figure 11. The total potential PV capacity within in this area is 27 MWp, which has a simulated year 1 yield of 30.76 GWh.

Table 3. Generation potential from ground-mounted PV inside Flood Zone 2 and / or 3.

Total Area (Ha)	Capacity (MWp)	Year 1 yield (MWh)	Yield estimate over 30-year lifespan (MW)
68	27	30,761	871,263

The following assumptions were made in calculating generation potential from ground mounted PV:

- 0.4% annual degradation.
- No shading losses were modelled.
- 0.5 MW PV capacity / hectare.
- 14% system losses (due to cell temperature rise, electrical losses, etc.,).
- 20% reduction on Deployable Land / Hectares.
- 30-year lifespan of PV modules.
- For the purpose of this report, a generic specific yield of 1125 MWh/MWp for the Lewes area was used.

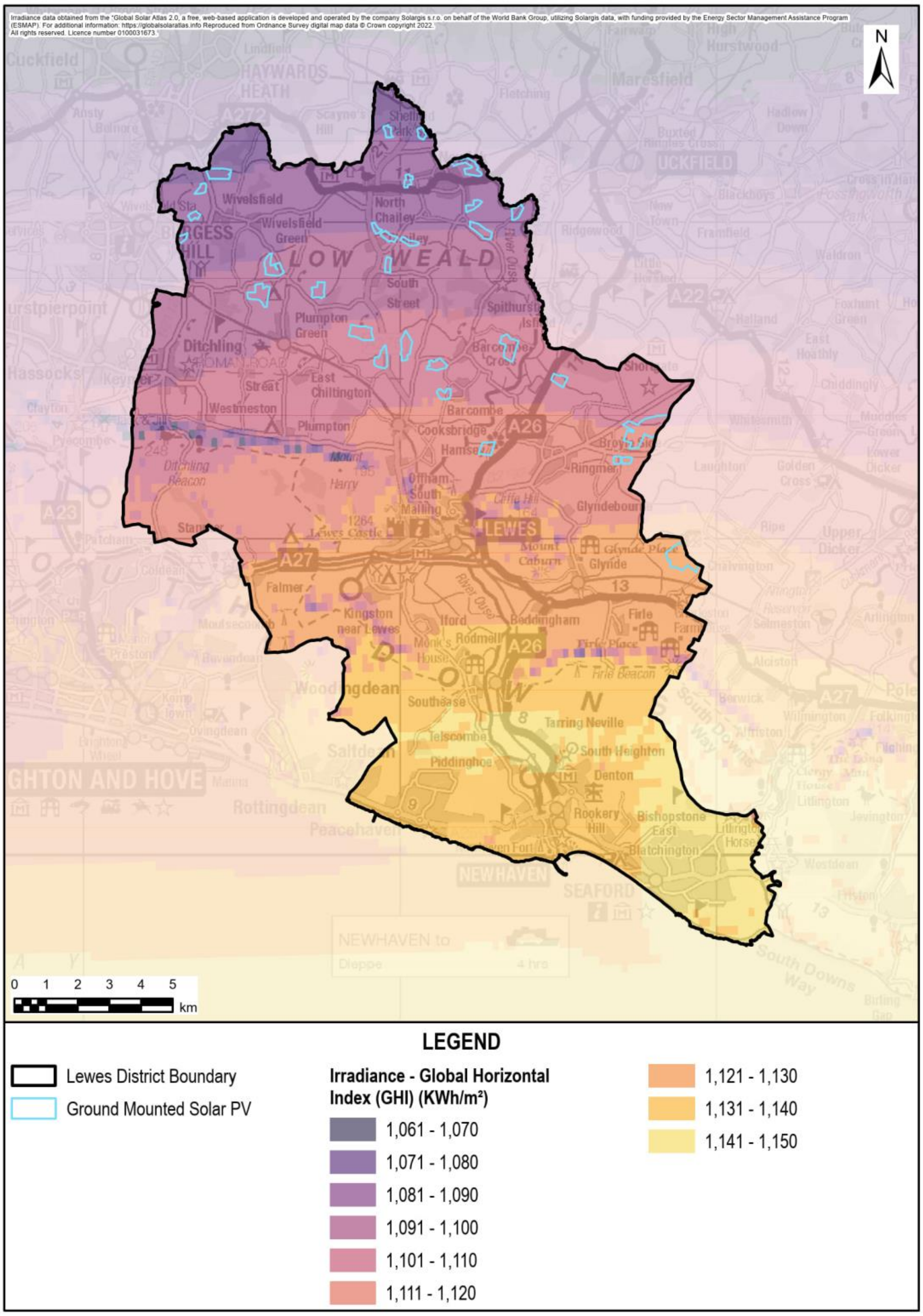


Figure 9. Ground mounted solar PV opportunities in Lewes outside the SDNP and Flood Zone

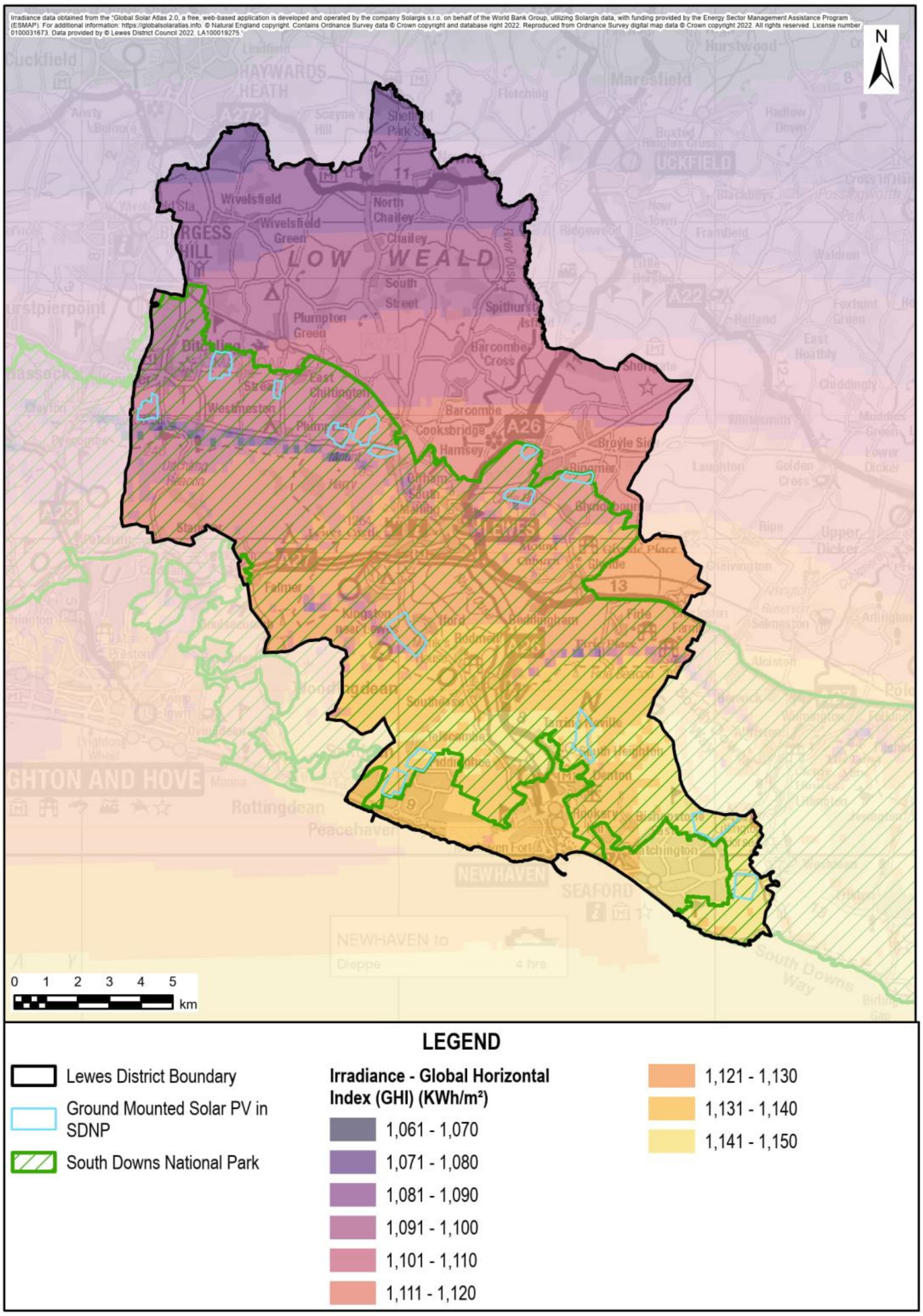


Figure 10. Ground mounted solar PV opportunities in Lewes in the SDNP

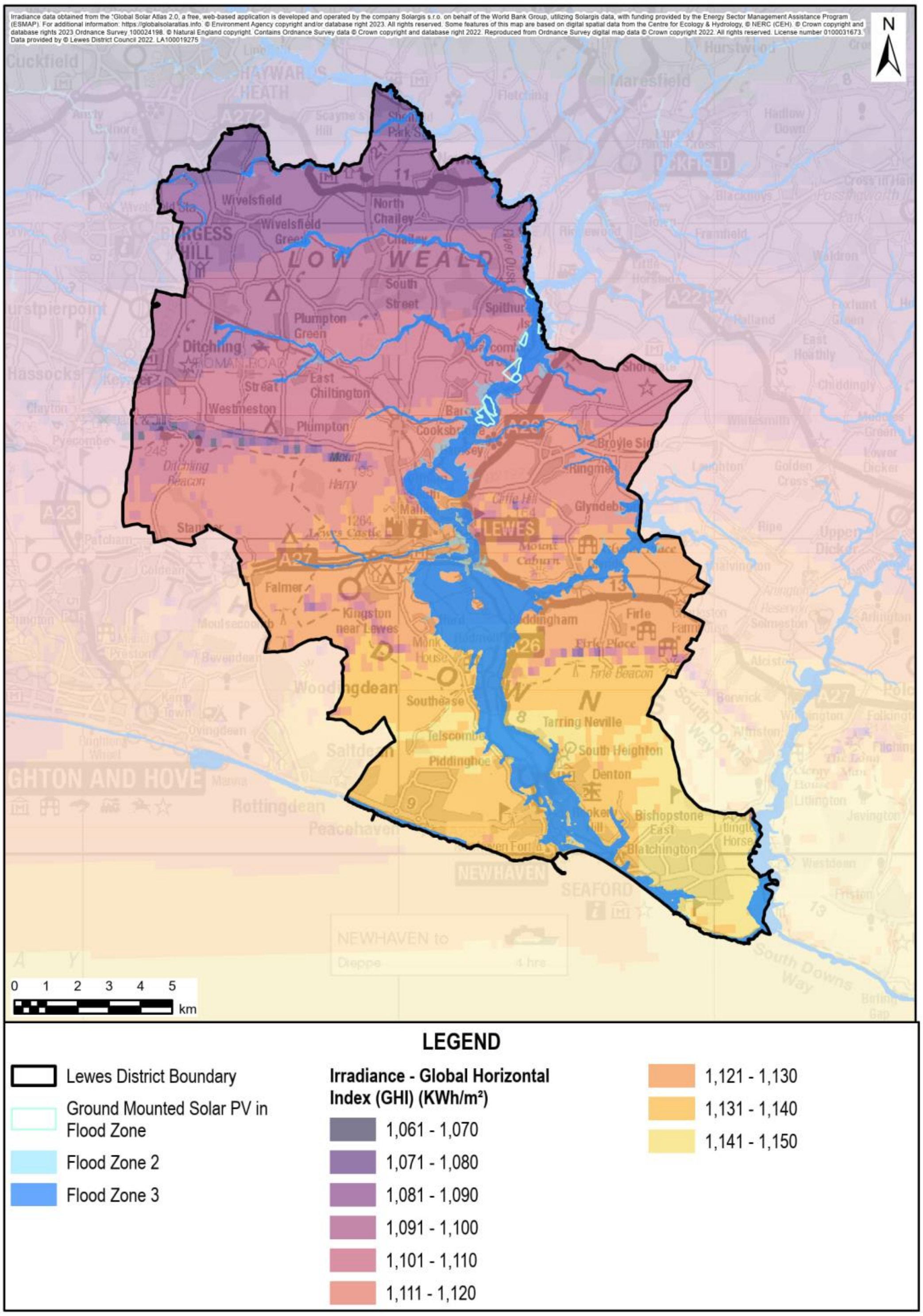


Figure 11. Ground mounted solar PV opportunities in Lewes in a Flood Zone

2.2 Roof Mounted Solar PV

In a roof-mounted PV system, modules are fixed directly onto a roof using rails in the case of pitched roofs, or a ballasted mounting solution for flat roofs. This often makes good use of an otherwise empty space and PV modules are sited up high, away from most shading. As there is little mounting kit needed for pitched roof systems, large commercial pitched roofs tend to have the lowest cost of installation.

2.2.1 Potential Roof Mounted Solar PV Locations

Solar PV can be mounted on most roofs, subject to listed building consent or permissions in conservation areas, as well as technical constraints such as shading and structural integrity. Commercial and public buildings (i.e. non-domestic) with a footprint of exceeding 50 m^2 within Lewes were assessed as they are opportunities with substantial PV capacity across a smaller number of buildings. There appears to be a number of conservation areas within the built-up areas in Lewes. Even though solar PV installations are not permitted development on the front of properties in these areas (i.e. permission must be granted), after careful consideration it was decided not to exclude these areas from analysis in this study. However, it should be noted that this presents a further constraint to provision of roof mounted PV. Figure 12 shows all commercial buildings in Lewes with footprint > 50 m^2. The analysis does not exclude roofs that may already be hosting some PV.

2.2.2 Estimated Roof Mounted PV Generation (Non-Domestic)

There are a total of 1,907 non-domestic buildings with a footprint exceeding 50 m^2 in Lewes. To approximate useable roof space, considering shading, unsuitable orientation, edge boundaries etc., a PV coverage factor of 0.3 was applied to the total footprint. Efficiency of PV modules varies, but 20% is commonly seen in the current marketplace. That level of efficiency provides 200 Wp/m^2, therefore a total capacity potential of 33 MWp across these selected commercial buildings. Using open-source software, PV GIS, a generic specific yield was assumed for the Lewes area, resulting in a forecasted generation of 37 GWh in year 1 (Table 4).

Table 4. Generation potential from PV on non-domestic buildings

Total useable roof space (m^2)	Capacity (MWp)	Year 1 yield (MWh)	Yield estimate over 30-year lifespan (MWh)
164,990	33	37,135	1,051,770

The following assumptions were made in calculating generation potential from roof-mounted PV:

- 0.4% annual degradation of PV modules.
- No shading losses were calculated.
- 200 Wp capacity / m^2.
- 0.3 solar PV coverage factor.
- 14% system energy losses.
- 30 year expected system lifespan.
- Minimum building footprint of 50 m^2.
- For the purpose of this report, a generic specific yield of 1,125 MWh/MWp for the Lewes area was used.

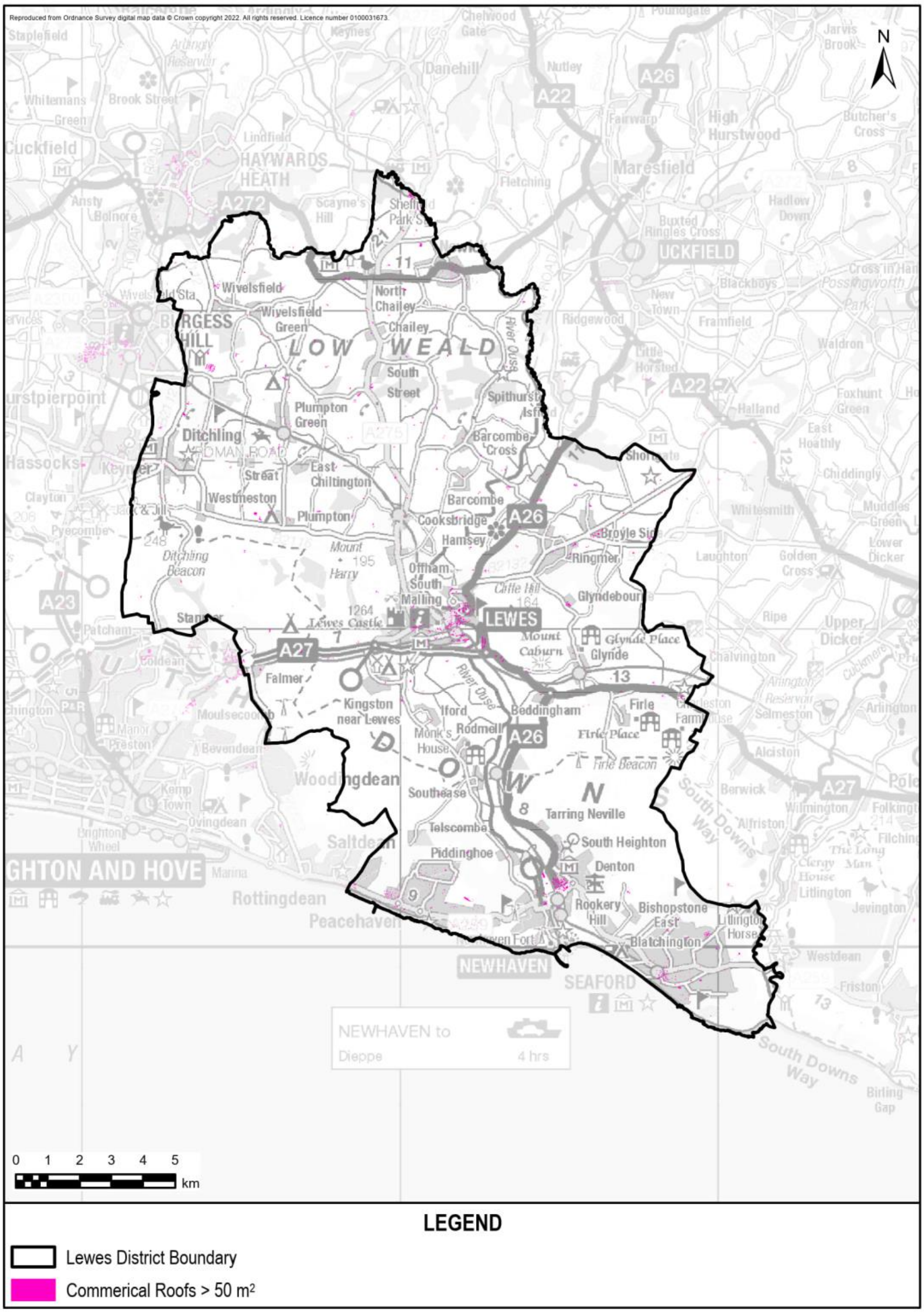


Figure 12. Commercial buildings in Lewes with footprint > 50 m^2.

2.3 Wind Turbine Generators

WTGs exist in various forms and sizes. The two main types are horizontal axis – and vertical axis wind turbines, both of which can be installed at the domestic and commercial levels, or at grid-scale. The assessment of potential from domestic and commercial sites is outside the scope of this study, instead the focus is on large grid-scale deployment of horizontal axis WTGs, illustrated in Figure 13. This turbine type is preferable due to higher energy conversion efficiencies.

Figure 13. Example of a wind farm consisting of horizontal axis wind turbines

For development of WTGs land ideally should be flat or elevated terrain and free from obstructions to the wind flow. Obstructions cause the wind flow to become turbulent which increases the wear on equipment. The main adverse effect on local residents is the sound created by air passing over the turbine blades. Therefore, the following constraints have also been considered for WTGs, in addition from the previous constraints.

Residential Buffer

Practice Guidance – Planning Implications of Renewable and Low Carbon Energy (2011) indicates that careful consideration of the siting and layout design of individual turbines/wind farms is important to ensure that increases in ambient noise levels around noise-sensitive development (i.e. residential properties) are kept to acceptable levels in relation to existing background noise. Effects from increases in noise levels can be minimised by ensuring that there is sufficient distance between the turbines and residential properties.

The existing Wind Energy Development Guidelines published in 2006 do not have a prescribed setback distance but do indicate that a 500 m setback distance should be sufficient to prevent any significant noise impact arising from the operations of wind turbines.

The 2019 Draft Wind Energy Development Guidelines propose a “visual amenity setback of 4 times the turbine height between a wind turbine and the nearest residential property, subject to a mandatory minimum distance of 500 metres”.

For this study, a typical buffer of 500 m between WTGs and residential dwellings has been implemented to mitigate noise, amenity, and safety issues.

Slope

WTGs are tall, and their construction requires a sturdy and relatively flat terrain for a crane. Generally, slopes below 10% (5.71 degrees) are acceptable to support access tracks to WTGs.

Shadow Flicker

Shadow flicker is the effect of the sun (low on the horizon) shining through the rotating blades of a WTG, casting a moving shadow. It will be perceived as a "flicker" due to the rotating blades repeatedly casting the shadow. Although, in many cases shadow flicker occurs only a few hours in a year, it can potentially create a nuisance for homeowners in close proximity to turbines.

The magnitude of shadow flicker effects varies both spatially and temporally, and depends on a number of environmental conditions coinciding at a particular point in time, which include:

- time of day and year.
- wind direction (rotor orientation).
- height of wind turbine and blade length.
- position of the sun in the sky.
- weather conditions.
- proportion of daylight hours in which the WTG operate.
- type and frequency of use of the affected space.
- distance and direction of the wind turbine from the receptor.

There is no applicable legislation that directly deals with the assessment or control of shadow flicker. Planning for Renewable Energy – A Companion Guide to PPS22 Office of the Deputy Prime Minister (2004) makes the following Statements:

- Shadow flicker only occurs inside buildings where the flicker appears through a narrow window opening.
- Only properties within 130 degrees either side of north of the turbines can be affected at UK latitudes.
- Shadow flicker has been proven to occur only within ten rotor diameters of a turbine position.
- Less than 5% of photo-sensitive epileptics are sensitive to the lowest frequencies of 2.5-3 Hz; the remainder being sensitive to higher frequencies.
- A fast-moving three-bladed wind turbine will give rise to the highest levels of flicker frequency of well below 2 Hz. The new generation of wind turbines is known to operate at levels below 1 Hz.

Computer models can accurately predict when, where, and to what degree this problem will occur, so wind project developers can mitigate this impact during the site selection process. However, this affect has not been looked at as part of this initial feasibility study.

2.3.1 Potential Wind Turbine Locations

As previously discussed, most of the open land in the Lewes area, with the highest wind speeds, are constrained.

Figure 14 illustrates the locations in Lewes which may be suitable for WTGs; the locations are marked by red circles with a radius of 120 m each to demonstrate the rotor diameter of a Siemens 3.6 MW turbine. A minimum distance of 500 m is kept between WTG locations to reduce yield loss from wake effects (blocking of wind flow by upstream WTGs). Proximity to Electrical Transmission lines is also kept to 300 m. The final separation distance from turbines to each other and other constraints will be determined by the final turbine size.

From a technical perspective, the most suitable area for wind energy generation in Lewes is in the SDNP zone. The prevailing wind direction is from the southwest so turbines placed here would mostly be free from wind flow obstruction (depending on height), due to proximity to the coast. Other locations, closer to Newhaven, are more likely to experience obstructed wind flow and turbulence caused by the buildings of the town. There are examples of existing WTGs in UK national parks[8]. Figure 15 shows the potential locations for WTGs inside the national park.

[8] https://cairngorms.co.uk/wind-turbine-approved-in-the-national-park/

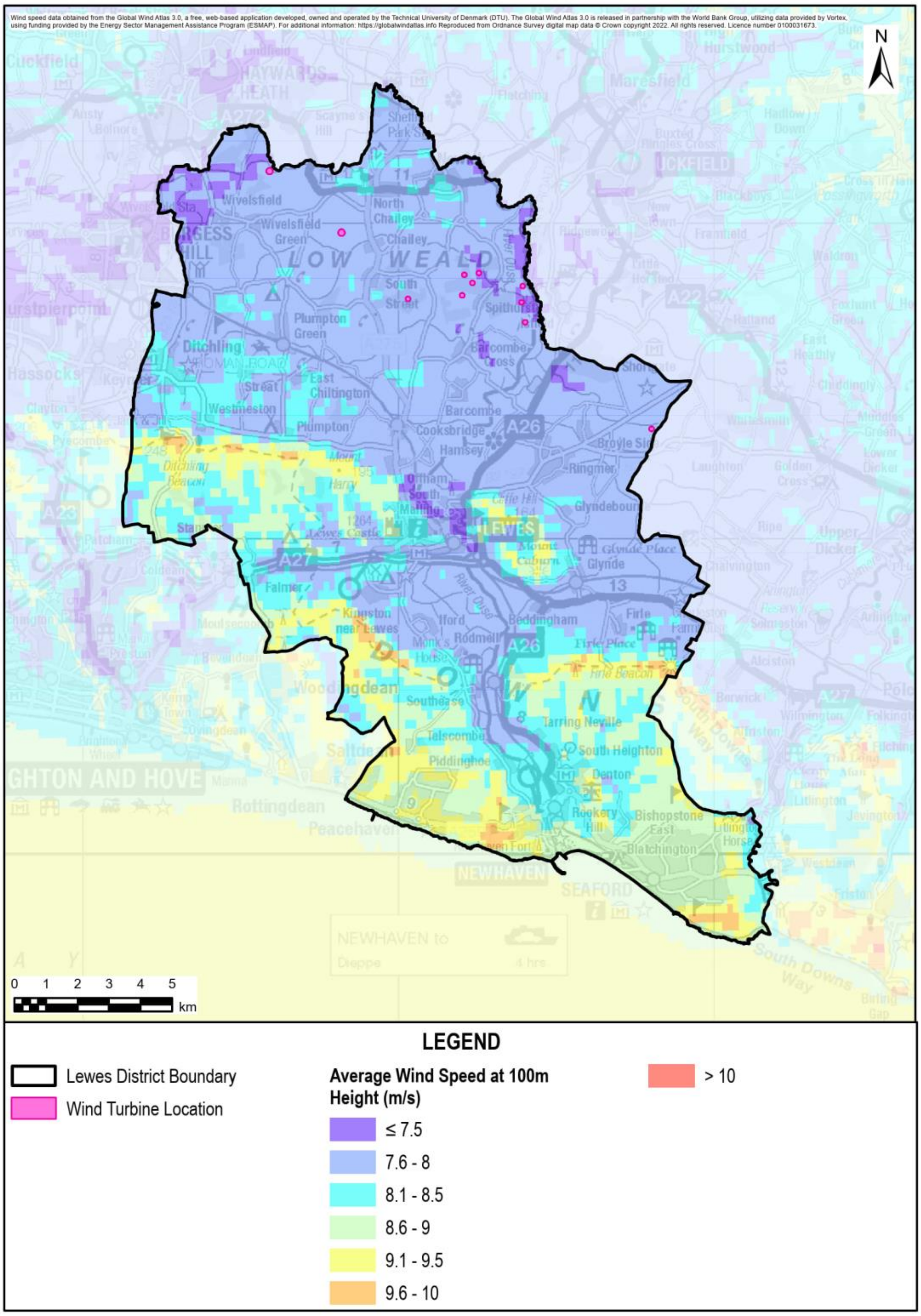


Figure 14. Potential locations for wind turbines

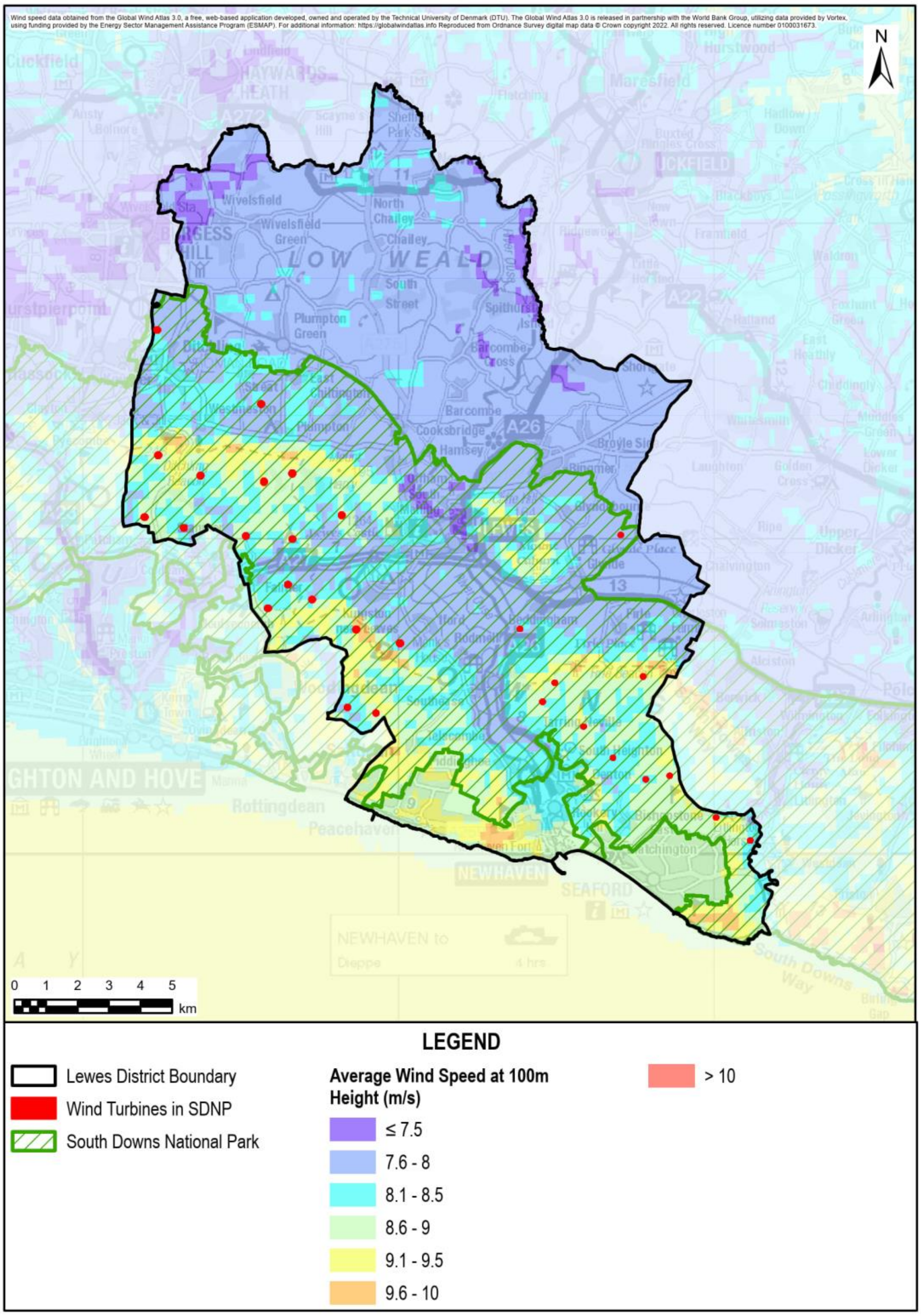


Figure 15. Potential locations for wind turbines in the SDNP

2.3.2 Estimated Generation from Wind Turbines

Potential wind energy yield was simulated in the energy modelling software HOMER. For this exercise a single Siemens 3.6 MW turbine with hub height of 100 m was selected. The wind climate and temperature were based on the NASA Prediction of Worldwide Energy Resource (POWER) database, monthly average wind speed at 50 m above earth's surface, spanning a 30-year period. An industry standard power law equation was applied to scale up the wind speeds realised at 100 m. The location of the data source is latitude 50.75, longitude 0.25, which is within the 'red' wind resource zone just outside of the Lewes District Boundary, approximately 9 km southeast of the most southern wind turbine locations in Figure 15. Therefore, the resulting yield is generally most accurate for the turbines positioned in the national park area.

Table 5 shows the yield estimates for a single 3.6 MW turbine and scaled up to 40 which could potentially be sited within the LDC boundary including inside and outside the SDNP zone. The table also highlights the total WTGs outside the SDNP zone as shown in Figure 14. It is assumed that the WTG's would derate in capacity by 0.3% per year and have a lifespan of 25 years. The estimated capacity factor is 45.8%, which is above average for existing onshore wind turbines in southern England. The result is due to the high recorded resource data on which the simulation was based. The annual maximum annual yield from WTGs in Lewes is estimated to be 558 GWh.

Table 5. Generation potential from wind turbines

Wind Turbines	Total Capacity (MW)	Year 1 yield (MWh)	Yield estimate over 25-year lifespan (MWh)
1	3.6	13,956	336,624
11, outside the SDNP zone	40	153,516	3,702,862
40, total including inside and outside SDNP zone	144	558,240	13,464,950

The following assumptions were made in calculating generation potential from wind turbines:

- 100 m hub height.
- 500 m min distance to domestic buildings.
- 500 m min distance between individual wind turbines.
- Weibull k factor 2.0.
- Power law exponent 0.14.
- 0.3% annual derating of capacity.
- No wake losses were modelled.
- 25-year wind turbine lifespan.

3. Grid Connection Capacity

In order to connect any type of renewable generator, a connection agreement must first be secured with the distribution network operator (DNO). An initial assessment of available grid connection capacity was undertaken by review of information available on the website of the DNO, UK Power Networks. It was found that the Lewes area is currently without major constraints for inverter-based generation (solar PV) and synchronous generation (WTGs). The total available 'Headroom' on the distribution network is currently 15.7 MW[9]. This means that the availability of grid connections will likely not be a barrier to renewable energy installation up to that total capacity. To be noted is that availability of connection capacity is dynamic, it changes as new connections are agreed or grid upgrade are carried out.

At feasibility stage grid connection should be assessed on a site-by-site basis, through a grid study by the DNO, as the electrical infrastructure local to the generating equipment must be capable of handling the additional power. Where this is not the case, the installation project bears the required upgrade costs. Grid connection costs can vary vastly depending on the effects that the generator may or may not have on the DNO's equipment. Early engagement with the DNO is recommended for any renewable energy project.

[9] https://ukpowernetworks.opendatasoft.com/explore/dataset/dfes-network-headroom-report/custom/?q=lewes&location=13,50.77463,0.26436&basemap=jawg.light

4. Summary

An assessment of renewable energy potential in Lewes has been carried out. The technologies assessed were solar PV and WTGs. A GIS model was constructed and used to find and measure areas of opportunity. A summary of these opportunities is shown in Table 6. This highlights that the largest opportunity is from WTGs when all zones are considered such as inside and outside the SDNP zone which all together produce an annual yield generation potential of 558 GWh. When viewing these figures, it should also be considered that wind energy has a different seasonal profile to solar PV with winter months typically being the strongest and generation also at night-time. The energy transition requires a mix of technologies and resources to reduce strain on the electricity networks and decrease required energy storage capacities.

The second largest opportunity is from ground-mount PV when all three zones are considered such as inside the SDNP zone, outside the SDNP zone and within the Flood zone 2 or 3 which all together produce an annual yield potential of 547 GWh.

Table 6. Generation potential from all identified opportunities

Technology type	Total capacity (MWp)	Year 1 yield (MWh)	Yield estimate over lifespan (MWh)
Ground-mounted solar PV, total of inside and outside SDNP and inside Flood zone 2 or 3	486 (258 inside SDNP)	547,015 (290,307 inside SDNP)	15,493,237 (8,222,430 inside SDNP)
Roof mounted solar PV, total of non-domestic buildings	33	37,135	1,051,770
WTGs, total of inside and outside SDNP zone	144 (104 inside SDNP)	558,240 (404,724 inside SDNP)	13,464,950 (9,762,088 inside SDNP)
Total	663	1,142,390	30,009,957

A comparison can be drawn between the energy consumption figures shown in section and the estimated renewable energy generation potential. The total demand for all fuels in 2019 was 1,833 GWh[10], which is of the same order of magnitude as the total yearly renewables yield of 1,142 GWh, as illustrated by Figure 16. That is not to say that Lewes should aim to become energy independent, but it does highlight the scale of deployment required to meet energy demand.

To be noted is that the renewables yield includes generation from utility-scale WTGs; and commercial, and utility-scale solar PV. The potential contribution from large numbers of small-scale generators of these technology types, as well as other renewable energy sources (e.g. biomass, hydropower, geothermal), is likely to be significant, but their investigation was outside the scope of this study.

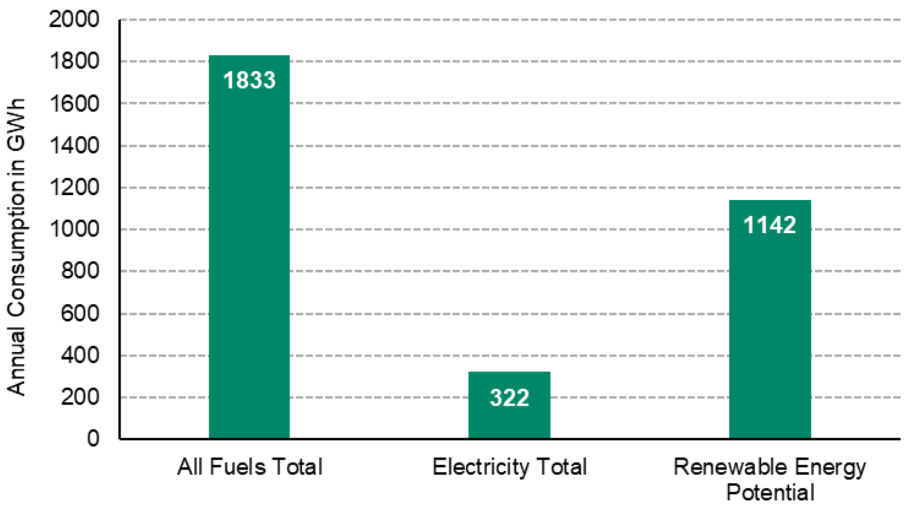


Figure 16. Lewes total fuel and electricity consumption in 2019 against estimated renewable energy potential

[10] https://www.gov.uk/government/statistics/total-final-energy-consumption-at-regional-and-local-authority-level-2005-to-2019

A high-level review of the available distribution grid connection capacity showed that currently the area is unconstrained with 15.7 MW available on the distribution network. This allows for connection of renewable energy systems of significant size, but not the total of the opportunities discussed.

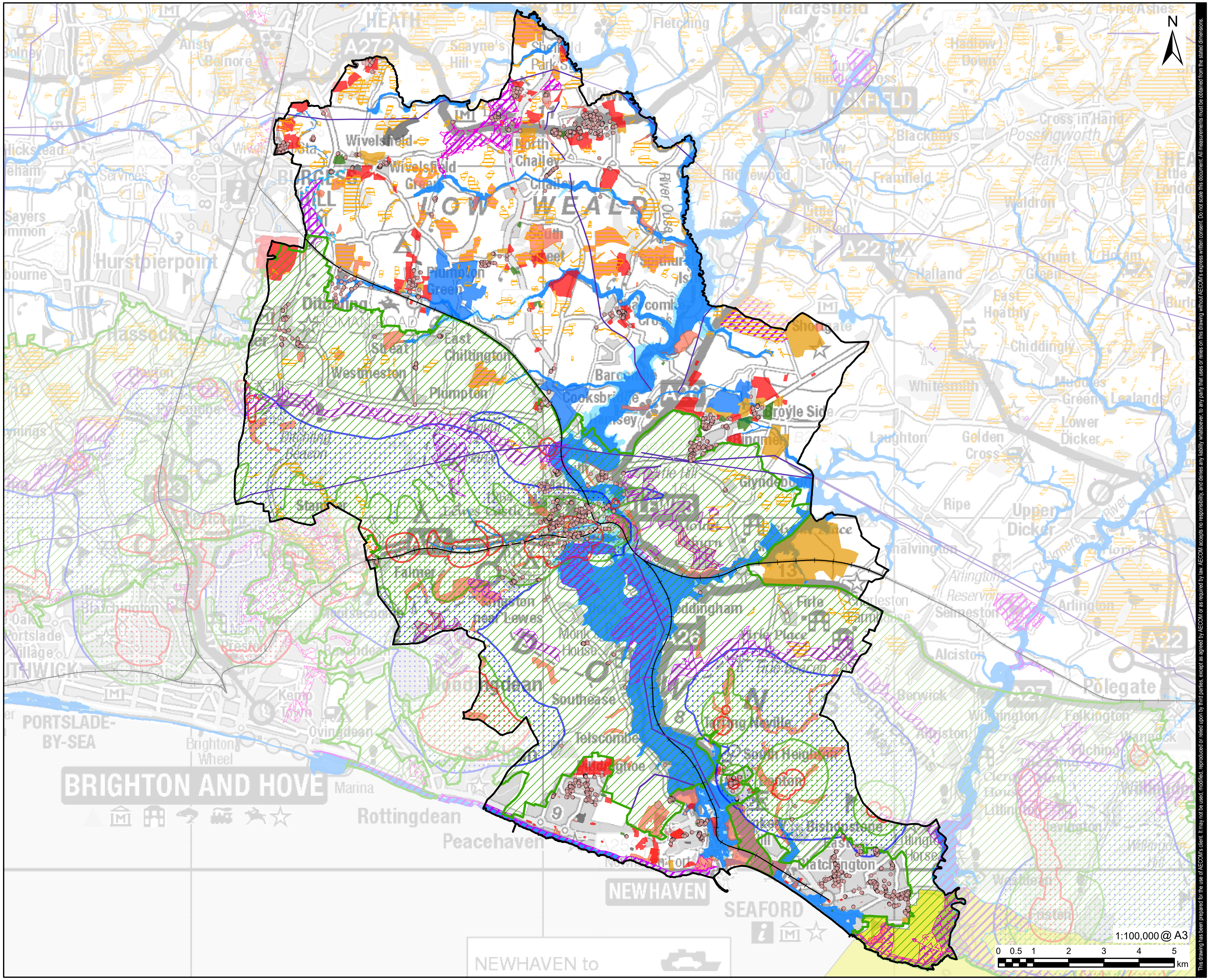
There are important details that the figures presented here do not take into account. For example, there is no analysis into time of generation against demand, which becomes an important factor in net zero carbon scenarios, as any mismatch must be levelled via energy storage or carbon offset.

It is recommended that LDC develop a renewable energy strategy to map out how the required energy can be deployed in the available timeframe. Individual opportunities could be further developed and ranked. The Council could then directly or indirectly progress installation of ‘cherry picked’ schemes, such as ground-mounted PV connected by private-wire to the hospital.

Appendix A Figures

Please see the following figures in this appendix:

- Figure 1 – Constraints;
- Figure 2 – South Downs National Park;
- Figure 3 – Environmental Constraints and Priority Habitats;
- Figure 4 – Flood and Source Protection Zones;
- Figure 5 – Agricultural Land Classification (ALC);
- Figure 6 – Global Horizontal Index (GHI);
- Figure 7 – Average Wind Speed;
- Figure 8 – Ground Mounted Solar PV;
- Figure 9 – Ground Mounted Solar PV in South Downs National Park;
- Figure 10 – Ground Mounted Solar PV in Flood Zone;
- Figure 11 – Wind Turbine Location outside of South Downs National Park;
- Figure 12 – Wind Turbine Location within South Downs National Park; and
- Figure 13 – Commercial Roofs Solar PV.



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LEGEND

- Lewes District Boundary
- Tree Preservation Order
- Overheard lines (National Grid, 33kv and 132kv)
- Railway
- South Downs National Park
- Ancient Woodland
- Country Park
- National Nature Reserve (NNR)
- Local Nature Reserve (LNR)
- Site of Special Scientific Interest (SSSI)
- Tree Preservation Order
- Local Wildlife Site (LWS)
- Special Area of Conservation (SAC)
- Heritage Coast
- Flood Zone 3
- Flood Zone 2

Source Protection Zone

- Zone I - Inner Protection Zone
- Zone II - Outer Protection Zone
- Zone III - Total Catchment

Lewes LAA RAG Rating

- Deliverable
- Developable
- Potentially Deliverable or Developable
- Not Deliverable or Developable
- Filtered
- Strategic Site
- Unknown

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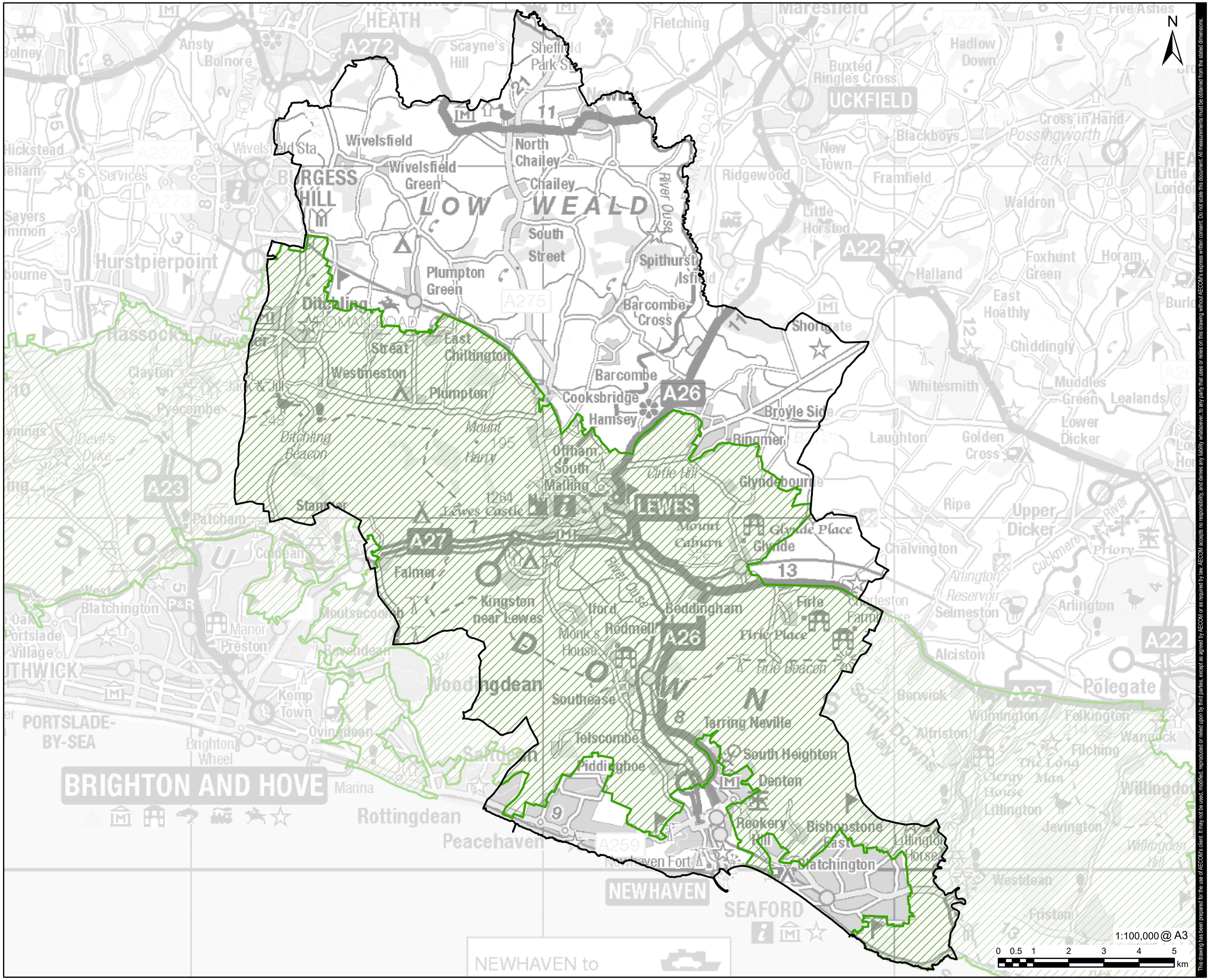
FIGURE TITLE

Constraints

FIGURE NUMBER

Figure 1



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LEGEND

- Lewes District Boundary
- South Downs National Park

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FIGURE TITLE

South Downs National Park

FIGURE NUMBER

Figure 2

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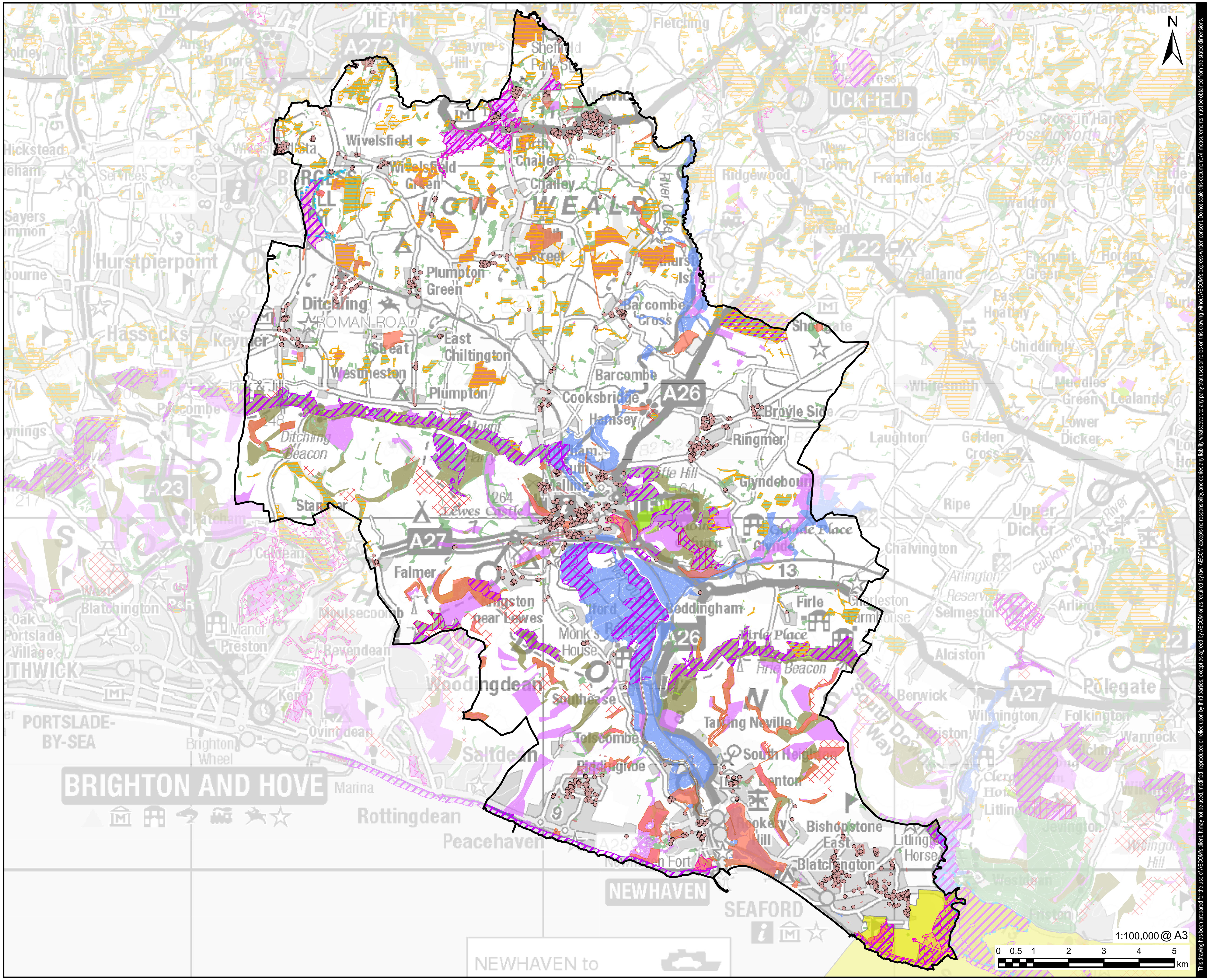

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LEGEND

- Lewes District Boundary
- Tree Preservation Order
- Ancient Woodland
- Country Park
- National Nature Reserve (NNR)
- Local Nature Reserve (LNR)
- Site of Special Scientific Interest (SSSI)
- Tree Preservation Order
- Local Wildlife Site (LWS)
- Special Area of Conservation (SAC)
- Heritage Coast

Priority Habitat

- Coastal and floodplain grazing marsh
- Coastal saltmarsh
- Coastal vegetated shingle
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland calcareous grassland
- Lowland dry acid grassland
- Lowland fens
- Lowland heathland
- Lowland meadows
- Maritime cliff and slope
- Mudflats
- Reedbeds
- Saline lagoons
- Traditional orchard
- No main habitat but additional habitats present

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FIGURE TITLE

Constraints and Priority Habitats

FIGURE NUMBER

Figure 3

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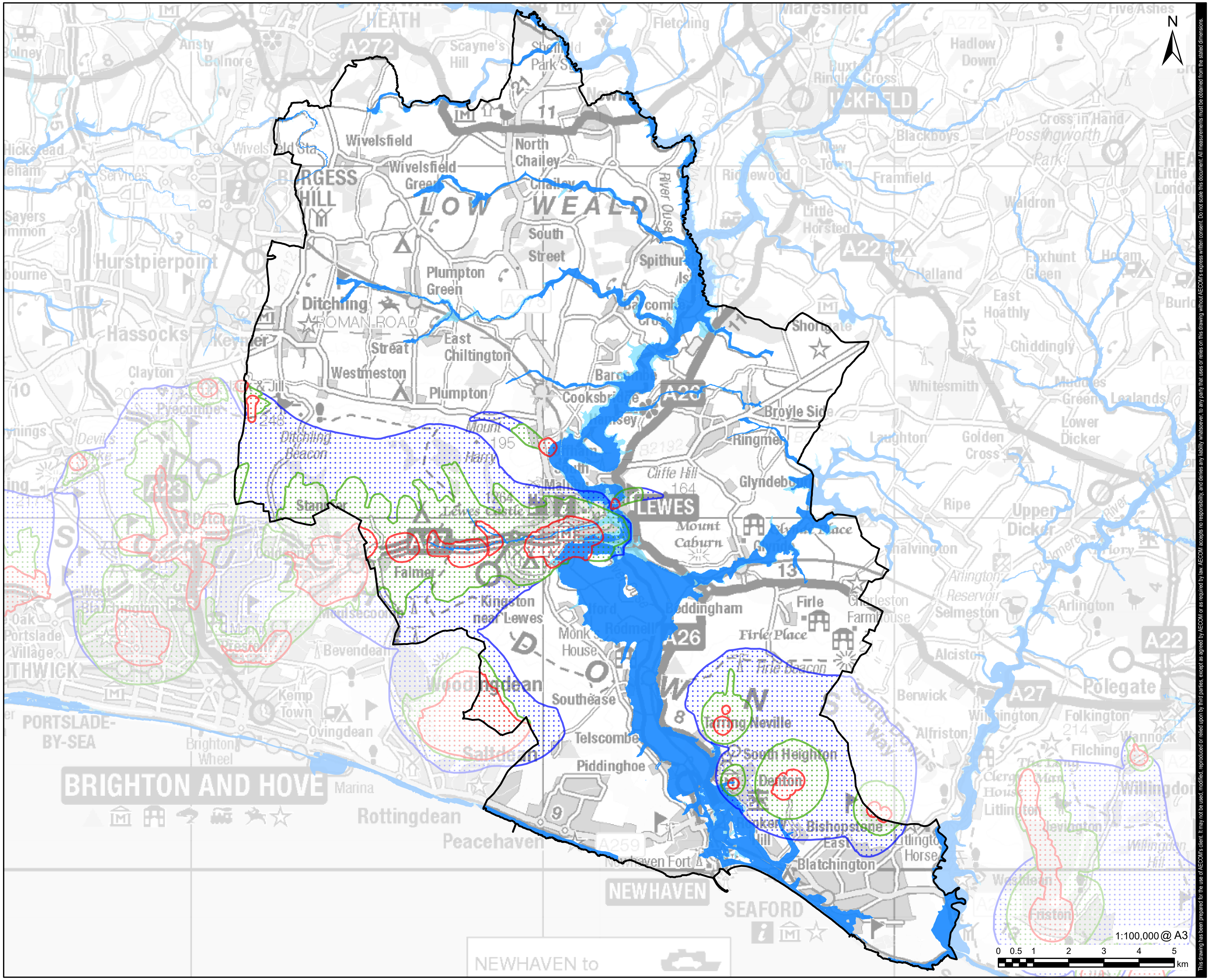

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LEGEND

- Lewes District Boundary
- Flood Zone 2
- Flood Zone 3

Source Protection Zone

- Zone I - Inner Protection Zone
- Zone II - Outer Protection Zone
- Zone III - Total Catchment

NOTES

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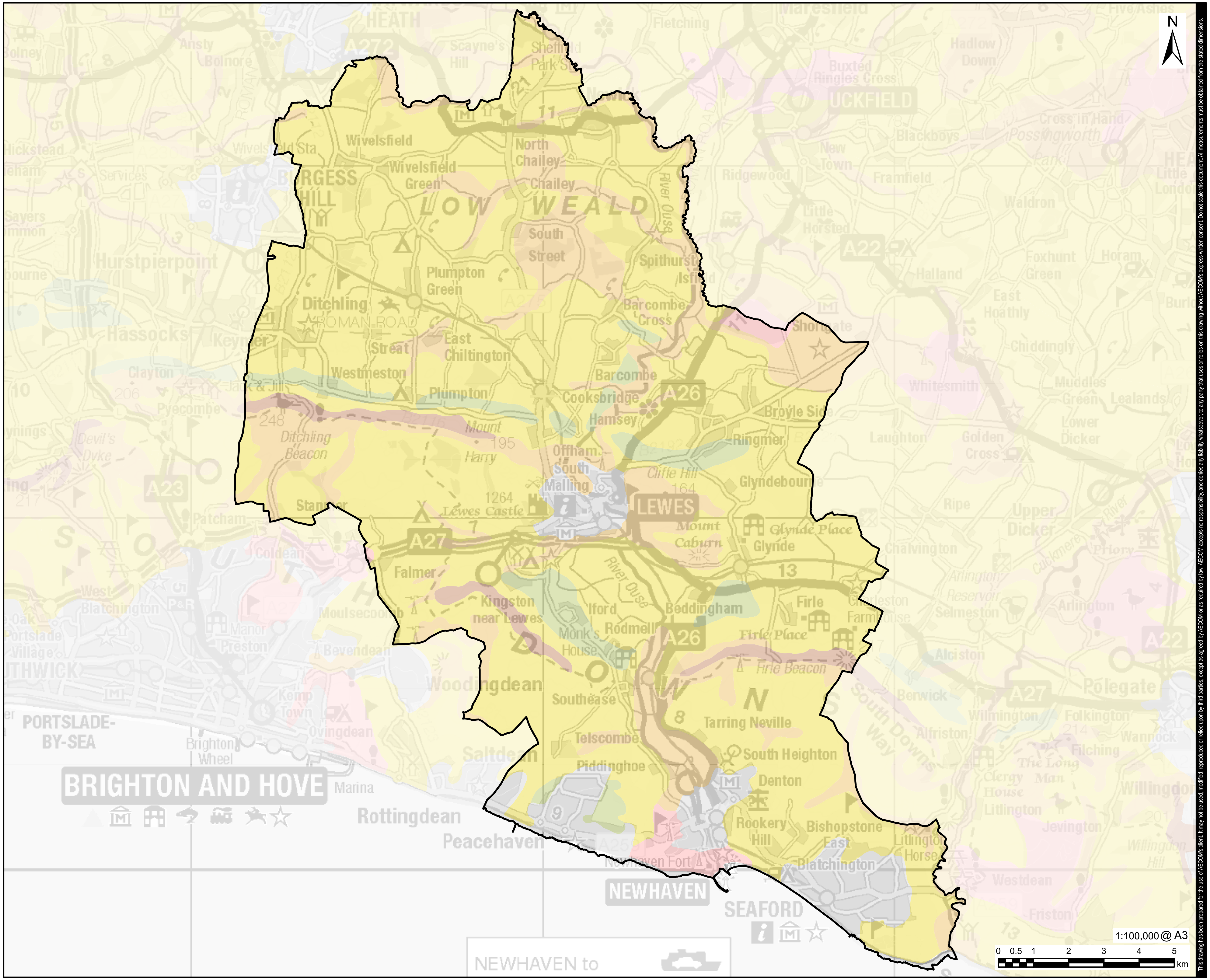
FIGURE TITLE

Flood and Source Protection Zone

FIGURE NUMBER

Figure 4



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LEGEND

Lewes District Boundary

Agricultural Land Classification

- Grade 2
- Grade 3
- Grade 4
- Grade 5
- Non Agricultural
- Urban

NOTES

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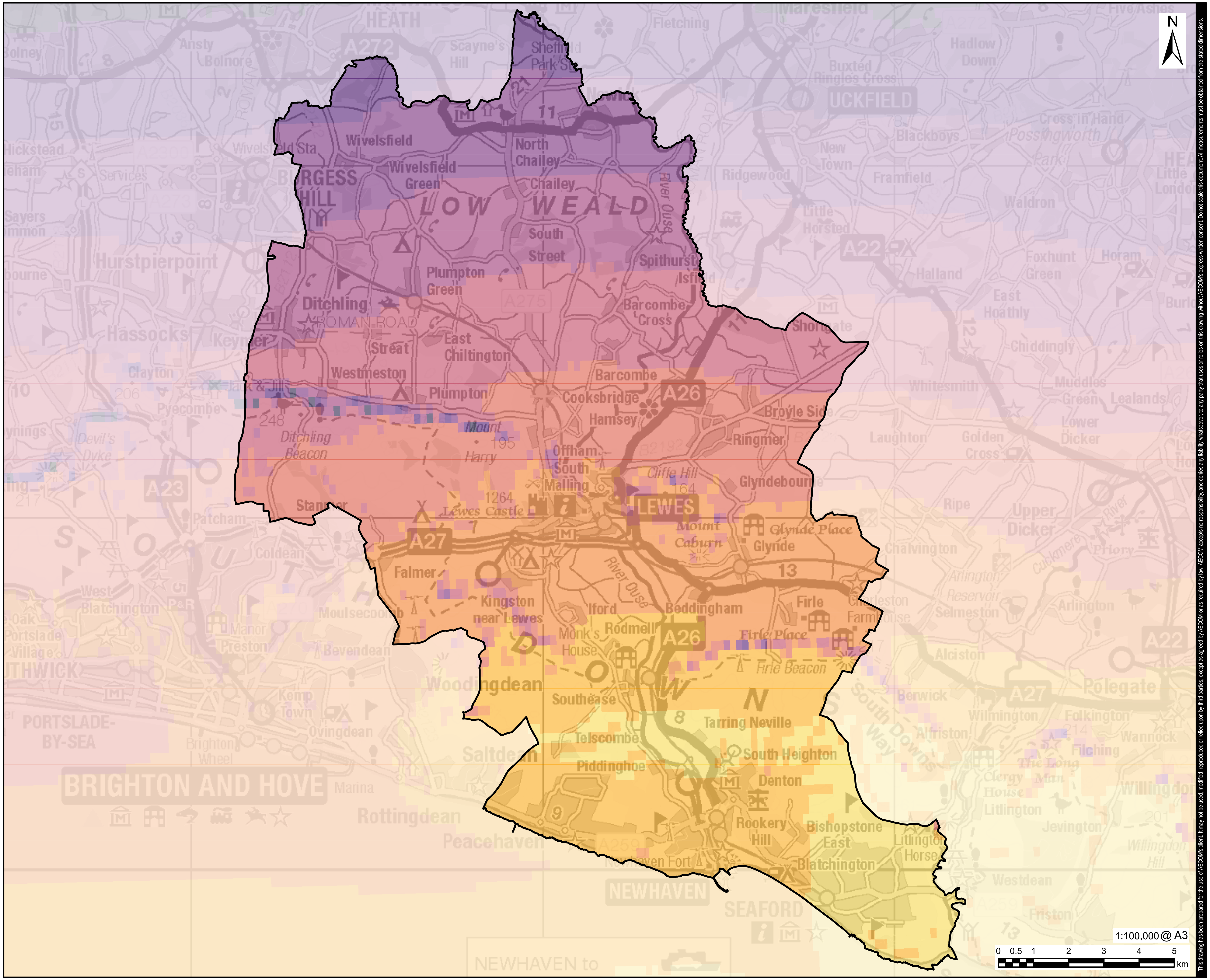
FIGURE TITLE

Agricultural Land Classification (ALC)

FIGURE NUMBER

Figure 5



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LEGEND

Lewes District Boundary

Irradiance - Global Horizontal Index (GHI) (KWh/m²)

- 1,061 - 1,070
- 1,071 - 1,080
- 1,081 - 1,090
- 1,091 - 1,100
- 1,101 - 1,110
- 1,111 - 1,120
- 1,121 - 1,130
- 1,131- 1,140
- 1,141 - 1,150

NOTES

Irradiance data obtained from the "Global Solar Atlas 2.0, a free, web-based application is developed and operated by the company Solargis s.r.o. on behalf of the World Bank Group, utilizing Solargis data, with funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalsolaratlas.info Reproduced from Ordnance Survey digital map data © Crown copyright 2022. All rights reserved. Licence number 0100031673.

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FIGURE TITLE

Global Horizontal Index (GHI)

FIGURE NUMBER

Figure 6

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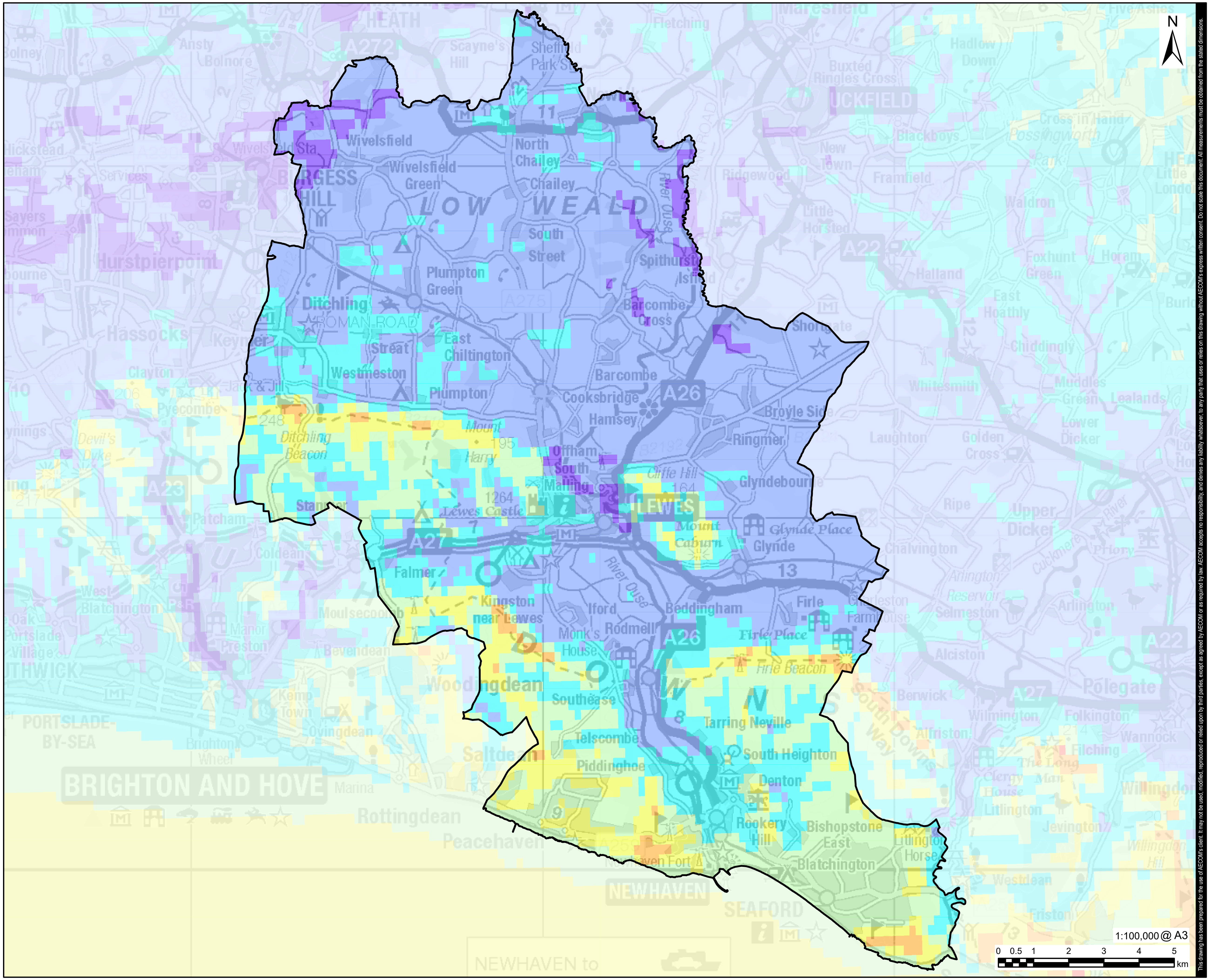

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LEGEND

Lewes District Boundary

Average Wind Speed at 100m Height (m/s)

- ≤ 7.5
- 7.6 - 8
- 8.1 - 8.5
- 8.6 - 9
- 9.1 - 9.5
- 9.6 - 10
- > 10

NOTES

Wind speed data obtained from the Global Wind Atlas 3.0, a free, web-based application developed, owned and operated by the Technical University of Denmark (DTU). The Global Wind Atlas 3.0 is released in partnership with the World Bank Group, utilizing data provided by Vortex, using funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalwindatlas.info Reproduced from Ordnance Survey digital map data © Crown copyright 2022. All rights reserved. Licence number 0100031673.

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FIGURE TITLE

Average Wind Speed

FIGURE NUMBER

Figure 7

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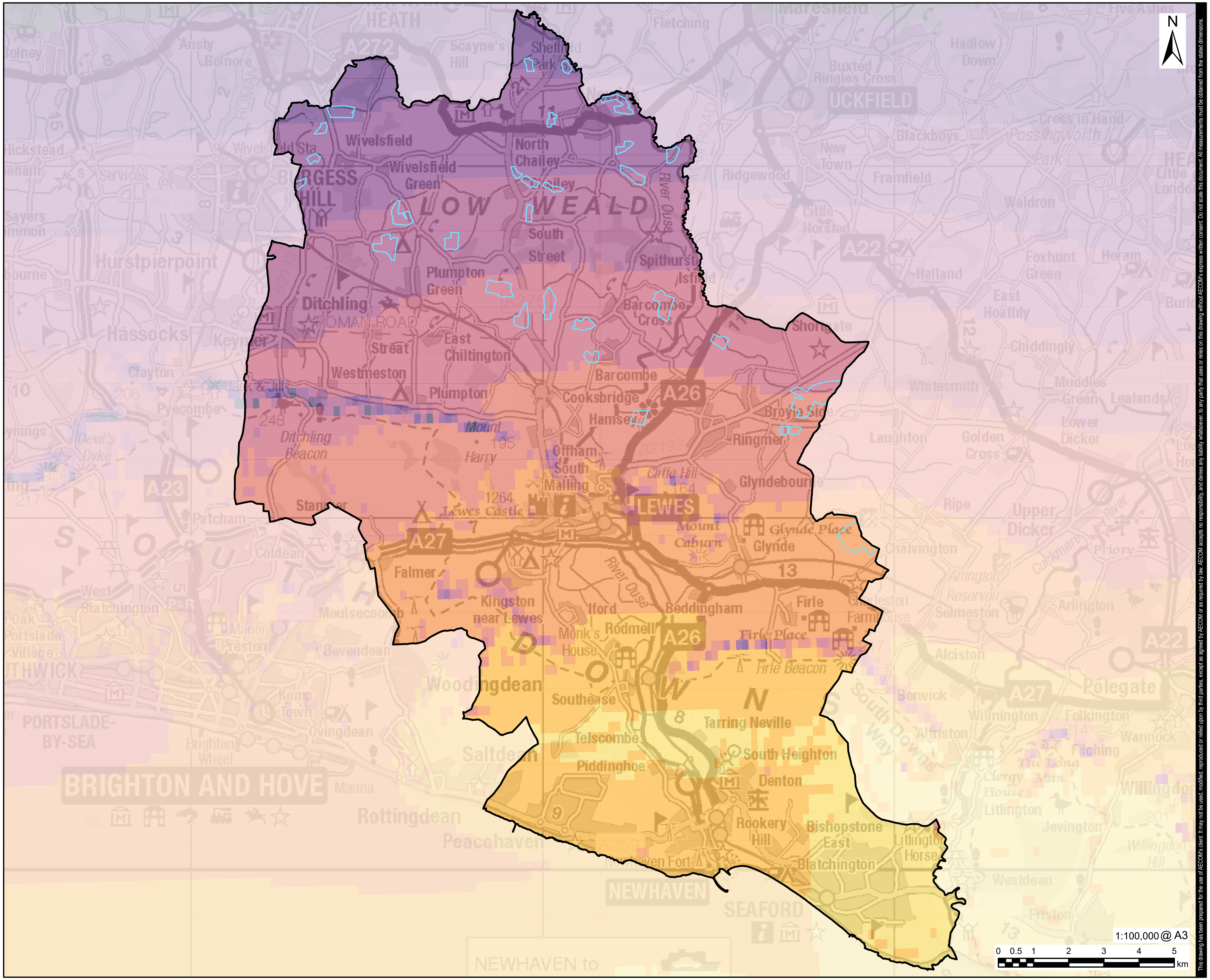

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LEGEND

- Lewes District Boundary
- Ground Mounted Solar PV

Irradiance - Global Horizontal Index (GHI) (KWh/m²)

- 1,061 - 1,070
- 1,071 - 1,080
- 1,081 - 1,090
- 1,091 - 1,100
- 1,101 - 1,110
- 1,111 - 1,120
- 1,121 - 1,130
- 1,131 - 1,140
- 1,141 - 1,150

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FIGURE TITLE

Ground Mounted Solar PV

FIGURE NUMBER

Figure 8

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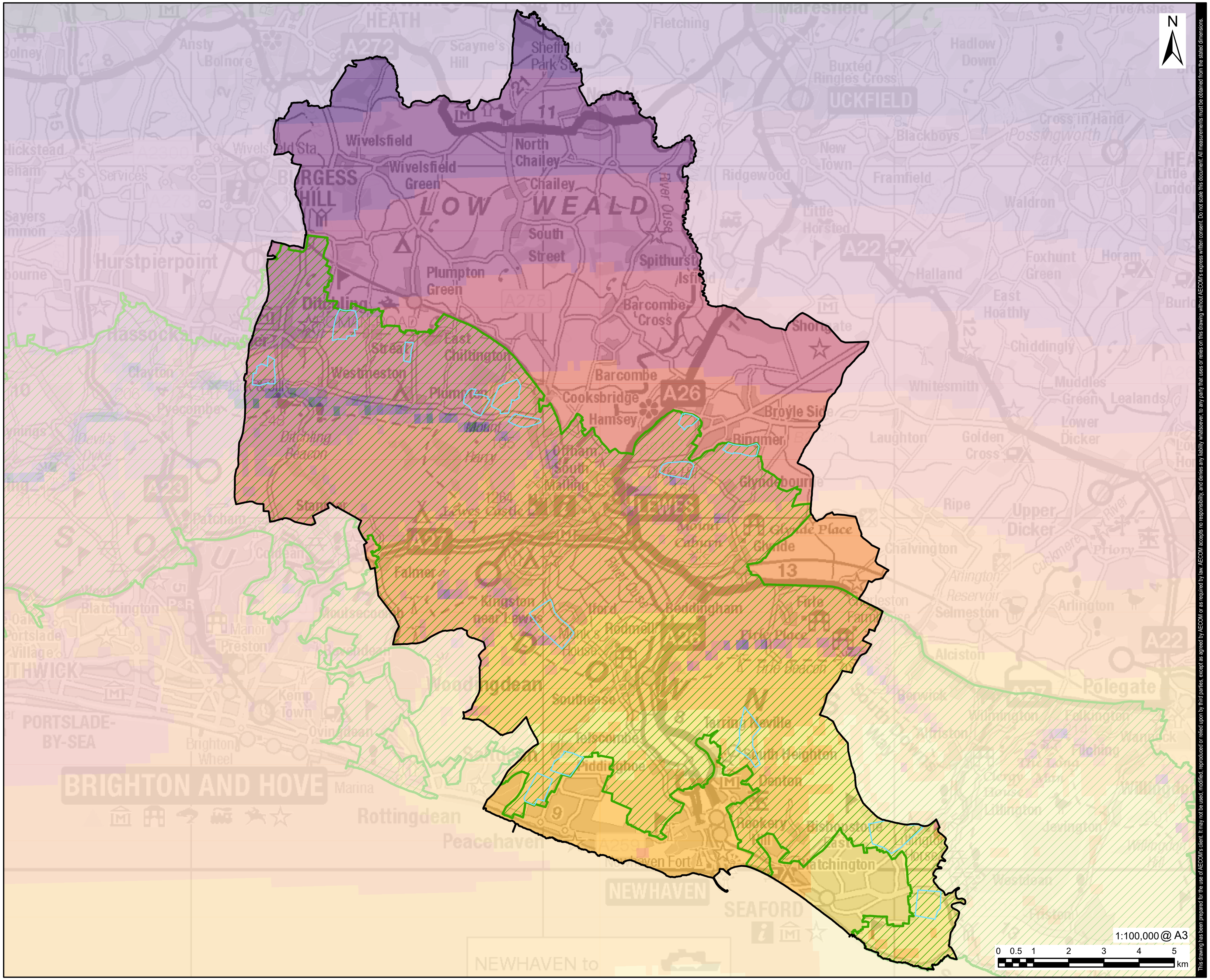

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LEGEND

- Lewes District Boundary
- Ground Mounted Solar PV in SDNP
- South Downs National Park

Irradiance - Global Horizontal Index (GHI) (KWh/m²)

- 1,061 - 1,070
- 1,071 - 1,080
- 1,081 - 1,090
- 1,091 - 1,100
- 1,101 - 1,110
- 1,111 - 1,120
- 1,121 - 1,130
- 1,131 - 1,140
- 1,141 - 1,150

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FIGURE TITLE

Ground Mounted Solar PV in South Downs National Park

FIGURE NUMBER

Figure 9

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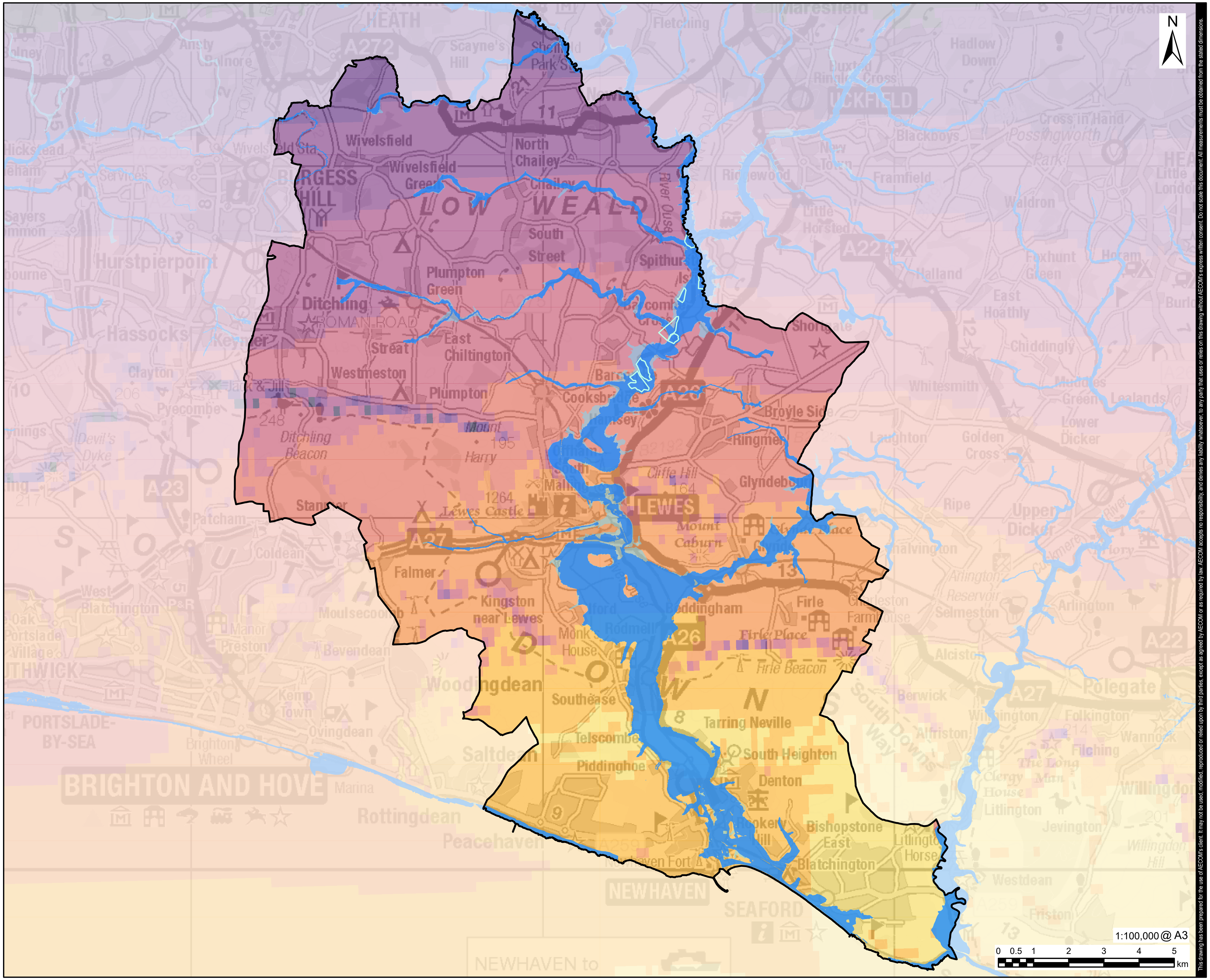

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LEGEND

- Lewes District Boundary
- Ground Mounted Solar PV in Flood Zone
- Flood Zone 3
- Flood Zone 2

Irradiance - Global Horizontal Index (GHI) (KWh/m²)

- 1,061 - 1,070
- 1,071 - 1,080
- 1,081 - 1,090
- 1,091 - 1,100
- 1,101 - 1,110
- 1,111 - 1,120
- 1,121 - 1,130
- 1,131 - 1,140
- 1,141 - 1,150

NOTES

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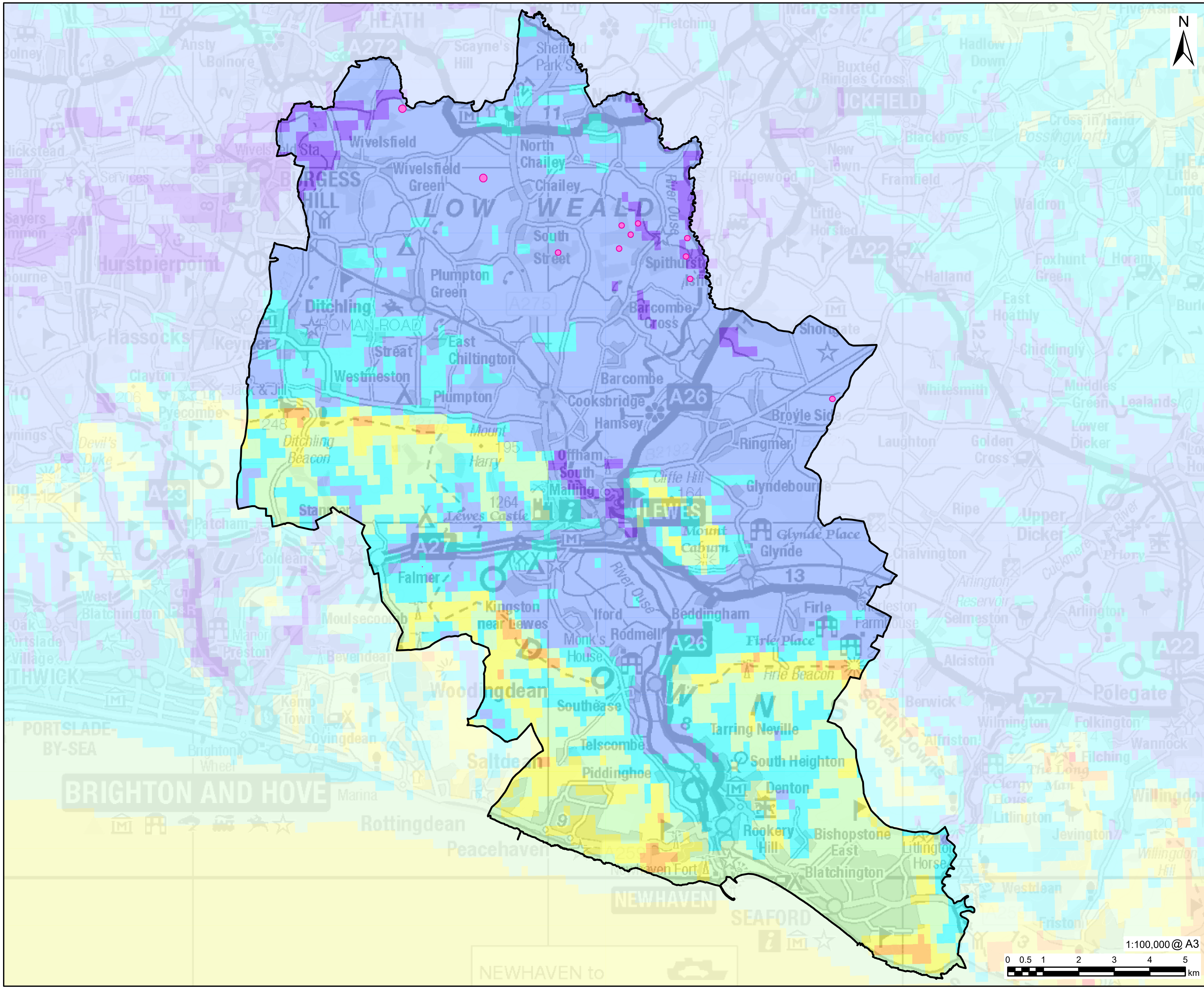
FIGURE TITLE

Ground Mounted Solar PV in Flood Zone

FIGURE NUMBER

Figure 10



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LEGEND

- Lewes District Boundary
- Wind Turbine Location

Average Wind Speed at 100m Height (m/s)

- ≤ 7.5
- 7.6 - 8
- 8.1 - 8.5
- 8.6 - 9
- 9.1 - 9.5
- 9.6 - 10
- > 10

NOTES

Wind speed data obtained from the Global Wind Atlas 3.0, a free, web-based application developed, owned and operated by the Technical University of Denmark (DTU). The Global Wind Atlas 3.0 is released in partnership with the World Bank Group, utilizing data provided by Vortex, using funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalwindatlas.info

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FIGURE TITLE

Wind Turbine Location outside South Downs National Park

FIGURE NUMBER

Figure 11

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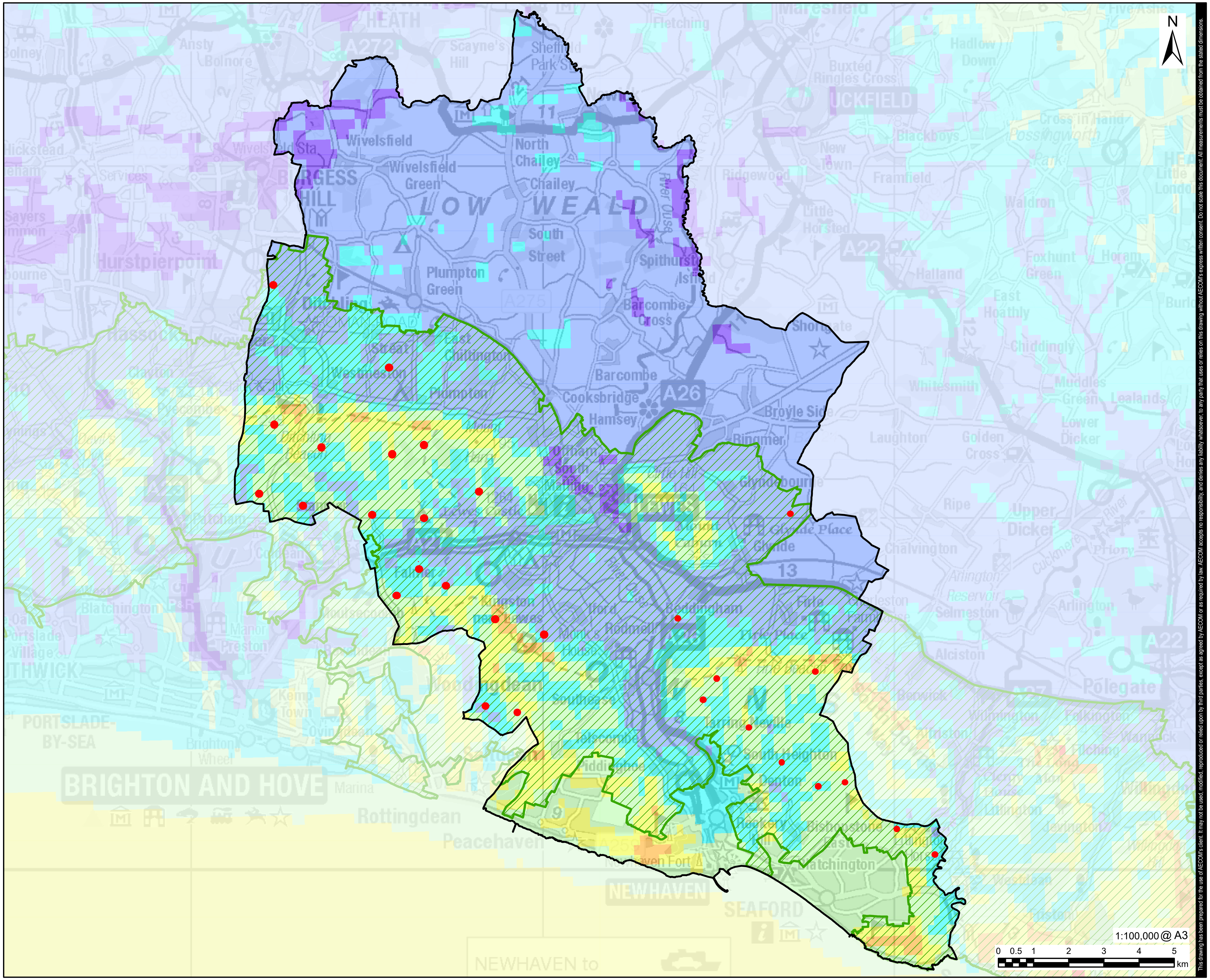

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LEGEND

- Lewes District Boundary
- Wind Turbines in SDNP
- South Downs National Park

Average Wind Speed at 100m Height (m/s)

- ≤ 7.5
- 7.6 - 8
- 8.1 - 8.5
- 8.6 - 9
- 9.1 - 9.5
- 9.6 - 10
- > 10

NOTES

Wind speed data obtained from the Global Wind Atlas 3.0, a free, web-based application developed, owned and operated by the Technical University of Denmark (DTU). The Global Wind Atlas 3.0 is released in partnership with the World Bank Group, utilizing data provided by Vortex, using funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalwindatlas.info Reproduced from Ordnance Survey digital map data © Crown copyright 2022. All rights reserved. Licence number 0100031673.

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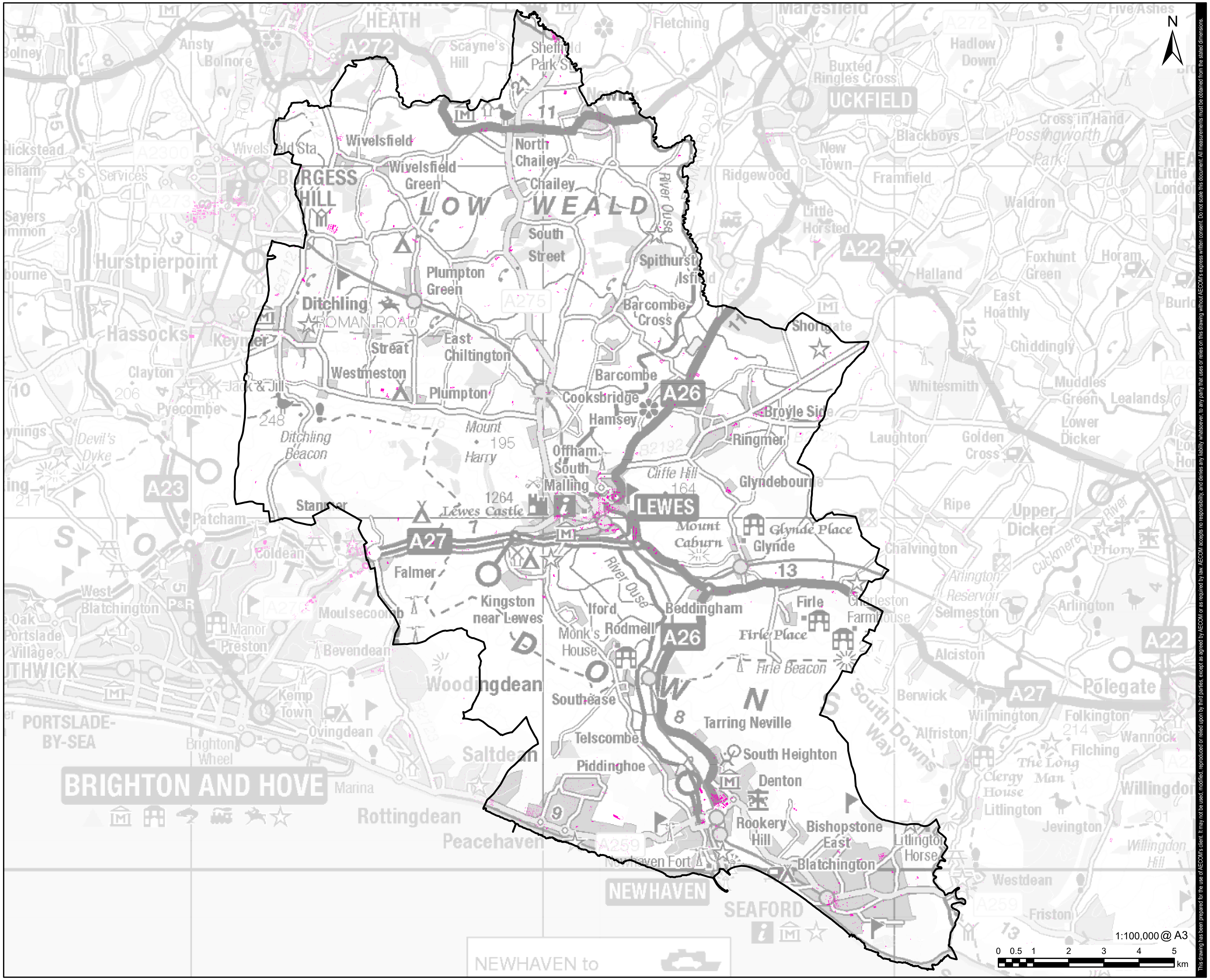
FIGURE TITLE

Wind Turbine Location within South Downs National Park

FIGURE NUMBER

Figure 12



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LEGEND
Lewes District Boundary
Commerical Roofs > 50 m2

NOTES

ISSUE PURPOSE
FINAL

PROJECT NUMBER
60676353

FIGURE TITLE
Commercial Roofs

FIGURE NUMBER
Figure 13

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