Frodsham Solar

Environmental Statement: Volume 2
Appendix 5-2: Climate Baseline Report

May 2025

Cubico SUSTAINABLE INVESTMENTS

PINS Ref: EN010153
Document Ref: EN010153/DR/6.2
Planning Act 2008; and Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations Regulation 5(2)(a)

Revision P01

FICHTNER

Consulting Engineers Limited

Frodsham Solar

AXIS

Appendix 5-2: Climate Baseline Report

ENGINEERING CONSULTING

Document approval

	Name	Signature	Position	Date
Prepared by:	Juliet Snow (JS1)	JS1	Environmental Consultant	22/05/2025
Checked by:	Rosalind Flavell (RSF)	RSF	Lead Environmental Consultant	22/05/2025

Document revision record

Revision no	Date	Details of revisions	Prepared by	Checked by
00	31/03/2025	ES appendix draft to client	JS1	RSF
01	08/05/2025	Update following review of legal comments	JS1	RSF
02	22/05/2025	Final issue	JS1	RSF

© 2025 Fichtner Consulting Engineers. All rights reserved.

This document and its accompanying documents contain information which is confidential and is intended only for the use of AXIS. If you are not one of the intended recipients any disclosure, copying, distribution or action taken in reliance on the contents of the information is strictly prohibited.

Unless expressly agreed, any reproduction of material from this document must be requested and authorised in writing from Fichtner Consulting Engineers. Authorised reproduction of material must include all copyright and proprietary notices in the same form and manner as the original and must not be modified in any way. Acknowledgement of the source of the material must also be included in all references.

Contents

1 Introduction

This appendix has been written in support of **ES Vol 1 Chapter 5: Climate Change [EN010153/DR/6.1]**. This appendix provides detail of the current climate baseline in the vicinity of the Proposed Development, based on UK Meteorological Office (Met Office) historical climate averages and regional profile descriptions. In addition, the future climate baseline for the area has been quantified based on the latest UK Climate Projections (UKCP).

2 Current Baseline Climate

The current climate baseline at the Site has been determined based on Met Office historical climate averages data from the period 1991-2020 (which is the most recent period of climatic data from the Met Office), from the closest meteorological station with this historical data, Hawarden[1] (approximately 22 km to the south west of the Site in a straight line) and the Met Office UK regional climate summary from the same time period for North West England and the Isle of Man[2].

Within this analysis:

- winter refers to the months of December, January and February;
- spring refers to March, April and May;
- summer refers to the months of June, July and August; and
- autumn refers to September, October and November.

2.1 Temperature

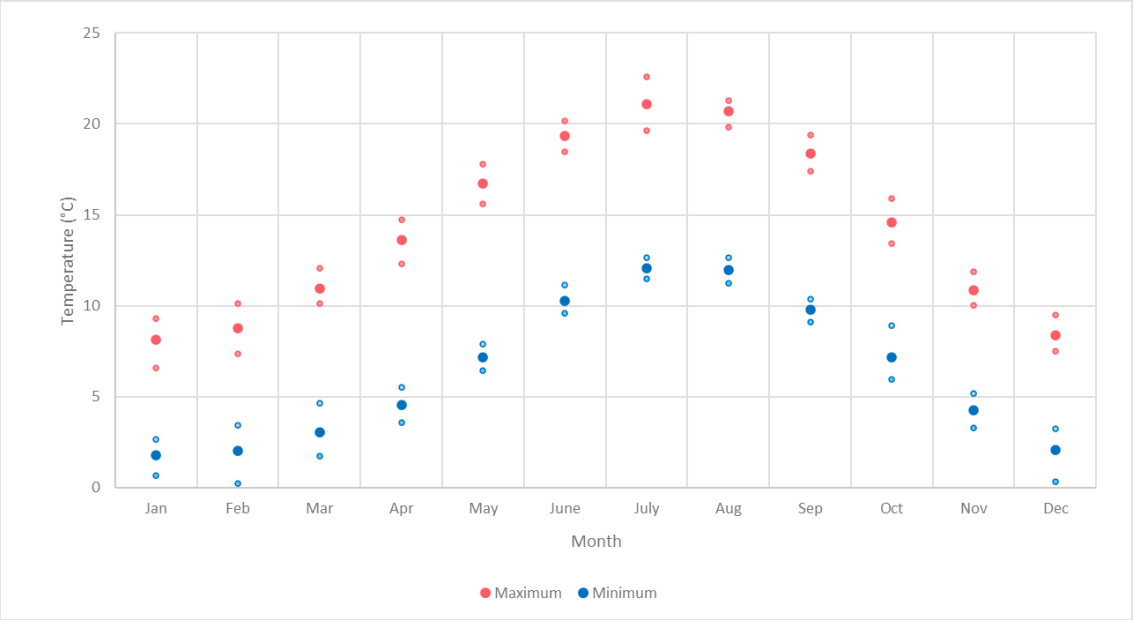
The long-term annual mean temperature at Hawarden is 10.3 °C. Temperature shows both a seasonal and a diurnal variation, with January being the coldest month and July being the warmest month.

The long-term mean temperature during winter recorded at Hawarden is 5.18 °C and the long-term mean temperature during summer is 15.9 °C. The maximum mean temperature during winter is 8.4 °C and the maximum mean temperature during summer is 20.4 °C. It should be noted that temperatures presented are means, and there will be individual days where the temperature will be greater (or lower) than this each year. Figure 1 graphically shows the temperature trend for Hawarden from 1991 to 2020.

[1] Met Office (2023). *UK Climate Averages: Hawarden*. Available at: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages [Last Accessed: 04 April 2024].

[2] Met Office (2016). *North West England and the Isle of Man: climate*. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/weather/regional-climates/north-west-england--isle-of-man_-climate-met-office.pdf. [Last Accessed: 27 March 2024].

Figure 1: Long term temperature trend record at Hawarden 1991-2020



Source: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcmys019j

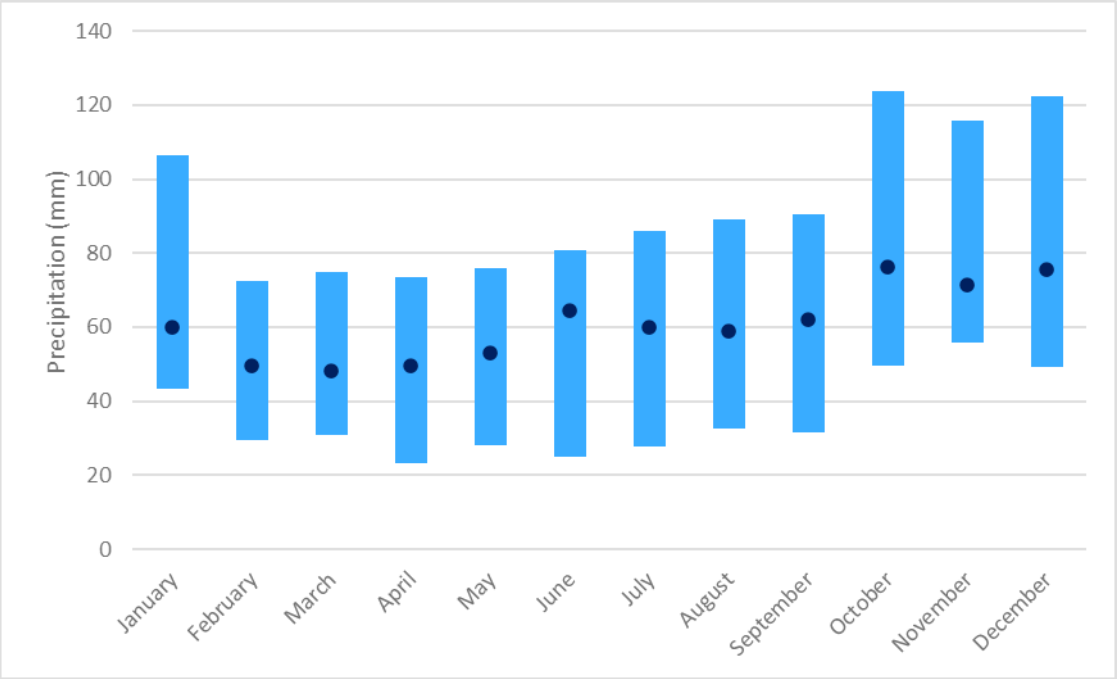
2.2 Precipitation

Across the UK, rainfall tends to be associated with Atlantic depressions or with convection. The Atlantic lows are more vigorous in autumn and winter and bring most of the rain that falls in these seasons. In summer, convection caused by solar surface heating sometimes forms shower clouds and a large proportion of rain falls from showers and thunderstorms. A further factor that greatly affects the rainfall distribution is altitude. Moist air that is forced to ascend hills can be cooled below the dew point to produce clouds and rain.

The exposure of North West England to westerly maritime air masses and the presence of extensive areas of high ground mean that the region has some of the wettest places in the UK. However, the more sheltered area of Cheshire is relatively dry as it benefits from the 'rain shadow' effect of the high ground of North Wales. The mean annual precipitation at Hawarden is 60.7 mm, reflecting the relatively low precipitation of the region. For context, the UK mean annual precipitation in 2023 was 1,290 mm[3]. Long-term data from Hawarden shows that there tends to be higher rainfall over autumn and winter than the spring and summer. Long term seasonal means recorded at Hawarden are 61.1 mm in summer and 61.7 mm in winter. Figure 2 graphically shows the precipitation trend for Hawarden from 1991 to 2020.

[3]Met Office (2024). *Annual Summary 2023*. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/summaries/uk_climate_summary_calendar_year_2023.pdf [Last Accessed 5 April 2024].

Figure 2: Long term precipitation trend record at Hawarden 1991-2020



Source: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcmys019j

The number of thunderstorms in a year can make a significant contribution to the total annual rainfall. They can occur throughout the year but are more frequent during the summer months. It is estimated in North West England that there are eight to 12 days of thunderstorms per year. In some thunderstorms or heavy showers, the precipitation may be in the form of hail. However, the Met Office regional climate profile for North West England and the Isle of Man does not refer to any noteworthy hail storms.

The occurrence of snow is linked closely with temperature, with falls rarely occurring if the temperature is higher than 4 °C. For snow to lie for any length of time, the temperature normally has to be lower than this. Snowfall is not included within the historical climate average data from Hawarden. However, the Met Office regional climate profile for the region states the average number of days with snow falling each year is about 20 days in lower-lying parts of the mainland where the Site is located.

2.3 Wind

The North West England and the Isle of Man region is a very exposed region of the UK, being relatively close to the Atlantic and containing large upland areas. The strongest winds are associated with the passage of deep areas of low pressure close to or across the UK. The frequency and strength of these depressions is greatest in the winter half of the year, especially from December to February, and this is when mean speeds and gusts (short duration peak values) are strongest.

A day of gale is defined as a day on which the wind speed attains a mean value of 34 knots or more over any period of 10 minutes. The low-lying places inland of the region experience less than five days of gale each year, with only exposed areas having more than this.

2.4 Summary

A summary of the baseline climate is included in Table 1.

Table 1: Existing baseline conditions

Item	Units	Baseline (Hawarden 1991-2020)
Mean annual temperatures	°C	10.3
Mean winter temperatures	°C	5.2
Mean summer temperatures	°C	15.9
Mean in winter precipitation	mm	61.7
Mean summer precipitation	mm	61.1

3 Future Baseline Climate

The future climate baseline at the Site has been defined using the latest UK Climate Projections (UKCP) which provides the most up-to-date assessment of how the UK's climate may change in the future. The latest version is UKCP18.

UKCP18 has predictions based on different emissions scenarios. These are determined by the Representative Concentration Pathways (RCPs), which specify concentrations of GHGs that will result in total radiative forcing (the difference between the incoming and outgoing radiation at the top of the atmosphere). Radiative forcing targets for 2100 have been set at 2.6, 4.5, 6.0 and 8.5 watts per square metre (w/m^2) to span a wide range of plausible future emissions scenarios. Each scenario includes many assumptions regarding population growth, economic development, technological innovation and attitudes to social and environmental sustainability. This assessment has used the data produced by using the high emissions scenario (RCP8.5). This is the worst-case scenario as this is based on a massive increase in coal use across the world but is recommended for use by the Institute of Environmental Management and Assessment (IEMA) unless a case can be made for using a different, lower emission scenario. In UKCP18, the probabilistic projections provide local low, central and high changes across the UK, corresponding to 10%, 50% and 90% probability levels. This assessment has used the central estimate, which is considered to be the level at which as much evidence points to a lower outcome as a higher one. The 10^{th} and 90^{th} percentiles reflect the lowest and highest 10% of the model runs – the value at which 10% of the model runs fall at or below (10^{th} percentile) or at and above (90^{th} percentile) fall at or above. These have been considered where the direction of change is predicted to vary at each level. The predictions also cover a range of spatial resolutions. The data scenario from which the future baseline has been calculated and is summarised in Table 2.

The UKCP18 regional profiles are based on the UK administrative regions and therefore, vary slightly from the Met Office regional profiles. Within the Met Office regional profiles, the Site falls just within North West England and the Isle of Man; however, within the UK administrative regions, the Site falls within North West England. Therefore, the North West England region has been used for the future climate predictions.

Table 2: Future climate change data scenario summary.

Projection	Emissions Scenario	Percentile	Area	Baseline time	Time horizon
UKCP18	RCP8.5	50^{th}, 10^{th} and 90^{th} (where appropriate)	North West England	1981-2000	2060-2079

The identified changes have been incorporated into the current baseline from Hawarden to give a local prediction of future climate.

It is noted that the baseline from which the predicted changes are based is not the same as the baseline climate data from Hawarden. Therefore, some of the results may be slight over or under estimations. Nevertheless, they offer an estimate sufficient for this assessment to determine likely significant effects.

3.1 Temperature

Climate change is projected to lead to hotter summers and warmer winters. Probabilistic projections show that there is more warming in summer than winter, and a more pronounced north-south contrast in summer. This trend is projected in the low, central and high estimates. The projected changes in mean temperature as a central estimate are an overall annual increase of 2.5 °C, with an increase of 2.1 °C in winter and an increase of 3.1 °C in summer.

3.2 Precipitation

Over land, projections indicate a move towards wetter winters and drier summers as a central estimate. However, there is some variation in the projections. The change in winter precipitation for the low estimate is projected to decrease, but for the central and high estimate this is projected to increase. The change in summer precipitation for the low and central estimate is projected to decrease, but for the high estimate is predicted to increase. Projections also show that it is likely that more rain will fall during intense or extreme events.

The projected change in mean precipitation during winter is for an increase of 16% as a central estimate. Projected change in mean precipitation during summer is for a decrease of 23% as a central estimate.

3.3 Wind

There is large uncertainty in projected changes in wind and air circulation across the UK and it is difficult to represent regional extreme winds for the future. However, projections indicate there will be an increase in near surface wind speeds over the UK and more significant impacts of wind will be experienced in the winter months, including an increase in frequency of winter storms.

3.4 Summary

Table 3 shows the variations in projections at the low, medium and high estimates.

Table 3: Future baseline climate conditions variables

Item	Units	Low estimate – 10th percentile	Central estimate – 50th percentile	High estimate – 90th percentile
Mean annual temperatures	°C	1.3	2.5	3.8
Mean winter temperatures	°C	0.6	2.1	3.7
Mean summer temperatures	°C	1.3	3.1	5
Mean in winter precipitation	%	-3	16	39
Mean summer precipitation	%	-45	-23	2

It should be noted that predictions are a general trend. Due to natural variations, there will still be cold winters, dry winters, cooler summers and wetter summers. Table 4 summarises the future baseline climate conditions at Hawarden which is considered representative of likely conditions at the Site.

Table 4: Future baseline climate conditions.

Item	Units	Baseline (Hawarden 1981-2010)	Predicted change (UKCP18)	Future baseline (At Hawarden 2060-2079)
Central (50th percentile) estimate				
Mean annual temperatures	°C	10.3	2.50	12.8
Mean winter temperatures	°C	5.2	2.10	7.3
Mean summer temperatures	°C	15.9	3.10	19.0
Mean in winter precipitation	mm	62.0	16.0%	72.0
Mean summer precipitation	mm	61.0	-23.0%	47.0
Central (90th percentile) estimate				
Mean summer precipitation	mm	61.0	2.0%	62.0
Central (90th percentile) estimate				
Mean summer precipitation	mm	62.0	-3.0%	60.0

ENGINEERING CONSULTING

FICHTNER

Consulting Engineers Limited

Kingsgate (Floor 3), Wellington Road North,
Stockport, Cheshire, SK4 1LW,
United Kingdom

t: +44 (0)161 476 0032
f: +44 (0)161 474 0618

www.fichtner.co.uk