Gatwick Airport Northern Runway Project

Environmental Statement
Appendix 15.5.2: Urban Heat Island Assessment

Book 5

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1 Introduction

1.1.1 This document forms Appendix 15.5.2 of the Environmental Statement (ES) prepared on behalf of Gatwick Airport Limited (GAL) for the proposal to make best use of Gatwick Airport's existing runways and infrastructure (referred to within this report as 'the Project').

1.1.2 This document provides the Urban Heat Island (UHI) assessment for the Project. The UHI effect describes the warmer temperatures urban areas experience compared to their rural surroundings. This can have harmful impacts on the climate, residents and businesses. The primary causes for the temperature difference seen in UHIs concerns the retention and absorption of heat from urban surfaces and the reduced airflow in urban areas due to the large structures present in urban areas. UHI can have negative effects on urban areas by increasing temperatures and reducing air quality and water quality.

1.1.3 Currently there is no clear method for quantifying the impact on UHI of developments and therefore, accurate modelling of UHI is complex and unfeasible. An alternative method has been developed for this assessment which focuses on the influencing factors that contribute to UHI (Table 1.1.1; Ryu and Baik, 2012). These can be grouped into four main categories, and they are directly related to design decisions. The influence of these factors on UHI varies during both day-time and night-time conditions. This method investigates how a given design performs against each factor.

Table 1.1.1: Factors contributing to UHI (Ryu and Baik, 2012)

Factor	Examples
Building Geometry	▪ Height to area ratio of buildings ▪ Building density ▪ Sky view factor
Building materials	▪ Albedo distribution ▪ Impervious surface area ▪ Thermal mass
Anthropogenic heat	▪ From buildings ▪ From people ▪ From transport
Green space	▪ Tree cover ▪ Percentage green space ▪ Impervious surface area

2 Method

2.1 Establish current conditions

2.1.1 Historical weather data was used to establish current conditions from a range of weather station sites. The analysis used the US National Oceanic and Atmospheric Administration (NOAA) dataset and cross referenced with the Met Office Integrated Data Archive System (MIDAS) Land and Marine Surface Stations data.

2.1.2 The coverage aimed for 20 years of data until 2022, with hourly resolution to determine day-time and night-time UHI effects. The assessed weather stations and data coverage are presented in Table 2.1.1.

Table 2.1.1: Overview of available weather stations for UHI assessment

Weather station	Site	Coverage from 2002	Completeness
Gatwick Airport	Site for Assessment	2002 – 2022	Good hourly resolution
London City Airport	Urban City	2002 -2022	Good hourly resolution
Crawley	Urban Town	2002 – 2007	Only 5 data points
Charlwood	Rural	2002 – 2022	Good hourly resolution

2.1.3 The following locations were used for this assessment, using the NOAA dataset, in light of their completeness and resolution:

- Gatwick Airport (site of interest)
- London City Airport (urban site)
- Charlwood (rural site)

2.2 Climate projections

2.2.1 Future climate projections from the UK Climate Projections 2018 (UKCP18) were extracted to understand how climate change may impact the UHI.

2.2.2 The latest UK climate projections from the Met Office (UKCP18) were used to extract climate change projections. The Probabilistic Projections were used, which are on a 25km dataset, therefore one grid square was used for London City Airport, and another which encompassed Gatwick Airport and Charlwood. As a result it is hard to differentiate between Gatwick Airport and Charlwood and this is therefore an indicative assessment of potential future changes. However, this is the best available data for this assessment.

2.3 Evaluation of Project

2.3.1 A high-level assessment of the Gatwick area using satellite imagery was conducted to investigate the parameters which influence UHI. The dataset used was Ordnance Survey MasterMap data.

3 Assessment

3.1 Current conditions

3.1.1 The analysis of the current conditions at the three sites is presented below (Table 3.1.). Average summer (June to September) day-time and night-time temperatures[1] were extracted from 2002 to 2022. A recent heatwave event (19 July 2022) was also analysed to assess how extreme temperatures differ between the sites.

[1] Day-time temperatures were analysed from 8am to 6pm, and night-time from 9pm to 4am.

Table 3.1.1: Comparison of temperature values at the assessment site (Gatwick Airport), an urban city location (London City Airport) and a rural location (Charlwood)

Weather station	Site	Summer average Day-time temperature (°C)	Summer average Night-time temperature (°C)	Summer heatwave event Day-time temperature (°C)	Summer heatwave event Night-time temperature (°C)
Gatwick Airport	Site for Assessment	19.9 (+0.3)	14.8 (+1)	34.9 (-0.7)	19.2 (+1.4)
London City Airport	Urban City	20.5 (+0.9)	16.9 (+3.1)	37.1 (+1.5)	23.1 (+5.3)
Charlwood	Rural	19.6	13.8	35.6	17.8

Brackets indicate temperature difference from Charlwood.

Average temperature

3.1.2 Average summer day-time temperatures are higher at London City Airport (20.5°C) than Gatwick (19.9°C). The lowest temperatures are recorded at Charlwood (19.5°C), the most rural site.

3.1.3 Average summer night-time temperatures are much lower for Charlwood (13.8°C) than London City Airport (19.9°C). The difference between night-time and day-time temperatures are lowest in city areas as less heat is lost at night as it is trapped due to the UHI effect. There is a lower difference in day-time and night-time temperatures for Gatwick Airport (Δ5.1°C) than the rural area Charlwood (Δ5.8°C). This suggests that an UHI may be present.

Heatwave temperatures

3.1.4 Day-time temperatures during a heatwave are significantly higher at London City Airport (37.1°C) than at Gatwick Airport (34.9°C) or Charlwood (35.6°C).

3.1.5 Whilst the recorded day-time temperatures during the heatwave were slightly lower at Gatwick than Charlwood, the night-time temperature is higher at Gatwick (19.2°C) than Charlwood (17.8°C). This means there is less heat loss at night at Gatwick than the rural area, indicating there could be a possible UHI effect.

3.2 Climate projections

3.2.1 The climate projection data is presented in Table 3.2.1.

Table 3.2.1: Temperature anomalies (from 1981-2010 baseline) under RCP8.5

Site	Summer Average Temperature (°C)		Summer Maximum Temperature (°C)		Summer Minimum Temperature (°C)	
	2020-2049	2050-2079	2020-2049	2050-2079	2020-2049	2050-2079
Gatwick Airport and Charlwood	**1.5** (2.4-0.5)	**3.5** (5.3-1.7)	**1.6** (2.9-0.3)	**3.8** (6.2-1.6)	**1.3** (2.1–0.5)	**3.1** (4.7-1.6)
London City Airport	**1.4** (2.3-0.5)	**3.4** (5.2-1.6)	**1.6** (2.8-0.3)	**3.8** (6.1-1.5)	**1.2** (2.0-0.5)	**3.0** (4.6-1.5)

The 50th percentile is presented with the 10th-90th percentiles in brackets.

3.2.2 Temperatures are projected to increase across all sites included within this assessment (see Table 3.2.1).

3.2.3 The effect of UHI and climate change together means that the impact of high temperatures will be exacerbated in urban centres, with added heat stress and more energy consumption from cooling. Factors such as population increase and building development could further increase the impact of UHI. This highlights that mitigation of UHI is essential to ensure future resilience as the climate changes.

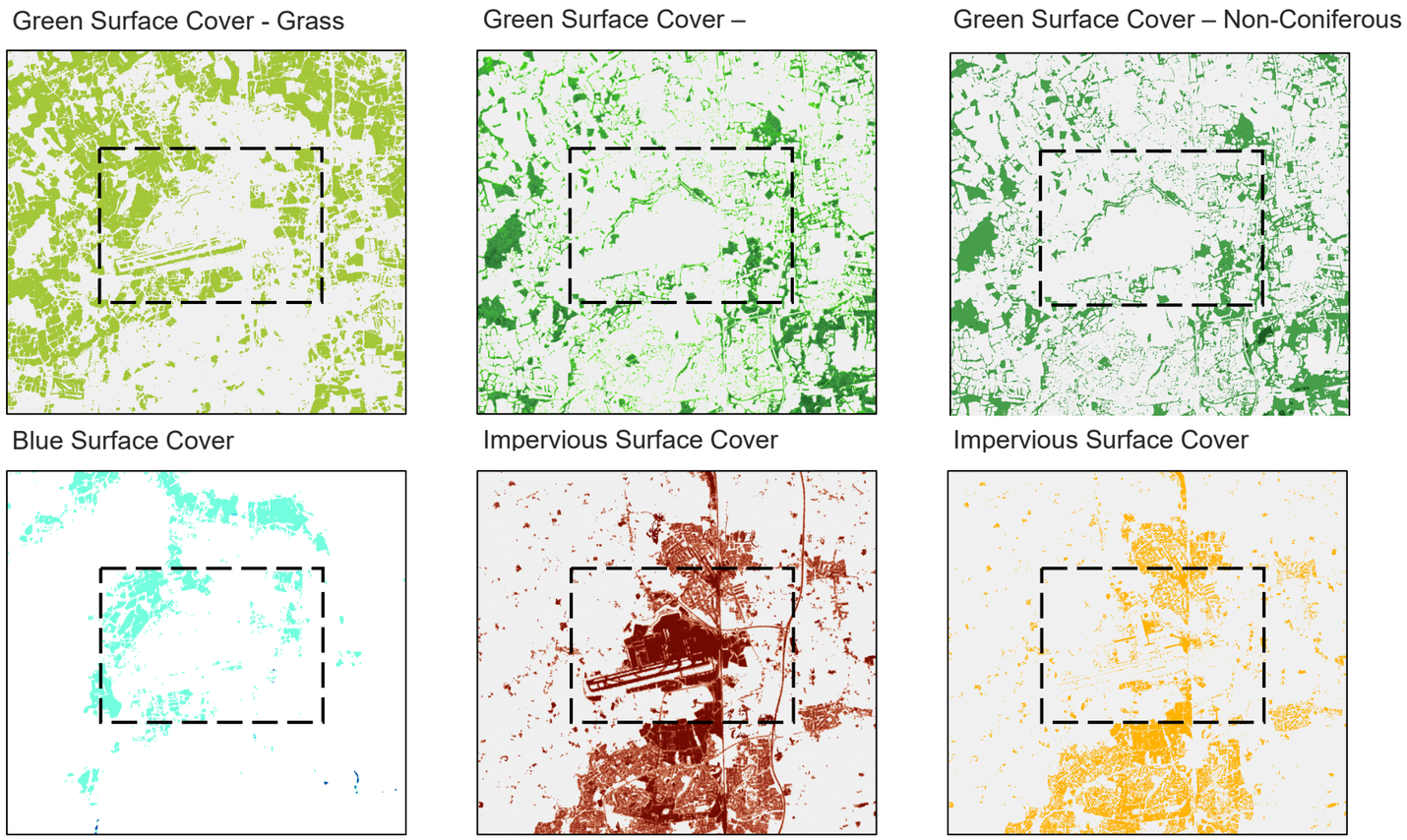
3.3 Evaluation of the Project

3.3.1 OS MasterMap data highlight that at present there is a large area of impervious surface at Gatwick Airport (Figure 3.3.1). This factor has a high influence on UHI effect at both day- and night-time. The developed site would have increased impervious surface cover and buildings due to the extension of the taxiways, hotels and car parks, among other features. It is not expected that the Project would create a new UHI effect, but that the increased impervious surface cover and buildings (Figure 3.3.1) alongside projected increases in temperature from climate change could exacerbate the increase in the UHI effect at the Project site itself local to the airport and not the wider area, particularly at night. However, this UHI effect is low compared to the one for London.

3.3.2 Both the Climate Change Resilience Assessment and In-Combination Climate Change Assessment rated the impacts related to UHI as medium or not significant due to embedded design measures or existing plans and operational procedures. However, further monitoring is required around these related medium risks identified in both assessments to check if in the future they would become high risk and therefore significant as set out in the **ES Chapter 15: Climate Change** (Doc Ref. 5.1). In that case, there would be a need for further mitigation by:

- increased green and blue space at the site, which act as heat sinks to provide night-time cooling; and
- increasing the albedo of surfaces at the site. Highly reflective (high albedo) surfaces reduce the amount of heat absorbed by materials and can mitigate against UHI effects.

Figure 3.3.1: Satellite imagery of various land cover at Gatwick Airport. The dashed boxes highlight the Gatwick Airport area



4 Summary and conclusions

4.1.1 The assessment of current conditions at Gatwick Airport shows that there is a slight increase in temperatures compared to a nearby rural site (average summer day-time temperatures of 19.9°C and 19.6 °C for Gatwick Airport and Charlwood, respectively). However night-time temperatures at Gatwick were 14.8 °C compared to 13.8 °C at Charlwood. This indicates that there may be an urban heat island present at Gatwick Airport, however this is low compared to London, where day-time averages were 20.5 °C and night-time 16.9 °C.

4.1.2 Climate change projections show increases in temperatures at Gatwick Airport. UHI effects in combination with climate change would increase the impact of higher temperatures local to Gatwick Airport.

4.1.3 It is not expected that the Project would create a new UHI effect, but that the increased impervious surface cover and buildings alongside projected increases in temperature from climate change could exacerbate the increase in the UHI effect at the Project site itself, local to the airport and not the wider area, particularly at night. However, this UHI effect is low compared to the one for London. Both the Climate Change Resilience Assessment and In-Combination Climate Change Assessment rated the impacts related to UHI as medium or not significant. However, further monitoring is required around these related medium risks identified in both assessments to check if in the future they become high risk and therefore significant as set out in **ES Chapter 15: Climate Change** (Doc Ref. 5.1). In that case, there would be a need for mitigation by increased greening and blue surface cover. Consideration of the albedo of materials could help reduce UHI effects if highly reflective (high albedo) materials are chosen.

5 References

Ryu, Y., and J. Baik, 2012: Quantitative Analysis of Factors Contributing to Urban Heat Island Intensity. J. Appl. Meteor. Climatol., 51, 842–854. Available online at: https://doi.org/10.1175/JAMC-D-11-098.1

6 Glossary

6.1 Glossary of Terms

Table 6.1.1: Glossary of Terms

Term	Description
ES	Environmental Statement
GAL	Gatwick Airport Limited
MIDAS	Met Office Integrated Data Archive System
NOAA	National Oceanic and Atmospheric Administration
UHI	Urban Heat Island
UKCP18	UK Climate Projections 2018