Reducing urban heat risk

Our cities are getting hotter. Extreme hot weather events are happening more frequently and as a result London and other major cities around the world face significant risks to people and properties.

How do we develop approaches to understand and address urban heat risk?

Problem

By 2030, 60% of the world's population will be living in urban areas. For some people living in these areas, hot weather can be a real threat. There are four main reasons why hot weather poses an increasing risk to the health and comfort of people in London and other cities.

The Arup Urban Heat Risk Mapping and Visualisation project has identified the factors which contribute to urban heat risk, and has developed approaches and responses to address these factors.

1\ Climate change is resulting in higher average temperatures and more extreme hot weather events.

2\ The prevalence of the urban heat island (UHI) effect reduces the ability of areas of the city to stay cool or cool down at night during hot weather.

3\ A changing demographic, particularly an ageing population as well as more under five year olds, increasing the number of potentially vulnerable people.

4\ Increasing urban development and densification which contributes to the UHI effect, puts pressure on existing open green spaces and green infrastructure which provide essential shade and cooling for cities.

As a result of these factors, hot weather is causing more than just discomfort. As temperatures rise in cities, so do the number of heat related illnesses, emergency call outs and, in some cases, deaths.

Decision makers in London including housing and public health professionals, planners and developers and local politicians need to be well-informed about the risks of hot weather and understand the approaches to protect the most vulnerable people. In the absence of any approaches to address urban heat risk, heat-related deaths in London could more than double by the 2050s.

In the UK, heat-related stress currently accounts for ≈1,100 premature deaths and <100,000 hospital patient-days / year.

Risk factors

The triple risk index for assessing urban heat risk

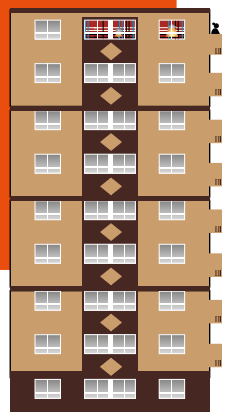
Location =
e.g. proximity to a UHI 'hot spot' such as a densely built area or a major road junction, or a 'cool spot' such as a large park or water body. Levels of air quality, crime, traffic, noise and deprivation.

Building characteristics =
e.g. age of building, materials, orientation, layout, height, storeys, deep plan, dual aspect, presence of a balcony or a garden.

Characteristics of people =
e.g. age, physical and mental health, mobility, gender, socio-economic status, culture, languages spoken, awareness and perception of heat risk.

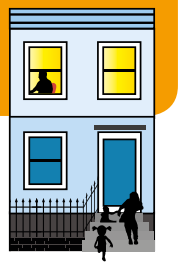
High risk example

Ms X is 68 years old with limited mobility and a respiratory condition. Her days are spent mostly at home with occasional visitors. Her top floor flat is in a tower block with poorly insulated walls, south facing windows and balcony and no external shading. She lives within a UHI, close to a main road with no green or blue space in the area.
The area suffers from poor air quality and high levels of noise, traffic and crime.



Medium risk example

Mr and Mrs Y are both 36 with two children, both under five years old. Mr Y works from home in the evenings and during the day, looks after the children, one of which suffers from asthma. They live in a top floor flat of a converted terraced house which has poorly insulated walls and roof. It is dual aspect but with no garden, no external shading and west facing windows. Situated within a UHI, there is no green or blue space or mature trees in the local area.



Low risk example

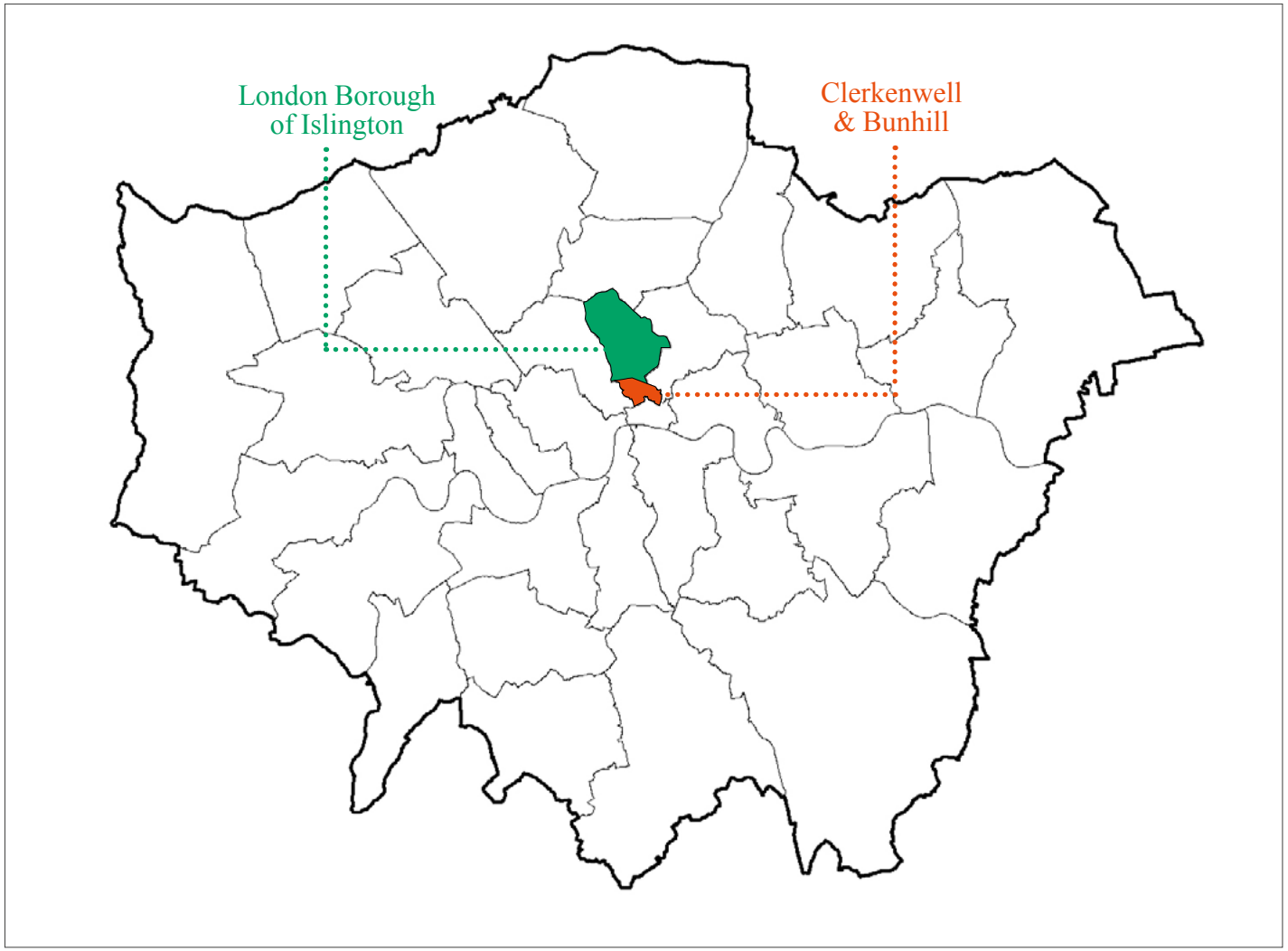
Mr and Mrs Z are a young couple with no children who spend most of the day away from home. They live in a mid-level floor flat with well insulated walls and roof on a quiet residential estate. The flat is outside the UHI, has west facing windows with a balcony and external shading, and is located close to blue space and mature trees. There are low levels of crime.

Overview of mapping and visualisation

The aim was to visualise data sets gathered for London at a range of spatial scales. The first level of resolution was London as a whole (city scale), next a pilot area; the London Borough of Islington (borough scale), was visualised. Finally the neighbourhood scale, within the south of the London Borough of Islington was visualised.

By considering a number of data sets together it is possible to highlight areas where factors such as high temperatures and pollution coincide with building forms conducive to heat risk and vulnerable people.

Greater London



City scale

At the city scale, visualisations depicting the spatial variation of air temperature and land surface temperature over the whole of Greater London were produced. These images give an immediate indication of high heat risk.

The difference in both air and land temperature between Greater London and the surrounding counties is quite evident from these images. As you move away from central London temperatures are seen to decrease significantly.

In addition it is possible to pick out the cooler spots around large scale parks and green spaces such as Hyde Park, Richmond Park and Regents Park, especially from the land surface temperature visualisation.

base map | air temperature | land surface temperature

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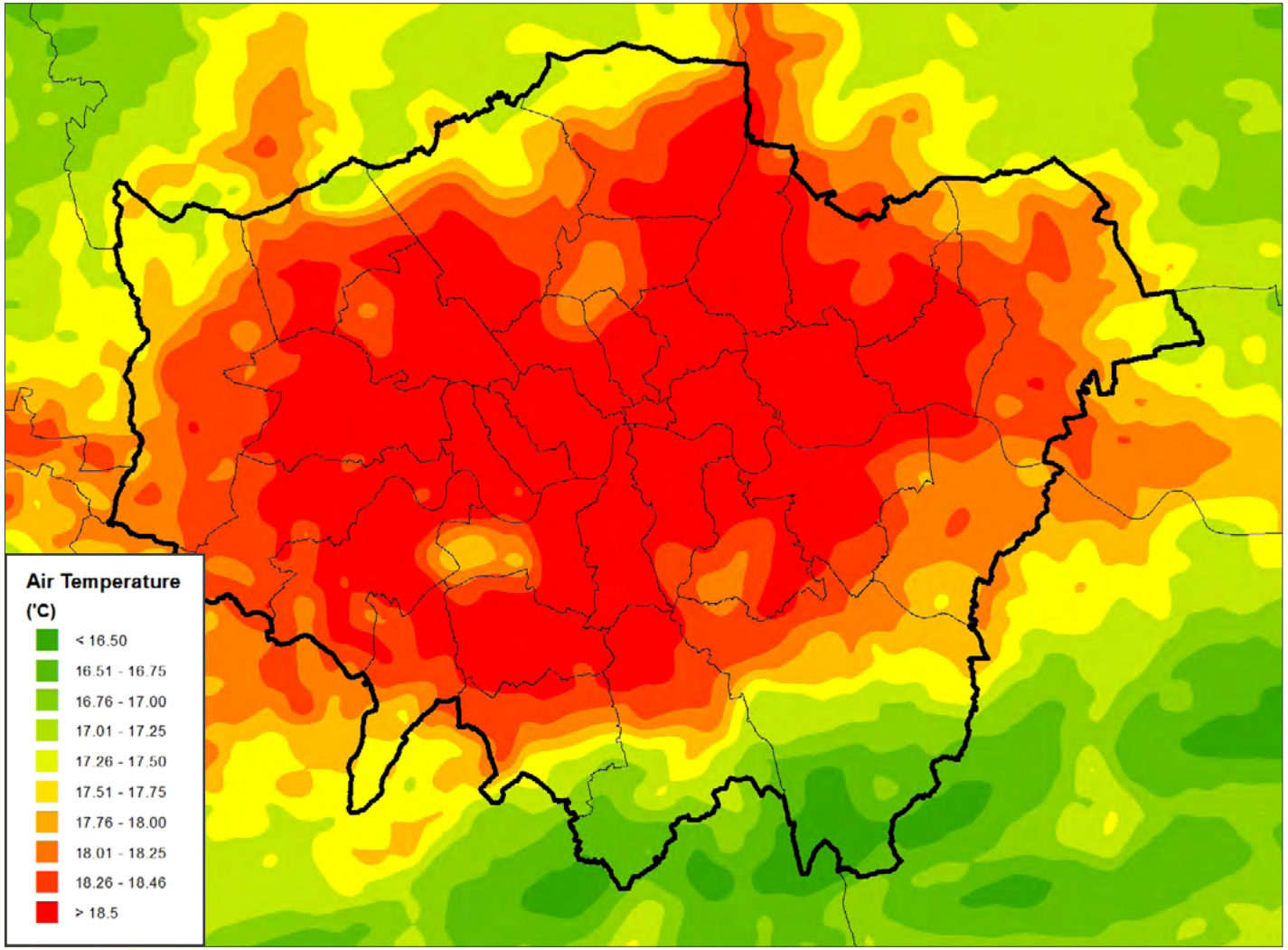

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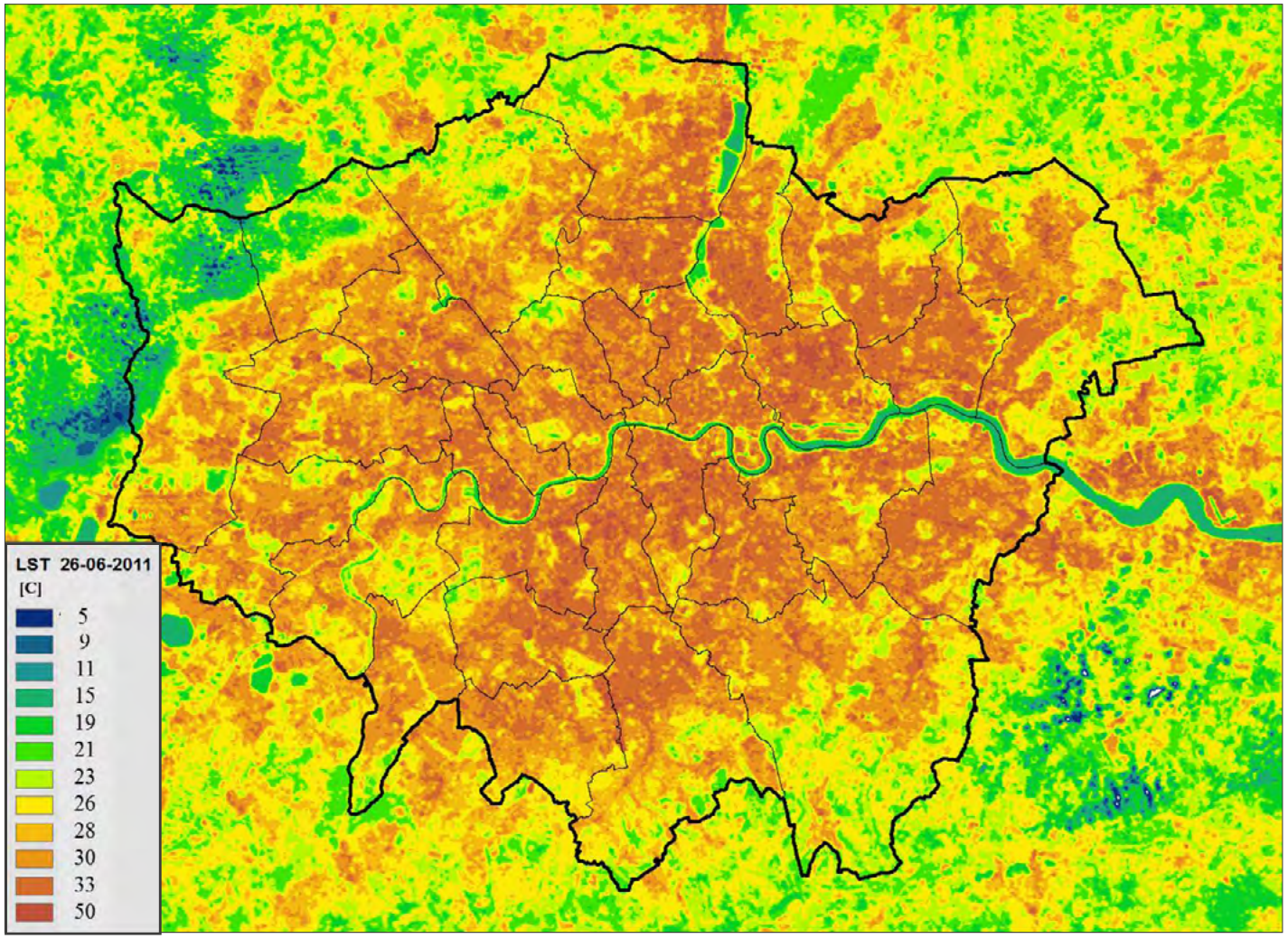


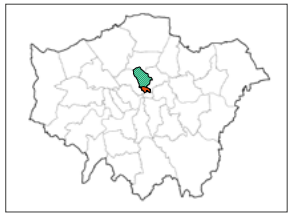
Borough scale

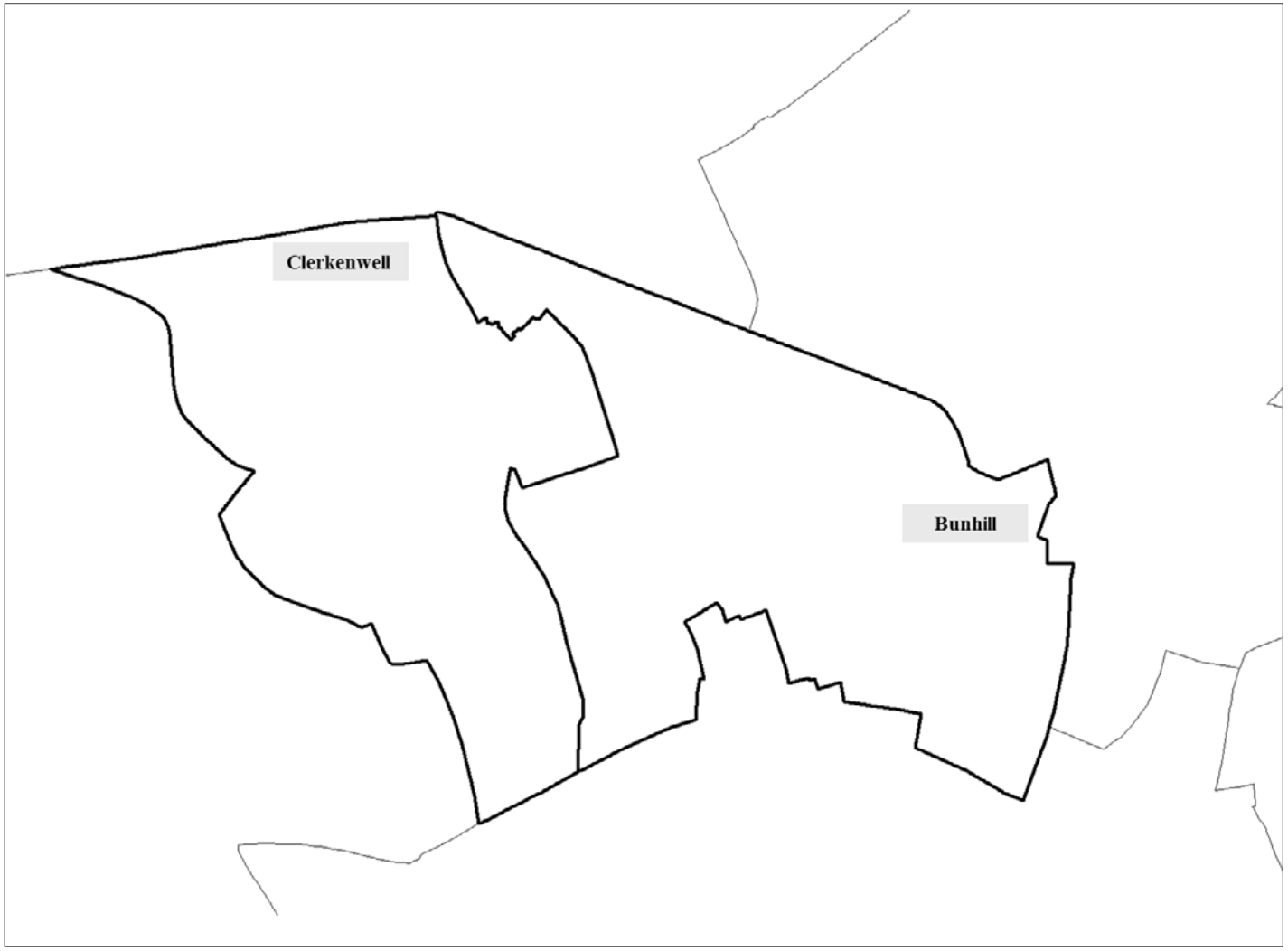
The borough scale pilot area was the two wards of Clerkenwell and Bunhill in the south of the London Borough of Islington.

The pilot area is well within the central London urban heat island and as a result is potentially at risk from the associated additional heat. Looking at a finer spatial scale than the city scale, other factors can be identified which relate to social vulnerability and smaller geographical features such as local parks and buildings.

The combination of being within the Urban Heat Island, having a low density of green space and the added factor of also being amongst the most socially deprived Super Output Area (SOA) in England potentially puts residents in the south of the London Borough of Islington at particular risk of hot weather.

base map | green space | deprivation





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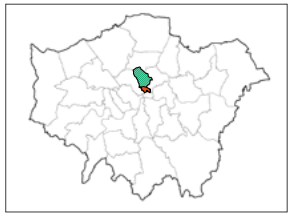

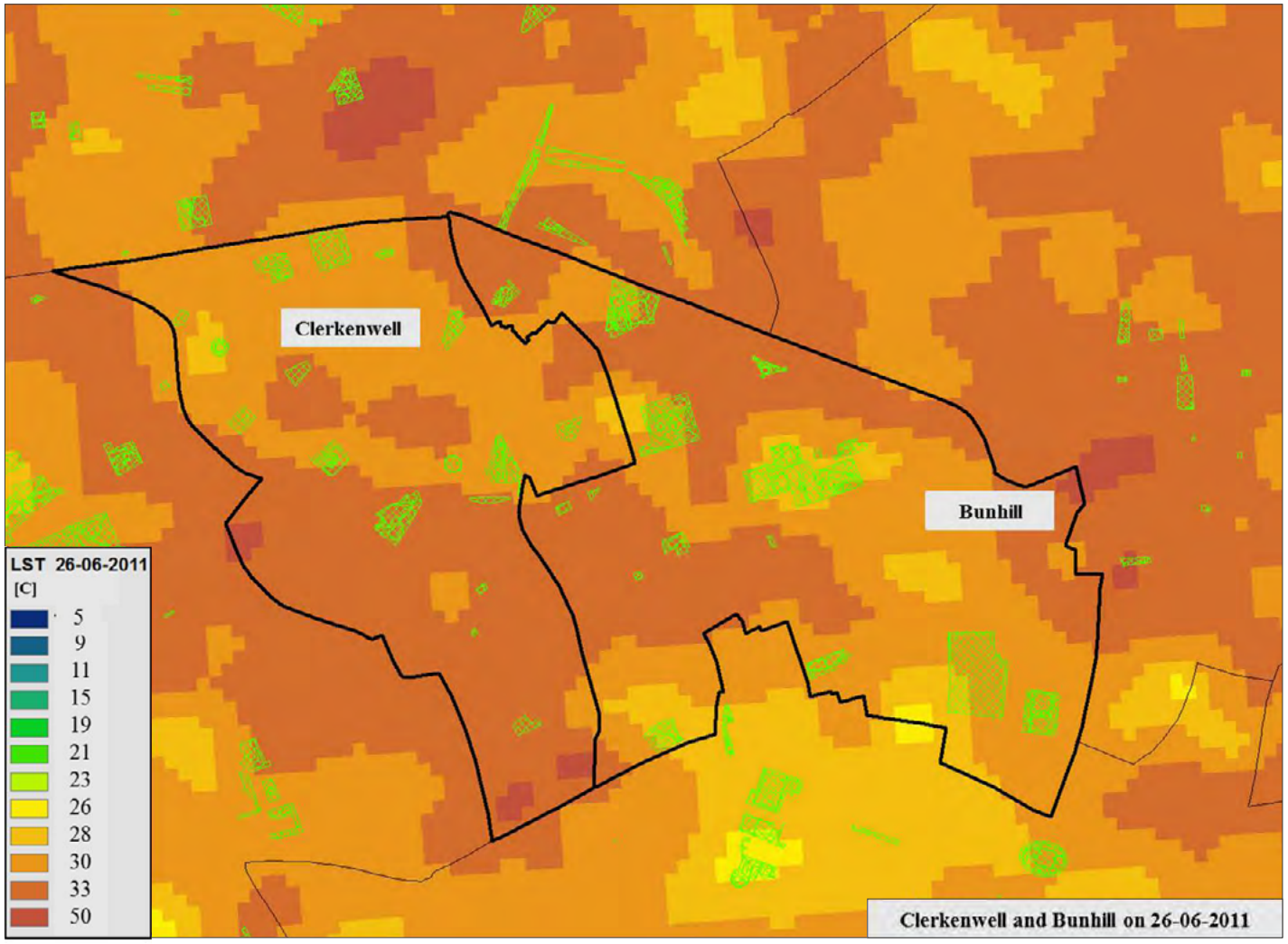

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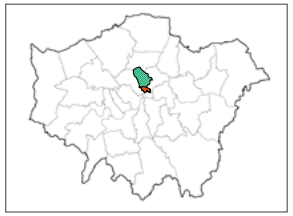
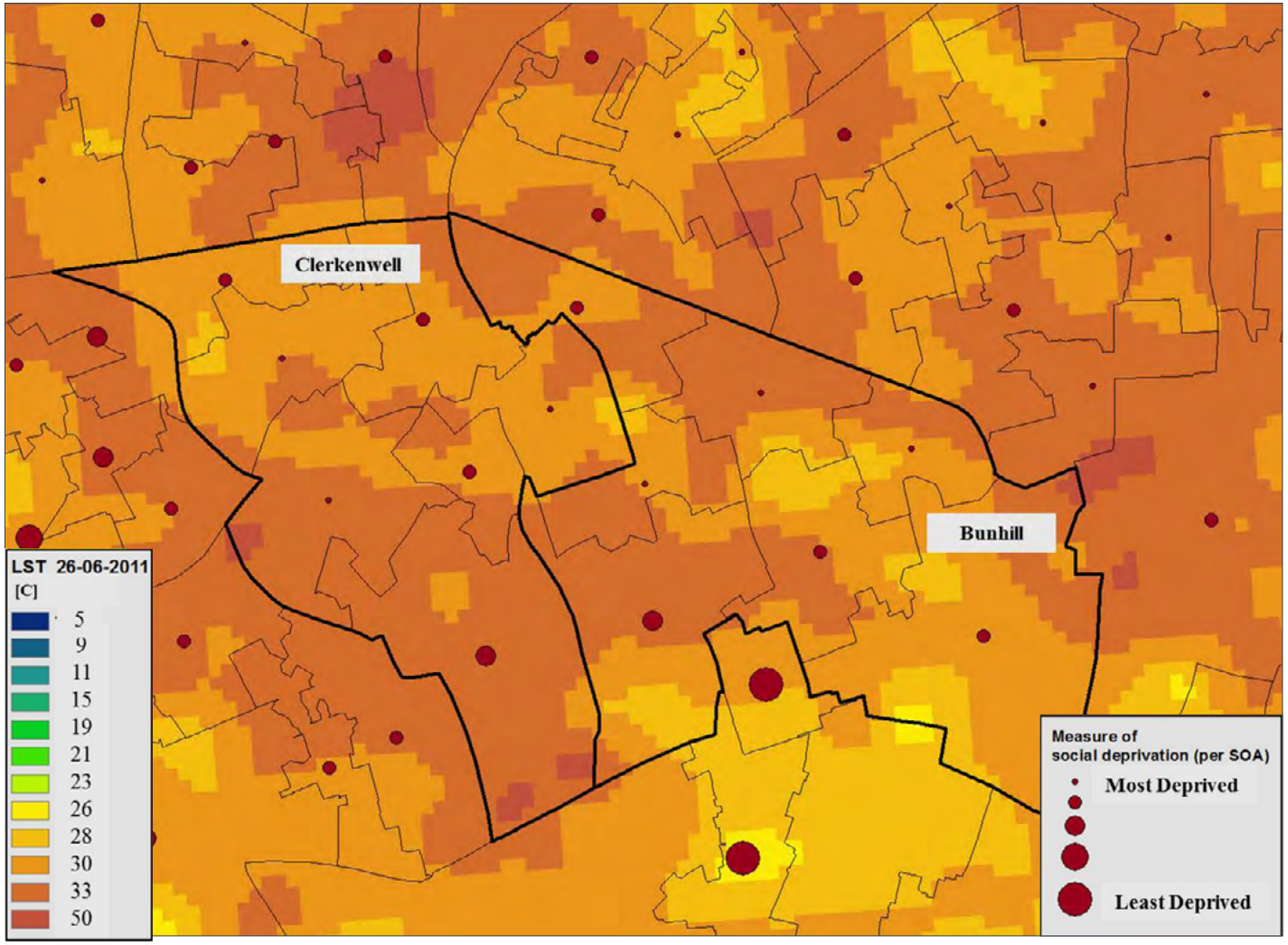




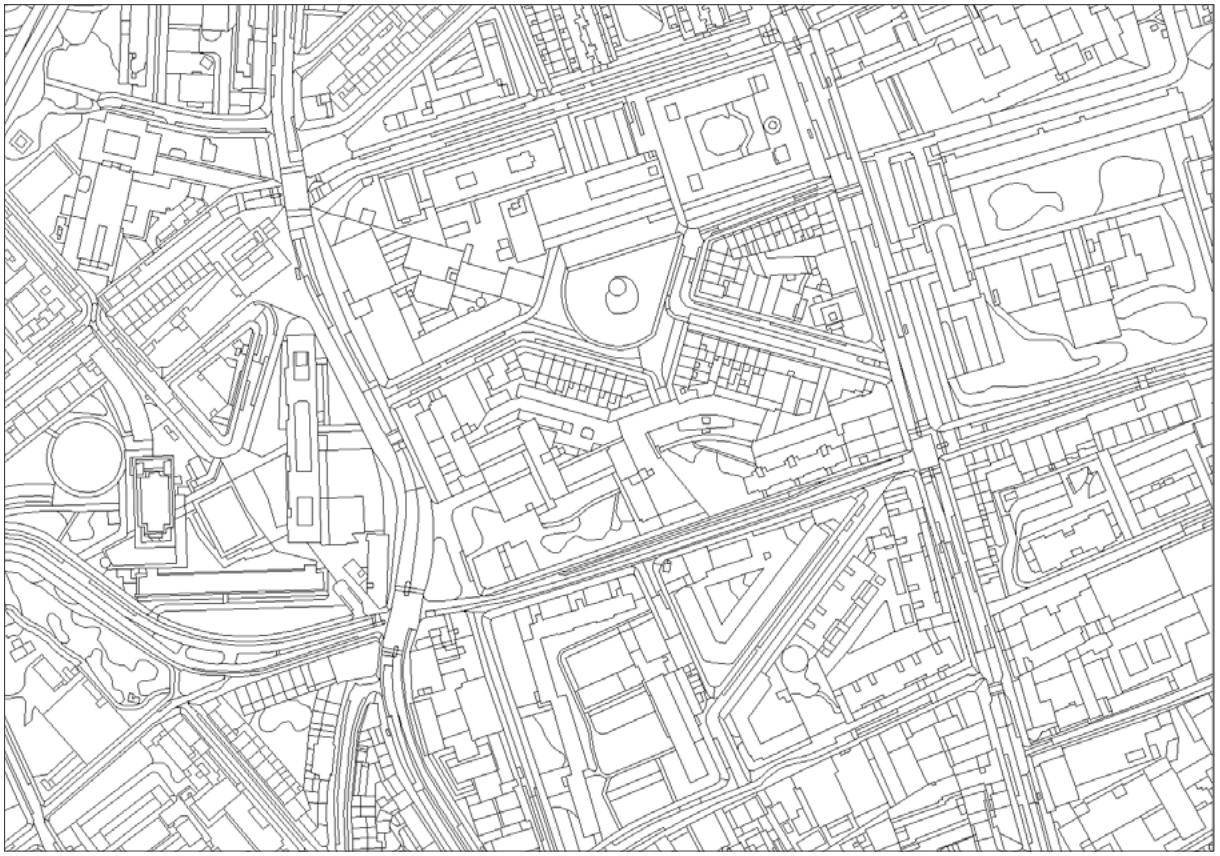
Neighbourhood scale

At an even finer spatial resolution, further details about the vulnerability of buildings and particular groups of residents can be identified. Urban heat risk is known to be greater on the highest floors of multi-storey buildings. Therefore to map and visualise this risk it was considered relevant to understand the location of buildings over 40m (10-15 storeys) and 60m (15-20 storeys) high, as this represents the buildings at highest risk.

Residents on the upper floors of these high rise buildings may potentially be at greater risk as a result of hot weather than residents on the lower floors or in lower rise buildings. Another method to explore this risk would be to produce a thematic map of all building heights in the area, rather than use specific cut-off values of 40m and 60m. This would highlight residents potentially at risk in top-floor flats of buildings still considered high rise but lower than 40m or 60m.

It is apparent that by combining data sets together, it is possible to reveal the interactions between data. Furthermore, using this information in combination it should be possible to quantify thresholds and ratios for data relevant to heat risk, although this was not tackled in this project.

base map | buildings over 40m | buildings over 60m



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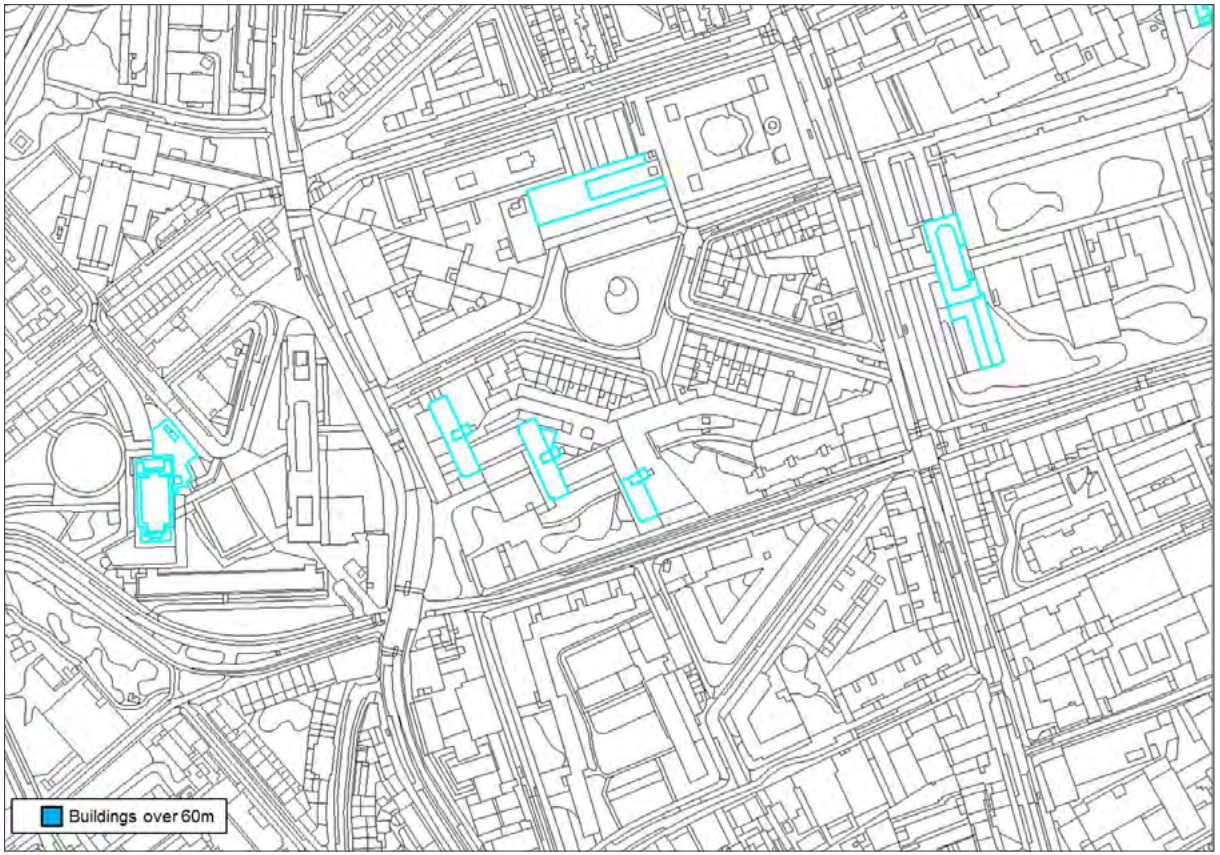


Approaches and responses to reducing urban heat risk can be categorised as physical or social and strategic or operational. Combinations of these can be useful for managing urban heat risk.

STRATEGIC	OPERATIONAL
▲ physical	● physical
△ social	○ social
Approaches and responses implemented: **BEFORE** hot weather	Approaches and responses implemented: **DURING** hot weather

Approaches and responses

Strategic
Involve longer term, larger investments of time and resources with less immediate results. **BEFORE** a hot weather event.

Physical
Involve a change, intervention or improvement to the urban environment, or a particular neighbourhood or building.

Social
Involve policies and practice relating to awareness raising, communication and behaviour change.

Operational
Involve shorter term reactive efforts with more immediate results. **DURING** a hot weather event.

Approaches and responses

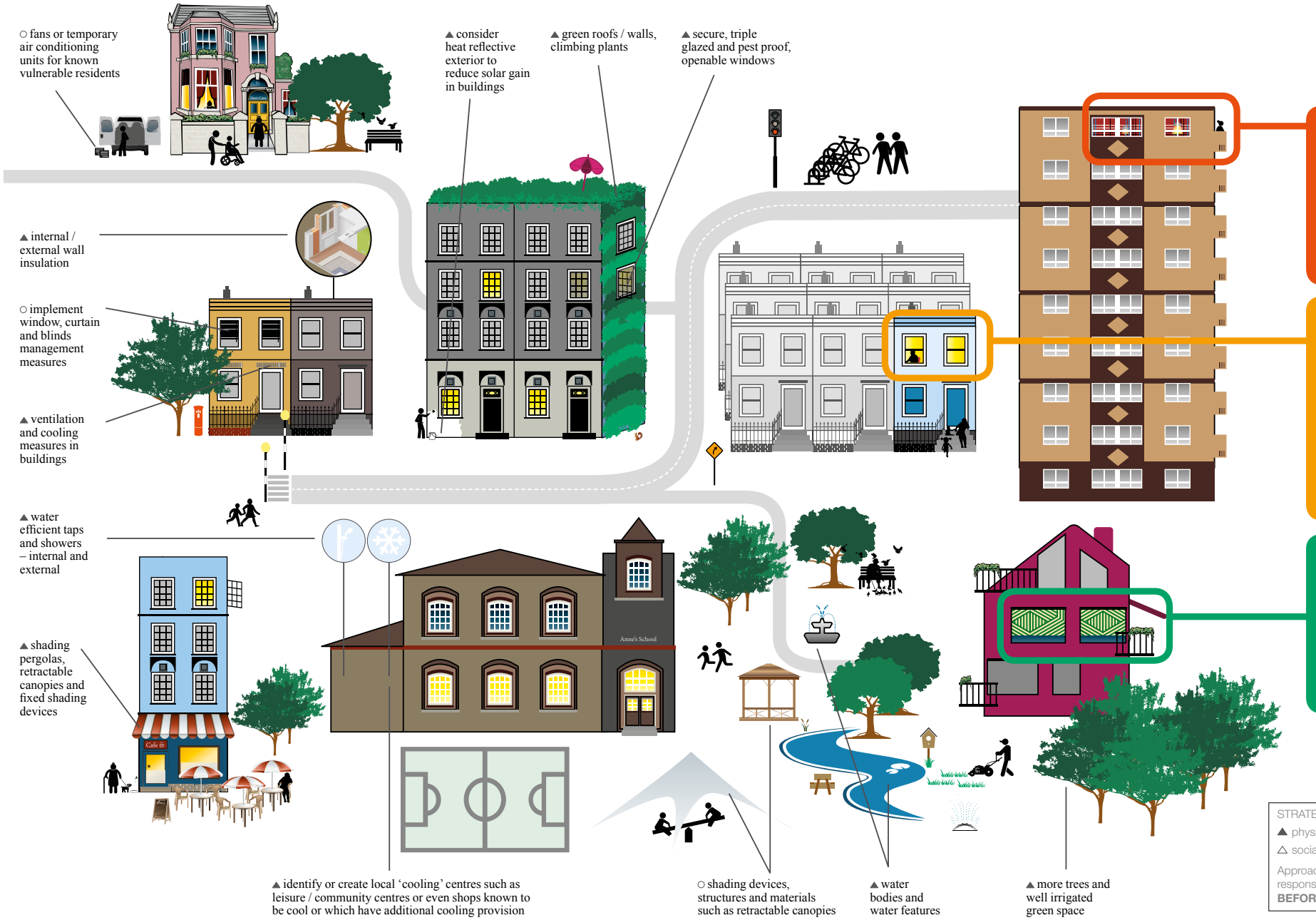
▲ Strategic physical approaches and responses would be the increased planting of trees and provision of well irrigated green space in urban neighbourhoods, or ensuring the integration of physical measures to reduce urban heat risk into planned refurbishment and upgrade works to residential properties.

△ Strategic social approaches and responses would be the development of policies for action following a heatwave which could be utilised during the next heatwave with relatively low additional investment.

● Operational physical approaches and responses would be the provision of fans or even temporary energy efficient air conditioning units for known vulnerable residents during a heatwave, or the opening of windows at the right times of day to allow ventilation and cooling without letting in heat.

○ Operational social approaches and responses might be the resourcing of a dedicated hot weather emergency telephone line during the summer for residents who needed advice or home visits to help them deal with the effects of hot weather.

Summary of approaches and responses



High risk example

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Medium risk example

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STRATEGIC	OPERATIONAL
▲ physical	● physical
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Approaches and responses implemented: **BEFORE** hot weather	Approaches and responses implemented: **DURING** hot weather

City

At the city scale, most approaches will necessarily be strategic, and will involve consideration of the spatial distribution of urban heat risk across the city. Many of the physical approaches involve managing, enhancing and creating more trees and green spaces.

▲ Develop significant areas of greenspace, street trees & canopy cover in London.

Planting and management of trees.

Increase number and type of green spaces and water bodies.

Reduce sources of noise and air pollution especially during hottest months of the year (ie car free days).

△ Key plans and policies for addressing heat risk in London.

Tree planting targets.

Requirements on developers to enhance or create green spaces.

STRATEGIC	OPERATIONAL
▲ physical	● physical
△ social	○ social
Approaches and responses implemented: **BEFORE** hot weather	Approaches and responses implemented: **DURING** hot weather

Borough / neighbourhood

At the borough and neighbourhood scale, many of the strategic and physical approaches are versions of those developed at the city scale, but due to the closer connection with local residents, there is more overlap with operational and social approaches too.

▲ Planting trees.

Street shading using e.g. pergolas/ canopies.

Switching from grey to green surfaces.

△ Localised adendums to NHS heatwave plan.

● Paddling pools filled, fountains turned on during hot weather.

Retractable canopies used during hot weather.

Building / block

At the building or block scale, most approaches are strategic and physical and often related to planned upgrades and major refurbishment as well as adhoc opportunities to make improvements. Some have overlaps with operational approaches, but all social approaches are considered under the community / individual category.

▲ Appropriate wall insulation.

Ventilation and cooling.

Green roofs, walls and climbing plants.

Intallation of water efficient taps.

Security proof and pest proof windows

Temperature maintaining in residential properties and cae homes.

△ Communication of risks and responsibilities.

● Ensure ventilation systems work during hot weather.

Community / individual

At the community and individual scale, approaches are very much linked to strategic and social approaches at the borough and neighbourhood scale, and those at the building or block scale. There is much more of a focus on communication and awareness, and on how to respond to hot weather events when they happen.

▲ Establish supply of energy efficient electric fans.

Identification of low carbon local cooling centres.

△ Provision of reliable means of communication and broadband.

In home overheating reduction advice.

Develop keep cool information materials for residents.

Develop capability for hot weather hotline.

● Use of energy efficient electric fans.

Use low carbon local cooling centres.

○ Air quality alerts.

Hetawave broadcasts.

Distribute keep cool packs and information to residents.

Social visits & hot weather hotline.

Based upon the work carried out and the outputs produced, the following high level key messages have been distilled for all decision makers in London

Urban heat risk is already an issue for London and is projected to increase due to:

- climate change
- urban heat risk
- demographic change (ageing population and growing number of under-fives)
- urban development and densification

The areas of London which are most at risk are those:

- within the existing urban heat island
- with high population density, noise and air pollution
- with heavy traffic
- with crime and security issues
- with hard surfaces and lack of tree canopy or green space
- with limited access to water bodies and water features

The buildings within London which are most at risk tend to be those which:

- are in the high risk areas identified
- have poor insulation
- are exposed to direct sunshine
- have large areas of glazing
- are often south/west facing
- are un-shaded
- are less able to be ventilated naturally, i.e. single aspect, have little or no outdoor space.

The people within London who are most at risk are:

- the elderly and the under-fives
- those with existing respiratory, mental health or cardio-vascular conditions
- living in the high risk buildings and the areas identified

- The **'triple risk index' approach** to understanding the urban heat risk factors is a useful way of thinking about the potential problem
- the concept of an 'urban heat risk index' for London should be developed further
- the strategic, operational, physical and operational approaches and responses to addressing urban heat risk before and during a hot weather event should focus on these areas, these buildings and these people.

Key messages for specific groups of policy and decision makers

Mayor of London

Ensure that managing and reducing urban heat risk continues to be reflected within relevant plans, policies and strategy documents such as the London Plan and the Climate Change Adaptation Strategy. Ensure that approaches to addressing urban heat risk continue to be clarified and strengthened with increasing requirements and pressure on planners and developers to incorporate them into redevelopment projects as essential requirements. There may be a need for legislation and regulation to enforce policy. Link measures to reduce urban heat risk to measures to improve air quality in London for example the Street Tree initiative, RE:LEAF and the Low Emissions Zone.

Planners and developers

Make the most of opportunities provided by planning applications and redevelopments to incorporate urban heat risk reduction measures including urban greening. It is recommended that priority be given to multi-functional green infrastructure design approaches, fulfilling the objectives of planning guidance like the All London Green Grid and planting large species trees to significantly increase the canopy cover of the city where possible. It takes 15 - 40 years, and the right species, for a tree to grow large enough to deliver meaningful cooling benefits (as well rainwater management and biodiversity benefits) so planting trees and increasing canopy cover now will be essential to reduce the increased urban heat risk for London in the future.

Local politicians

Older people and parents with young children are voters. Demonstrating that there is a local understanding of urban heat risk issues, and that approaches to addressing them are being developed and implemented, will engender confidence amongst your constituents and keep them healthy and safe.

Key messages for specific groups of policy and decision makers

Members of the public

Most people who live, work or visit London enjoy hot weather when we get it. But hot weather can also pose serious risks to us all if we are not aware of basic measures to reduce them as explained in the 'Keep Cool' information and pack. As urban heat risk is more of an issue for older people, under-five year olds and people with existing respiratory, mental health or cardio-vascular conditions, look out for friends, family, neighbours and colleagues who fall into these groups during hot weather.

Public health professionals

Cold weather still poses more of a risk to vulnerable residents than hot weather, but urban heat risk is now a significant issue leading to heat related stress and excess deaths and is clearly an increasing issue in London. Consider dealing with hot and cold weather events as part of a wider Seasonal Management Plan. Create information hubs for the 'Keep Cool' guidance, and signpost members of the public to relevant information and local cooling centres.

Housing professionals

Consider all of the physical and social measures for reducing urban heat risk for buildings and people. Assess which ones might be viable and cost effective given planned upgrades and refurbishment plans, and which ones might require engagement and communication with local residents. Create information hubs for the 'Keep Cool' guidance, and signpost residents to relevant information and local cooling centres.

Insurers

Urban heat risk may have implications for buildings insurance and health insurance policies. Informing clients and customers about the potential risks and what can be done to reduce them may be beneficial.

The project identified three areas for further work:

Further development of a web-based interactive database which provides a platform to host all of the data identified and collated which is related to urban heat risk in London. This could have potential links to existing resources listed on this page.

SHAPE

London Data Store

ALGG

GiGL

more information

Further development of an Urban Heat Risk Index for London and its boroughs

An Urban Heat Risk Index should be developed further at the London wide scale and at the borough scale

Targeted monitoring and measurement of relevant data

Continued and increased monitoring and measurement of relevant data for London such as air temperatures and land surface temperatures and the number, characteristics and value of trees and green spaces.

SHAPE

Strategic Health Asset Planning and Evaluation (SHAPE) database

SHAPE is a web-enabled, evidence-based application which informs and supports the strategic planning of services and physical assets across a whole health economy. It links national datasets for clinical analysis, public health, primary care and demographic data with estates performance and facilities location, and enables interactive investigations by Local Area Teams, Providing Trusts, Clinical Commission Groups (CCGs), GP practices and Local Authorities.

London Data Store

London Data Store

The London Datastore has been created by the Greater London Authority (GLA) as an innovation towards freeing London's data. It wants citizens to be able access the data that the GLA and other public sector organisations hold, and to use that data however they see fit, free of charge.

ALGG

All London Green Grid (ALGG)

The ALGG is a policy framework to promote the design and delivery of green infrastructure across London. It has been developed to support London Plan policies on green infrastructure and urban greening, and those relating to open spaces, biodiversity, trees & woodland, and river corridors.

GiGL

Greenspace Information for Greater London (GiGL)

GiGL is the capital's environmental records centre – it collates, manages and makes available detailed information on London's wildlife, parks, nature reserves, gardens and other open spaces.

Reducing urban heat risk project partners:

Arup

Greater London Authority

London Climate Change Partnership

University College London

London Borough of Islington

For more information please contact:

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Anna Coppel anna.coppel@arup.com

The full report can be downloaded here