

MAYOR OF LONDON

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# London City Resilience Strategy 2020

February 2020



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## Foreword by the Mayor

Londoners are resourceful and resilient. Over the course of our two thousand-year history we have endured plague, fire, the Blitz, terrorist attacks, financial crises, recessions and more to emerge as the dynamic, diverse and successful global city we are today.

Indeed, one of the defining features of our city is that in times of adversity Londoners always pull together, enabling our city to overcome hate and hardship and bounce back stronger and more united than ever.

But resilience is central not only to our identity but to how we think about and shape our city. London has survived and prospered because of its capacity to withstand external shocks, its ability to adapt to change and respond to upheaval, and its commitment to the open and progressive values that bind us together. It is our responsibility to current and future Londoners, to make sure that our city remains resilient and that the conditions which allow us to thrive and flourish persist long into the future.

Today, London is faced with unprecedented challenges. As a city, we must be prepared to deal with the consequences of climate change, urbanisation, rapid population growth, social inequality and the risks associated with economic integration and interconnectivity. But we must also be ambitious and stand ready to seize the opportunities that come with addressing these issues – from the possibility of creating new jobs in the green energy sector to the potential scope for adopting new technologies that make London safer and our economy stronger.

Ultimately though, it is Londoners who make London resilient, and so this strategy is about enlisting our citizens in a shared endeavour – to create a London where everyone can connect, engage and mobilise together with their communities, uniting in their daily lives as well as during disruption and disaster.

This strategy is also about how we serve Londoners and work to improve our city so that it provides opportunities for all, as well as a pleasant place to live. London has already taken bold steps to protect our environment. We must also now seek to turn major trends, such as the growth of digital technology and big data, to our advantage – using them to build and support our resilience. We want everyone to have a stake in building resilience, from citizens and businesses to charities and London's leading institutions, as we all have a role to play in making London resilient.

This strategy is part of a global movement to enhance city resilience, and in its development, we have learned valuable lessons from other cities around the world. Global collaboration is vital to a resilient future for London and, going forward, we will continue to work across borders with our friends and partners for the benefit of all.

London's City Resilience Strategy marks the next stage of our work to support the London of tomorrow, and I would like to thank all those who have supported and guided us in this critical step towards a resilient future.

A handwritten signature in blue ink, appearing to read 'Sadiq Khan', with a small '2' written below the 'n'.

**Sadiq Khan**  
Mayor of London



## Foreword by the Deputy Mayor for Fire & Resilience

London is a diverse, open and vibrant city, home to of 8.9 million residents, predicted to grow to 10 million over the next 10 years. We are a cosmopolitan and diverse city, four in ten of us were born abroad and in our schools over 300 different languages are spoken, making London the world's most linguistically diverse city.

London is the economic engine of our country, accounting for 23 percent of the UK's economic output.<sup>1</sup> We are a smart city, a leader in digital industries, ranked number one European city for supporting digital entrepreneurship by the Digital City Index.

We are a busy city, leading in sustainable travel: every month we make 300 million journeys by public transport and hire just under one million bikes. London is open and full of life, but, like any thriving city, London is vulnerable to both shocks and stresses which, when exposed, can weaken its ability to work for everyone.

For us, building resilience in London is about building the ability of all Londoners, our businesses and our communities to survive and thrive no matter what kinds of chronic stresses and acute shocks we as a city experience.

London has well-rehearsed responses to major incidents, which have been used to life-saving effect at some terrible events in the past few years, including the Westminster and London Bridge terrorist attacks and the Croydon tram crash.

However, over time London and other cities around the world have understood the need not just to have a world-class response to shocks, but the need to look at the stresses our cities are under that make recovery more difficult. We need to place equal emphasis on reducing the likelihood of emergencies happening in the first place and mitigating their impact, as we do on reacting once they have happened.

If we can make our communities stronger, make our climate, transport and planning policies more robust, understand the systems that run our city runs better, then we can avert crises before they happen, feel less of an effect when they do happen and bounce back more quickly and with greater strength when an emergency has happened.

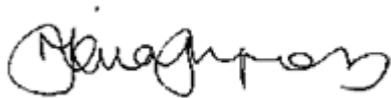
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<sup>1</sup> City Intelligence (2018)

Our aim in this strategy has been to look specifically at the long-term shocks and stresses that are likely to affect the material wellbeing of the city between now and 2050. To see where there are gaps in London's resilience and then to highlight projects and actions that will work toward filling those gaps.

In researching this strategy we have collaborated with the 100 Resilient Cities Project, helping us to gain international perspectives on resilience. We have engaged with Londoners and businesses, spoken to national and international experts, held workshops and conducted research in London and beyond.

We have found that London is already well-served in all areas of policy and governance aimed at making the city more robust, however, we can and should always do more. This is particularly important in developing cross-cutting projects aimed specifically at developing the resilience of our city. From educating all Londoners in basic first aid, to opening up London's underused spaces to using London's cultural assets to practice emergency response, this strategy aims to take the broadest possible approach to what it means for London to be a resilient city.



**Fiona Twycross**  
Deputy Mayor for Fire and Resilience



## What is Resilience for a City?

**Resilience is the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and thrive no matter what kinds of chronic stresses and acute shocks they experience** - 100 Resilient Cities, pioneered by the Rockefeller Foundation

Cities and urban environments face complex and interconnected challenges, some old, some new, and all more urgent as populations grow. Climate change and environmental degradation create a need for new ways of managing resources. Economic instability, inequality, social tensions and terror threats undermine citizens' confidence and community integration.

London is a thriving global centre of diversity, arts, culture, business, entrepreneurship and history served by world-class institutions. One of the first large and internationally connected cities, London has demonstrated strength, unity and determination in response to many previous crises.

This strategy focuses specifically on the long-term resilience challenges facing our city from now to 2050. Developing London's resilience in the long term will improve our ability to manage future crises successfully, together. By investing in resilience now, we can prepare London for anticipated shocks and stresses, and for unforeseen challenges, and support Londoners to adapt and to thrive.

This strategy is a starting point for developing long-term holistic resilience for London, bringing together different policy areas to deliver cross-cutting benefits. It highlights policy activity already contributing to resilience-building and sets out projects to develop this further. This strategy aspires to make resilience central to policymaking in London.

The first part of the strategy explains our vision for, and approach to, city resilience in London and provides an analysis of the resilience activities that are already taking place in the capital. The second part sets out projects that have been identified during the process of developing this strategy, some of which are funded and underway, while others need further exploration. Together, the strategy creates a vision for a more resilient London, and a series of actions that could help us to realise that vision.

## Vision of a Resilient London

Planning for a city's future resilience is a specific type of challenge. The shocks and stresses we are likely to face in the coming decades will be varied, and our recent experience of unpredictable events like Brexit have reminded us that many future challenges will not yet be known to us. Although no one knows what the future will bring, we can increase our preparedness for different eventualities.

The key to successful resilience is to create a city that has the systems, approaches and flexibility to deal with unpredictable events, and to recover to a new, and better, normal when things go wrong.

In 2050 London will be a city that:

- **Starts with resilient citizens, actively participating in city life**
- **Is capable of adapting to changing social and economic vulnerabilities and local needs**
- **Has the agility to develop resilience measures that can address long-term stresses, turning future challenges into opportunities**
- **Mobilises its collective intelligence to improve societal wellbeing for current and future generations**
- **Is continuously preparing and developing to face all types of disruptive shock, with resilience part of our day to day thinking and actions**

## Features of City Resilience

To make a city resilient, it needs systems that can withstand, respond to, and adapt more readily to shocks and stresses. The work of 100 Resilient Cities determined that cities that are resilient have systems that can be described as inclusive, integrated, adaptive, reflective, resourceful, robust and redundant, as set out on the next page.

In particular, cities need governance and social and financial infrastructure that responds effectively to longer-term pressures, to continue to deliver for citizens by changing and adapting to circumstances.

### London as a resilient city

As a global city with an open economy, London is exposed to continual international, regional and local change. It has already made great progress in its capacity to respond. Over the last 15 years London has developed world-class multi-agency emergency response infrastructure. London has declared a Climate Emergency, and we are proud to lead work on climate change adaptation and addressing other environmental pressures including by launching the world's first 24 hour Ultra Low Emission Zone (ULEZ) to clean up the city's toxic air, and becoming the world's first National Park City.

This strategy takes a broad and long view of what city resilience means, by considering immediate risks and looking at a wider range of shocks and stresses to determine how best to respond to them. By considering our resilience holistically, we can help London and Londoners be better prepared for the future.

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## **INCLUSIVE**

Based on broad consultation and engagement with stakeholders



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## **INTEGRATED**

Builds links between different systems, institutions and disciplines to maximise benefits



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## **ADAPTIVE**

Flexible by design, willing and able to adopt alternative options in response to changing circumstances



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## **REFLECTIVE**

Learns from past experience to inform future decisions



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## **RESOURCEFUL**

Considers alternative ways to use resources to achieve goals



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## **ROBUST**

Well designed and durable, constructed and managed to reduce risk of failure



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## **REDUNDANT**

Built-in spare capacity to accommodate disruption



## Managing for Resilience

London has developed robust emergency plans through the London Resilience Partnership. These are crucial to a resilient city, but they are just one distinct area in a bigger system that needs to be geared to building overall resilience. True resilience starts well before this stage, with governance structures that support, develop and maintain the key characteristics of city resilience.

The value of resilience should be reflected in all levels of city governance, from citizen engagement and empowerment which helps build local resilient communities, through core city-level policy action on wellbeing, sustainability and good growth, to embedding resilience thinking into policymaking which tackles long term challenges.

Understanding and communicating risk at all levels will support a framework where all policy areas can contribute towards the city’s overall resilience.



Figure 1 - How London policy can contribute to resilience

## London & 100 Resilient Cities

As a member of the 100 Resilient Cities Programme, London has had access to specialist tools and methodology to help develop a resilience strategy.

100 Resilient Cities, pioneered by the Rockefeller Foundation, was launched in 2013 to help cities around the world become more resilient to the physical, social and economic challenges that are a growing part of urban reality. The 100 Resilient Cities methodology supports the adaptation and incorporating of a view of resilience that includes the shocks (such as earthquakes or floods) as well as stresses that weaken the fabric of a city on a day to day or cyclical basis.

London, like other cities in the network, received support from 100 Resilient Cities in a number of ways:

- Financial support for the position of a Deputy Chief Resilience Officer/Urban Resilience Manager and Resilience Policy Officer
- Access to technical expertise in guiding the process of developing a resilience strategy through a Strategy Partner
- Access to support from 100RC platform partners – a group of leading service providers offering in-kind services to member cities
- Membership of a network of world cities for knowledge exchange and learning to build resilience

The 100RC programme concluded in 2019. The Global Network of Resilient Cities that was created through the 100RC programme will continue. The opportunities this network of cities can provide for collaboration and knowledge-sharing are invaluable to help London build resilience.

This Resilience Strategy is only the start. We have created London's Resilience Strategy using tools and opportunities provided by 100RC, but it is the international partnerships developed through this programme that will help us continue to create new opportunities to build resilience and learn from others.

We will continue to work with citizens, businesses and institutions to deliver the objectives set out here, and to build our collective capacity to adapt and respond in the future.

We have engaged with stakeholders, spoken to national and international experts, held workshops and conducted research. Along the way we have received a lot of support, ideas and contributions to this document, for which we are thankful.



## London: Key Statistics

- London is the economic engine of our country, accounting for 23 percent of the UK's economic output<sup>2</sup> and contributing £34.3 billion<sup>3</sup> to the Exchequer in 2017/18
- London exported over £131 billion of goods and services in 2015<sup>1</sup>. Over three quarters was exports of services: the EU is London's largest export destination
- London is connected to the world and a centre for global trade and services, with 396 international destinations served by direct connections from London airports
- London is a smart city and a leader in digital industries, ranked number one European city for supporting digital entrepreneurship by the Digital City Index<sup>4</sup>
- London is young and highly qualified: 56 percent of Londoners aged 25-64 have a further or higher education degree compared to 40 percent in the rest of the UK<sup>1</sup>
- Social inequality is stark: half of London households own 5 percent of the total household wealth<sup>1</sup>
- London is cosmopolitan and diverse: 38 percent of Londoners were born abroad<sup>1</sup>
- Over 300 different languages are spoken in London's schools, making London the world's most linguistically diverse city<sup>5</sup>
- London is embracing sustainable travel: every month in 2019 300 million public transport passenger journeys<sup>6</sup> and 910,000 bicycle hires<sup>7</sup> took place on average
- Londoners care: 52 percent of Londoners took part in informal volunteering and 28 percent in formal volunteering in the past twelve months<sup>8</sup>
- London has the highest percentage of pupils in state-funded schools achieving grades 5 or above in English and Mathematics GCSEs<sup>9</sup>

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<sup>2</sup> City Intelligence (2018)

<sup>3</sup> Net figure - GLA (2019)

<sup>4</sup> European Digital Forum (2016)

<sup>5</sup> UCL (2019)

<sup>6</sup> TfL (2019a)

<sup>7</sup> TfL (2019b)

<sup>8</sup> City Intelligence (2019)

<sup>9</sup> DfE (2019)

## Opportunities to Build Resilience

During the development of this strategy, a number of challenges likely to impact on London and Londoners were identified. Any list of challenges is not exhaustive, as London is likely to face new risks in future, some of which we may not even be able to imagine at present.

London is connected in multiple, complex ways to the rest of the UK and internationally. Utilities, telecoms, food and business supply chains are regional and global. Disruption may be caused by a sudden shock event, or could result from a slow stress that becomes increasingly problematic over time. Chronic stresses can increase the likelihood of shock events. They are also likely to amplify the impacts when shock events do occur and lengthen recovery time and cost, both in financial terms and for individuals and communities.

Identifying shocks and stresses, and using a holistic view of how London supports Londoners, communities, business and governance, will help us manage community needs, risks and vulnerabilities in such a way as to build long-term resilience.

Our profile of shocks and stresses has been developed through discussion with stakeholders, a review of the risk data underpinning existing Mayoral Strategies, workshops using 100RC tools and a review of the London Risk Register<sup>10</sup>. Our aim has been to look specifically at the long-term shocks and stresses that are likely to affect the material wellbeing of the city between now and 2050. This is distinct from the London Resilience Partnership Strategy<sup>11</sup> which focuses on emergency plans for risks over a 5-year time horizon. This risk profile is likely to change over time, and our work is limited to the timeframe of this strategy.

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<sup>10</sup> London Resilience Partnership (2019)

<sup>11</sup> London Resilience Partnership (2016)

## Shocks

### **Sudden impact events that can immediately disrupt a city and may have wide-ranging and unexpected impacts**

Climate change is resulting in increasingly frequent extreme weather events, such as heatwaves and storms and the impacts they have, such as flooding and drought. The Thames is a tidal river that is sensitive to future sea level rises and requires a complex system of barriers and other measures to manage tides and prevent flooding. The perception of London as a cold and wet city is no longer true - in fact, reduced rainfall is leading to more regular drought warnings.

Events such as heatwaves put pressure on our infrastructure, with transport, electrical and telecoms infrastructure more likely to stop working, interrupting daily life and business, while also making it harder for Londoners to get help to deal with impacts.

London relies on overseas workers from Europe and elsewhere across many sectors, including in the health service, hospitality, and food sectors – a strength which gives London its unique culture. However, Brexit threatens to cause interruptions to trade, availability of workers, and could encourage institutions and investment to relocate in order to maintain links to the EU.

London has proven ways to deal with shocks. The London Risk Register sets out our main risks – and well-rehearsed plans are in place to manage these. Because of this there are already high levels of awareness and planning to deal with many types of disruption, including flooding or disease prevention. However, over time these risks are likely to change and develop, and it will be necessary to adapt and develop our planning.

## LONDON'S MAJOR SHOCKS

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### Drought



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### Terror attack



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### Flooding



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### Extreme weather



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### Cyber attack



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### Infrastructure failure



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### Disease pandemic



## Stresses

### **Chronic issues that weaken the fabric of a city and can eventually lead to a major shock**

A number of London's stresses are associated with the age of our city, and the growth of the capital's population.

London is at once a booming centre for global finance and has high levels of poverty and deprivation. Income inequality is more pronounced in London than elsewhere in the UK<sup>12</sup>. The long-term stresses of increasing income disparity and lack of affordable housing make families and communities more vulnerable to shock events.

Chronic stresses can also amplify the impacts of shock events. The loss of water through leakages in a Victorian system exacerbate a drought situation. Regular heatwaves can worsen air quality, exacerbating existing health conditions while compromising Londoners' ability to manage their health and wellbeing effectively.

London's stresses interact with one another, and the overall impacts they have in the long term on Londoners and London's communities are often unclear and difficult to quantify. If we do not understand and deal with London's stresses, they could have a severe and detrimental effect on our city's ability to manage and recover from shocks.

As an example, the Mayor's Housing Strategy has already set out how workers such as nurses and social care staff struggle to afford to live in London. Aside from the fundamental unfairness of this situation, if there are insufficient people to fill these roles, this could have a huge impact on the health of many Londoners. Brexit is likely to add an additional pressure to availability of those key workers.

As well as looking at groups within the population, we need to take account of social integration across communities. Effective planning can deliver more affordable accommodation, jobs, business space and access to healthcare (among many other things). However, it is also vital to create systems and situations where Londoners can build community connections through personal interactions. Without these human connections and community life, individuals and families cannot build a personal safety net to fall back on should things go wrong. Without these safety nets across communities the city becomes less resilient, and people will struggle to manage in the event of a shock.

We need to facilitate these types of connections, and act as a facilitator of community life. Social infrastructure, volunteering and participation are key: the way London develops should prioritise connectivity, otherwise we will fail to build fundamental resilience.

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<sup>12</sup> Trust for London (2019)

## LONDON'S CHRONIC STRESSES

**Lack of Social Cohesion**



**Inequality**



**Poor Air Quality**



**Food Insecurity**



**Poor housing affordability and quality**



**Ageing infrastructure**



**Poor health and wellbeing**



**Brexit**



## Prevention is better than cure

Building resilience as widely as possible will help London and Londoners face any future shock or stress as best we can – not waiting until a shock has occurred to remediate the situation. This forward-looking mitigation work goes hand in hand with the robust and well-established emergency response plans London already has in place to deal with a wide variety of existing risks and potential emergencies. Acting to prevent emergencies before they happen will make London more robust to future challenges.

This strategy focuses specifically on the long-term resilience challenges facing our city. Managing the types of challenges that will face us in 2050 requires a different approach to the traditional risk management that we have used to develop robust emergency planning for London.

Based on the objectives set out in the Preliminary Resilience Assessment<sup>13</sup>, and further supported by the feedback from the consultation, we have identified three cross-cutting opportunities that will, if taken, help us achieve our vision for a more resilient London.

These resilience opportunities should not be viewed in isolation, as they are highly interconnected. Each initiative we are developing in this strategy can link to more than one resilience opportunity and deliver multiple resilience benefits.

<b>Resilience for People</b>	<b>Building resilience for London's Communities</b>
<b>Resilience for Place</b>	<b>Developing resilience for London's physical environment and infrastructure</b>
<b>Resilience for Process</b>	<b>Designing resilience into governance</b>

<sup>13</sup> GLA (2019)

This strategy is a starting point for developing long-term holistic resilience for London, bringing together different policy areas to deliver cross-cutting benefits.

It is designed to highlight policy activity that is already contributing to resilience-building and uses this to analyse and understand where more work should be carried out. Where opportunities for additional work have been identified, we have developed specific projects that improve resilience.

In writing this strategy we are also developing ways of making resilience central to our own policymaking, and supporting resilience initiatives across the Greater London Authority (GLA) and our wider stakeholder base.

## Actions to Build London's Resilience

As part of the process of drafting the strategy, we have looked at how we can bring together an understanding of the impact of potential shocks and stresses with an analysis of how the range of existing GLA policies contribute to London's resilience<sup>14</sup>. This provides a snapshot of London's resilience at the current time, in the context of the risks London is facing.

The next part of this document sets out steps that could help address these challenges, outlining projects that are aimed at building resilience to one or more risks. Because the GLA already actively contributes to resilience through many policy areas and initiatives, the projects set out in the next section focus predominantly on building cross-cutting resilience with a number of different partners.

These projects are a starting point to achieving a resilient city: collectively they contribute to overall city resilience, by focussing on increasing resilience in different areas. The projects are currently at different stages – some are funded and underway, others require further scoping work to determine whether they should be taken forward, and how. All have the engagement of the relevant partners, but some need to be explored further before those partners can commit to delivery.

The aim of this strategy is to set out the capability London has to develop projects addressing the diverse resilience issues of the city. This work does not finish once the strategy has been published; this strategy is the first stage in an ongoing process of developing opportunities to build resilience across London.

### How to read London Resilience Strategy Projects

Projects have been divided up into three sections: People, Place and Process. Each section provides an explanation of why a focus on this area is central to resilience.

Each project description explains why we believe the work should be undertaken, what we intend to do and how we intend to do it. It identifies key shocks and stresses, and the resilience value of completing the project.

Projects are at different stages of development, and we have stated wherever possible intended completion dates. Where a project has been funded this has been indicated; where not indicated further work is required to determine whether and how the project should be taken forward, and whether support should be sought from external partners.

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<sup>14</sup> An analysis of how existing GLA policy contributes to building resilience in London has been carried out as part of the Preliminary Resilience Assessment work and can be found in the GLA website.

## Resilience Projects: People

The next section of this document focuses on a number of projects aimed at promoting and supporting community resilience building and preparing communities for disruptive events.

Supporting community resilience is a Mayoral priority, and many initiatives already exist in London to support community capacity building and promote good mental health, to increase personal resilience.

Like many large cities, London is a city of opposites. It suffers from socioeconomic inequality, which poses a threat to social integration. And because of rising housing costs, decreasing job security and economic upheaval, more Londoners are becoming vulnerable to poverty. Threats to social integration, increasing inequality and associated vulnerability mean London will be less able to cope with shocks and stresses, as marginalised Londoners are less likely to be equipped to cope with disruptions or disruptive change.

Years of austerity have hit key public services hard. This has had an impact on the resilience of some of London's communities<sup>15</sup>, having a disproportionate effect on the vulnerable, increasing social exclusion, narrowing opportunities to maintain health and wellbeing, and decreasing social mobility. It has also created a vicious cycle, adding pressure on already scarce public resources. This is, and will remain, a resilience issue for the capital, as the most vulnerable are liable to experience more stresses, and are less able to cope with disruptions or disruptive change<sup>16</sup>.

As seen in the aftermath of Hurricane Katrina, the support networks generated by communities make cities more resilient, and more capable of managing major shocks, through strengthening links within and between communities and building networks amongst friends and connections that are critical, especially during disruption.<sup>17</sup>

By supporting communities to become resilient, we can improve London's overall resilience.

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<sup>15</sup> Centre for Cities (2019)

<sup>16</sup> GLA (2019)

<sup>17</sup> RAND (2015)

## Action A1: First Aid

### Provide first aid education to Londoners, enabling resilience and preparedness in an emergency

#### Why

Traditionally, emergency management has not included much involvement from members of the public. However, members of the public are frequently first on the scene in the event of an emergency, and assistance from the public before the arrival of emergency services can be a valuable resource. Without training, people may lack the confidence to step forward during an emergency, as they are unaware of how to help. Individuals who are equipped with first aid skills are better positioned to deal with an emergency at home or in any other situation. This can save lives.

First aid is a valuable skill. By training members of the public in first aid, they are empowered to take action and can potentially save lives when the situation arises.

#### What

This project seeks to promote the value of first aid education and make provision for it as part of responding to traumatic events. First aid education can cover a broad spectrum of skills useful in an emergency, including dealing with choking, burns, wounds, cardiac arrest, resuscitation or stabbing.

The British Red Cross has experience in running training sessions for young people and community groups. By delivering first aid education, people would gain the skills, willingness and confidence to act if they encounter a situation in which they could save a life – without putting themselves in danger - in the event of an injury to a friend, family member or member of the public.

The project aims to identify where the need is greatest for first aid, and whether there are specific at-risk groups who would benefit from training. This will help develop the content and delivery mechanisms for a training programme.

#### Lead

British Red Cross

#### Partners

NHS England, Local Authorities, London Resilience Group, GLA

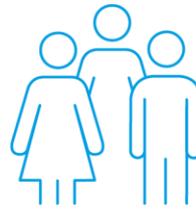
#### Funding

Funding requirements are being explored

#### Timeline

Short-term: Research and development of delivery model

Medium-term: Start full roll out of the training in 2021

**SHOCK AND STRESSES****Lack of cohesion****RESILIENCE VALUE****Communities****How**

The first stage will involve research to identify training needs and target groups. This is likely to include some pilot projects and will cover work with community and volunteer groups on content and communications mechanisms. From this data, a first-aid education programme will be developed.

In parallel, this project aims to promote the value of first aid education, including by volunteers, and identify effective ways of communicating this to Londoners. This work will, in part, be coproduced by community groups, young people, health organisations with specific specialisms (for example the British Heart Foundation). GLA will promote the value of this initiative.

**Case Study: First Aid in Paris**

After the November 2015 attacks thousands of Parisians requested first aid training so they would know how to respond in the event of an emergency. It is estimated that if 20 percent of French citizens received basic emergency response skills, 10,000 lives could be saved each year. In response, the City of Paris has developed the 'Paris qui Sauve' (Paris Saves) programme. Paris now intends to expand the scheme by increasing the number of defibrillators in public spaces, expanding first aid training and furthering education on health and environmental risks including major climactic events.

The objective is to have 90 percent of Parisians trained in first aid by 2030.

## Action A2: Extreme Heat Management

### Establish a network of cool spots to help Londoners deal with high temperatures during summer heatwaves

#### Why

The frequency and severity of hot weather and heatwaves in London is projected to increase. London's average summer temperatures are predicted to keep rising and we are likely to experience hotter, drier summers and warmer, wetter winters.

By the middle of this century we can expect our climate to resemble that of Barcelona, with average summertime temperatures approximately 3°C higher than at present<sup>18</sup>, and what we currently think of as heatwaves to occur most summers. This will affect the way we go about life in the capital as London also generates its own microclimate - known as the Urban Heat Island - which can result in the centre of London being up to 10°C warmer than rural areas around the city. Summer heatwaves compromise Londoners' quality of life, making homes, workplaces, and public transport uncomfortable. They also pose a threat to life for those individuals who are more susceptible to the impacts of extreme heat.

#### What

This project seeks to establish a network of cool spots across the city that are accessible to all Londoners.

During summer heatwaves, there is a need for spaces in the city where members of the public can rest from the heat, cool down and access water. This complements the Mayor's partnership with Thames Water to install a network of more than 100 drinking fountains across London.

#### Lead

Public Health England (PHE), GLA

#### Partners

London Resilience Group (LRG), Boroughs and Borough Resilience Forums, London Climate Change Partnership, Business Improvement Districts, the Third Sector and the London Interfaith Network

#### Funding

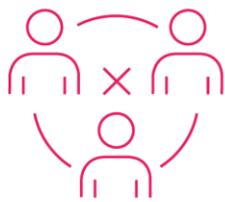
This project will be developed using existing GLA and PHE resources

#### Timeline

Immediate: Planning underway to establish an initial network of cool spots by April 2020

Medium-term: Development of extended public communications plans for the network by 2021

<sup>18</sup> Harvey (2019)

**SHOCK AND STRESSES****Lack of cohesion****Extreme weather****RESILIENCE VALUE****Communities****Infrastructure and environment****How**

This project aims to establish publicly available cool spots across the capital. These could include green spaces such as wooded areas or parks or areas designed to receive members of the public, such as retail outlets, museums or places of worship.

In addition to identifying specific spaces, communications will be required to inform Londoners about the locations of, and access to designated spaces, plus tips on keeping cool. The project will explore innovative ways of communicating this information.

**Case Study: Heatwave plans in European Cities**

By 2020, the goal is for all Parisians to be within a 7-minute walk of a cool island. The City of Paris has been working collaboratively to identify, create, and inform the public about the “cool islands and routes” that are available every summer. Plans include parks staying open 24 hours, swimming pools extending opening times, some arrondissements opening special air-conditioned rooms, and additional public drinking water points being set up.

Similarly, cities such as Athens, Rotterdam, Milan and Lisbon have also taken action to advise and protect citizens from the risks of heat. These cities have worked with Extrema, an app platform that is an emergency notification system for extreme temperatures, to develop interactive apps and websites with live information to show users where they can escape the heat, and provide advice on what actions to take in hot weather.

## Action A3: Using Water Sustainably

### Promote ways of decreasing water wastage

#### Why

Contrary to its international reputation as a rainy city, London is prone to drought after only two dry winters. By 2020 London is forecast to have a water resource gap of over 100 mega-litres per day, rising to a deficit of over 400 mega-litres per day by 2040<sup>19</sup>. To make London's water use more sustainable, different ways of reducing potable water consumption and water wastage should be explored.

The London Environment Strategy contains a suite of proposals aimed at 'ensuring efficient, secure, resilient, and affordable water supplies for Londoners'<sup>20</sup>. This includes holding water companies to account over leakage and water mains repair, promoting metering, supporting water saving through GLA retrofit programmes, promoting an integrated water management approach in key growth areas, and London Plan policies requiring water efficiency in new developments.

Water companies operating in London undertake critical work to reduce water consumption, fixing leaks, supporting adoption of smart metering and promoting water saving solutions. They are responsible for managing water systems, and promoting efficiency measures.

Despite existing initiatives, increasing the participation in water efficiency initiatives and getting organisations to implement water saving measures at a faster rate is challenging.

#### Lead

GLA, LRP, Thames Water

#### Partners

LRP Water Group (including the Environment Agency and other water companies)

#### Funding

Resources and necessary funding provided by water companies

#### Timeline

Short-term: Launch collaboration to promote trial programme with partner organisations

Medium-term: Explore options to scale-up; explore feasibility of public awareness-raising

<sup>19</sup> GLA (2018) – London Environment Strategy Evidence Base

<sup>20</sup> GLA (2018)

**What**

This project aims to explore collaborative ways of promoting water saving measures, building on existing programmes and initiatives with stakeholders.

This project involves collaboration between the London Resilience Partnership (LRP), which manages drought communications plans, and other networks to understand what water saving actions are being implemented by partner organisations. This will support the development of a targeted approach to improve the uptake of water saving measures, in collaboration with Thames Water.

By targeting existing resources and stakeholders, this project will promote water saving initiatives and learn lessons for scaling up. This project will provide data on the feasibility of wider public awareness initiatives that promote actions to help manage water scarcity, and inform the LRP emergency plans for drought communications.

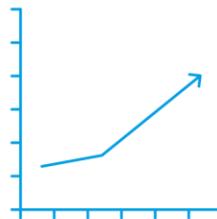
**SHOCK AND STRESSES**

**Drought**



**RESILIENCE VALUE**

**Good Growth**



**Infrastructure and environment**



## How

This project will review what initiatives partner organisations have put in place, and identify the main barriers to further uptake of water-saving measures. This will help develop effective and targeted methods of communication with stakeholder organisations.

The intention is to develop a targeted trial programme for water improvement in selected organisations with Thames Water, and engage with partner organisations throughout the process to monitor progress and report results. We will use lessons from the trial to develop better targeted policies, including potential scale ups that will allow us to move towards communicating larger scale water efficiency initiatives.

### **Case Study: 'Day Zero' - Cape Town's response to severe drought**

Following three consecutive years of poor rainfall, Cape Town faced a severe water crisis. In January 2018, officials announced that the city of 4 million people was three months away from running out of water, and labelled the 12 April as 'Day Zero'. This resulted in a campaign aimed at averting the crisis, involving public awareness initiatives including publishing photos of parched-earth dams, increasing water tariffs, restricting non-essential water consumption and implementing a new water-pressure system.

Central to the campaign was the use of data to raise public awareness, including a city-wide water map showing water consumption on a household level, that allowed locals to compare their consumption to that of their neighbours and the rest of the city. Water-saving techniques were widely advertised and businesses, prompted by new water tariffs, increased efforts to communicate the need to save water to customers and employees.

By the end of March 2018, the emergency efforts had provided a small additional buffer in the city's water reserves, allowing city officials to first push back and then eventually call off Day Zero. Cape Town continues to promote sustainable water use, and raise public awareness of drought risk. Average public consumption of water is now significantly lower than before the crisis, demonstrating that the Day Zero campaign has facilitated behavioural change.

There are many lessons to be learned from Cape Town's water crisis. Strong governance, good public communication and awareness raising activity, and a multi-stakeholder response are critical to managing extreme drought.

## Action A4: Food Security

### Mitigate food insecurity by understanding London's food supply and the impacts of its disruption

#### Why

All Londoners should be able to eat healthy, affordable food, no matter where they live, their personal circumstances or their income. However, data<sup>21</sup> show that 1.5 million adults and 400,000 children in London have low or very low food security - with inadequate access to food due to resource constraints. Food insecurity is a facet of broader poverty: of low pay, a punitive benefits regime and high housing costs in London.

London's food supply chains are amongst the most efficient in the world, relying on a complex set of interdependencies and just-in-time delivery systems. This efficiency has consequences for resilience, as disruption of food supply is likely to disproportionately affect the food security of already vulnerable Londoners.

In December 2018 the Governor of the Bank of England, Mark Carney, stated that a disorderly or no-deal Brexit scenario could lead to an increase in food costs of between 6 and 10 percent. Any disruption to supply chains could have similar effects - exacerbating food insecurity and making more Londoners vulnerable. It could also threaten the food support programmes that vulnerable Londoners rely on.

No-deal Brexit planning prompted London to explore the likely impacts of food supply disruption more generally, and consider the effectiveness of existing governance, policies, and programmes to mitigate the risk. This work will be used to inform wider resilience efforts for food, including where it intersects with efforts on climate change adaptation.

#### Lead GLA

#### Partners

LRP, London Climate Change Partnership, Defra, DWP, MHCLG, London Food Board, London boroughs, Food Foundation, Sustainable Food Cities network, FareShare, Trussell Trust

#### Funding

Funding secured for 2019/20; future funding to be secured for ongoing work

#### Timeline

Short-term: Promote food insecurity evidence to boroughs

Medium-term: Develop local food insecurity data; promote the role of peri-urban farms

<sup>21</sup> City Intelligence (2019)

**What**

The London Resilience Partnership’s Brexit working group for food has developed modelling showing a timeline of impact on different parts of the food system resulting from disruption to the supply of fresh food to the UK. This data will help develop a strategy for lobbying central government to improve London’s food system resilience.

It will also support the development of more resilient food systems for London, by providing a wide-ranging evidence base of food system insecurity, and demonstrating the need for increasing food growing in the capital.

This data will be used to develop measures to address risks to vulnerable populations and to promote evidence of food insecurity to local authorities and other organisations involved in protecting vulnerable Londoners.

**SHOCK AND STRESSES**

**RESILIENCE VALUE**

**Infrastructure failure**

**Communities**



**Food insecurity**

**Governance**



## How

This project aims to promote evidence of food insecurity and potential disruption to existing local authority networks to inform local interventions, and support London boroughs to target local initiatives.

Further research on food security for vulnerable Londoners will be launched to identify priority interventions that increase resilience. This will focus on points such as wholesale and street markets, and the regional chains supplying healthy, affordable food to vulnerable Londoners. Evidence collected from this will inform policy on resilience by researching the potential for farms around London to sell produce to vulnerable Londoners, including via community trading models.

### **Case study: London Resilience Partnership work on food resilience**

No-deal Brexit planning assumptions (provided through Operation Yellowhammer documents) indicated there could be severe disruptions to the food supply chain. To understand the impacts on London, the London Resilience Partnership established a working group to clarify how London's population is supplied with food, primarily focusing on fresh food supply.

Through a series of workshops, food supply chains and their interdependencies and vulnerabilities were mapped from port to plate. This included an analysis of the impact and consequences of food disruption throughout the distribution system and the effects on retailers, markets and households.

This work has demonstrated the complexity of London's food network, in the context of an equally complicated national food supply system that has developed to its current status over many decades through international (predominantly European) free trade and market forces – to rely on rapid cross border delivery to manage supply and demand through just in time delivery.

Further work is necessary to develop more resilience to disruption from within this system, including at a national level. In London we will use this work to develop our work on food insecurity and identify specific areas where resilience can be built from within the capital.

## Action A5: Community Risk Communication

### Build resilience in communities by developing ways of communicating risks to the public

#### Why

The types of risks Londoners face are often dependent on location. This means there is value in providing bespoke local risk communication. The risk landscape in London is constantly changing, so local and community risk communication is most effective as a dynamic and evolving process, that harnesses existing community networks.

If communities in London understand the risks they may be susceptible to, they can then begin to build resilience to that risk within their area. Providing the public with information about the risks they face, advising on what provisions are being made by responder organisations, and sharing information about how individuals and communities can prepare to respond to these risks, can improve resilience.

#### What

London has a well-established and engaged London Risk Advisory Group that brings together subject matter experts across the London Resilience Partnership (LRP) to assess risk thoroughly. The group takes guidance from the National Security Risk Assessment to inform the London Risk Register, which is published annually on London.gov.uk.

The London Risk Register is the first step to informing the public of the risks that impact the city as a whole. This could be developed into an easily digestible, user-friendly and informative format. An existing channel for this information is the London Prepared website, hosted by the GLA – by increasing the website’s presence on social media it will be possible to expand public communications on local risk. A more formal approach to risk communication in London can then be established. At present different agencies own different risk communication responsibilities: once this is overseen by an LRP-wide approach, it will be possible to ensure collective support for communications, extend the reach of messaging and identify where gaps may exist.

#### Lead

London Risk Advisory Group, London Community Resilience Sub-Group

#### Partners

London Resilience Communications Group, other LRFs, potential academic partners to be confirmed

#### Funding

Funding models to be determined during project scoping phase

#### Timeline

Medium-term: Public facing risk communication - 2020-21; implement risk communication programme - 2021-22

## SHOCKS AND STRESSES

Infrastructure failure



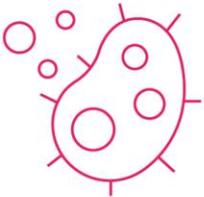
Flooding



Extreme weather



Disease pandemic



Drought

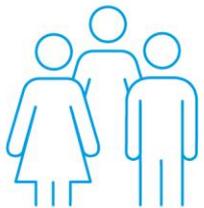


Terror attack



## RESILIENCE VALUE

Community



Governance



## How

This project seeks to develop a risk communication programme that reviews and explores leading practice, perception and effectiveness of public risk communication. It will include determining organisational responsibilities for specific risk communication from within London and nationally (e.g. Catch it, Bin it, Kill it or Run Hide Tell) and appropriate ways of communicating to Londoners and London's diverse communities. This project also aims to develop active ways of communicating at a local level through a London Community Resilience week event, in partnership with Boroughs and others.

### **Case Study: Risk communication in Scotland**

Scotland's Community Risk Registers (CRR) are used to inform the public of risks in their area, in a user-friendly way. CRRs are multi-agency publications developed by Scottish Regional Resilience Partnerships. They are published locally and highlight risks that have the highest likelihood and potential to cause disruption. The short documents are aimed at informing businesses, organisations and the public, and provide links to websites with further information.

The documents identify a number of potential local risks and their consequences, describing how they could affect the region. They describe and encourage measures that individuals, communities and businesses can take to support themselves in case of an emergency.

## Action A6. Scenario Planning and Theatre

### Use culture and theatre to collectively prepare for emergencies

#### Why

Scenario planning and training exercises is a major part of emergency preparedness. Exercises aim to test and to improve emergency plans, and prepare responders to deal with any incidents that may occur. Exercises are standard practice for many organisations, including the London Resilience Partnership, as they build resilience through developing experience in emergency preparedness.

They can range from desktop run-throughs to train people on emergency protocols to live multi-agency simulations of a response to a major incident. Exercising prepares people by helping them understand what they need to do when things go wrong, so they can be ready to act, should the worst happen. This helps people and organisations prepare logistical and mental resilience. This is an opportunity to explore new and engaging ways to carry out exercising in London.

#### Lead

GLA

#### Partners

To be scoped

#### Funding

Requirements to be scoped

#### Timeline

Medium-term: Identify producers and advisers to develop a cultural experience

#### What

Because exercises are valuable in helping manage shocks in the capital, this project aims to explore how emergency responders can use immersive theatre to inform scenario planning and involve the public in readiness exercises. This project aims expand training exercises using the capital's world-renowned expertise in immersive theatre and include an opportunity for involving a public role in preparing for shocks. This will give responders the opportunity to involve Londoners in emergency scenario practice and learn from the public. It would not replace critical emergency response activity, but complement existing work and develop it in new ways.

#### How

Planning and organising training exercises is time consuming and costly for emergency responders. However, London has a dynamic theatre scene and is regarded as the world leader in immersive theatre. The aim of this project is to collaborate with a theatre company to co-develop scenario planning exercises with responders that involve members of the public, and in doing so pioneer new approaches to building resilience.

## SHOCKS AND STRESSES

Infrastructure failure



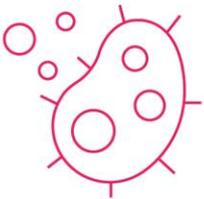
Flooding



Extreme weather



Disease pandemic



Drought

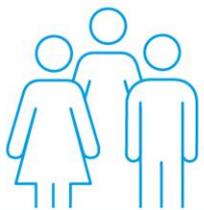


Terror attack



## RESILIENCE VALUE

Community



Governance



## Resilience Projects: Place

The next section focuses on projects that develop environmental resilience, and resilient infrastructure for Londoners, looking at the long-term sustainable use of resources. London relies on environmental and infrastructure resilience not just to function, but to be a liveable city.

Developing robust resilience measures requires working collaboratively and adding value across different policy areas – using data, infrastructure, digitisation and planning to improve our environment, pursue climate change mitigation, and identify innovative opportunities to manage stresses.

London's climate is changing. Average temperatures are set to rise in the coming decades, and more extreme weather events are expected. London is at increasing risk of drought and heatwaves, while also being likely to experience more extreme rainfall, violent storms and localised flooding. The Thames, as a tidal river, is also vulnerable to rising sea levels.

Responding to the climate emergency means increasing efforts to reduce carbon emissions and becoming more sustainable, cleaner and greener. Doing so at pace involves overcoming big challenges, and requires close collaboration with infrastructure providers and others to prepare for the changes we need to be resilient.

Much of London's built environment was designed for a previous era - our buildings and infrastructure are not necessarily designed for extreme weather or high population density.

But work is already underway to improve ageing infrastructure. The Thames Tideway Tunnel is being constructed to remove pressure from London's Victorian sewerage infrastructure, and prevent the Thames being polluted during heavy rainfall when sewers overflow. Transport for London continues to develop its plans to improve and expand the transport network in London to cope effectively with population growth. The Ultra Low Emission Zone has achieved considerable success in infrastructure resilience, decreasing toxic vehicle emissions and making the air cleaner, thereby helping to improve health of Londoners. These benefits will increase when it is expanded to the whole of inner London in 2021.

As our capital grows, we must find ways of making the most of our place and space, and ways of supporting creative uses of space to open up community and economic opportunities.

## Action B1: Integrated Circular Water Systems

### Improve London's underlying water systems to increase water recycling

#### Why

The London Environment Strategy sets out the current and future threats to London's water systems. London lies in the driest part of the United Kingdom and is at risk of drought when reservoirs and groundwater aquifers are not refilled through regular rainfall. With a growing population, increased urban density, aging infrastructure and climate change, London's water deficit is anticipated to get worse.

To serve the population within existing resources and reduce the stress on limited water supplies, we need to reduce demand on potable water and avoid the need for carbon-intensive new water resources, such as desalination. Increasing water reuse significantly reduces demand and consumption of potable water. This reduces waste and means water that would otherwise become waste or cause flooding can be used.

Existing policies within the London Plan require the prioritisation of water reuse options as part of a drainage hierarchy, however, uptake of water recycling systems remains low, meaning barriers preventing widespread uptake of integrated, circular water systems must be overcome. If we are to raise awareness effectively among Londoners about the importance of using water sustainably (in action A3) due to the risk of drought, London's infrastructure must equally use and reuse water with optimal efficiency and sustainability.

#### What

Targeted investment for demand management, including water efficiency, leakage and metering, plus planning for new sustainable water supply infrastructure is vital to meet long term needs. These measures alone are unlikely to be enough to meet London's water challenges so a more integrated and circular approach is required to become resilient.

#### Lead

GLA

#### Partners

Members of the Mayor's Water Advisory Group (WAG) - Task and Finish Group

#### Funding

Approach and scoping funded through existing budgets; additional funding requirements to be identified during scoping process

#### Timeline

Short-term: Identify enabling projects; scope project delivery

Medium/long-term: Develop selected projects; implement policy identified; develop financing models

The technology and innovation to recycle water from multiple sources already exists. The challenge is to identify at what scale they should be deployed - and what policy, governance, financing, education or other mechanisms are needed to transform the way London manages water. Circular water reuse approaches also help reduce demand and create new supply at a more local and distributed scale, increasing resilience to drought.

## How

The Mayor's Water Advisory Group has recognised water reuse as a key issue in need of further investigation. A Task and Finish Group has been created to look into potential actions available to increase water reuse in London.

This project will focus on identifying initiatives likely to increase water reuse. These may include investigating the suitability of rainwater, greywater and reclaimed wastewater reuse technology, the scale at which such technology should be encouraged, clarifying if additional planning policy, guidance or regulatory change is necessary, and identifying means of incentivising investment.

### **Case Study: San Francisco, USA – Changing policy to mandate reuse**

San Francisco has increased the uptake of water reuse systems by introducing policy to mandate their use. In 1991 the City of San Francisco required property owners to install recycled water systems in new construction and modification projects to maximise water reuse in designated areas. Property owners were required to install dual plumbing for recycled water use for new developments of over 40,000 square feet, any major alterations to large structures, or new and existing irrigated areas of 10,000 square feet or more.

In July 2015, it became a mandatory requirement for all new development projects of 250,000 square feet or more to install and operate an onsite non-potable water system to treat and reuse available greywater, rainwater, and foundation drainage for toilet or urinal flushing and irrigation purposes. This was achieved by adding an article to the San Francisco Health Code.

To date, these policies have enabled the offset of 89 million gallons per year of potable water.

**SHOCK AND STRESSES**

**Drought**

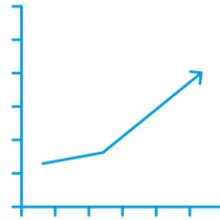


**Flooding**



**RESILIENCE VALUE**

**Good Growth**



**Infrastructure and environment**



## Action B2: Encouraging Meanwhile Space

### Scope the development of a framework for Meanwhile Use in London

#### Why

London has many vacant, forgotten and underused spaces spread across the capital, which we describe as meanwhile spaces. Over the last few years, there has been an increase in meanwhile use projects that occupy vacant land or property for a short timeframe, before another permanent use. This increase reflects several changes and trends in the city from soaring land prices through to changes in consumer behaviours. These spaces can have an important role to play in making London resilient and in addressing some of the city's pressing challenges. Our aim is to explore what role the GLA can play in facilitating the activation of these spaces.

**Lead**

GLA

**Partners**

Boroughs

**Funding**

Research funding secured

**Timeline**

Immediate: Develop opportunities identified during research phase

Meanwhile use interventions can take many forms, from temporary community and recreational activities, to arts, culture and commercial uses. Using spaces in this way can ensure that assets are continuously contributing to the communities around them by facilitating the human connections that build community resilience. Although the physical use of space is temporary, these projects can promote long-lasting economic and social benefits to local communities.

#### What

This project aims to explore the challenges and opportunities to develop a framework for initiating, planning and activating London's vacant and underused spaces we can bring multiple benefits to Londoners. This could be in the form of creating community spaces that align with wider Mayoral objectives such as improving air quality, climate change adaptation, employment, culture, night time economy and more, as well as the Good Growth by Design programme.

The objective is to identify actions that the GLA and London boroughs could take to facilitate meanwhile use, either themselves or through partnership working. Actions may include policy development, digital products, competitions or other means to support meanwhile use.

Policy on the meanwhile use of vacant space is closely linked to policy on the underuse and reactivation of existing public spaces – including community buildings, outside space and other public assets. As work in this area develops, this project will explore possibilities for increasing the use of community spaces more widely.

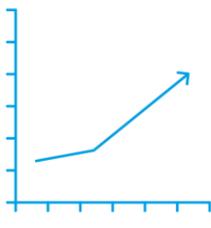
## SHOCKS AND STRESSES

### Lack of Social Cohesion



## RESILIENCE VALUE

### Good growth



### Infrastructure and environment



### Governance



## How

As part of this project a report has been commissioned that includes research on supply, demand and barriers to activation of meanwhile space. Based on the research, case studies and recommendations of this report we will review opportunities to support and facilitate greater levels of positive meanwhile use in London.

## Action B3: Data to Solve Civic Challenges

### Develop common standards and support for responsible data sharing and joined up data for London

#### Why

London's data plays a critical role in achieving resilience outcomes. The London Datastore, the city's central register of open and secure data, supports public agencies and institutions to solve some of the most complex urban challenges faced by Londoners: like poor air quality, housing and inequality.

Many public services and regulated utilities have developed their own approach for data to aid service design and infrastructure. This has led to fragmentation and friction when trying to capture the big picture. With the growth of data from sensors and emerging technologies the city needs to ensure that data can be mobilised to solve civic problems and stored and shared securely.

#### Lead GLA

#### Partners

Open Data Institute, London Office of Technology & Innovation

#### Funding

Funding allocated from GLA budgets

#### Timeline

Immediate: Developing data-sharing initiatives

Medium-term: New Data store; vision for joined-up data for London

#### What

Data-sharing between public agencies and utilities should be focused on maximising public value while minimising potential harmful impact. As part of the Smarter London Together Roadmap, the Chief Digital Officer is developing an approach which emphasises common standards and support for responsible data-sharing.

## SHOCKS AND STRESSES

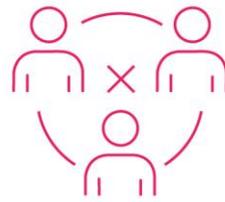
Infrastructure failure



Flooding



Lack of social integration



Drought



## RESILIENCE VALUE

Community



Governance



Infrastructure and environment



## How we use data

**Better evidence base** - By informing policy development from existing data sets we can determine patterns and predict future outcomes and trends to inform policy development. The public then benefits through improved public services and better outcomes from policies that affect them.

**Visualisation** – This often also involves building a tool, such as an interactive map, to help users explore the data gathered from different agencies or make comparisons.

**Transparency** - Publishing data to allow the public to hold public bodies to account; and for public bodies to justify their decisions and earn the public's trust.

**Access to services** - Providing data to the public to improve access to public services, for example search tools to link people with the information they need.

**Third party innovation** - Data used by third parties for innovation, for an example an API allowing the developer community to create new products and services to help passengers better plan their journeys on public transport from real-time data streams.

## How

The GLA is working with the Open Data Institute on the next version of the Datastore and there are a significant number of data-sharing initiatives currently underway, including NHS One London care record and London Office of Technology & Innovation's responsible data-sharing code.

The findings of the discovery will inform work on the new Datastore and create a vision for joined-up data for London.

## Action B4: Cyber Emergency Response Capability

### Improve London's ability to respond to the consequences of a cyber emergency

#### Why

London is a world-leading tech hub and Europe's largest cyber hub. Through the London Resilience Partnership, the GLA has a key role in setting the standards for cyber security in London, including coordinating the support and knowledge-sharing required by public agencies to become more resilient.

2019 saw an increase in global ransomware attacks, with a particular focus on cities – a risk predicted to increase. For London's citizens to benefit from digital transformation, all of London's public services must be cyber secure.

A national cyber emergency is defined as a 'cyber attack which causes sustained disruption of UK essential services or affects UK national security, leading to severe economic or social consequences or to loss of life'<sup>22</sup>. London must have coordinated multiagency cyber response plans to respond to the consequences of cyber emergencies.

#### What

A number of projects to build cyber resilience in London will be set out in the cyber security action plan for London that is being developed by London's Chief Digital Officer. To support the roll out of these projects a coherent and rehearsed cyber response capability should be in place for London.

The London Cyber Incident Framework was agreed by the London Resilience Partnership in 2019. The framework sets out how the Partnership will provide a response to the wider

#### Lead

London Resilience Group, GLA

#### Partners

London Resilience Partnership, MHCLG

#### Funding

Funding requirements and sources to be determined during project scoping phase

#### Timeline

Immediate: Implement incident response framework

Medium-term: Develop comprehensive cyber emergency response capability

<sup>22</sup> NCSC (2018)

consequences of a cyber emergency and covers multiagency consequence management protecting human welfare and the ensuring the delivery of critical public services - not technical ICT solutions to an attack.

The Partnership will now focus on developing its collective emergency response capability by training sufficient specialists to respond to a cyber emergency, developing the infrastructure and equipment to support a collective response, identifying the data required to inform the response, and testing response arrangements through exercises.

The Counter Terrorism Preparedness Network (CTPN) (see action C1), led by London Resilience, has identified research into cyber terrorism as a priority for 2020/21. This work will inform the future development of London's cyber emergency response capability.

## SHOCK AND STRESSES

### Cyber attack



## RESILIENCE VALUE

### Governance



### Infrastructure and environment



## How

This project aims to implement a cyber incident response framework for London and improve current response capabilities. This will involve improving understanding of the cyber threat and developing the cyber incident response framework into a tried and tested capability. The project will explore opportunities to improve London's incident response framework by sharing good practice with other cities and implementing lessons from other responders, city experts and international partners.

### **Case Study: Atlanta's Cyber Attack**

On 22 March 2018, the city of Atlanta suffered what is considered to be the largest and most expensive ransomware attack on a city government to date. Ransomware is a type of malicious software designed to block access to a computer system until a sum of money is paid. Many devices at Atlanta's City Hall were locked down, affecting law enforcement and the Atlanta Municipal Court shut-down payment systems for tickets, water bills, and business licenses and renewals, online and in person.

A multiagency response, including city officials, FBI, Homeland Security and private sector experts worked to protect the digital infrastructure and neutralise the threat. Regular updates were issued to citizens through social media, and a dedicated news website was set up. Despite all this, the closure continued for around five days.

The ransom demanded was approximately \$50,000, a sum the city declined to pay. The cost to the city in emergency response measures was estimated in excess of \$2.6 million, and highlights the importance of having robust response systems in place, but only as part of a whole ecosystem of digital security measures.

## Action B5: Innovative data use for infrastructure

### Improve the resilience of London's infrastructure systems and prioritise investment through the use of data

#### Why

London's infrastructure networks are increasingly complex and interlinked. These systems rely on digital, electrical and physical connections to function properly. A disruption to one network can produce far-reaching and unanticipated domino effects.

In August 2019 a major power outage affecting parts of London resulted in severe disruption to trains, the Underground and roads, and caused a brief loss of water provision to 3,000 homes. Failures in water supply, flood protection network or transport system could have similarly diverse impacts.

Protecting the infrastructure that keeps London moving means understanding how it links together and how its failure could affect Londoners. Improved knowledge of the condition and performance of infrastructure assets may also help us to predict and prevent failures. Collectively, this information can help to prioritise investment towards the interventions that will have the most significant impact on building the resilience of London's infrastructure.

**Lead**  
GLA

**Partners**  
Infrastructure providers, regulators, government departments, other public bodies

**Funding**  
Immediate work funded through existing GLA budgets; opportunities for additional financial support to be explored

**Timeline**  
Immediate: Engagement with infrastructure providers, identification of priorities  
Medium to long-term: Development and application of modelling tools and technology

## SHOCKS AND STRESSES

Infrastructure failure



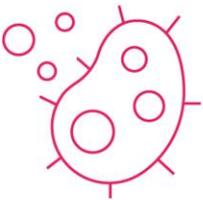
Flooding



Extreme weather



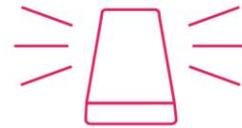
Disease pandemic



Drought



Terror attack



## RESILIENCE VALUE

Community



Governance



## **What**

This project aims to use data innovation to facilitate more effective action. By identifying and compiling the data that already exists, it is possible to generate previously out of reach insights to inform decision-making on infrastructure in London. For example, integrated data on infrastructure interdependencies and asset health, allows GLA to work with infrastructure providers to identify where investment should be prioritised to reduce London's vulnerability. Infrastructure partners and experts have explicitly stated that this kind of support is required to deliver resilience.

## **How**

This project aims to build on existing cross-sectoral work on data innovation, including the London Resilience Partnership Anytown project mapping cascading failures and infrastructure interdependencies, to improve the ability to monitor the health of infrastructure assets, assess interdependencies and identify priority investment areas for building resilience.

By engaging infrastructure providers to support a focus on prioritising relevant investment areas, this project will also review opportunities to monitor the condition of high priority utility assets and explore applications of modelling tools and technology to process data and provide decision support.

## Action B6: Resilient & Zero Carbon Infrastructure

### Identify practical steps to achieve ambitions for a sustainable London

#### Why

In declaring a Climate Emergency, the Mayor recognised the urgent need to meet London's zero carbon objectives and build its resilience to the impacts of climate change.

London's infrastructure is central to this transition. Transforming and strengthening the city's water, energy, transport and flood protection systems requires investment and action over the coming decades. The steady growth of London's population makes this task more difficult.

Policies in the Draft London Plan, and strategies on transport, housing and the environment set out our approach to ensure that the infrastructure sector responds to the Climate Emergency. However, there are practical challenges to delivery.

Determining the best way to decarbonise or develop climate resilience can be challenging. Guidance is required for infrastructure providers to turn routine activities, such as digging up the road to repair assets, into opportunities to further these objectives. Organisations must work together to deliver investment at pace, but collaboration can be challenging.

#### What

This project aims to maximise the use of available tools to deliver resilient infrastructure compatible with a zero carbon future. It will clarify what is expected of stakeholders and introduce new measures and guidance to make resilience and carbon reduction central considerations in every infrastructure decision in London. The project will build on action facilitating infrastructure coordination to encourage joint working on climate solutions, and explore how innovative funding and regulatory change can accelerate implementation.

#### Lead

GLA

#### Partners

Utilities organisations, Infrastructure Group of industry CEOs

#### Funding

Secured through existing GLA budgets and partner organisations

#### Timeline

Immediate: Incorporate resilience and carbon reduction measures into the infrastructure coordination programme

Medium-term: Develop new frameworks, tools and guidance for infrastructure providers

**How**

This project aims to integrate climate sustainability and resilience objectives into the Mayor’s infrastructure coordination programme by facilitating cross-sector collaboration on climate solutions and enabling investment in resilience while ensuring services remain affordable to Londoners.

By completing a gap analysis of the spatial planning system, the project will identify the guidance required to deliver resilience and decarbonisation, and develop frameworks, tools and recommendations to assist decision-making by infrastructure providers, Local Authorities and others to integrate delivery of climate solutions into routine interventions and investment programmes.

**SHOCK AND STRESSES**

**Aging infrastructure**



**RESILIENCE VALUE**

**Governance**



**Infrastructure and environment**



**Case study: Planning for growth on the Isle of Dogs**

The Mayor's Infrastructure Coordination Team has partnered with the London Borough of Tower Hamlets to trial improved planning methods for the infrastructure requirements needed for the large-scale development in the Isle of Dogs and South Poplar.

Central to this work is the development of an integrated water management strategy for the area. This will consider how to manage future needs for clean water, sewage, and surface water drainage. Subsequent strategies will address plans for meeting the area's energy needs and securing digital connectivity infrastructure. This approach will integrate the physical infrastructure required to support growth, local planning and placemaking objectives. Resilience and decarbonisation are central considerations in these strategies at both planning and implementation stages.

## Action B7: Safe, Resilient Homes & Buildings

### Transform our existing housing stock to prioritise safety

#### Why

Londoners should feel safe and secure in their homes, and London's buildings should be designed and fitted to ensure safety is treated as a priority. Safety is important to all buildings, especially residential buildings and those that are home to vulnerable people.

In the past year, there were 5,215 fires in Londoners' homes, 1,782 fires in non-domestic buildings and 341 fires in care homes or other specialist housing for older people. On average 920 people are injured and 50 people die in fires in London every year<sup>23</sup>.

#### What

High safety standards should be applied to all new buildings. The law must change to deliver homes that are as safe from fire as they can be. Combustible cladding and combustible wall systems should not be legal on any new building regardless of height or use. Automatic fire suppression systems should be standard in new residential buildings, especially in homes to vulnerable communities, such as care homes or schools.

Londoners' homes should be protected through an inspection and enforcement regime - local authorities and the London Fire Brigade should be given the necessary powers and resources to deliver this.

Retrofitting can be a means of increasing the safety, security and resilience of buildings in multiple ways. Making safety improvements is an opportunity to explore ways of improving both security to non-fire threats and sustainability by identifying efficiency savings (such as energy or water) and addressing zero-carbon objectives.

#### Lead

GLA and London Fire Brigade

#### Partners

Home Office, MHCLG, Regulator of Social Housing, London Boroughs, social landlords, developers, homebuilders, Department of Health and Social Care, Care Quality Commission, care providers

#### Funding

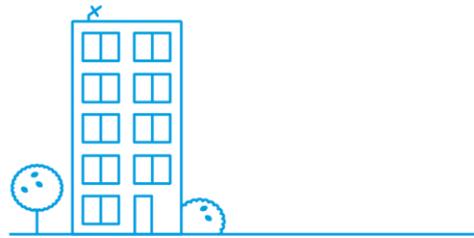
Some funding in place from central government, administered by the GLA, further funding to be identified

#### Timeline

Immediate: ACM Cladding removal, lobbying Government, LFB programme for building inspection and home safety advice

Long-term: Explore promotion of integrated retrofitting solutions

<sup>23</sup> LFB (2019)

**SHOCK AND STRESSES****Infrastructure failure****RESILIENCE VALUE****Infrastructure and environment****Aging infrastructure****Communities****How**

This project aims to improve the safety of buildings in a number of ways, starting with lobbying for the removal of combustible cladding from high-rise buildings in London and extending the Government's ban on combustible cladding to all new buildings regardless of height or use, and improving safety by setting out requirements for new developments to have the highest standards of fire safety through the Draft London Plan.

This will be supported by lobbying for further remediation funding - to make buildings that have other types of combustible wall systems or cladding safe - and higher national fire safety standards in Building Regulations, including the requirement for sprinklers to be included in all new buildings.

This project will also promote visits by the London Fire Brigade to Londoners' homes to provide advice on fire safety and support an inspection and enforcement regime for non-residential buildings to assess fire safety.

## Action B8: Business resilience

### Understand and promote business adaptation and resilience

#### Why

In his 2006 review of the economics of climate change, Lord Nicholas Stern estimated that climate change, if left unchecked, could cost as much as one-fifth of the world's economic output annually.

In the second UK Climate Change Risk Assessment in 2017<sup>24</sup>, the Committee on Climate Change identified flooding and extreme weather - events that damage assets and disrupt business operations - as one of the greatest risks to the UK now and in the future.

Risks to London's economy may be direct – from weather-related damage to buildings and assets (for example, the cost of a severe drought to London's economy is estimated at £330m per day<sup>25</sup>), or indirect – from risks to international supply chains (in 2011, UK investors had £10 trillion in assets abroad, including in countries with significant vulnerabilities to the effects of climate change) or damage to infrastructure on which business rely, such as IT systems, transport or energy.

Despite these findings, understanding of the risk to London's business and economy from climate change, and of the extent to which London businesses are considering the risks, is limited. A small number of surveys have examined how many firms have assessed their climate change-related risks and developed business continuity or adaptation plans, however these are typically UK-wide, with no comparable evidence available on adaptation by London businesses.

#### Lead

London Climate Change Partnership

#### Partners

GLA; others currently being scoped

#### Funding

Funding requirements and sources to be determined during scoping phase

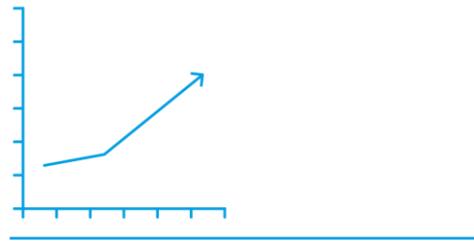
#### Timeline

Short-term: Engage with partners to develop understanding of challenge

Future: Explore opportunities to develop and promote business resilience tools

<sup>24</sup> CCC (2016)

<sup>25</sup> Thames Water (2017)

**SHOCK AND STRESSES****Infrastructure failure****RESILIENCE VALUE****Good Growth****Extreme weather****Governance****What**

This project aims to improve our understanding of risks to London's businesses and economy, and the extent to which businesses in the city are taking action to understand and manage risks and link this to Good Growth and other Mayoral economic objectives.

Gathering this data is also an opportunity to promote business resilience tools to support the business community.

**How**

This project aims to identify relevant datasets and establish links with key operators such as insurance, industry associations and other business facing organisations, Business Improvement Districts and others to develop an effective way of surveying London business.

## Resilience Projects: Process

This section focuses on enabling London's systems of governance to continue building resilience.

Robust emergency plans are a core part of ensuring our city is resilient, but they are not, by themselves, sufficient. Good governance requires a means of understanding the impact of policy and strategy, alongside the ability to innovate and adapt, to manage changing circumstances. London must continue to improve its capability to respond to disruptive events and mitigate against potential shocks and stresses. Embedding an understanding of resilience and an ability to monitor and manage risks within our governance structures will support this.

London does not exist in isolation, so it is vital to take local, national and international challenges into consideration. Considering future resilience challenges when developing policy for London and Londoners will make us stronger in the long term. Developing resilience means working with cities around the world. Collaborating with global partners, sharing knowledge and practice to deliver solutions, will benefit us all.

Resilience also means maintaining strong relationships between the GLA and its stakeholders. Building resilience will involve citizen and stakeholder mobilisation, whether to deliver adaptation measures, find collaborative means of building resilience across sectors, or develop innovative ways of responding to previously unknown challenges.

The 21st century is one of digital connectivity and infrastructure. The Mayor has appointed a Chief Digital Officer, one of only a small number worldwide, to deliver digital opportunities for Londoners. London's leading global position as a city of digital entrepreneurship is an opportunity to build resilience. Collecting and analysing London's data can help us build resilience into our city - by delivering opportunities for more effective services and accurate modelling.

London is a capital city of 8.9 million inhabitants<sup>26</sup>. The daily ebb and flow of commuters adds over 900,000 people to the capital's workforce<sup>27</sup> plus millions of guests and visitors every year. Governance that promotes and embraces resilience will help everyone benefit from a more resilient London.

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<sup>26</sup> City Intelligence (2018)

<sup>27</sup> ONS (2018)

## Action C1: Adaptive Greater London Authority

### Develop agile GLA governance to support adaptive, collaborative, inclusive and sustainable policymaking

#### Why

London is a complex, fast-paced operating environment. It is shaped as much by global events, shocks and stresses, as by national, regional and local contexts.

London has robust multi-agency resilience structures in place to manage emergency planning and respond to immediate shocks. There are fewer structures in place to manage planning and mobilising resources to address medium-term structural adjustments and stress factors that cause the gradual deterioration of systems and services in the capital, or to facilitate joined-up actions to address cross-cutting issues.

Mayoral Strategies provide a comprehensive strategic framework for the capital. As the pace and scale of change becomes ever more complicated, the GLA needs the capability to develop more agile internal governance to develop and implement policy and strategy to keep up with the pace of change.

The capability of being prepared to rapidly navigate change, embrace change, and learn from change will help GLA meet changing political dynamics and policy contexts, and provide value to London's stakeholders, institutions and Londoners.

**Lead**  
GLA

**Funding**  
This work will be developed within existing budgets

**Timeline**  
Immediate: Project conclusion anticipated end 2020, subject to policy modelling

#### RESILIENCE VALUE

##### Governance



## **What**

The aim of this project is to make GLA more proactive and effective in anticipating and responding to emerging challenges (such as those posed by climate change) by embedding resilience principles into our governance processes.

By augmenting GLA's existing governance processes to enable the rapid and ongoing circulation of policy ideas and information, involving policy teams and stakeholders in a dynamic learning process, we will help address new challenges in London. This will help build resilience to future shocks and stresses.

The project will be informed by the new City Resilience Standard (BS67000) and by analytical tools and resources used to develop this strategy.

## **How**

This project aims to develop and pilot a model to evaluate existing work more effectively and understand if it continues to meet citizens' values and needs, and gauge the effectiveness of existing policy initiatives in response to known challenges.

The work aims to evaluate existing Mayoral strategies and GLA governance processes to gauge the effectiveness of existing policy initiatives in response to known challenges, with the intention of developing and piloting a model for agile governance that augments policy making processes to allow for adaptation to rapid change.

## Action C2: Extending Adaptive Governance

### Expand the agile city governance model to support an adaptive, London-wide approach to city resilience

#### Why

The GLA is one small part of London's dynamic and complex ecosystem of stakeholders. Developing and delivering London's policies and strategies should be a multi-stakeholder effort.

London, and London's resilience, will benefit from the capability to provide effective, whole-system strategic planning. This requires research to understand effective means of building out from the GLA's internal agile governance model (itself aimed at improving long-term resilience). This would allow GLA to develop an iterative external governance process, informed and shaped by Londoners.

#### What

The aim of this project is to find new ways of engaging and developing a common agenda and trusted relationships with London's boroughs, institutions, and Londoners to enhance the city's resilience. This project will be further developed by engaging with external partners and governance experts to understand the benefits of joining up GLA's internal governance with London's wider governance ecosystem, especially at Borough level, and developing options of how this can be achieved.

#### How

This project will seek to engage with multiple stakeholders to understand opportunities for extending a resilient governance model and share internal learning and practice.

**Lead**  
GLA

#### Partners

Exploring collaboration with think tanks and other partners

#### Funding

Funding requirements and sources to be determined during scoping phase

#### Timeline

Medium to long-term: Build on the work of Action C2 in 2020

### RESILIENCE VALUE

#### Governance



## Action C3: Counter Terrorism Collaboration

### Expand city collaboration on counter terrorism preparedness through the CTPN network to keep cities safe

#### Why

Cities are affected in different ways to nations by the shocks, stresses and challenges of the persistent threat of terrorism.

In June 2018 representatives from Barcelona, Greater Manchester, London, Paris, Rotterdam and Stockholm recognised that much could be learned from one another, and created the Counter Terrorism Preparedness Network (CTPN) as a means to develop a new collaborative approach to counter terrorism, strategic preparedness and response arrangements.

The CTPN focuses on the experiences and practices of cities to identify opportunities to inform and influence priorities. It offers a shared platform for knowledge exchange. This innovative and unique approach enables practitioner experiences and expertise to meet academic research at a targeted city-policy level.

The CTPN's collaborative approach benefits resilience in London by exploring policy design and implementation in an integrated manner and developing a strategic and integrated multi-agency approach to prepare for, respond to, and recover from terrorism. This complements UK and international strategies, the London Resilience Partnership Strategy and the Lord Harris review into London's preparedness to respond to a major terrorist Incident<sup>28</sup>.

#### What

In November 2019, the Mayor of London formally launched the network with the publication of five strategic reports<sup>29</sup>. The success of CTPN to date has attracted interest from a number of other cities that wish to become formal members in the future. It has also

#### Lead

London Resilience Group

#### Partners

International cities, academic institutions, independent experts

#### Funding

Immediate work funded through existing resources; future funding requirements to be determined

#### Timeline

Immediate: Secure continued operation of the network; explore opportunities for future funding and governance

<sup>28</sup> Harris (2016)

<sup>29</sup> CTPN (2019)

received endorsement from a range of key stakeholders working in counter terrorism. The CTPN aims to influence the strategic multi-agency arrangements of cities in managing terrorism by undertaking and promoting city-level research and actively developing and using relationships across CTPN partner cities.

## SHOCK AND STRESSES

### Infrastructure failure

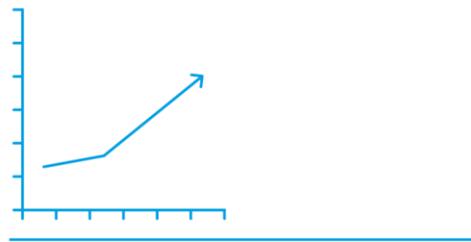


### Extreme weather



## RESILIENCE VALUE

### Good Growth



### Governance



## How

The CTPN will continue to support the development of city-level policies and multi-agency arrangements over the coming year. This will include an upscaling of city-to-city learning through the exchange of expertise, experience and practice, monitoring the impact of reports and exploring additional research and recommendations. The network has identified strategic reports on cyber terrorism and communications as priorities.

London Resilience Group has absorbed set-up costs to date. This project aims to sustain and ultimately expand the network by exploring opportunities to absorb the network into existing structures, to access funding for the network, and for formal alignment with academic or other institutions.

## Action C4: Addressing Long-Term Risk

### Integrate London Resilience Partnership risk management process and policy planning for future risks

#### Why

The London Resilience Partnership actively manages the development of emergency frameworks and capabilities for London based on risks set out in the London Risk Register.

This process is based on strong evidence and leading practice, but is limited by its reliance on learning from previous incidents and currently only considers risks within a five-year time period. Longer-term stresses, such as those related to climate change are not necessarily considered within this model.

Conversely, the work of GLA policy teams generally involves long-term strategic considerations, from climate change adaptation to developing opportunities to use digital technology. This work is aimed at managing and mitigating against potential future stresses and uncertainty.

Recent collaborative work undertaken on food resilience has demonstrated the benefits of linking risk management expertise with future policy planning – both to improve emergency planning and to develop more active risk awareness for longer-term food policy development. Other policy areas have benefited from similar collaboration.

#### What

This project aims to develop a collaborative approach between London's policymakers and emergency planners that will improve preparedness for long term shocks and stresses to London, as well as enhance existing emergency plans by bridging the gap between past incidents and future trends.

#### Lead

GLA

#### Partners

London Risk Advisory Group, academic institutions

#### Funding

To be developed within existing budgets

#### Timeline

Immediate: To be developed alongside project C2 - Adaptive Greater London Authority

## SHOCKS AND STRESSES

Infrastructure failure



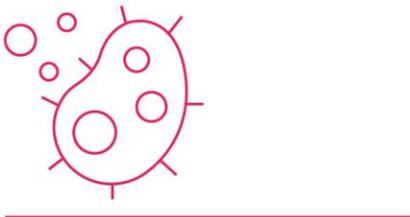
Flooding



Extreme weather



Disease pandemic



Drought

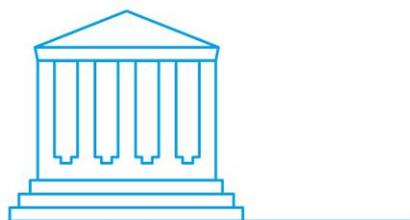


Terror attack



## RESILIENCE VALUE

Governance



## How

Project C2 reviews GLA governance with a view to make it more adaptive to shocks and stresses. This project will use evidence identified through this work to find ways of optimising engagement between GLA policymakers and London Resilience Partnership on risk management.

### **Case Study: London Risk Assessment**

The National Security Risk Assessment (NSRA) is a central government publication that identifies and prioritises UK security risks. The new NSRA 2019 differs significantly from the previous National Risk Assessment (NRA) 2016 in methodology, as a result of the merging of threats and hazards. Threats in the new NSRA 2019 are assessed on a two-year likelihood - previously this was based on a five-year term. This means that all risks in the NSRA 2019 are now assessed on a shortened likelihood scale.

The London Risk Advisory Group will be adapting the London Risk Register (LRR) to this methodology following completion of the current risk assessment cycle.

The change from five-year to two-year assessments may require a mindset shift in risk perception. A shorter timeframe is likely to identify risks that are potentially more likely, but less severe. However, it leaves a gap in addressing longer term risk.

This change means there needs to be a means of effectively managing risks to London that exist beyond a two-year time horizon.

## Action C5: Quantifying the Cost of Disruption

### Develop a model to understand the cost of disruptions to London and inform policy decision making

#### Why

Disruptions come at a cost to London and Londoners. Predictions indicate that in future, disruptions - for example as a result of severe weather - are likely to get more frequent and more severe. Understanding costs associated with disruptions, whether for an hour, a day or several weeks, in more depth will help us understand the financial impact of shocks to Londoners, and to London itself.

Understanding the nature and complexity of costs that result from disruptions more comprehensively can help clarify the full impact of disruptions, inform policy planning and support decision making on resilience.

#### What

Models can help identify populations that are vulnerable to different disruptive events, and estimate costs of disruption under different scenarios by modelling damage to infrastructure and economic activity. This project aims to develop simulation models that can provide evidence of the impact of different types of disruptions.

#### How

This project will develop a broad understanding of the range of approaches available to model disruptions, and identify and collaborate with partners to develop a modelling tool that can quantify and clarify the impacts of disruption.

**Lead**  
GLA

**Partners**  
London Resilience Group;  
other specialists to be  
determined

**Funding**  
Initial scoping developed  
within existing budgets;  
funding requirements and  
models for subsequent stages  
to be determined

**Timeline**  
Short-term: Identify partners,  
scope modelling needs

Medium to long-term:  
Develop new approaches and  
models

### RESILIENCE VALUE

#### Governance



## Action C6: Using forecasting to improve resilience

### Support data-focussed approaches to enable adaptive policymaking in a changing city

#### Why

Future trends are increasingly complex and hard to predict, particularly in relation to long-term stresses. Finding ways of building uncertainty into GLA policy will make GLA policy better equipped to manage change and develop the right approach to the challenges of the 21st century. This will make London more resilient.

To improve policy making processes data is needed to clarify the extent to which GLA policy is already robust and adaptive to changing environments. GLA models can quantify some uncertainty to help understand the human impact of events, especially on London's most vulnerable populations. Impacts can then be examined under different climate change and demographic growth or shrinkage scenarios and present scenarios for more uncertain, high-impact futures.

#### What

This project focusses on the extent to which GLA policy are robust and adaptive to changing environments, and aims to explore ways of incorporating increased uncertainty in policy making processes. This supports the work set out in project C2 aiming to develop governance that can be more agile and responsive to future shocks and stresses.

Drawing on existing international good practice, this project aims to develop a pilot model that incorporates uncertainty and long-term strategic thinking into policy. This will help policy makers consider alternative development pathways, and make GLA strategies more resilient to climate change, population change and other future disruptive challenges affecting London.

#### Lead

GLA

#### Partners

Partnerships with academic institutions and other organisations to be explored

#### Funding

Initial review and development of models funded from existing budgets; funding requirements for subsequent stages to be determined

#### Timeline

Short-term: Internal review and development of models

Medium to long-term: Establish forecasting processes; develop pilot project

## RESILIENCE VALUE

### Governance



#### How

This project will review current good practice on uncertainty modelling, seek to understand how forecasting and future trend planning are informing policy, and aim to identify the right methods to ensure our policies are sufficiently robust to deal with future shocks and stresses.

The project aims to develop and pilot a model that considers uncertainty (such as probabilistic or scenario-based modelling) to test with internal policy, and use the lessons learned from this pilot to explore how similar models could be extended to incorporate uncertainty planning in GLA policy development more widely.

#### **Case Study: Transport for London travel scenario planning**

TfL's major projects need to work in all development pathways. The GLA has supported TfL's work to describe carefully chosen potential futures, qualitatively sense-checking the scenarios and suggesting adjustments. These scenarios are now being used to guide policy and planning within TfL. Similar work for GLA policy teams could provide a more general, flexible tool to support our organisation to create scenarios, simulate them, quantify them, and evaluate their plausibility.

## Action C7: Preparing for a Cashless Society

### Understand the social impacts of an economy dominated by digital transactions

#### Why

Digital transactions are increasingly becoming the norm, with significant numbers of businesses shifting away from cash use. A proliferation of digital payment technologies allow individuals to all but avoid the use of cash on a day to day basis. According to the AT Kearney Global Trends 2019-2024 Report<sup>30</sup> 'the growth of digital applications, e-commerce, and online payment technologies will keep growing over the next five years and beyond' and we are 'likely to see the emergence of the first truly cashless society in the next five years'.

**Lead**  
GLA

Funding, partners and timelines to be determined during project scoping phase

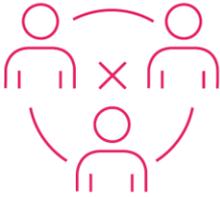
A move away from cash may pose a risk to certain vulnerable groups, notably those facing barriers to digital transactions, or those more likely to be excluded from the mainstream banking system. This could affect the resilience of these groups, as well as on the personal resilience of isolated people, including older generations who are more likely to be reliant on cash.

#### What

This project aims to understand the nature of the risk of moving to a cashless society in more detail, and identify impacts upon societal resilience. This will help GLA policy makers understand what actions may need to be taken to support vulnerable groups or those likely to be negatively affected by the move towards a cashless society.

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<sup>30</sup> Laudicina et al. (2019)

**SHOCK AND STRESSES****Lack of cohesion****RESILIENCE VALUE****Communities****How**

This project will initially seek to understand the value of developing a cross-cutting project to clarify the impacts of a cashless society, specifically in relation to vulnerable groups.

## Conclusion

Taken together, our analysis of policy and risk and the proposed projects set out in the chapters above provide a basis upon which we can continue building our capital's resilience. By identifying shocks and stresses, and developing a snapshot of where GLA policy contributes to resilience, a clearer picture has been developed to understand where more activity could take place. For London – in 2020 – this means a focus on cross cutting projects, many addressing a need for increased knowledge and capacity to improve preparedness, whether this is for the GLA, for example by developing more useful datasets to aid decision-making, or for Londoners, for example by improving first aid skills.

The projects set out above are designed to start building alliances and partnerships that address a number of London's main resilience challenges. As these projects develop, it will become clearer how they will contribute to London's overall resilience and where gaps remain. Although we have separated the projects into three distinct areas, each project is likely to have an impact on improving resilience in other areas – for example, making communities more aware of the risks around them means that individuals will be more prepared and able to cope, meaning that recovery from any event is likely to be faster.

Together, the projects are designed to make London a more resilient city across multiple areas. These inspiring initiatives show what can be achieved when 'resilience-thinking' is supported within the GLA family. They are a path forward to embed resilience within the GLA family, demonstrating the thinking that will continue to be required to make London more resilient in the future. Collectively, the projects set out a direction of travel, with practical actions that can start to take place now. However, risks to the capital will inevitably change over time, meaning the process of becoming resilient needs to be a continual one, as the city learns from and adapts to new and emerging risks, challenges and opportunities.

Implementing this strategy is a starting point to ensuring London is ready for future shocks and stresses, and new projects will need to be created and developed to build London's resilience on an ongoing basis. We also need the global network of resilient cities to help us to continue improving our resilience, as the collaborative knowledge, understanding and support gained from this is invaluable.

**It is our investment and commitment to ongoing resilience-building – through continuing to develop projects, partnerships and policy that address changing resilience issues, locally, nationally and internationally and by promoting resilience as a central part of London's future - that will help us make London a truly resilient city.**

## Implementation and Next Steps

### Resilience in the Greater London Authority

The London City Resilience Strategy has been developed over the course of the past year in the GLA, and the main milestones of this process are set out below.

- November 2018: Agenda Setting Workshop – an opportunity for dozens of representatives from local resilience, local government and other stakeholders to discuss urban resilience – identifying shocks and stresses and beginning to capture and understand London’s ability to face challenges
- March 2019: Resilience Team created and GLA resilience officers appointed
- September 2019: Preliminary Resilience Assessment developed and publicly consulted upon, following consultation with stakeholders and review of existing risk data for London
- Autumn 2019: Co-designing solutions, workshops, research, engagement, strategy development
- Winter 2020: Internal Strategy clearance
- February 2020: Publication of the London City Resilience Strategy

## Implementation

Each project sets out actions that are required to take forward the resilience work we are proposing, and the timeframes within which we are proposing to take them forward.

Implementing the resilience strategy will take time and require ongoing coordination with many different stakeholders. It is this partnership work that is invaluable for building resilience in London, and all the contributors to this strategy have been, and will be integral to building resilience in the capital in the long term.

The cross-cutting nature of the projects in the strategy means that there is no one single lead responsible for delivering all activities, and each project will have differing governance and reporting requirements. However, progress will be monitored, and ongoing work supported by the GLA Fire & Resilience team.

Project progress will be reported quarterly through the London Resilience Forum and updates will be posted to the GLA Fire & Resilience web page.

## Legal Context

The GLA has a general power to do anything to further its principal purposes to promote: (i) economic development and wealth creation; (ii) social development; and (iii) environmental improvement (ss.30(1) and (2), GLAA 1999). The GLA cannot duplicate the work of its functional bodies or those of local authorities or other public bodies (s.31(1) and (3)) although it can co-operate, co-ordinate or facilitate the activities of such bodies (s.31(6)).

This strategy has been developed to provide leadership on resilience, and meet London's agreement to produce a Resilience Strategy as part of the 100 Resilient Cities Programme. It's overarching objective is to ensure that London can continue to prosper and function well for its citizens in the future. Where powers to act to deliver actions in this strategy are held by others, the Mayor can use leadership, influence and funding to ensure that the right actions are taken for London.

### Civil Contingencies Act

The Mayor of London chairs the London Resilience Forum (LRF). The LRF ensures effective delivery of those duties under the Civil Contingencies Act that need to be developed in a multi-agency environment. The Forum is not a legal entity and does not have powers to direct its members. It is a means for responders with duties under the Act to collaboratively discharge their responsibilities. The Forum sets the strategy and objectives for the London Resilience Partnership (LRP) through its Partnership Work Programme. It is accountable for multi-agency coordination of emergency preparedness arrangements in London. The LRP includes over 200 partners, including Local Authorities, Emergency Services, Government Agencies, the voluntary sector and business. Under the Civil Contingencies Act, Category 1 responders (of which GLA is one) are subject to the full set of civil protection duties. They are required to:

- Assess the risk of emergencies occurring and use this to inform contingency planning
- Put in place emergency plans
- Put in place business continuity management arrangements
- Put in place arrangements to make information available to the public about civil protection matters and maintain arrangements to warn, inform and advise the public in the event of an emergency
- Share information with other local responders to enhance co-ordination
- Co-operate with other local responders to enhance co-ordination and efficiency
- Provide advice and assistance to businesses and voluntary organisations about business continuity management (local authorities only)

## Appendix 1: Public Consultation

A public consultation was held during development of the Resilience Strategy.

As part of the process for developing the Strategy we prepared a Preliminary Resilience Assessment (PRA). The PRA set out an initial evidence base of current resilience activity and analysed London's strengths and opportunities against potential shocks and stresses. It outlined a vision for what we mean by a resilient London, and identified a number of themes for further research.

We formally consulted on the Preliminary Resilience Assessment between 1 September and 18 October 2019. This section summarises the key stakeholder comments provided during the consultation and outlines how they have been addressed in the City Resilience Strategy.

### Consultation Process

The consultation was targeted at organisations and technical stakeholders, but was open to members of the public. The consultation process was based on an online survey with four questions:

1. What does a resilient London mean to you?
2. This document sets out a direction of travel to increase resilience. Are there further areas that should be considered (either now or in the future) to build resilience in London?
3. Are you involved in resilience-building initiatives or activities that the GLA should be aware of and should be using as examples of good practice in the Resilience Strategy?
4. Please provide any further comments.

The PRA and survey were available on the GLA website. In addition to the four questions above, participants had the option to submit additional information. The PRA and online survey were sent directly to 96 external stakeholders; we received 11 formal responses.

## Comments raised by respondents

Consultees provided wide-ranging feedback on the PRA. The comments covered below are those cited repeatedly by stakeholders, or that may have significant implications for the strategy.

### Defining resilience (responses to Q1)

Stakeholders see resilience as a broad, multi-dimensional concept, and value the importance of considering long-term challenges. Resilience is perceived as about coping with long-term challenges such as globalisation and climate change, understanding interconnectedness between city functions and systems, the impact of disruptions, and effectively communicating risk.

The importance of community aspects of resilience – including the need to focus on the most vulnerable – was emphasised, as was the link between cities in the UK, and London and different countries. Several respondents recommended that the Strategy should provide a clear definition of resilience, outlining the scope of resilience policy.

### Resilience themes (responses to Q2)

When asked to identify any further areas that should be considered when building resilience in London, respondents suggested a number of topics including aspects related to mental health, the river Thames, digital economy, social innovation, business resilience and homelessness following a shock.

Respondents also made suggestions regarding the need to embed resilience across London. The value of collaboration between the GLA, Local Authorities and Community and Voluntary Sector organisations to deliver resilience objectives was emphasised, as well as the benefits of close engagement with government and local political leaders, and of collaboration with academic organisations.

Other comments concerned embedding resilience and ensuring multi-stakeholder buy-in, and bottom-up engagement and leadership; considering the practicalities of project implementation at the local level (including producing explicit guidance and support for boroughs); promoting effective communication of resilience principles and local risks with communities; and including resilience requirements in Mayoral funding programmes.

A number of recommendations related to the governance and implementation of the Resilience Strategy, including developing clear links between policy and evidence gathered by the London Risk Register, focusing on tangible actions with high impact, and understanding how progress will be monitored.

### **Existing resilience-building initiatives (responses to Q3)**

The third question allowed us to collect information on existing initiatives on resilience or examples of good practice. Respondents indicated a number of initiatives, both in the UK and internationally, including:

- The Thames Estuary 2100 Plan, initiatives to raise awareness of the risk of flooding and how to respond in case on an incident, a flood warning service which sends messages to public, businesses and organisations when flooding is forecasted, and the Riverside Strategy Approach to flood defence raising
- Initiatives to help small businesses and the communities to understand key risks and be better equipped to prepare for, respond to and recover from emergencies
- Several international initiatives, including the Singapore national water programme, 'One Water', approaches in Los Angeles and Singapore, and resilience co-ordination and guidance in New York
- Initiatives led by boroughs, including on business resilience and continuity planning, communications to enhance community or household resilience, and initiatives focusing on Older People

### **Additional comments (responses to Q4)**

The final question gave stakeholders the opportunity to share any further thoughts. Suggestions from respondents included:

- Collaboration with Government and Local Authorities on areas such as transport, crime, international tax compliance, international trade, education and health, as well as continuing to cooperate with other large UK and global cities are beneficial
- Recognising the role of central government (including Cabinet Office: Civil Contingencies Secretariat and the Environment Agency) as well as of public, private and voluntary sector organisations in helping deliver resilience objectives
- Future areas for further work could include managing a financial crisis, technological complexity, the contribution of infrastructure for resilience, retrofitting the existing built environment, and social justice and economic inequality

### **Addressing comments in the Resilience Strategy**

Most of the issues raised by respondents are addressed in the Resilience Strategy, either through acknowledgement of their importance or by developing actions to target them. The Strategy explicitly addresses a number of comments raised by respondents. In response to the comments we received, the Strategy:

- Identifies what is meant by resilience, clarifying the scope of the work and incorporating a number of the resilience aspects mentioned by respondents. Resilience is considered across different policy areas, bringing in projects and actors from a wide range of disciplines

- Focuses on a number of community resilience activities
- Acknowledges the importance of mental health, and highlights actions underway to support good mental health for Londoners
- Proposes workstreams to understand and promote business resilience, understand the impacts of disruptions, use data more effectively in infrastructure planning, promote more effective risk communication to local communities, and improve London's ability to respond to the consequences of a cyber emergency
- Addresses opportunities to embed resilience principles into GLA governance processes and policymaking
- Emphasises the importance of multi-stakeholder collaboration to deliver resilience and clarifies the complementary roles of the GLA and the London Resilience Group

Some of the issues identified by stakeholders will not be directly addressed in the Strategy as they are outside of the initial scope of the areas identified as priority. However, they are pertinent resilience challenges which have been noted and will be considered in future as appropriate. Resilience issues related to the Thames and the collaborative work on the Thames Estuary 2100 Plan are briefly mentioned in the Strategy, but not addressed in detail as they are already covered by other Mayoral strategies and policy.

Finally, examples of good practice provided by stakeholders are valuable. Some examples have been included in the Strategy as case-studies. We will also use this information as a basis for further engagement with stakeholders following the publication of the Strategy.

## Appendix 2: Glossary

**Adaptation** – the process (or outcome of a process) that leads to a reduction in harm or risk of harm, or realisation of benefits associated with climate variability and climate change. Adaptation policies can lead to greater resilience of communities and ecosystems to climate change.

**Affordable housing** – homes that are affordable for Londoners on low and middle incomes to rent and buy. These include homes at around social rent levels for Londoners on low incomes; London Living Rent homes for middle income Londoners struggling to save for a deposit; and shared ownership homes for Londoners who cannot afford to buy on the open market.

**Accident** – Unplanned, unexpected, unintended and undesirable happening which results in or has the potential for injury, harm, ill-health or damage.

**Air pollution** – substances in the air that harm human health, welfare, plant or animal life. Most pollution in London is caused by road transport and domestic and commercial heating systems.

**Air quality** – whether levels of air pollutants are relatively high or low. It usually considers pollutants in the UK Air Quality Standards Regulations 2010 (for example, particulate matter, lead, nitrogen dioxide).

**BID** – Business Improvement District

**Biodiversity** – refers to the variety of plants and animals and other living things in a particular area or region. It encompasses habitat diversity, species diversity and genetic diversity.

**Boroughs** – Usually used to refer to the 32 London boroughs and the City of London. The boroughs are the principal local authorities in London and are responsible for running most local services in their areas, such as schools, social services, waste collection and roads.

**Carbon footprint** – total greenhouse gas emissions resulting from an activity or group of activities, including embodied carbon.

**Civil Contingencies** – Risks to civilian health, safety, and property from emergencies as defined in the Civil Contingencies Act (2004).

**Circular economy** – economic model in which resources are kept in use at the highest level possible for as long as possible in order to maximise value and reduce waste, moving away from the traditional linear economic model of ‘make, use, dispose’.

**Civil society organisation** – voluntary or not-for-profit organisations, charities, and social enterprises (see ‘Third sector’).

**Climate change** – large scale, long-term shift in the planet’s weather patterns or average temperatures. Characterised by higher temperatures, sea level rise, changing rainfall, and more frequent and severe extreme weather.

**Disadvantaged group** – those less able to anticipate, cope with, resist and recover from the impacts of disasters, such as the elderly and the very young, those suffering from poor health, those with limited mobility, the socially isolated, and the economically deprived.

**Disruption** - deviation from expected performance in any aspect of a city caused by a shock or stress

**Drought** – an extended period of insufficient rainfall (or other precipitation) that results in water shortages with impacts on people, animals, and vegetation.

**Emergency** – event or situation which threatens serious damage to human welfare in a place in the UK, the environment of a place in the UK, or the security of the UK or of a place in the UK.

**Energy efficiency** – making the best or most efficient use of energy in order to achieve a given output of goods or services, and of comfort and convenience.

**Equality** – recognising and respecting differences, including different needs, to ensure people can live their lives free from discrimination, know their rights will be protected, and have what they need to succeed in life. It is about ensuring equality of opportunity by tackling the barriers that some groups face, and making London fairer by narrowing the social and economic divides that separate people. The characteristics protected by equality legislation are age, disability, gender, gender reassignment, ethnicity, pregnancy and maternity, religion and/or belief and sexual orientation.

**Flooding** – see ‘Fluvial flooding, ‘Surface Water flooding’ and ‘Tidal flooding’.

**Fluvial flooding** – rivers bursting and/or overtopping their banks as a result of heavy rainfall can cause

**Food insecurity** – the state of being, or at risk of being, without reliable access to a sufficient quantity of affordable, nutritious food – at different life stages.

**Food system** – the term for how food works for Londoners and businesses. It includes the contribution of food businesses to London’s economy; the role of the built food environment which Londoners experience; and the contribution of food to Londoners’ health.

**Fuel Poverty** – a household is considered to be in fuel poverty if the fuel costs required to heat and power the home adequately are above average (the national median level) and if they were to spend that amount, they would be left with a residual income below the official poverty line. It is caused by the combination of three factors: low incomes; the poor energy efficiency of homes; and high energy prices.

**Functional bodies** – see ‘GLA group’.

**Geographic Information System (GIS)** – a form of data storage software that stores information linked to a geographical location.

**Good growth** – the Mayor has defined good growth as being about designing a city that is inclusive, environmentally sustainable, attractive and accommodates a variety of uses. It means addressing the stark inequality that exists here.

**Greater London Authority (GLA)** – the administrative body for Greater London. It comprises a directly elected Mayor and directly elected London Assembly.

**GLA group** – the Mayor has responsibility for appointing members to, and setting budgets for, five organisations: Transport for London (TfL), London Legacy Development Corporation (LLDC), London Fire Commissioner, Mayor’s Office for Policing and Crime (MOPAC), and Old Oak and Park Royal Development Corporation (OPDC).

**Greater London** – the geographical area encompassed by the 32 London boroughs and the City of London.

**Green infrastructure** – a network of green spaces – and features such as street trees, green roofs and blue spaces – that is planned, designed and managed to deliver a range of benefits. These include mitigating flooding, cooling the urban environment and enhancing biodiversity and ecological resilience, as well as providing more attractive places for people.

**Groundwater** – water stored within saturated rock or soil.

**Hazard** – Accidental or naturally occurring (non-malicious) event or situation with the potential to cause death or physical or psychological harm, damage or losses to property, and/or disruption to the environment and/or to economic, social and political structures.

**Heatwave** – an extended period of hot weather relative to the expected conditions of the area at that time of year, which may be accompanied by high humidity.

**Inclusive growth** – is economic growth that creates opportunity for the whole population and distributes the dividends of increased prosperity, both in monetary and non-monetary terms, fairly across society.

**Inclusion** – removing barriers and taking steps to create equality, harness diversity and ensure safe, welcoming communities and cultures that encourage innovative and fresh ways of thinking and allow people to speak up, especially to suggest where things could be done better.

**Income inequality** – the gap between those with the highest and lowest incomes. There are different measures to assess income inequalities and how they change over time

**Local authorities** – see ‘boroughs’.

**London** – shorthand for Greater London.

**London Assembly** – the directly-elected London regional body comprising 14 constituency members and 11 pan-London members. A component of the Greater London Authority.

**London Plan** – The Mayor’s spatial development strategy for London.

**London Resilience Forum (LRF)** – formalised by the Civil Contingencies Act 2004, the LRF sets the strategy for the work of the London Resilience Partnership. The LRF was established in 2002 and is chaired by the Deputy Mayor for Fire and Resilience, on behalf of the Mayor of London.

**London Resilience Group (LRG)** – provides secretariat to the London Resilience Forum, and supports the work of the London Resilience Partnership in assessing risks, and working to reduce their likelihood or impact and preparing arrangements to respond, recover and learn from emergencies.

**London Resilience Partnership (LRP)** – partnership of over 200 organisations that is responsible for ensuring London is prepared to respond to and recover from emergencies, driven by the Civil Contingencies Act. Members have a shared responsibility for continually developing London’s resilience through prevention, management and recovery from emergencies. Members are drawn from the public and private sector, including emergency services, local authorities, NHS, utilities and transport providers.

**Mayor of London** – directly elected executive body of the Greater London Authority. The Mayor provides citywide leadership and sets an overall vision for London. He has a duty to set a budget and create plans and policies for Greater London.

**Mayor's Office for Policing and Crime (MOPAC)** – mayoral office responsible for policing in the capital outside the City of London.

**Mental ill health** – covers a very wide spectrum of mental health issues. It includes the worries and grief we all experience in everyday life to suicidal depression or complete loss of touch with daily reality.

**MHCLG** – Ministry for Housing, Communities and Local Government

**National Risk Register** – a publicly available statement of the assessment of the likelihood and potential impact of a range of different risks that might directly affect the UK.

**Opportunity Areas** – London's major source of brownfield land, designated in the London Plan, which have significant capacity for development – such as housing or commercial use - and existing or potentially improved public transport access.

**Poverty** – defined relative to the standards of living in a society at a specific time. People live in poverty when they are denied an income sufficient for their material needs and when these circumstances exclude them from taking part in activities that are an accepted part of daily life in that society.

**Preparedness** – activities, programmes, and systems developed and implemented prior to an incident that can be used to support and enhance prevention, protection from, mitigation of, response to and recovery from disruptions, emergencies or disasters.

**Public health** – the science and art of promoting and protecting health and wellbeing, preventing ill health and prolonging life through society's organised efforts.

**Resilience dividend** – the difference in the outcomes between the scenario with a resilience approach and without.

**Retrofitting** – the addition of new technology or features to existing buildings, vehicles and infrastructure in order to make them more efficient and to reduce their environmental impacts.

**Reuse** – can be practised by the commercial sector with the use of products designed to be used a number of times, such as reusable packaging. Householders can purchase products that use refillable containers, or reuse plastic bags. The processes contribute to sustainable development and can save raw materials, energy and transport costs.

**Risk** – measure of the significance of a potential emergency in terms of its assessed likelihood and impact.

**Risk Assessment** – a structured and auditable process of identifying potentially significant events, assessing their likelihood and impacts, and then combining these to provide an overall assessment of risk, as a basis for further decisions and action.

**Shock** – a sudden impact events that can immediately disrupt a city, and may have diverse and unexpected impacts.

**Social inclusion** – means removing barriers and taking steps to create equality, harness diversity and produce safe, welcoming communities and cultures.

**Social integration** – the extent to which people interact and connect with others who are different to themselves and is determined by the level of equality between people, the nature of their relationships, and their degree of participation in the communities in which they live.

**Stress** – stresses are slow-moving challenges that weaken the fabric of a city on a day-to-day or cyclical basis.

**Surface water flooding** – flooding caused when the volume of rainwater falling does not drain away through the existing drainage systems or soak into the ground but lies on or flows over the ground instead. Usually short lived and associated with heavy downpours of rain, thunderstorms etc.

**Sustainable development** – development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

**Third sector** – voluntary or not-for-profit organisations, charities, and social enterprises.

**Tidal flooding** – flooding as a result of exceptionally high tides, often combined with storm surges.

**Transport for London (TfL)** – GLA group of organisations, accountable to the Mayor, with responsibility for managing London's public transport and for delivering an integrated and sustainable transport strategy for London.

**Urban greening** – the act of adding green infrastructure elements that are most applicable in central London and London's town centres. Due to the morphology and density of the built environment in these areas, green roofs, street trees, and addition of vegetation, are the most appropriate elements of green infrastructure.

**Urban heat island** – the height of buildings and their arrangement means that while more heat is absorbed during the day, it takes longer to escape at night. As a result, the centre of London can be up to 10°C warmer than the rural areas around the city. The temperature difference is usually larger at night than during the day. The UHI effect is noticeable during both the summer and winter months.

**Urban Resilience** – the capacity of individuals, communities, institutions, businesses and systems within a city to survive adapt and grow no matter what kinds of chronic stresses and acute shocks they experience.

**Wellbeing** – a state of being where everyone can realise their potential, cope with the normal stresses of life, work productively and fruitfully and contribute to their community.

**Zero carbon** – activity that causes no net release of carbon dioxide and other greenhouse gas emissions into the atmosphere.

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- London Resilience Group
- London Resilience Partnership
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- Thames Water

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