Strategic Cycling Analysis

Identifying future cycling demand in London
June 2017

MAYOR OF LONDON

TRANSPORT FOR LONDON
EVERY JOURNEY MATTERS

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Executive Summary

The Mayor has asked Transport for London to put the Healthy Streets Approach at the heart of its decision making. Set out in 'Healthy Streets for London', this approach is a system of policies and strategies to help Londoners use cars less and walk, cycle and use public transport more often.

To achieve this it is important to plan a longer-term and coherent cycle network across London in a way that will complement walking and public transport priorities. This document provides a robust, analytical framework to help do this.

The Strategic Cycling Analysis presents what the latest datasets, forecasts and models show about potential corridors and locations where current and future cycling demand could justify future investment. It also identifies where demand for cycling, walking and public transport coincide, thus highlighting where investment is most needed to improve all sustainable transport modes together.

This document should become a valuable resource for Transport for London officers, London boroughs, developers, planners, communities and others interested in understanding how cycling can contribute to achieving the Healthy Streets Approach in their local area.

The Strategic Cycling Analysis

The report considers four broad areas of analysis:

- Where are the cycling connections with the greatest potential to contribute to cycling growth in London?
- How could these connections be prioritised?
- How could these connections contribute towards achieving Healthy Streets goals?
- What opportunities are there to deliver area-wide cycling improvements?

Each chapter addresses one of these questions, describing the datasets, methodology and findings together with next steps.

Next steps

The Strategic Cycling Analysis identifies a number of schematic cycling connections which could contribute to the growth of cycling in London and help achieve the Mayor's ambitions for Healthy Streets.

This analysis allows TfL and boroughs to plan for cycling in a more strategic way that aligns with the Healthy Streets Approach. It is not intended to be a completed, prescriptive or 'top-down' plan.

The next steps will enable TfL, boroughs, local expert groups and others to review the analysis and develop local and strategic plans.

TfL will also work with boroughs to develop proposals for potential connections identified by the Strategic Cycling Analysis, including beginning feasibility studies on the connections with the highest potential to increase levels of cycling.

These studies will help to plan for future Superhighways, Quietways and Liveable Neighbourhoods, and develop schemes which can achieve wider Healthy Streets goals including more people walking and using public transport.

Introduction

Cycling in London has grown significantly over the past 15 years. There are now more than 670,000 cycle trips a day in London[1], an increase of over 130 per cent since 2000. Under the Mayor of London's plans for Healthy Streets[2], TfL wants to help Londoners use cars less and walk, cycle and use public transport more. The easiest way for most Londoners to stay active is by walking or cycling as part of their daily travel.

The growth in London's cycling has been supported by continued investment in cycle infrastructure. Since its formation in 2000, TfL has been working with London boroughs and other partners to improve London's cycle facilities, starting with the London Cycle Network (LCN) and London Cycle Network + (LCN+), then Cycle Hire and the first generation of Cycle Superhighways, and more recently the second generation of Cycle Superhighways and first phases of Quietways and Mini-Hollands. London's combined Superhighway and Quietway network is now more than 100km long, and 10 per cent of Londoners live within 400m of at least one of these routes.

The Healthy Streets Approach includes the continued expansion of London's network of quality cycle routes. The TfL Business Plan (2016/17-2021/22), published in December 2016, set out a Healthy Streets investment portfolio that committed investment to increase provision for cycling in London, alongside improvements for walking, safety and bus reliability. This infrastructure should triple the proportion of Londoners living within 400m of one or more of these cycle routes to around 35 per cent by 2022.

The analysis in this report uses the investment in the cycling network set out in the Business Plan as a baseline (Figure 1), and provides the evidence to support further development of the network with a 2041 horizon, in line with the Mayor's Transport Strategy.

Purpose of this document

This analysis presents what the latest datasets, forecasts and models show about potential corridors and locations where cycling demand, current or future, would justify future investment.

The analysis addresses four questions:

- Where are the cycling connections with the greatest potential to contribute to cycling growth in London?
- How could these connections be prioritised?
- How could these connections contribute towards achieving Healthy Streets goals?
- What opportunities are there to deliver area-wide cycling improvements?

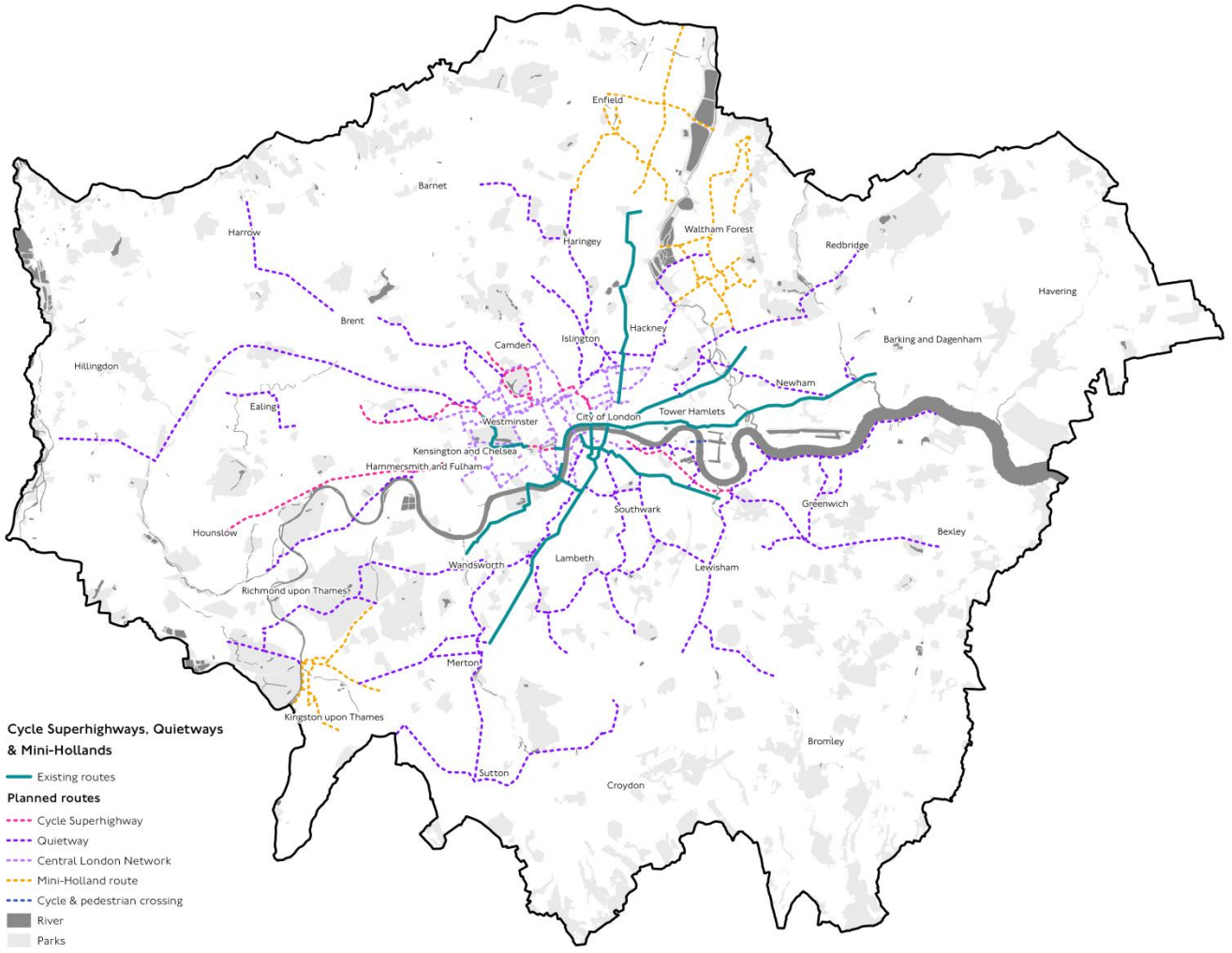
[1] Travel in London 9 (December 2016)
[2] Healthy Streets for London (February 2017)

Figure 1 represents the current understanding of the 2022 network, according to the latest Business Plan. Taking into account both existing and planned routes, the network will include more than 90km of Cycle Superhighways and 250km of Quietways, as well as investments in central London and Mini-Holland boroughs.

The Business Plan has also allocated additional investment for these programmes, so these routes are not the limit of the 2022 ambition. There are likely to be more routes but they are still under discussion and development with boroughs and key stakeholders.

With the exception of this map, all maps in this report should be read as a representation of potential cycling demand, and not as plans containing route alignments.

Figure 1: Current plan for cycling routes – according to the TfL Business Plan



Strategic Cycling Analysis

This research identifies cycling connections with the greatest potential to contribute to cycling growth in London. Future cycle demand has been considered by exploring the potential for people to switch specific motorised trips to cycling and walking, and by identifying areas expecting the highest growth in population and employment.

The cycling connections identified by the Strategic Cycling Analysis (SCA) can help enable the largest amount of cycle trips. They can serve local trips as well as longer ones, and can serve both non-commuter and commuter trips. However, the SCA only identifies a strategic set of connections, not the whole of London's cycling network. Other local schemes, including area-based interventions, should complement these strategic cycling connections by securing access to them, as well as enhancing cycle connectivity and permeability in each local area.

The strategic road network

This analysis explores data on where cycle trips are currently being made in London. A significant proportion of these trips take place on the strategic road network. This is likely to be for several reasons:

i) a large proportion of people choose to cycle the most direct route to their destination, for speed and ease of navigation, even if this involves using a main road
ii) when cycling people will often choose roads that they are familiar with. Main roads form part of people's 'mental map' of London and can be the default way of getting around
iii) trip attractors, including workplaces, shops and services, tend to be clustered around main roads

In addition to the above, the data on motorised trips that could be switched to cycling shows that a third of these trips start or end on a main road. This does not include the additional trips that start or end close to main roads

This means that a large proportion of the corridors of cycling demand shown in the SCA coincide with the strategic road network. This does not mean the cycle network must be accommodated only on main roads, but that important corridors for cycle movement are often centred on main roads. However, improving wayfinding and cycling provision on other roads can sometimes open up new and better routes for people cycling.

So, looking ahead, TfL will work with London boroughs to apply the Healthy Streets Approach, seeking to address the needs of all sustainable modes of transport and considering the movement and place function of all streets. In all cases where schemes are planned, an emphasis must be placed on achieving a quality level of service for people cycling.

Delivering the Healthy Streets Approach

The Healthy Streets Approach requires changes at three main levels of policy making and delivery:

- Street level: how do we provide Londoners with high-quality environments with space for walking, cycling and public transport use?
- Network level: how do we create appealing environments while still ensuring the reliability of the public transport network and movement of freight and deliveries?
- Strategic level: how do we plan for future growth to take advantage of walking, cycling and public transport networks – promoting active travel and reducing car dependency?

Cycling improvements are one aspect to consider within the Healthy Streets Approach. The SCA is based largely on cycling-centric data, although it includes synergies with walking and public transport demand. This analysis can help to inform a future cycling network but its impact on public transport and the wider road network will need to be considered in more detail, in partnership with boroughs, local communities and other modes of transport.

Well designed infrastructure for cycling

What kind of physical interventions can help to meet the demand for cycling identified in the SCA?

Good design for cycling in the context of Healthy Streets means taking into account the full range of uses and activities that streets and other spaces support. Interventions should be well planned at the network level and well designed as part of the wider place.

This approach to cycle infrastructure design is described in the London Cycling Design Standards (LCDS)[3]. LCDS establishes that well designed cycle facilities should be safe, direct, comfortable, coherent, attractive and adaptable. A key factor is the balance between integration with and separation from other users.

Table 1 overleaf shows how different forms of intervention might typically be appropriate for certain types of street, based on their movement and place characteristics.

[3] London Cycle Design Standards (December 2014)

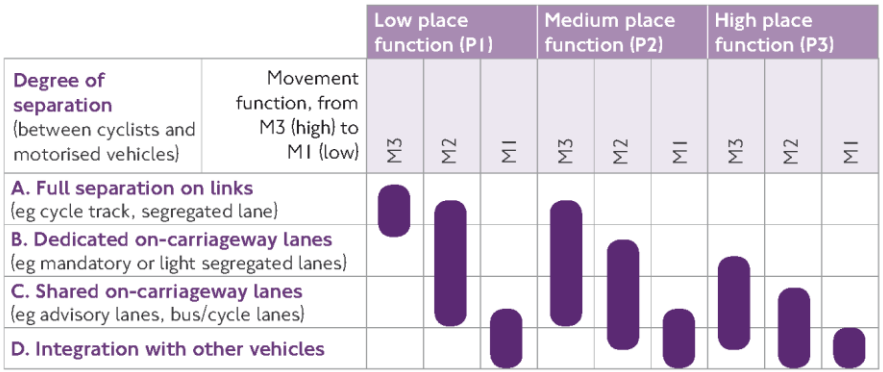


Table 1: Indicative range of cycling interventions

This recognises that people cycle in many different types of environment, not just on designated, signed routes or in cycle lanes or tracks. Demand for cycling might therefore be met in various ways, depending on the characteristics of the place in question. To help make sense of this at the network level, LCDS presents two idealised models for planning and delivering attractive places to cycle: route-based approaches and area-based approaches.

Route-based approaches could take the form of cycle lanes or tracks, or could be about changing the balance between modes and the speed and volume of traffic using a given corridor. A bus priority or speed reduction scheme, for example, could change the traffic conditions so that the level of service for cycling increases.

Area-based approaches might be about removing or substantially reducing through-traffic from an area, enabling cycle access where it is banned for other traffic, such as two-way cycling in one-way streets. They might involve dealing with severance: enabling better walking and cycling access across busier roads between areas where the streets are quieter.

Further details about these approaches can be found in Chapter 2 of LCDS. The most effective way of delivering a network capable of meeting the cycle demand established in the SCA is likely to be a combination of these approaches. For instance, modal filtering in De Beauvoir Town creates a pleasant, traffic-free environment for cycling and walking, and also forms part of longer signed Quietways and Cycle Superhighways.

This reinforces the point that where a corridor is prioritised, it does not follow that the best strategy is always a route-based intervention on a main road.

The potential for more and safer cycling may therefore be unlocked by key junction and crossing improvements, by enabling greater cycle permeability through an area, by calming key sections, or by managing traffic in different ways.

In some cases, where the urban form permits it, a corridor of demand aligned with a main road could be served by improving and connecting parallel, quieter streets for cycling.

PART ONE

Chapter 1: The Strategic Cycling Analysis

The SCA is informed by the origins, destinations, and connecting corridors that could serve the hundreds of thousands of Londoners cycling today. It is also informed by the opportunities to unlock cycling potential.

1.1. Data used

1.1.1. Cynemon: baseline scenario

The Cycle Network Model for London, known as Cynemon, is a new, strategic transport model developed by TfL that estimates cycling routes, journey times and flows at a strategic level across London. Similar models for the highway and public transport networks have long been used to analyse transport issues, but these do not capture cycling particularly well. Cynemon significantly upgrades TfL's ability to model cycle demand, bringing it in line with how other modes are studied.

Cynemon is based on a blend of data sources including Census data, TfL cycle counts and surveys, and data from Santander Cycles. It uses an algorithm to determine the likely route of cycle trips along the networks of streets and urban paths across Greater London, based on their origins and destinations. This algorithm has been calibrated to reflect actual route choice decisions made by people who cycle.

Cynemon's baseline scenario plots all cycle trips made between 08:00 and 09:00 on an average weekday morning in autumn 2014 (see caveats in section 1.3). The model plots the route of each of these trips simultaneously, showing cycle flows across London's network of roads and urban paths, allowing us to understand cycling demand in the Capital.

1.1.2. Cynemon: Analysis of Cycling Potential scenario

TfL has updated the Analysis of Cycling Potential (AoCP)[4]. This study analyses results from the London Travel Demand Survey – a rolling household survey of travel behaviour – and uses a set of criteria to identify trips currently being made by mechanised modes of transport that could reasonably be cycled. Such trips are referred to as 'cyclable trips'.

The AoCP report indicates there are around eight million cyclable trips made each day in London that could be easily cycled in their entirety. Of these trips, 79 per cent are made for purposes other than commuting and 58 per cent are currently made by car. Cyclable trips are predominantly short trips, with an average length of 3.15km.

The origins and destinations of these cyclable trips were used to create a Cynemon scenario identifying the routes each of these cyclable trips would take if they were cycled instead. This provides a picture of where potential demand is located, and where cycling connections would be required to enable these trips to be cycled.

[4] Analysis of Cycling Potential 2016 (March 2017)

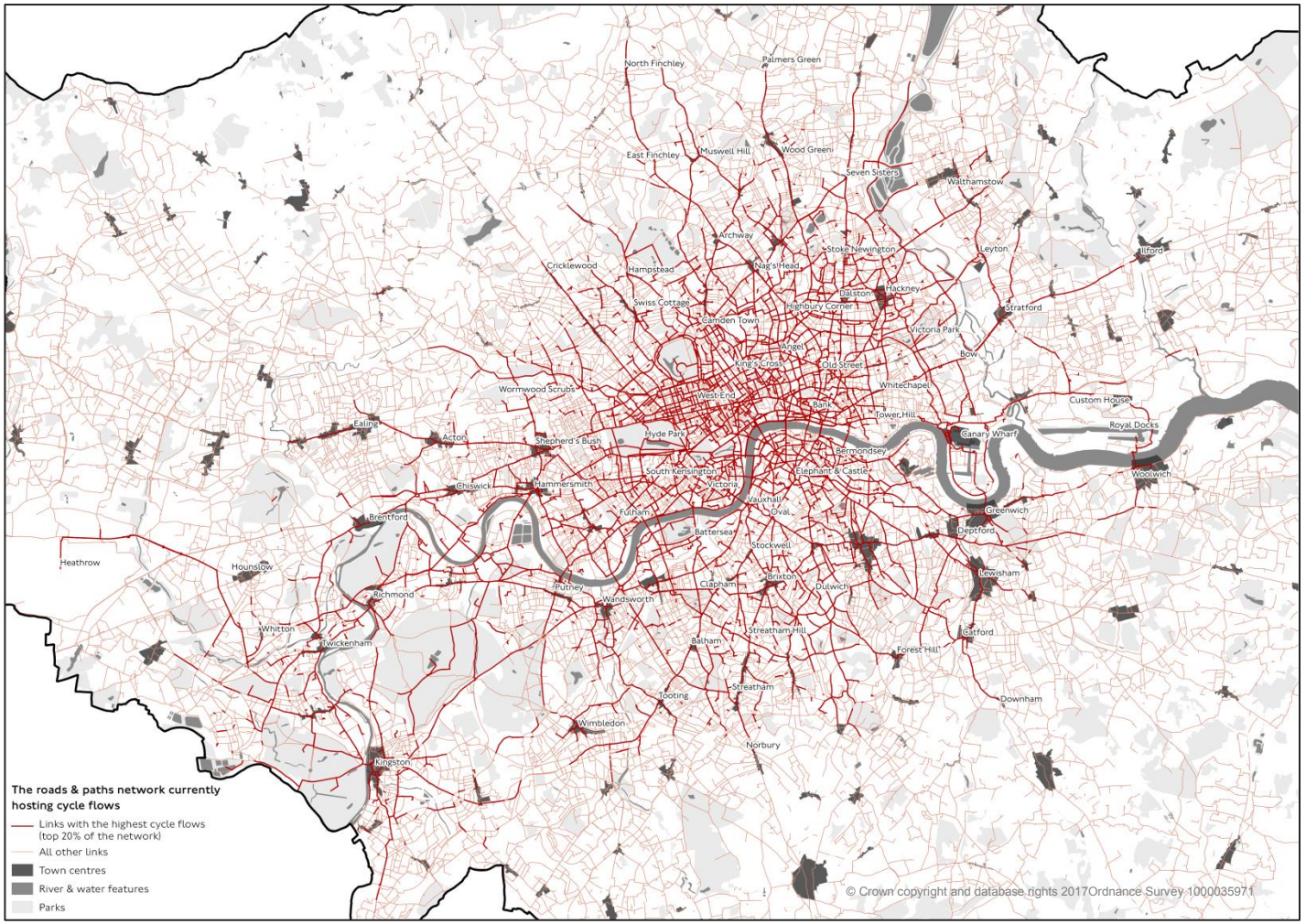
Identifying current cycle flows

The baseline Cynemon scenario was used to identify the streets and urban paths carrying significant levels of current cycle flow.

This was done by removing all links from the model which carry negligible levels of cycle flow (less than one cycle per hour), and mapping the top 20 per cent of the remaining streets and urban paths by current cycle flows.

This analysis revealed the set of corridors in Figure I.I, with which the strategic cycling analysis began.

Figure I.I: Roads and paths hosting the highest current cycle flows



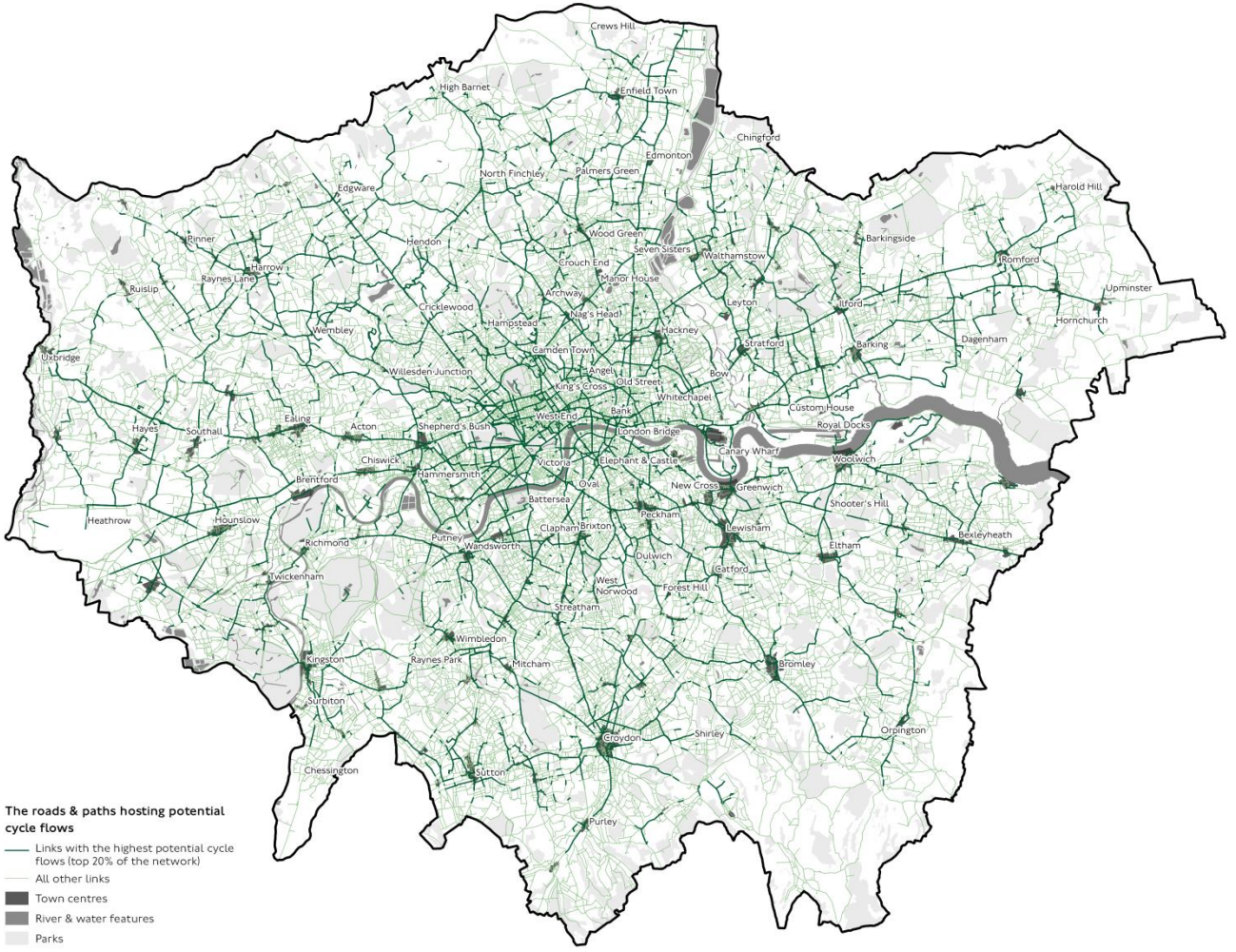
Identifying potential cycle demand

To identify broadly the kind of network London would need in order to attract new people to cycling, and to allow a wider range of trips to be cycled, data from the Analysis of Cycling Potential was routed through Cynemon.

The top 20 per cent of links for potential cycle demand were highlighted. This identified the cycling connections needed to provide for a large number of cyclable trips. This only shows potential demand – it isn't necessarily choosing the best route from a planning perspective.

The map in Figure 1.2 shows much of the top potential cycle demand is on London's strategic road network. Analysis of origins and destinations shows 33 per cent of cyclable trips start or finish on major roads, while many more cyclable trips would be made using the strategic road network in spite of not starting or ending on it. This has obvious challenges when considering interventions that might unlock this demand.

Figure 1.2: Roads and paths hosting the highest potential cycle demand



1.2. Cycle Network Analysis

The next step was to map the following together:

- Current cycle flows from Cynemon
- Top 20 per cent of potential cycle demand, informed by the Analysis of Cycling Potential
- TfL's planned cycling network, as known, to 2022

This allowed the identification of gaps in the planned network, and the analysis of the cycle connections required to serve strategic cycle demand beyond current plans.

It was assumed that the existing and planned cycle routes would serve parallel demand within a 400 metre radius, so a buffer of 400 metres was applied to the map in Figure 1.3 and corridors of high current and potential demand within 400 metres of them were excluded from the network analysis.

When analysing the network gaps, where two or more parallel corridors of either current flows or potential demand existed within 400 metres, just one of the corridors was selected. The intention was to identify the need for strategic cycling connections in a given area, not to identify all possible cycling connections in it.

Cycle Network Analysis

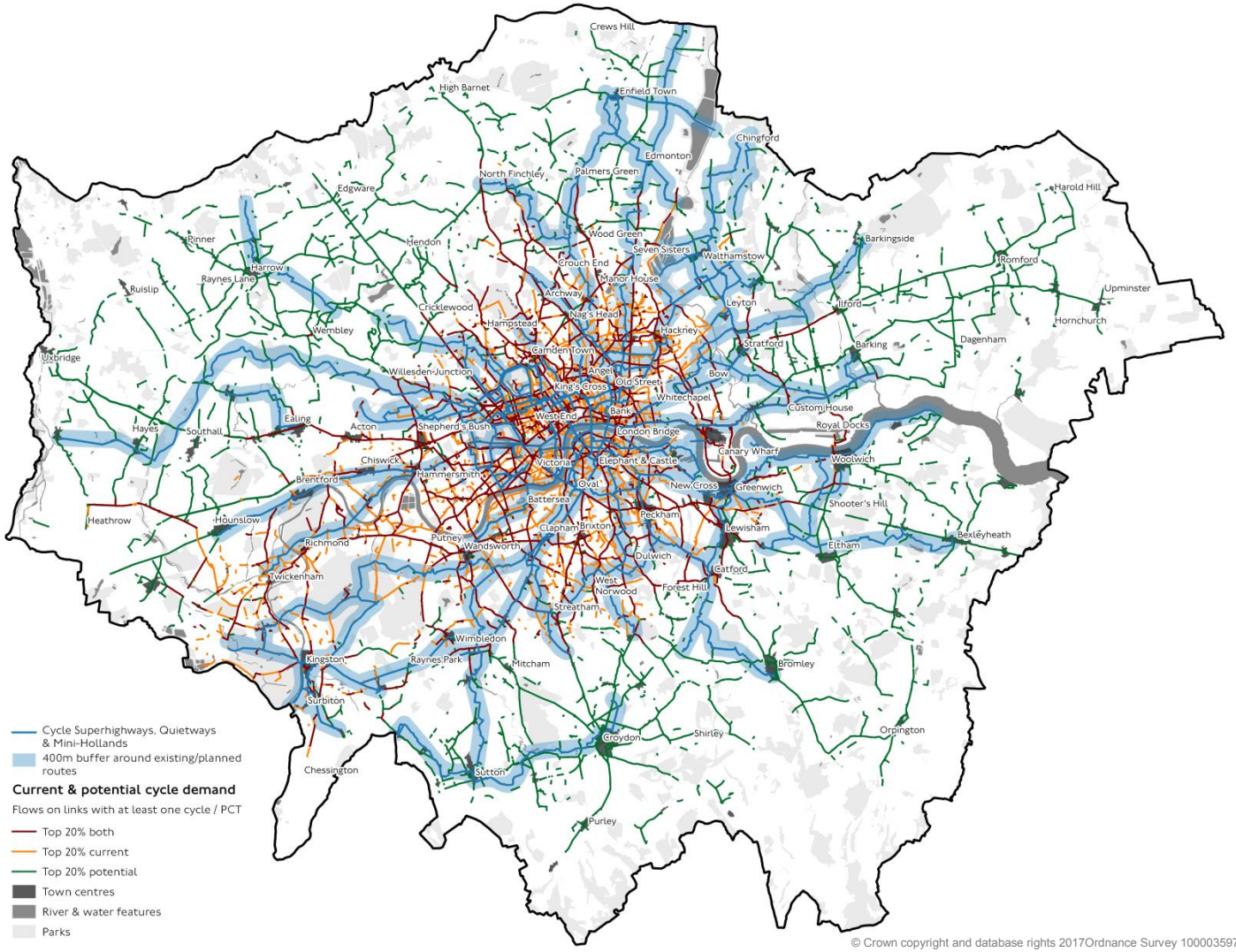
The links with the highest current and potential demand were analysed against TfL's planned network to 2022.

This was the base map used to identify the cycling connections needed beyond current plans.

In parts of outer London, where significant flows are sparser and more disjointed, the cycling connections identified were extended to connect with, or end at, the nearest pole of attraction – for example, a town centre. Similarly, cycle connections identified were extended to join up with existing and planned cycling infrastructure to ensure a continuous network.

Additional layers of information were added to this analysis, which informed the findings presented in Chapter 2.

Figure 1.3: Existing and planned cycle infrastructure with current and potential cycle demand



1.3. Further Explanation

While the data used to develop the SCA is based on robust evidence of the location of current and potential cycle trips, there are limitations on the robustness of this data when it is used to generalise cycle movement across the city.

Cynemon is a strategic model that describes cycle flows in the weekday morning peak. This means the model is biased towards capturing commuting trips and other peak hour travel. Models describing the evening peak hour (17:00 – 18:00) and average inter-peak period (10:00 – 16:00) have also been developed. The SCA was also assessed against current flows during these time periods which verified that important connections serving movement outside of the morning peak were not disregarded.

Future-year scenarios for Cynemon, reflecting the impact of cycle schemes implemented since 2014, are also being developed. Changes in the level and distribution of cycle flows are expected, particularly around new and upgraded cycle routes such as Cycle Superhighways 3 and 6 and Quietway 1. The SCA should be periodically reviewed to reflect new data available and advances in modelling techniques.

Cynemon uses a network based on existing streets and urban paths to route potentially cyclable trips, which can mask demand between two points where infrastructure does not currently exist. A good example is river crossings. In east London, demand may be high between Rotherhithe and Canary Wharf each side of the Thames, but because no existing infrastructure serves the desire line, the model assigns these trips to journeys using the Greenwich foot tunnel, which requires people to dismount and push their cycle. The planned crossing linking Rotherhithe and Canary Wharf would enable far more journeys so further analysis will be required to understand current severance between origins and destinations, and identify how to overcome it, rather than assuming the current cycle route as optimal.

The potentially cyclable trip data used in this analysis includes trips that could be cycled all the way, but not journey stages that could be cycled. There are around 1.2 million additional cyclable stages that make up part of longer, multi-modal trips. Further iterations of the analysis should include these to get a fuller picture of where cyclable journeys could be made.

Additionally, the analysis is based on a London-wide travel survey and so is unable to identify potentially cyclable trips made in London by non-London residents. Supplementary analysis contained in the AoCP shows that there are an estimated 250,000 potentially cyclable trips made by people travelling from outside London into central London rail termini every day.

Routeing cyclable trips provides a good insight into the connections that could be served by a strategic cycle network to attract new users. However, the data is based on existing trip patterns and doesn't indicate the impact of future growth on demand.

In the next chapter, growth forecasts are considered to understand the future needs of London and how these could be addressed. The new Transport Classification of Londoners is also used to improve our understanding of which residents are more likely to cycle or start cycling, and thus make use of new routes.

Chapter 2: Cycling Connections

This chapter outlines how cycling connections identified in the SCA could be prioritised based on their potential contribution to serving current cycle movements, enabling a shift from motorised modes and supporting London's sustainable growth.

Data on current and potential demand was complemented with growth forecasts and information on Londoners' propensity to cycle, based on socio-economic information. Cycling connections were categorised into three levels of priority: top potential connections, high potential connections and medium potential connections.

During the categorisation process, different criteria were applied in inner and outer London. This reflects the differing contexts of these areas and ensured the most important connections in outer London were not de-prioritised by unfairly comparing them to inner London ones.

2.1 Data used

2.1.1 Cynemon: baseline scenario (see section 1.1.1).

2.1.2 Cynemon: Analysis of Cycling Potential scenario (see section 1.1.2).

2.1.3 LTS employment and population forecasts

The London Transportation Studies (LTS) model uses GLA population and employment forecasts and other inputs to predict future numbers of trips between zones across Greater London. Most boroughs are divided into between 20 and 40 such zones, depending on the size of the borough and level of activity there.

LTS zone population and employment projections to 2041 were used to analyse growth.

2.1.4 Transport Classification of Londoners

In 2015/16, TfL developed a customer segmentation tool: the Transport Classification of Londoners. This tool segregates London's population into defined categories within small geographic areas, with each category having common characteristics, wants, needs and priorities. This data can be used to help understand the travel choices people make and their attitudes towards different modes of transport.

2.2 Prioritising Cycling Connections

The first stage of analysis was to understand the potential of each connection in achieving three key objectives:

- Serving the highest levels of current cycle trips
- Enabling the highest numbers of cyclable trips to be realised
- Providing for areas expecting the highest growth in population and employment

The second stage was to assign a level of priority to each connection according to their overall performance, considering propensity to cycle, and also acknowledging the differences between inner and outer London. This was done to assure a more even prioritisation rather than one solely focused on inner London.

2.2.1 Connections serving the highest levels of current cycle flows

The process for identifying connections included mapping the top 20 per cent of busiest connections for current cycle flows after negligible flows were discarded (see Figure 1.1).

To understand the potential of each connection to serve these flows, a finer distinction of the data was required. Therefore, the top 20 per cent of busiest connections were subdivided into the four categories, mapped in Figure 2.1.

2.2.2 Connections enabling the highest numbers of potential cycle demand

A better understanding of the Analysis of Cycling Potential was required to identify which strategic connections could enable the highest numbers of cyclable trips. The top 20 per cent of busiest links for cyclable trips (see Figure 1.2) were subdivided into four categories (see Figure 2.2).

To understand the likelihood of these trips switching to cycling, the Transport Classification of Londoners was used to identify those areas of Greater London where residents are likely to cycle more, or begin cycling.

These datasets were then mapped together, shown in Figure 2.2.

2.2.3 Connections for areas expecting the highest growth in population and employment

Areas expecting significant increases in population and employment were analysed to understand the potential impact of each connection in serving growth. To identify these areas, the 20 per cent of LTS zones with the highest forecast increases in population were mapped. Areas of significant employment growth were identified similarly. LTS zones expected to grow by less than either 2,000 residents or less than 1,000 employees were then excluded.

These datasets were subdivided into four categories (shown in Figure 2.3), resulting in the top 5, 10, 15 and 20 per cent LTS zones for population growth, and corresponding areas for employment growth.

Figure 2.1 shows the top 20 per cent of busiest connections for current cycle flow, subdivided into four categories.

This allows better understanding of which links carry the highest numbers of cycle trips today, and therefore which connections could make the greatest contribution to serving current demand.

	Top 5% busiest connections (current trips)
	5-10% busiest connections (current trips)
	10-15% busiest connections (current trips)
	15-20% busiest connections (current trips)

Figure 2.1: Categorisation of current cycle demand

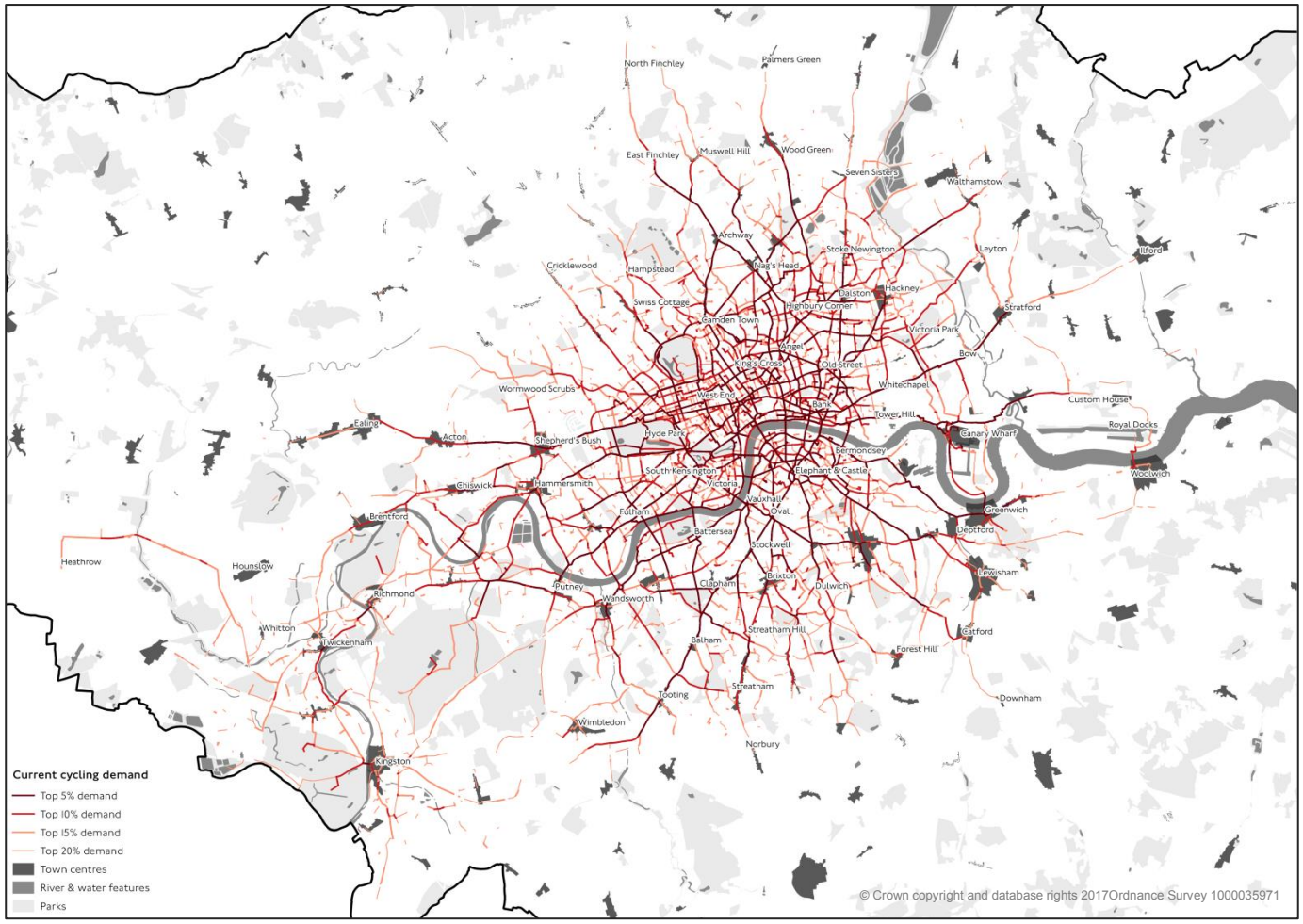


Figure 2.2 shows the top 20 per cent of busiest connections for potential cycling demand, subdivided into four categories.

It also shows areas where residents are more likely to cycle, or begin cycling.

This allows better understanding of which connections carry the highest numbers of cyclable trips, and where Londoners have a greater propensity to cycle. Connections with the greatest potential to enable cyclable trips can then be identified.

	Top 5% busiest connections (cyclable trips)
	5-10% busiest connections (cyclable trips)
	10-15% busiest connections (cyclable trips)
	15-20% busiest connections (cyclable trips)

Figure 2.2: Categorisation of potential cycle demand with high propensity to cycle areas

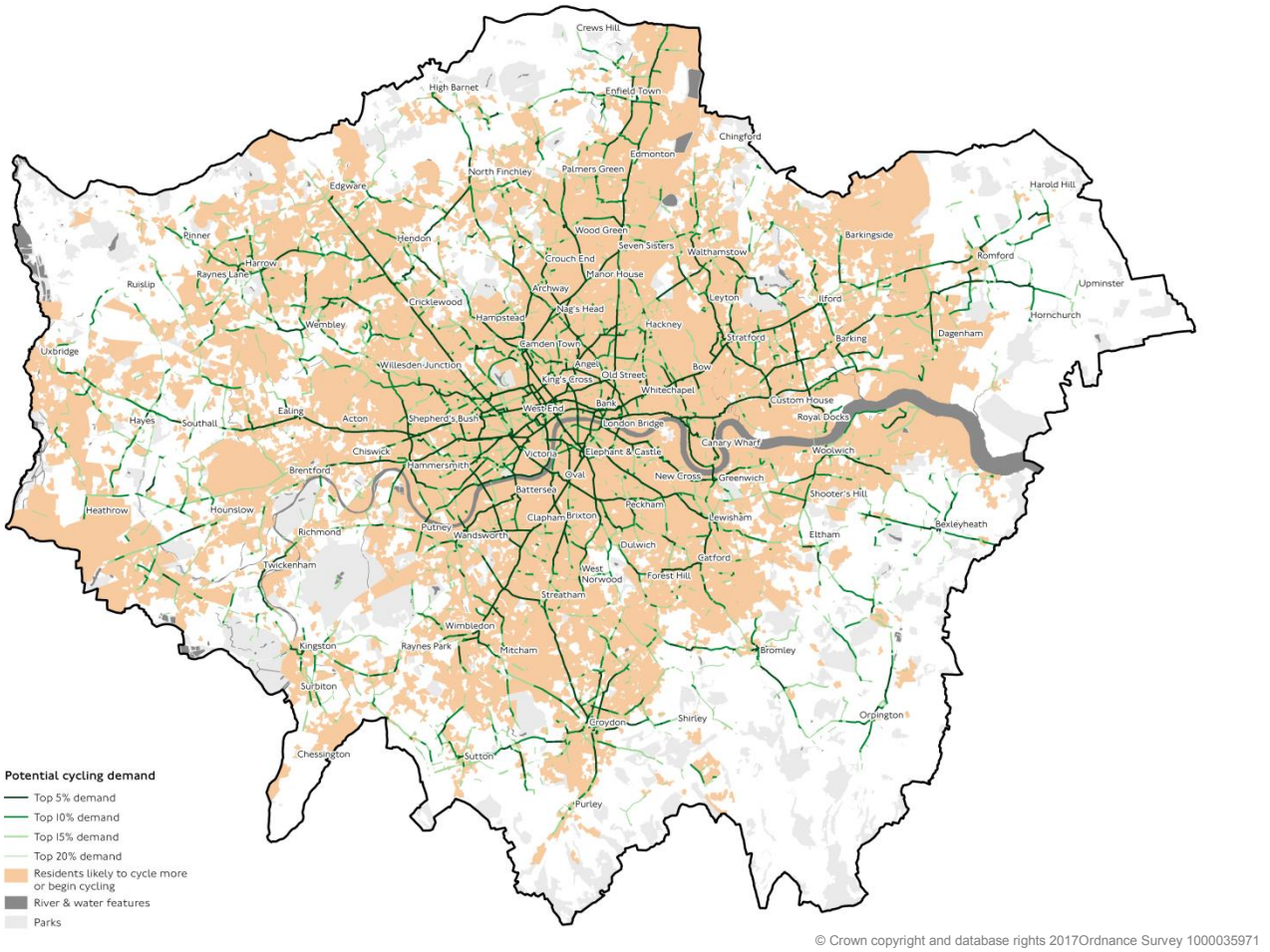
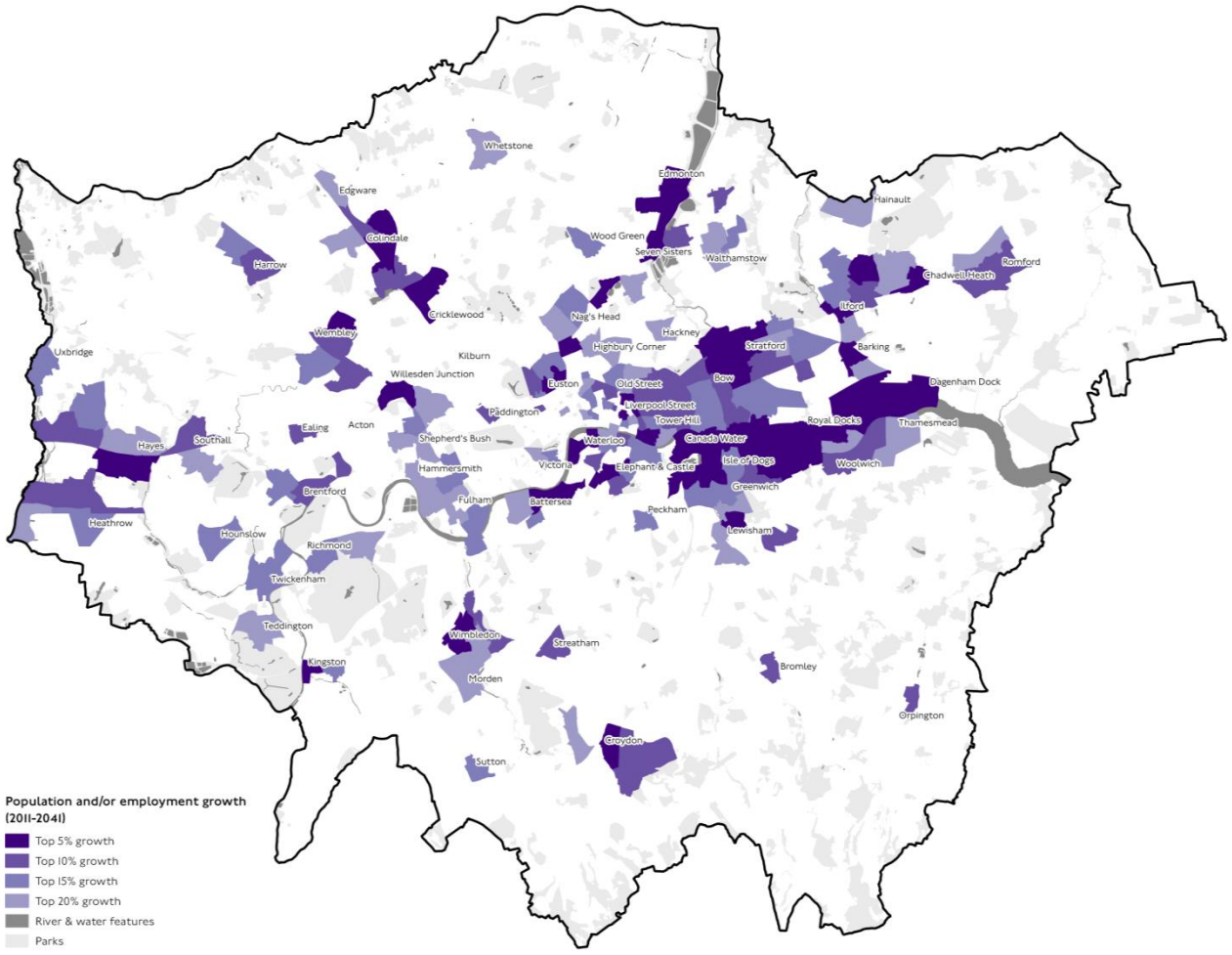


Figure 2.3 shows the top 20 per cent of areas of population growth or employment growth, subdivided into four categories.

This shows where connections could have the greatest potential to provide for cycling in areas expecting the highest levels of growth.

	Top 5% areas for growth
	Top 5-10% areas for growth
	Top 10-15% areas for growth
	Top 15-20% areas for growth

Figure 2.3: Categorisation of population and employment growth



2.3 Summary

Figures 2.1, 2.2 and 2.3 allow us to identify the connections in London which could serve the greatest current and future demand, according to where Londoners are most likely to choose to switch to cycling and where new development and growth will generate travel demand. In this way, we can ensure our future thinking is informed by how London is growing and how we could provide for cycling as a key transport mode to support this.

2.4 Assessing the priority level of each connection

Figures 2.1, 2.2 and 2.3 were used to understand the overall potential of each strategic connection. By comparing these maps, it is possible to understand the different levels of current demand, potential demand and growth served by each connection.

The spatial analysis revealed that few areas in outer London sit within the top 5 or 10 per cent categories for current demand, cyclable demand or growth[5]. This imbalance was considered when evaluating the priority level of each corridor, to ensure the great potential for cycling in some areas of outer London was acknowledged fairly.

Each potential connection was assigned one of three priority levels: top potential, high potential and medium potential.

This classification was a complex process based mainly on demand and growth data, but also informed by network design principles such as geographical spread and continuity.

Table 2.1 overleaf was used to categorise all potential connections.

[5] For the purpose of this analysis, outer London was defined as the areas of London beyond the North and South Circular roads.

Table 2.1: Criteria for categorising potential connections

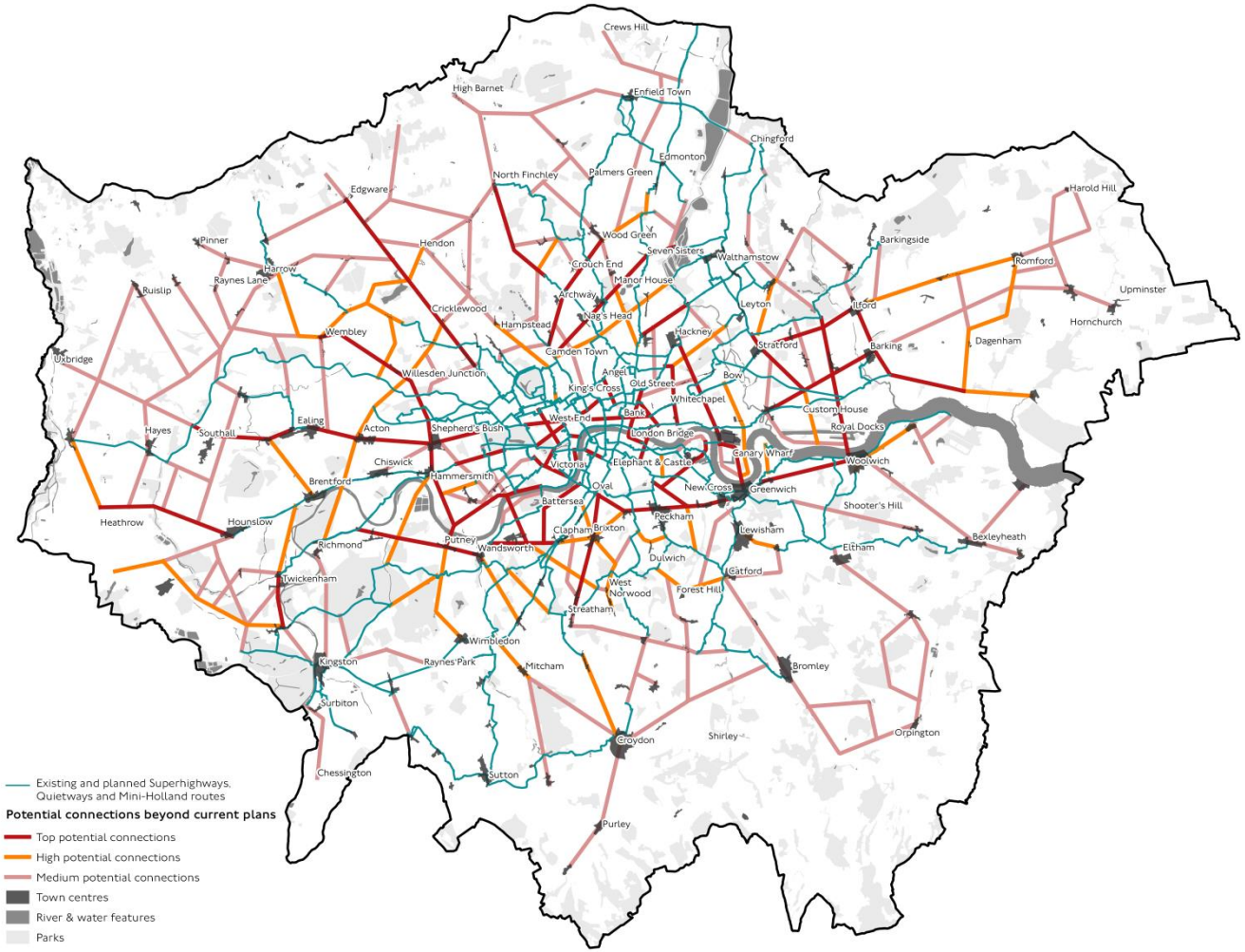
	Inner London criteria	Outer London criteria
Top potential connections	• Connections among the top 5 per cent busiest for both current and potential trips • Connections among the top 5 per cent busiest for potential trips and areas among the top 5 per cent for growth	• Connections among the top 5-10 per cent busiest for both current and potential trips • Connections among the top 5-10 per cent busiest for potential trips and areas among the top 5-10 per cent for growth
High potential connections	• Connections among the top 5-10 per cent busiest for current trips, but the top 5 per cent for potential trips • Connections among the top 5-10 per cent busiest for potential trips and areas within the top 5-10 per cent for growth • Connections among the top 5-10 per cent busiest for potential in areas with a high likelihood to start cycling or cycle more	• Connections among the top 10-15 per cent busiest for current trips, but the top 10 per cent for potential trips • Connections among the top 10-15 per cent busiest for potential trips and areas within the top 10-15 per cent for growth • Connections among the top 10-15 per cent busiest for potential in areas with a high likelihood to start cycling or cycle more
Medium potential connections	• All other connections identified in the Strategic Cycling Analysis.	

Figure 2.4 shows the priority levels assigned to each cycling connection, based on their potential contribution to addressing London's greatest cycling needs. Each connection is shown as a direct 'crow flies' line between origins and destinations and would be subject to further refinement.

This map does not represent specific alignments for routes, or a delivery plan.

These corridors are only prioritised from a cycling perspective. Under the Healthy Streets Approach, they would need to be considered in terms of their wider impacts and deliverability.

Figure 2.4: Prioritised Strategic Cycling Connections



2.5 Further explanation and next steps

2.5.1 Specific caveats of the datasets used

LTS employment and population forecasts are high-level estimates of growth. They show where growth will occur and how much growth there will be – but the accuracy of these forecasts is limited.

The Transport Classification of Londoners is based on the demographics and travel choices of people who live in different areas of London. It is a useful tool for analysing the cyclable trip data but there may also be potential flows originating in areas with a high propensity to cycle which pass through areas of low propensity.

2.5.2 Next steps

Further analysis is required to understand how this SCA can contribute towards addressing other Healthy Streets priorities, such as air quality, congestion and public transport crowding. The local benefits of connections should also be considered to understand the overall contribution each connection could make to improving London. These added benefits must be explored both through analysis of data and evidence, and through conversations between TfL, London boroughs and others.

PART TWO

Chapter 3: Healthy Streets benefits of the Strategic Cycling Analysis

'Healthy Streets for London' (February 2017) identifies low levels of physical activity and poor air quality as some of the most serious public health challenges for London. Tackling these challenges will require making London's streets great places for walking, cycling and spending time, and increasing walking and cycling connectivity to allow people to use active modes to reach the places where they want and need to travel.

This chapter focuses on the potential of cycling connections to contribute to the Healthy Streets Approach of:

- Creating better places and increasing walking
- Complementing and expanding the sustainable transport network
- Improving the connectivity of Londoners to jobs, services and public transport

Identifying these benefits in specific areas will help TfL and the London boroughs to understand the positive local impacts of the SCA, and enable them to effectively communicate these benefits to stakeholders.

As well as identifying opportunities for the SCA to enhance walking and public transport, consideration must also be given to freight. Cycling provision can be compatible with freight and loading, but good design, planning and cooperation are required. This could include physical measures, management of kerbside activity, such as retiming, or a blend of these approaches.

3.1 Creating better places and increasing walking

Investment in cycling infrastructure provides an opportunity to create healthier streets for everyone by reducing the dominance of motor traffic, overcoming local severance, increasing safety and improving the urban realm. These are fundamental ingredients to help unlock walking potential in specific areas of London.

3.1.1 Alignments between the SCA and areas of high potential for increasing walking

The Analysis of Walking Potential (AoWP)[6] indicates there are around 2.4 million journeys made each day in London that could be easily walked in their entirety, but currently are being made by motorised modes of transport. These journeys are called 'walkable trips'.

[6] Analysis of Walking Potential (March 2017)

Walkable trips were mapped as straight lines from origin to destination. A grid of 350m hexagons covering London was overlaid on to a map of London, and each hexagon was given a score based on the number of walkable trips it contained.

The top 20 per cent of highest scoring hexagons for walkable trips were mapped to highlight areas in London with the greatest possibilities for increasing walking.

The SCA was then overlaid with this information to identify the potential for improvements to the pedestrian environment alongside addressing the biggest cycling needs in London. This is shown in Figure 3.1.

3.1.1 Alignments between the SCA and areas with poorer road safety records for people walking and cycling

A grid of 350m hexagons covering London was overlaid on to a map showing all collisions between 2011 and 2015 which involved people walking, cycling or both.

The total number of such collisions in each hexagon was counted, and the 20 per cent poorest performing hexagons for walking and cycling safety were then identified.

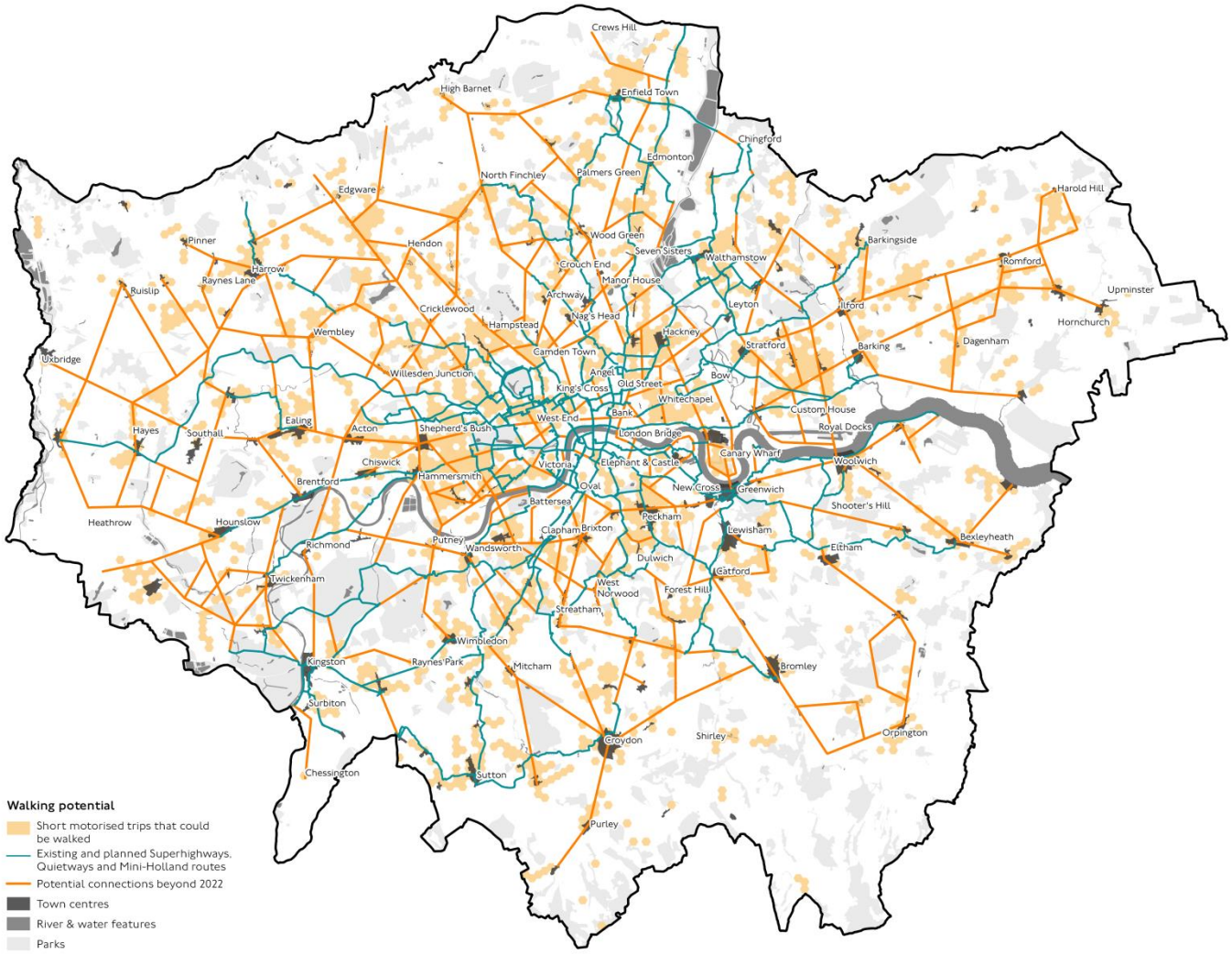
The SCA was overlaid to identify where cycling improvements could also improve road safety for people walking. This is shown in Figure 3.2.

Figure 3.1 shows synergies between currently planned cycle routes, the potential connections identified by the SCA, and those areas with the greatest number of walkable trips.

This demonstrates the many possibilities for cycling routes to contribute to increasing physical activity – by improving the environment for both walking and cycling in those areas where it matters most and where it could have the biggest impact.

The case study below gives an example of the potential pedestrian benefits of delivering improved cycling infrastructure.

Figure 3.1: Potential to improve pedestrian environment



Case Study: Orford Road, Waltham Forest

By managing motorised traffic in the daytime, the dominance of vehicles on Orford Road has been removed and the street has been improved for both cycling and walking. The scheme enhances the public realm, creating a pleasant environment for cycling and walking.

Traffic filters in nearby streets lower the overall number of vehicles in the area, making active travel in the neighbourhood more attractive.

The scheme also functions as bus priority, prioritising sustainable transport and making it a more convenient choice.

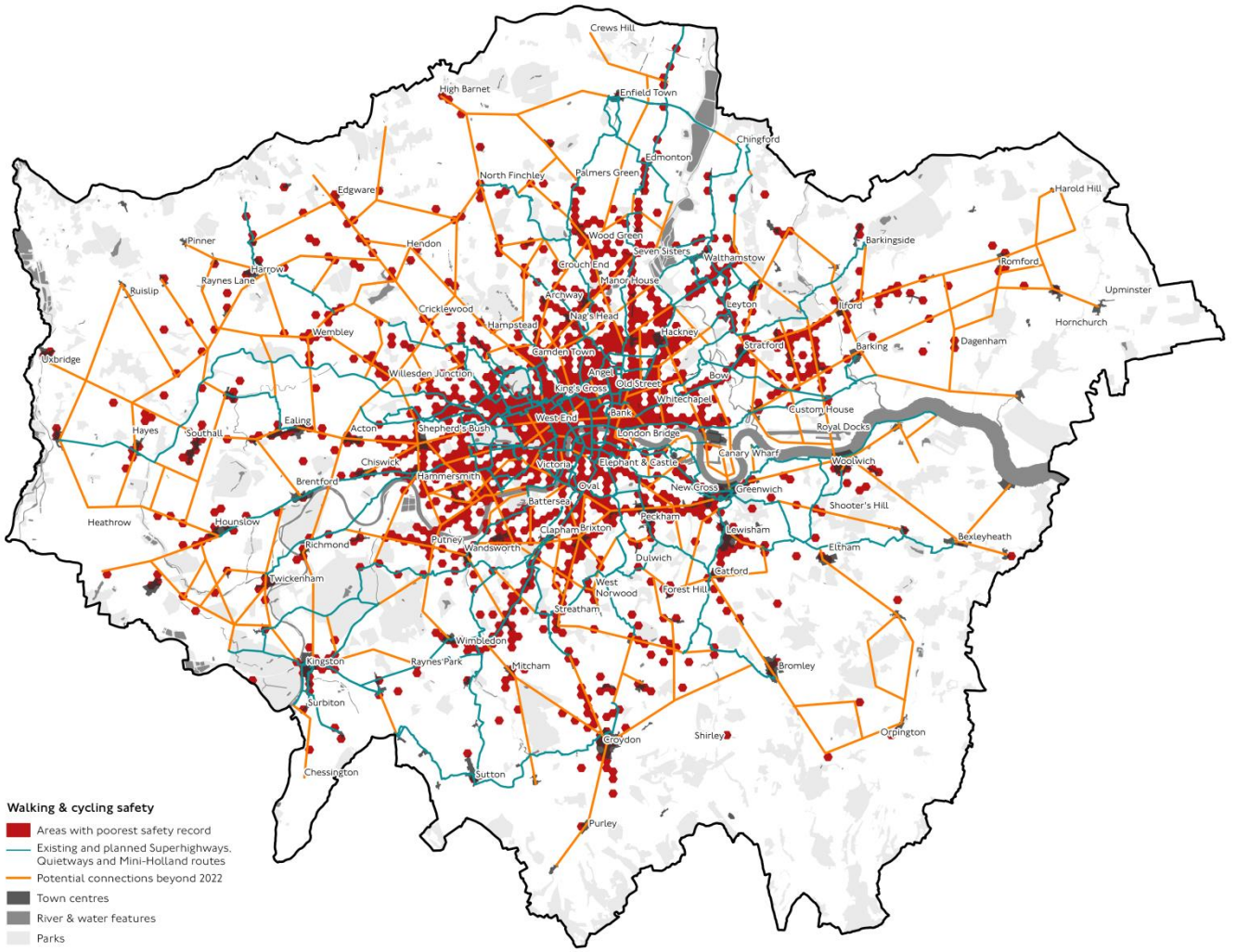
Figure 3.2 shows where the potential connections identified by the SCA could contribute to addressing walking and cycling safety.

The 20 per cent poorest performing areas for walking and cycling safety have been identified, based on the total number of collisions (all severities) involving people walking or cycling.

SCA connections can deliver improvements at these locations and help create a safer and more attractive environment in which to walk and cycle.

Additionally, TfL's Safer Junctions programme will improve road safety for all vulnerable road users at a number of TLRN junctions across London, with many of them located in areas identified on this map.

Figure 3.2: Potential to improve road safety for people walking and cycling



3.1.2 Further explanation and next steps

The walkable trip data used in this analysis includes trips that could be walked all the way, but not journey stages that could be walked. In addition, there are around 1.2 million potential walking journey stages which make up part of longer, multi-modal trips.

Therefore, there will be even higher walking potential in central London in particular, where there are a high number of walkable stages but a lower number of entirely walkable trips. Further iterations of the analysis are likely to include journey stages to provide a fuller picture of where walking potential could be unlocked.

In addition to walking potential, London Travel Demand Survey pedestrian density data can also be explored to analyse the SCA in relation to places that currently attract a high number of walking trips.

Some junctions and areas may have a low number of collisions but still cause considerable severance for people walking and cycling. Further understanding on the causes of local severance within each borough, and how cycling improvements could help address them, is required.

3.2 Complementing and expanding the sustainable transport network

A key Healthy Streets objective is to achieve a shift away from car use to more efficient modes of transport. The SCA can help deliver this outcome by identifying where cycling connections can complement and expand sustainable transport options.

The analysis in this section is structured in two parts:

- Delivering SCA connections alongside improvements for the bus network
- Supporting cycle interchange through the SCA and better connecting public transport hubs

3.2.1 Delivering SCA connections alongside improvements for the bus network

On some strategically important roads, high bus demand and high cycle demand may coincide. Sometimes, good provision for buses, cycles and general traffic can be offered on the same road. Where this isn't possible, an analysis of strategic movement in the area is recommended so that good choices for all sustainable transport modes are identified and prioritised.

This section presents four options for resolving situations in which the requirements of buses and cycles overlap on main roads:

1. Provide dedicated facilities for all modes
2. Prioritise buses and cycles through general traffic management (reduction or removal of private cars)
3. Provide high quality cycle provision on a nearby parallel street
4. Adapt the bus network in the area

Each option is illustrated by a case study. The most appropriate option will always depend on context and TfL is developing a Healthy Streets Appraisal Framework to aid decision making in this area.

Figure 3.3 shows where potential SCA connections may coincide with high bus frequencies.

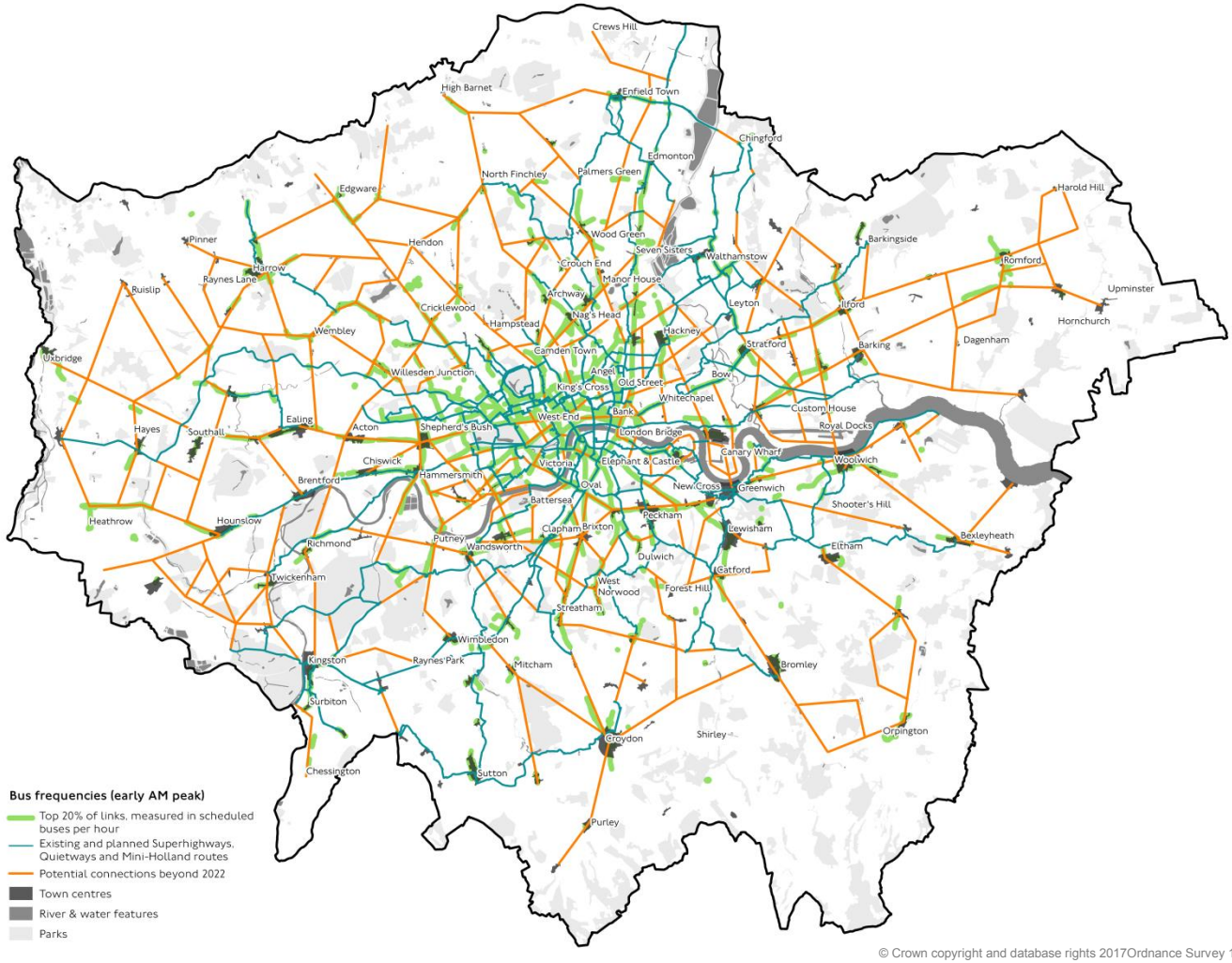
In order to identify roads where cycles and buses may compete for space, scheduled bus frequency data was mapped alongside SCA connections.

The scheduled bus frequency data represents the total number of buses per hour during the early AM peak period. The data represents one direction of travel for services operating in June 2016.

There are many ways in which improvements for both buses and cycles can be delivered when there is high demand for the two modes.

On the next pages, four options to resolve bus and cycle overlaps are explained. All options are based on emerging or delivered schemes in London.

Figure 3.3: The SCA and high bus frequencies



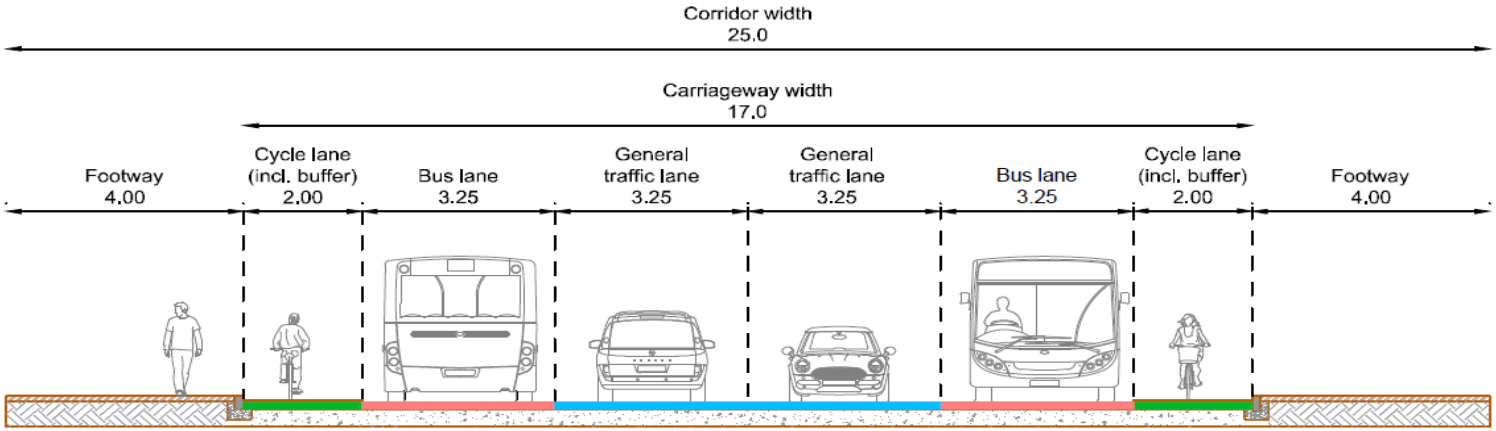
Option 1: Provide dedicated facilities for all modes

In this example, high cycle and bus demand coincide on a wide road.

Case Study: Design options for the Old Kent Road

One of the design options currently being explored for this corridor is to provide dedicated space for cycles, buses and general traffic, while securing an excellent environment for pedestrians.

Option A1 - One-way cycle lanes / tracks



Option 2: Prioritise buses and cycles through general traffic management (reduction or removal of private cars)

Where road space is more constrained and dedicated facilities cannot be accommodated for all modes, cycle and bus demand should be prioritised over general traffic. Two possible approaches to reducing general traffic and creating space for cycles and buses are:

A) Traffic management by:
- Filtering through-traffic (e.g. one-way entry and exits) to side roads
- Prioritising access (e.g. bus and cycle gates)
- Limiting general traffic to one-way flows with contraflow for buses and cycles
- Reducing access points along major arteries such as the North and South Circular
- Targeted charging (i.e. congestion charge, toxicity charge)

B) A road with high demand for buses and cycles could be radically improved by removing private car movements from it, either through a ban or using modal filters. This would provide dedicated space for buses and cycling, as well as improving the pedestrian environment and allowing an efficient consolidation and retiming of freight.

Case Study: Tottenham Court Road, Camden

The planned Tottenham Court Road scheme is an example where only buses and cycles have unlimited access and freight delivery is timed.

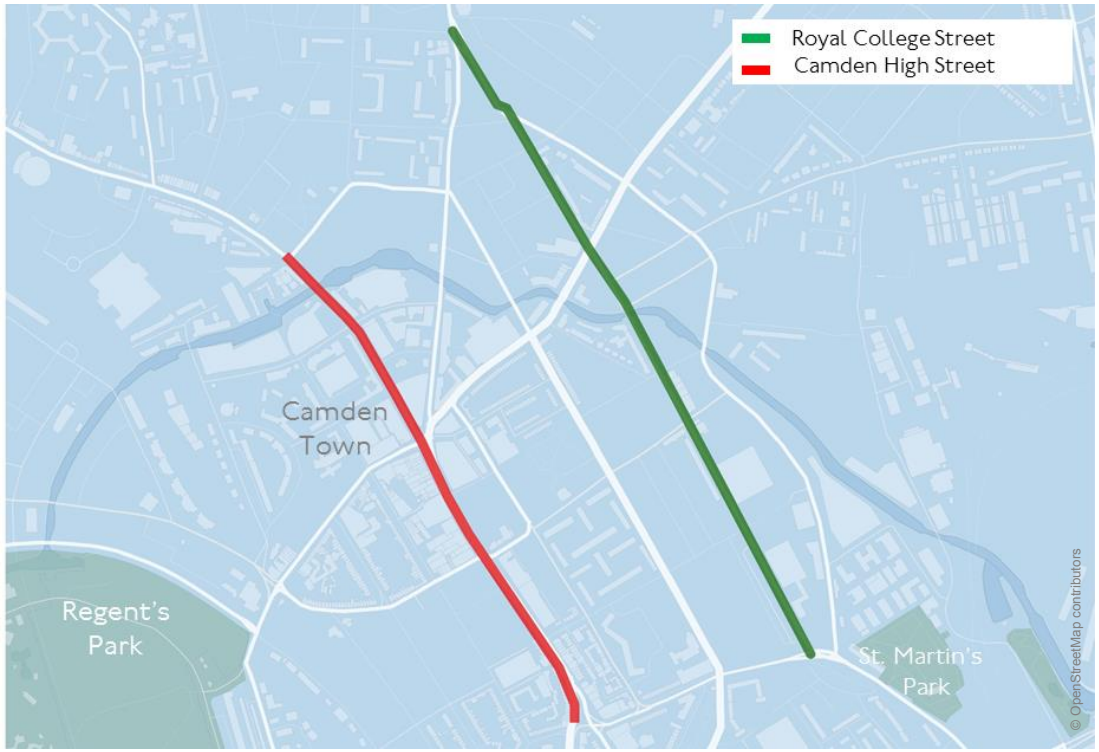
Option 3: Provide high quality cycle provision on a nearby parallel street

Where a suitable alternative connection exists parallel to the desire line, high-quality cycle provision can be offered on another road – either segregated or shared with low volumes of traffic.

This option requires a dense and well connected road network, where a suitable alternative without excessive deviation from the main road is available. The London Cycling Design Standards (LCDS) provides further guidance on providing alternative cycle routes to desire lines.

Case Study: Royal College Street and Camden High Street

Royal College Street in Camden is an example of where high quality infrastructure has been provided on a parallel road in order to serve a desire line for cycles without impacting the bus network. Light segregation on Royal College Street complements bus priority on Camden High Street, encouraging people to cycle or catch the bus along the corridor.



Camden High Street
Bus priority

Royal College Street
Cycle lanes

Option 4: Adapt the bus network in the area

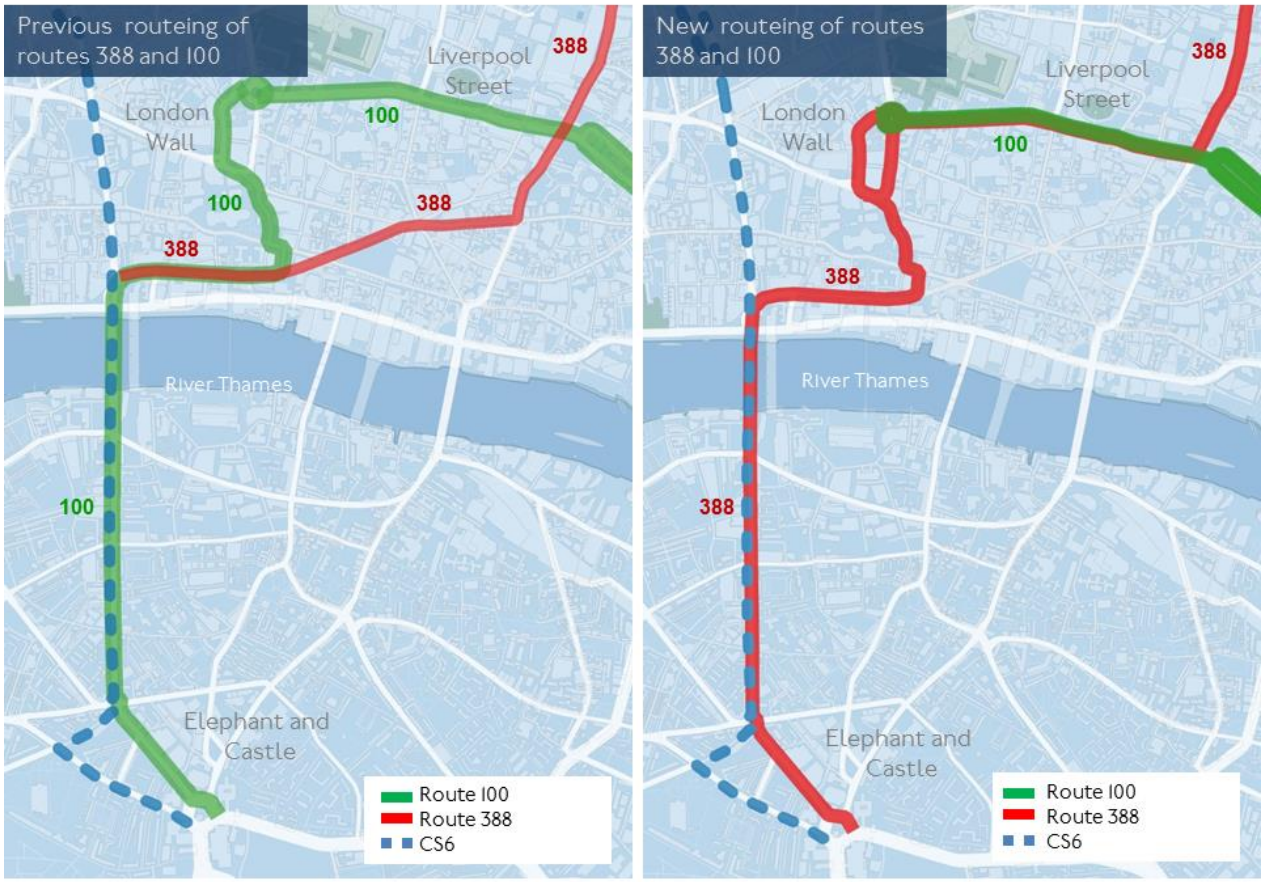
Integrated planning of bus routes as part of the scheme following the healthy Streets Approach provides opportunities to improve overall local provision for people cycling or catching the bus.

These include:

- Adapting bus frequencies and simplifying service patterns to match projected demands and travel patterns as a result of the scheme
- Shifting some bus services to adjacent corridors where existing or potential bus priority could enhance these journeys
- Optimising stopping patterns and bus stop locations to improve kerb-side interactions, reduce bus dwell times and facilitate transfers utilising the Hopper Ticket
- Delivering bus priority on and approaching the area to improve reliability of local services

Case Study: Cycle Superhighway 6 / Bus routes 100 and 388

Bus route 100 used to run alongside CS6 between Blackfriars and Elephant and Castle, and route 388 terminated at Blackfriars. Having considered the usage patterns for routes 388 and 100, these routes were changed with a new interchange between them at London Wall. This better matched bus capacity with usage, freeing up resources which can be used elsewhere on the network.



3.2.2. Public transport hubs for cycle interchange

This section describes the analysis performed to identify areas where cycling connections could support multimodal trips by improving cycle access to important rail and Underground stations. In these areas, cycling routes would better connect stations to their surrounding areas and contribute to reducing the dominance of motorised traffic.

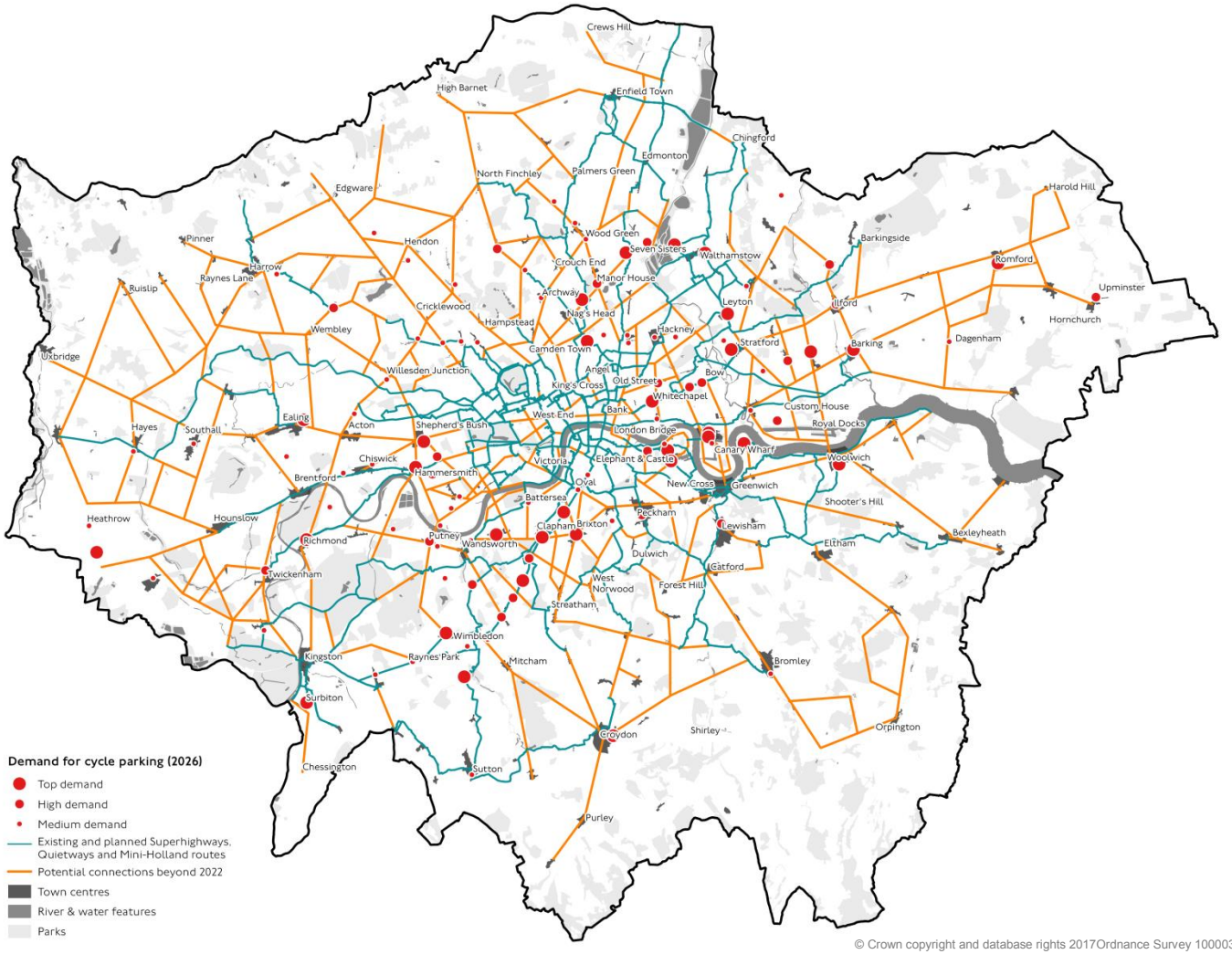
TfL's Cycle Parking Demand model was used for this analysis. The model identifies the benefits of providing cycle parking at stations within Zones 2 – 9. It also provides forecasts for the number of cycle parking spaces required in 2026 if a secure cycle park were to be provided.

Using data from the Cycle Parking Demand model, the most important public transport hubs for cycle interchange were identified. These consist of stations with the top 20 per cent forecast demand for cycle parking. This data was mapped with the SCA to assess how well these important stations could be served.

Figure 3.4 demonstrates that the majority of the stations with high forecast demand for cycle parking could be served by a network of cycling connections.

Notably, all stations with top or high projected demand would be served by the connections identified by the SCA.

Figure 3.4: The most important public transport hubs for cycle interchange



3.2.3 Further information and next steps

The Cycle Parking Demand Model has several caveats, outlined below, and would require substantial further development to address them. This is why it is used here to identify relative levels of demand for cycle parking and not to establish detailed cycle parking requirements at specific stations.

The model assumes that each station will have the same catchment distribution as the base year. However, in some areas, where significant housing development is planned, the mode share may change. Growth in the model is based on forecasts from TfL's Railplan model. These are recognised to understate the extent of passenger growth at some stations.

New stations due to be built, including along the Northern line extension and the Elizabeth line, are not included in the model and neither are planned future projects such as HS2 and Crossrail 2. The model does not consider stations that do not have typical passenger profiles, such as the Heathrow stations.

Many rail commuters leave a cycle in a secure facility overnight at the station and use it for their onward journey to work. There is significant potential for more cycle trips in central London to be made in this way, but the potential for this is not included in the Cycle Parking Demand Model. Further work is required to understand the potential for cycle provision at central London rail termini and elsewhere in Zone 1.

The next steps will include further analysis of cyclable stages to and from stations, made as part of a longer public transport journey, as identified by AoCP (see section 1.1.2). These could be routed using Cynemon to identify the greatest concentrations of trips.

3.3. Improving the connectivity of Londoners to jobs, services and public transport

The information from the SCA could play a key role in making London a more connected city for people. This section outlines the analysis that identified where cycling connections would have the greatest impact on improving access within a Healthy Streets framework.

3.3.1 The contribution of cycling connections to improving access to public transport

The potential of cycling connections to improve access to public transport was studied by comparing the Public Transport Access Level (PTAL) of an area with the corresponding Cycling PTAL (CTAL), and identifying areas with poor PTAL but good CTAL.

Public Transport Access Level (PTAL)

PTAL[7] is a measure of access to public transport across London. Each area in London is given a PTAL value between 0 and 6, based on the number and frequency of public transport services that can be accessed by a short walk. Areas with higher PTAL values have better access to the public transport network.

[7] http://content.tfl.gov.uk/connectivity-assessment-guide.pdf

Cycling PTAL (CTAL)

To derive CTAL values across London, a 100-metre grid was overlaid on the Cynemon network (described in section 1.1.1) and, for each grid square, the number of rail and Underground stations within a five-minute cycle was calculated. This was chosen as a conservative estimate of how far people will be willing to travel to access a station. It was assumed that people will still walk, rather than cycle, to access buses, due to the lack of cycle parking at bus stops.

The same methodology as PTAL was applied to each grid square to calculate a CTAL value, with higher CTAL values representing better access to the public transport network. CTAL values are calculated using the same scale as PTAL values (0 – 6b), allowing the PTAL and the CTAL of areas to be compared.

CTALs are based on the current geography of London. They show the current potential for cycling accessibility in an area but this potential might be unrealised without complementary infrastructure. For example, someone may live 15 minutes walk from a London Underground station in an area of low PTAL. But if a cycle route was provided linking them to their nearest London Underground station in less than five minutes on a bike, and additional cycle parking was provided, the CTAL could be realised.

Figure 3.5 shows areas with low PTAL values (2 or less) but high CTAL values (3 or more).

This analysis enables the identification of areas where access to the public transport network is currently low, but could be much improved if cycling was facilitated.

There are numerous overlaps between areas of low PTAL and high CTAL, which demonstrates the important role that a cycling network could play in increasing access to public transport for the local communities it would serve.

Figure 3.5: The potential for a cycling network to improve access to public transport

3.3.2 Further explanation and next steps

CTAL is a developing concept and work is being continued to refine it. For example, a better understanding is required of how far people are willing to cycle to access public transport services, and if people would be willing to cycle to access bus services. A maximum travel time of five minutes was used for this study, but this represents a conservative estimate.

CTAL uses information about the public transport services that can be accessed within a five-minute cycle ride, but does not consider the quality of cycling provision on the roads. Cycle access to stations from some areas could involve using roads that many would feel uncomfortable cycling on. To realise the improved access to public transport shown in Figure 3.5, conditions for cycling may need to be improved.

In some areas with improved CTAL, it may be more likely that the entire journey would be cycled, rather than just the first stage. This is more likely to be the case in inner and central London locations, where many rail and Underground trips are short enough to be cycled in their entirety.

Cycling infrastructure can also improve public transport access in areas with high PTAL values by allowing access to even more rail and Underground stations. Further study is needed to identify these areas.

Chapter 4: Area-wide opportunities to expand cycling connections

This analysis explores where there is most potential to develop and expand cycling connections via local interventions, such as:

- Traffic management measures to make neighbourhoods more permeable for cycling and walking, and better connected to key destinations, such as town centres and schools
- Positively influencing the street network of areas where growth will take place and where the urban form is most likely to change in the short- to medium-term
- Within programmes like Liveable Neighbourhoods, where boroughs will bid for funding to support the Healthy Streets Approach in particular areas

4.1. Identifying area-wide opportunities

Three elements were studied to identify area-wide opportunities to improve conditions for cycling:

- Areas of growth, as detailed in section 2.1.3.
- Areas of highest cycle demand, based on current and potential cycle demand
- Most permeable neighbourhoods, based on patterns of urban form

4.1.1 Defining areas

Severance was mapped using data on geographic features and the Street Types methodology developed by TfL and the London boroughs (figure 4.1). Severance was taken to include waterways, railway lines and roads with significant levels of traffic flow – the 'M2' and 'M3' roads from the Street Types dataset. This allowed the identification of where natural and man-made barriers to cycling are most likely to occur.

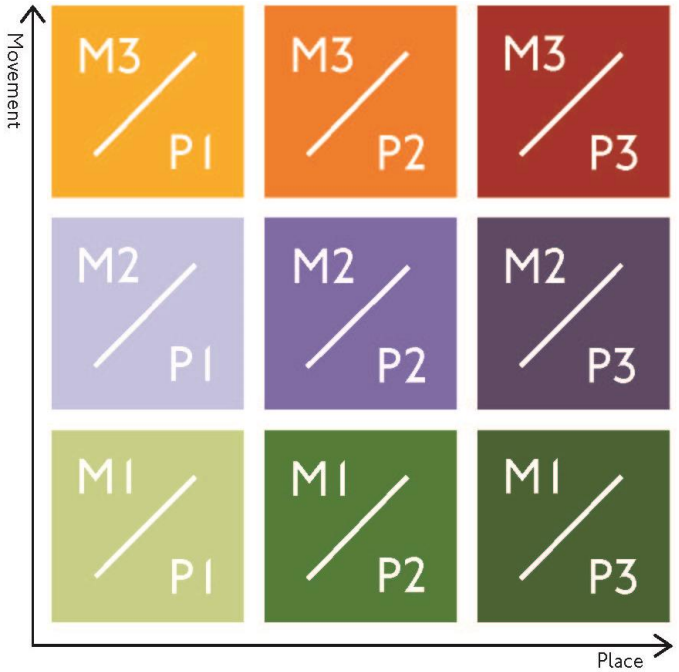


Figure 4.1: TfL Street Types Matrix

The resulting areas became the units for further analysis. Each unit is bound by likely barriers to cycling but has the potential to be internally permeable, depending on its urban form.

4.1.2 Identifying areas of highest cycle demand

Area-wide potential for large increases in cycle trips was mapped by assigning Cynemon data on current and potential cycle demand, equally weighted, to each of the unit areas identified in 4.1.1 above. Unit areas were ranked by score per area (sq km) and the top 50 per cent studied.

4.1.3 Identifying zones of transformation

GLA projections of population and employment growth were mapped to show where London's urban form is most likely to change over the coming decades. In such places, the opportunity may exist to plan permeability and greater route choice for cycling into the emerging street network at neighbourhood-wide scale.

Zones of transformation – the areas expecting the highest growth – have been defined as LTS zones (see 2.1.3) that are expected to grow by at least 40 per cent in population and 45 per cent in jobs by 2041.

4.1.4 Identifying the most permeable neighbourhoods

A dataset generated by UCL/Space Syntax was used for part of the analysis. This was prepared by rating every street in London on a 1-to-12 scale according to how connected it was to other links in the network. For example, a through-route, or a link, that enables many different journeys scores highly whereas a cul-de-sac has a low score.

Each unit area was scored according to the density of highly connected links in its street network. This meant dividing the length of links scoring three or higher in the UCL/Space Syntax model by the total length of all links in the unit area. The top 50 per cent of unit areas were studied.

4.2. Findings

Figure 4.2 shows distinct opportunities for creating more places where a whole area could support more cycling, not just a designated connection. These opportunities include where high cycle demand coincides with parts of the street network that are already amenable to improving cycle permeability. This can help inform boroughs' plans for Liveable Neighbourhoods.

Figure 4.2 also shows where growth coincides with high cycle demand. These areas are likely to change significantly over time and could accommodate good quality additions to a strategic cycle network, if well planned.

These areas are shown as possible additions to cycling connections because the means by which improvements

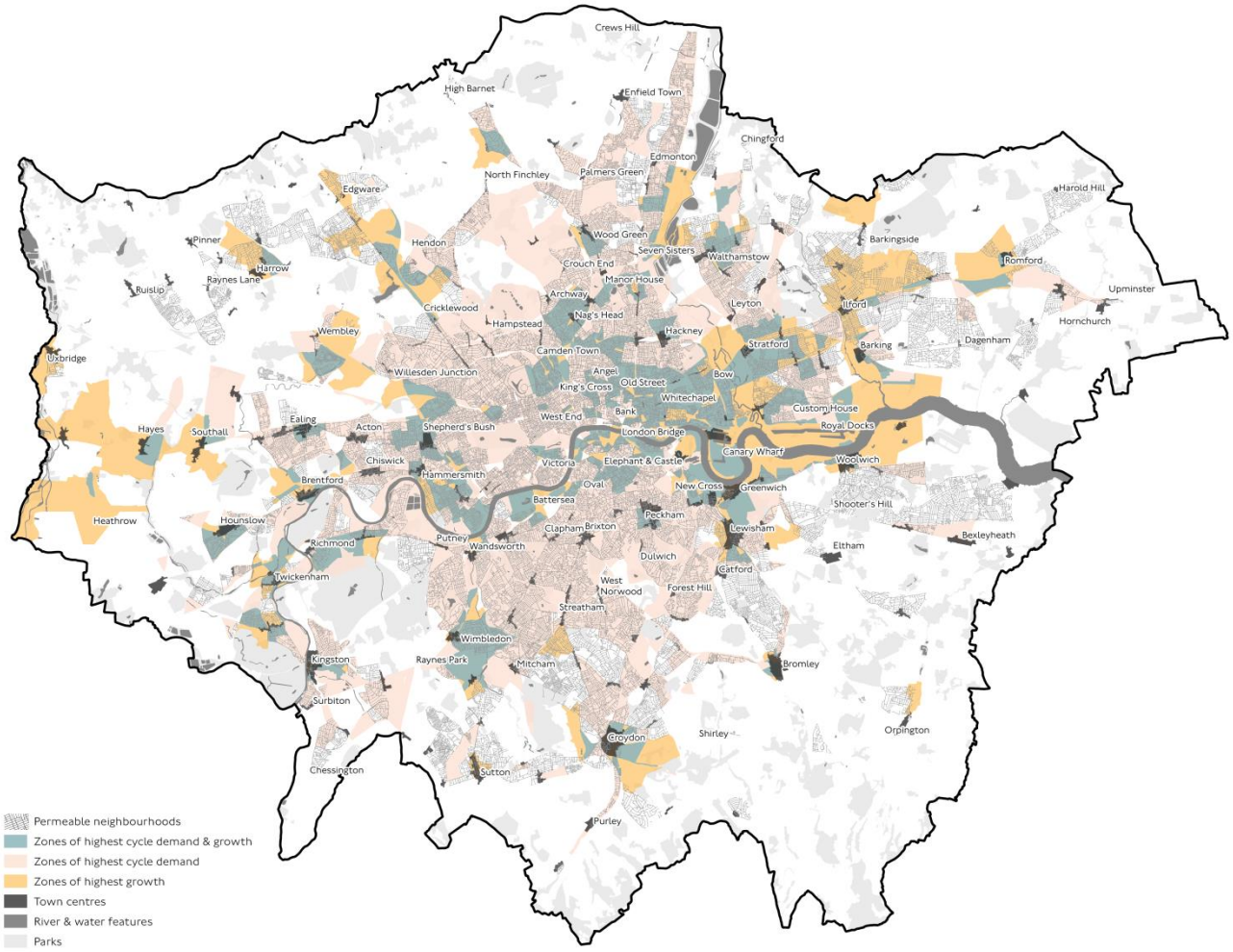
might be made are likely to be different and more incremental. This might, for example, be a case of ensuring that new developments create a street network that attracts more people to cycle, or of introducing traffic management measures to established neighbourhoods that would reduce through-motor traffic but maximise permeability for cycling and walking. Where these are done in conjunction with route-based improvements, greater benefits would be expected in terms of modal shift and the number and diversity of people cycling.

Figure 4.2 provides the basis for considering how a cycle network might be expanded locally, both in places where there is likely to be investment in new routes, and places located in the gaps between those routes.

This can inform discussions about area-wide plans or initiatives to better connect particular destinations by cycle, such as town centres, schools or places of work. It can provide boroughs with additional information to support their bids for Liveable Neighbourhood funding, or to help prioritise LIPs spending on Healthy Streets.

This data could also be used as the basis for planning how a public transport interchange might attract more multi-modal trips by relatively light-touch interventions in the local area and improvements to station cycle parking.

Figure 4.2: Area-wide opportunities to expand cycling connections



Area-wide improvements: Walthamstow Village case study

As a key part of its Mini-Holland programme, the London Borough of Waltham Forest trialled a series of filtered streets and public space improvements in Walthamstow Village aimed at getting more people in the area to choose to walk and cycle.

The changes were subsequently made permanent, creating a neighbourhood where most streets are calmed to support safer, more comfortable cycling and walking to local amenities. This has been done in conjunction with cycle infrastructure improvements on Hoe Street and Lea Bridge Road, which are main roads bounding the Walthamstow Village area.

This combination of route-based and area-based approaches has reduced through-traffic in the area. Average daily vehicle flow fell from 8,493 before the scheme to 4,808 afterwards. It also helped to join up other existing and proposed cycle infrastructure in the borough.

Modal filters were introduced in eight separate locations, allowing access by buses and cycles only. Selected streets were changed to one-way working.

Orford Road, the main shopping street, saw all through-traffic removed, except buses and cycles.

4.3. Further information and next steps

The data presented here focuses mainly on the potential for change and on the capacity of existing and future form to accommodate that change. More detailed analysis is needed of the possibilities this offers – ideally informed by specific local knowledge.

One important caveat to the information presented on urban form is that the UCL/Space Syntax data considers only the street network, so the mapping of permeability for cycling is likely to underestimate the significant potential for off-carriageway links to form important connections in the network.

The definition of unit areas was based on identifying likely barriers to cycling. This means that clusters of units are not always large, permeable areas but could disguise significant barriers. However, in such places, if an intervention could be made to overcome a given barrier then there is likely to be significant benefit in joining up unit areas that are internally permeable.

Another caveat is that it does not account for where barriers to cycling might already have been overcome, for example by bridges, subways or good quality crossing facilities. What appear to be barriers in this data analysis exercise may not be real barriers on the ground. Further qualitative analysis of severance within TfL and with boroughs would help to refine this.

Finally, more detailed analysis of connections to town centres and other important destinations would be beneficial. This could assist with further prioritisation of areas for future investment.

PART THREE

Chapter 5: Conclusion and Next Steps

This analysis shows the cycling connections with the greatest potential to contribute to cycling growth in London. It suggests a prioritisation of each connection based on their contribution to three main goals:

- Serving the highest number of current cycle trips
- Enabling the highest number of cyclable trips
- Connecting to the network areas expecting the highest growth

In line with the Healthy Streets Approach, the analysis also presents evidence to show how the cycle network could improve the health and quality of life of the communities it would connect.

Finally, the SCA identifies the zones for area-wide interventions that could expand and add value to cycling connections through other schemes, including Liveable Neighbourhoods, or LIPs spending.

5.1 Next Steps

This document provides a robust, analytical framework to help develop a long-term strategic plan for cycle routes in London in line with the Healthy Streets Approach. It is not intended to be a completed, prescriptive or 'top-down' network plan.

The next steps will involve engagement at sub-regional and borough level, to review this evidence and use it to guide decisions on delivery plans and strategies, including local cycling and walking infrastructure plans.

This analysis, in addition to feedback from the 2017 consultation on the draft Mayor's Transport Strategy, will be used to help develop TfL's strategy for cycling and Healthy Streets.

In practical terms, TfL will work with boroughs to develop proposals for potential connections and area improvements identified by the Strategic Cycling Analysis.

To help inform this, TfL will conduct initial feasibility studies on the 25 Top potential connections in inner and outer London (Figure 5.1). Alongside discussions with boroughs, these studies will help inform plans for the next generation of Cycle Superhighways and Quietways, while new proposals for central London will be developed through the Central London Grid programme.

Further steps include seeking creative ways to deliver the cycling connections identified through the Strategic Cycling Analysis. For example, identifying and incorporating the best LCN+ and other existing cycle routes into the network.

Other actions include aligning with other investment planned within the Healthy Streets Portfolio, as well as working in partnership with developers, to take advantage of every opportunity to secure good cycling provision on London's roads.

Figure 5.1 Top Potential Connections recommended for further study