Isabel Dedring

Future of transport

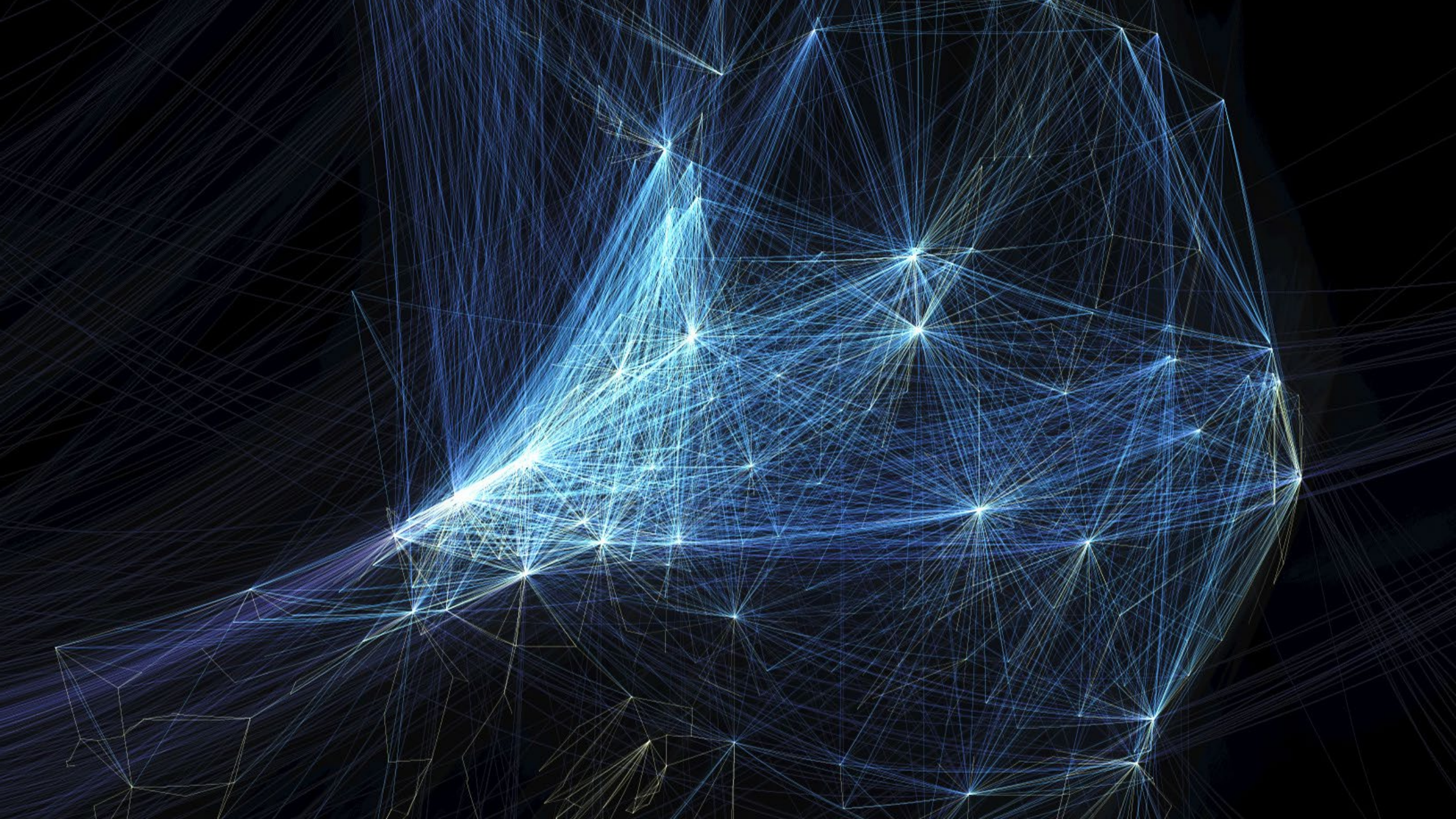ARUP

BEC after work event, Wellington

4 March 2019

The future has arrived…

ARUP

… or has it?

ARUP

Much more to be done

ARUP

Tengah town centre, Singapore (© HDB)

How can we use disruption to reinvent transport – and deliver better outcomes?

ARUP

Air pollution
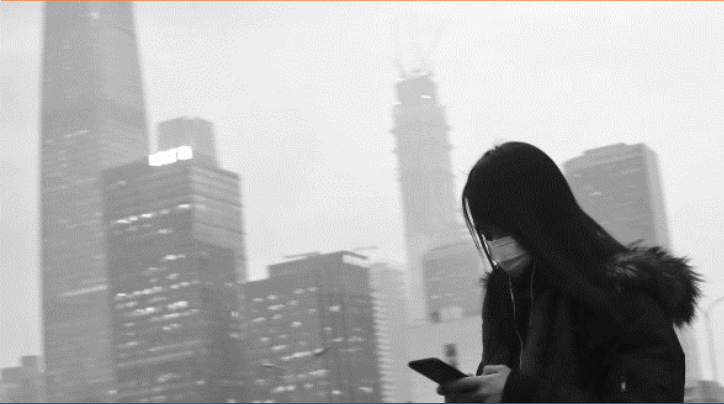
Urban Challenges

Congestion

Unequitable access

Need for more homes

Access to jobs

Cutting transport emissions

Urban Solutions

Cutting congestion

Connecting in areas of deprivation

Unlocking new homes

Improving the commute
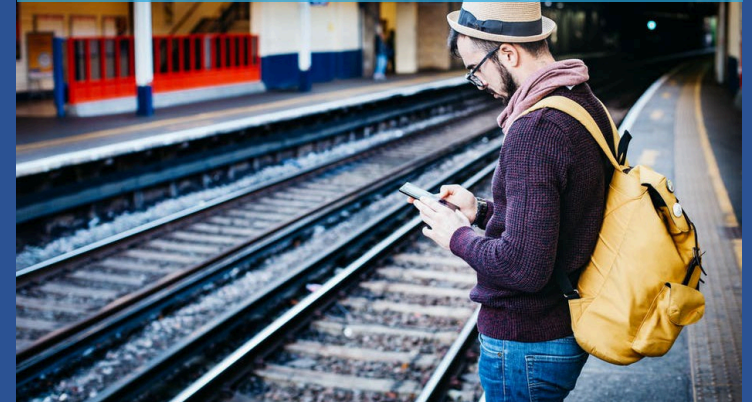
1
From planes, trains and automobiles… to homes, jobs and equity
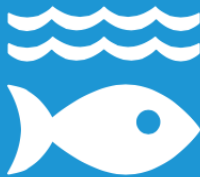
ARUP

We need to redefine the outcomes we want from transport

ARUP

Barking Riverside Extension Project - November 2015
Proposed Alignment and Extent of Land Required

LEGEND:

PROPOSED EXTENT OF LAND REQUIRED

INDICATIVE COMPOUND

INDICATIVE LAY DOWN AREA

PROPOSED TRACK

INDICATIVE VEHICLE ACCESS POINT
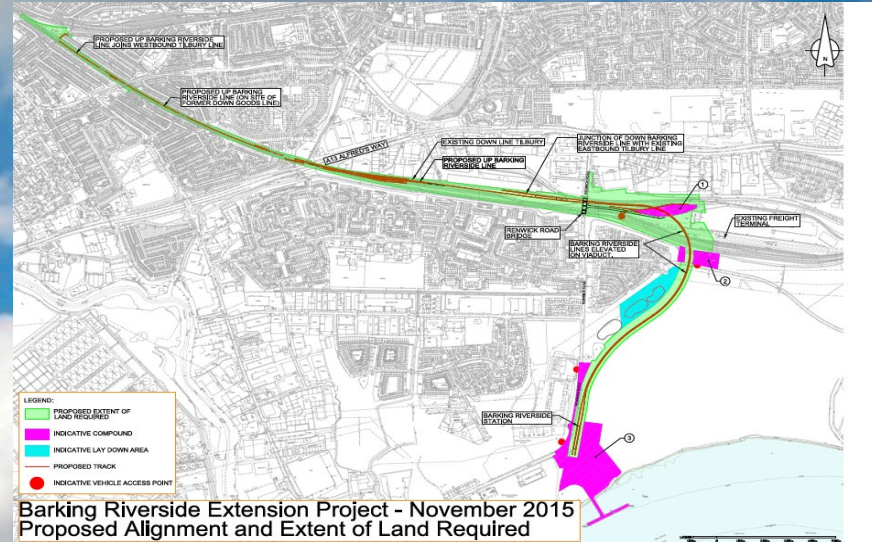
Map 2 Index of Multiple Deprivation 2015, London
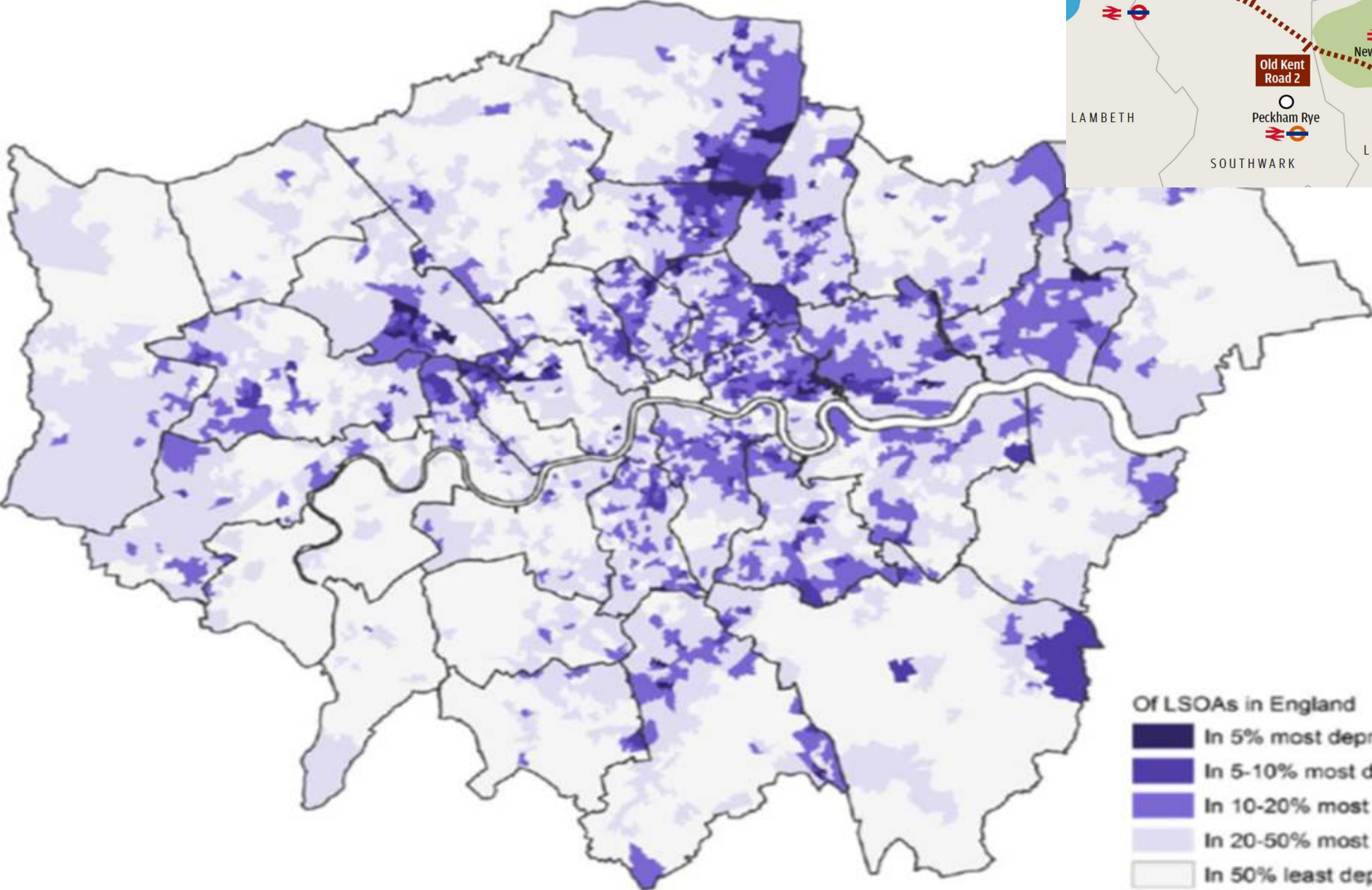
Of LSOAs in England

In 5% most deprived (52)
In 5-10% most deprived (222)
In 10-20% most deprived (815)
In 20-50% most deprived (1,964)
In 50% least deprived (1,782)

1
From planes, trains and automobiles… to homes, jobs and equity

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2
From provider pays…
to beneficiary pays

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We need to harness
new funding streams
for transport

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Key milestones of the Investment programme

Silvertown Tunnel

Construction starts

Crossing opens

New crossing links Greenwich Peninsula and the Royal Docks

Deep Tube Upgrade programme (Piccadilly, Bakerloo and Central lines)

Procurement begins

Summer: Award train contracts

First Piccadilly line train in passenger service
New trains replace current fleet. Each new train has 10% more capacity. Full train and signalling upgrades will provide 60% more capacity

Bakerloo and Central lines follow

Northern line extension

November: Tunnel boring machine journeys complete

Passenger trains running to Battersea Power Station

Four Line Modernisation

Signal testing begins

New Hammersmith control centre in operation and starts to bring increased reliability

New signalling goes live in central London

Up to 30 trains per hour in central London and to Barking

32 trains per hour on Circle, District and Hammersmith & City lines

Upgrades complete
28 trains per hour service on Metropolitan line

Barking Riverside extension

March: Contract award for main works

Extension opens
Four trains per hour service to new Barking Riverside development

Stations

Summer: **Paddington Bakerloo line link complete** – step-free to Bakerloo line
Victoria station upgrade complete – step-free and 110% capacity increase

Bank station capacity increased by 40%

May: **New Bank station entrance opens to Waterloo & City line**

| 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |

Map of EXTENSION LINES into METRO-LAND

English Miles

Metropolitan Railway
In Course of Construction
Other Railways
Roads

VERNEY JUNCTION
WINSLOW ROAD
GRANBOROUGH ROAD
QUAINTON ROAD
WADDESDON ROAD
WADDESDON
WESTCOTT
BRILL
WOTTON
WOOD SIDING
AYLESBURY
STOKE MANDEVILLE
WENDOVER
GREAT MISSENDEN
CHESHAM
CEDARS ESTATE
AMERSHAM & CHESHAM BOIS
CHALFONT & LATIMER
CHORLEY WOOD AND CHENIES
RICKMANSWORTH
MOOR PARK & SANDY LODGE
NORTHWOOD
GRANGE ESTATE
CHALK HILL ESTATE
RAYNERS LANE
EASTCOTE
RUISLIP MANOR
RUISLIP
ICKENHAM
PINNER
NORTH HARROW
HARROW-ON-THE-HILL
UXBRIDGE
SOUTH HARROW
WEMBLEY PARK ESTATE
KINGSBURY ESTATE
BAKER STREET

(ELECTRIC RAILWAY TRACKS AT WEMBLEY PARK—ESTATE ON RIGHT).

WEMBLEY PARK
THE IDEAL SUBURB.

AT LAST—A 'QUALITY' HOUSE AT LOW COST

HERE is your chance—seize it! A real worth-while "quality" seven-room house for £695 Freehold. No road charges, no legal costs, and no stamp fees to pay! Built of the finest materials, thoughtfully planned; excellently appointed, with rooms throughout that possess that cheery touch of brightness that means everything. Inner fittings and equipment include—totally enclosed porcelain enamelled bath; magnificent tiled fireplaces; chromium plated fittings throughout; beautifully tiled kitchens and bathrooms; constant hot water supply; electric fittings and shades, etc., etc.

The Ruislip Station Estate, on which these delightful houses are located, has everything in its favour. It can be

reached, from Town, in less time than it takes to read your evening paper. On all sides are green fields and pleasant hedgerows. The climate is mild and equable; the air is healthy and invigorating, whilst unlimited facilities for outdoor recreation obtain and particularly liberal educational and shopping facilities exist.

Why not go further into the matter—it will pay you! Write to-day, or telephone Ruislip 217 or 626, for free travelling voucher from any London station and for illustrated descriptive booklet. The houses can be inspected any day, including Sundays, and our representatives, who are always available, will readily answer any question or explain any point without the slightest obligation on your part to buy.

£695
FREEHOLD

H. L. BOWERS, RUISLIP STATION ESTATE, MIDDX.

SAY YOU SAW IT IN "METRO-LAND."

Page 132   SAY YOU SAW IT IN "METRO-LAND."   Page 133

EastWestRail
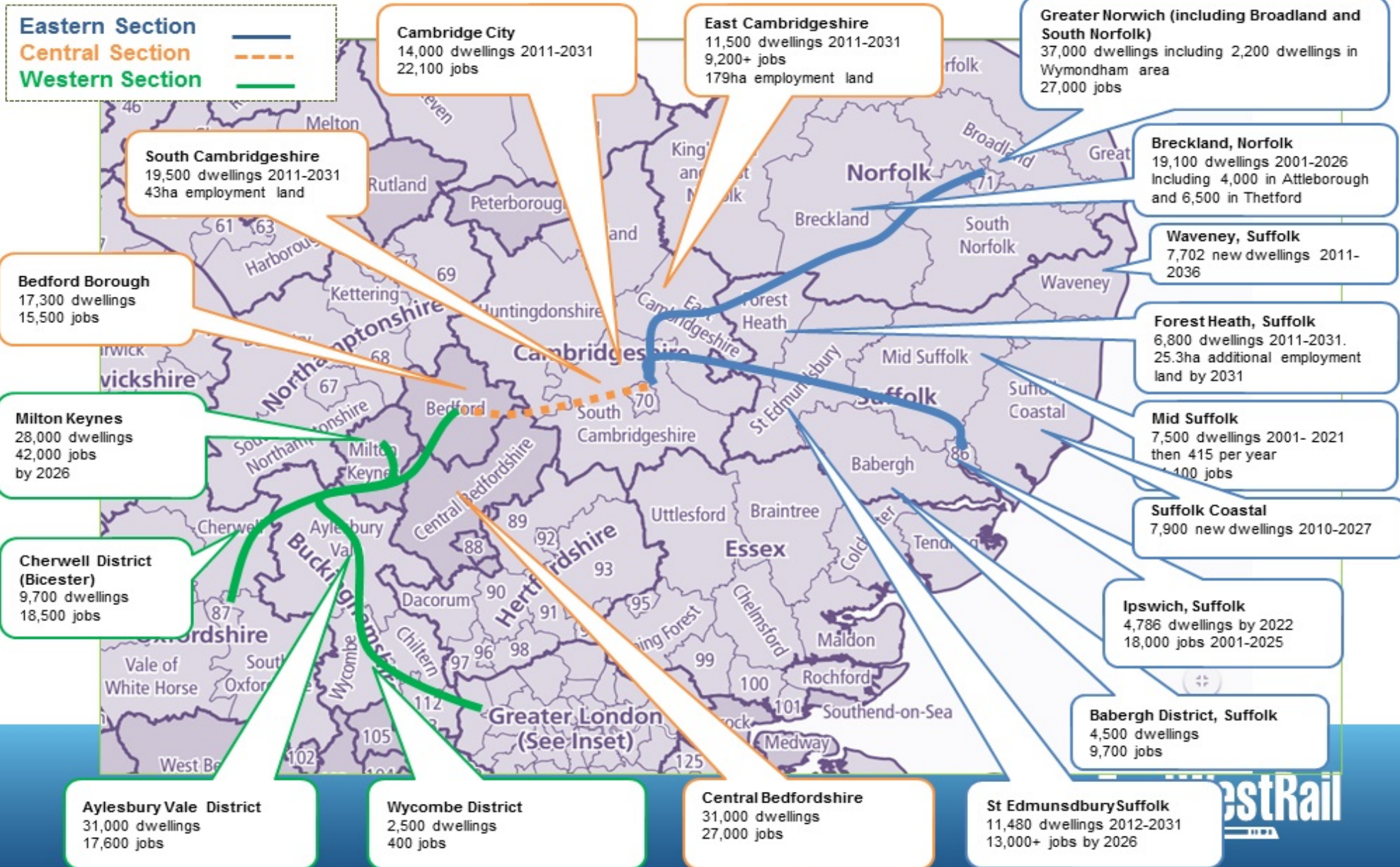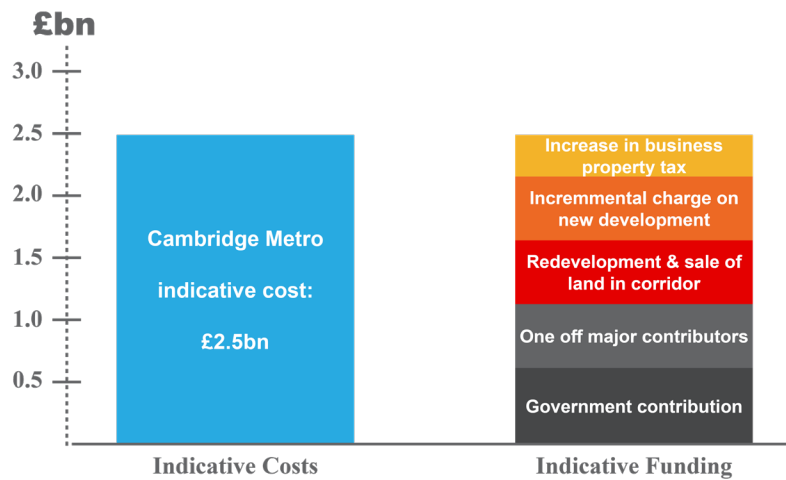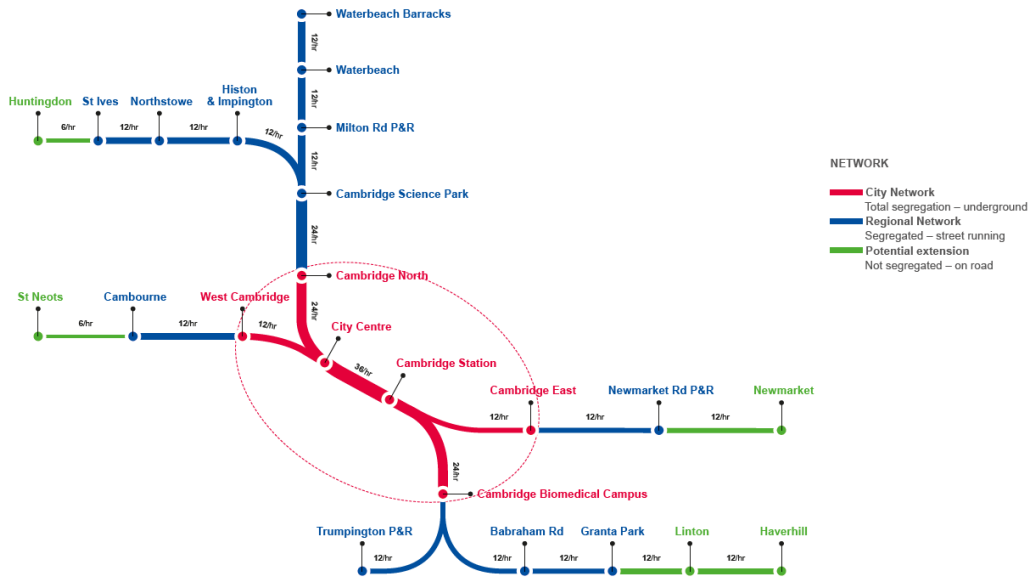
Anticipated Housing & Employment Growth to 2031*

*Unless stated otherwise; provisional figures at April 2016

Eastern Section —
Central Section ----
Western Section —

Cambridge City
14,000 dwellings 2011-2031
22,100 jobs

East Cambridgeshire
11,500 dwellings 2011-2031
9,200+ jobs
179ha employment land

Greater Norwich (including Broadland and South Norfolk)
37,000 dwellings including 2,200 dwellings in Wymondham area
27,000 jobs

South Cambridgeshire
19,500 dwellings 2011-2031
43ha employment land

Breckland, Norfolk
19,100 dwellings 2001-2026
Including 4,000 in Attleborough and 6,500 in Thetford

Waveney, Suffolk
7,702 new dwellings 2011-2036

Bedford Borough
17,300 dwellings
15,500 jobs

Forest Heath, Suffolk
6,800 dwellings 2011-2031.
25.3ha additional employment land by 2031

Mid Suffolk
7,500 dwellings 2001- 2021
then 415 per year
1,100 jobs

Milton Keynes
28,000 dwellings
42,000 jobs
by 2026

Cherwell District (Bicester)
9,700 dwellings
18,500 jobs

Suffolk Coastal
7,900 new dwellings 2010-2027

Ipswich, Suffolk
4,786 dwellings by 2022
18,000 jobs 2001-2025

Babergh District, Suffolk
4,500 dwellings
9,700 jobs

Aylesbury Vale District
31,000 dwellings
17,600 jobs

Wycombe District
2,500 dwellings
400 jobs

Central Bedfordshire
31,000 dwellings
27,000 jobs

St Edmunsdbury Suffolk
11,480 dwellings 2012-2031
13,000+ jobs by 2026

City level.
Showing Parramatta, Sydney
Olympic Park and Sydney
'friendly' development.
Supporting the city's
overall growth objectives

2
From provider pays…
to beneficiary pays

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3
From static…
to real-time

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We need to use new data streams to design transport that truly serves our users

ARUP

HOW?   Level of Service (LOS)

Fruin, J. J. (1971)
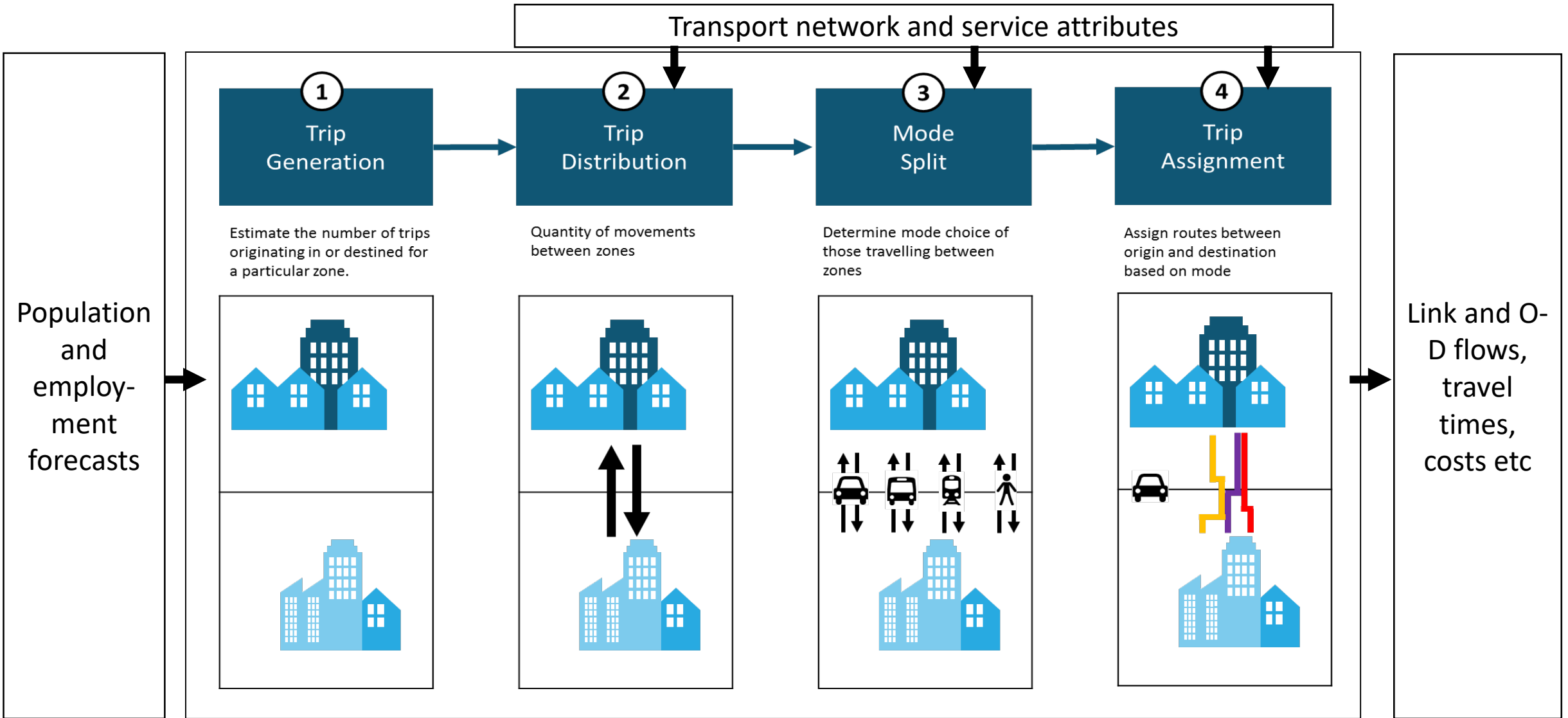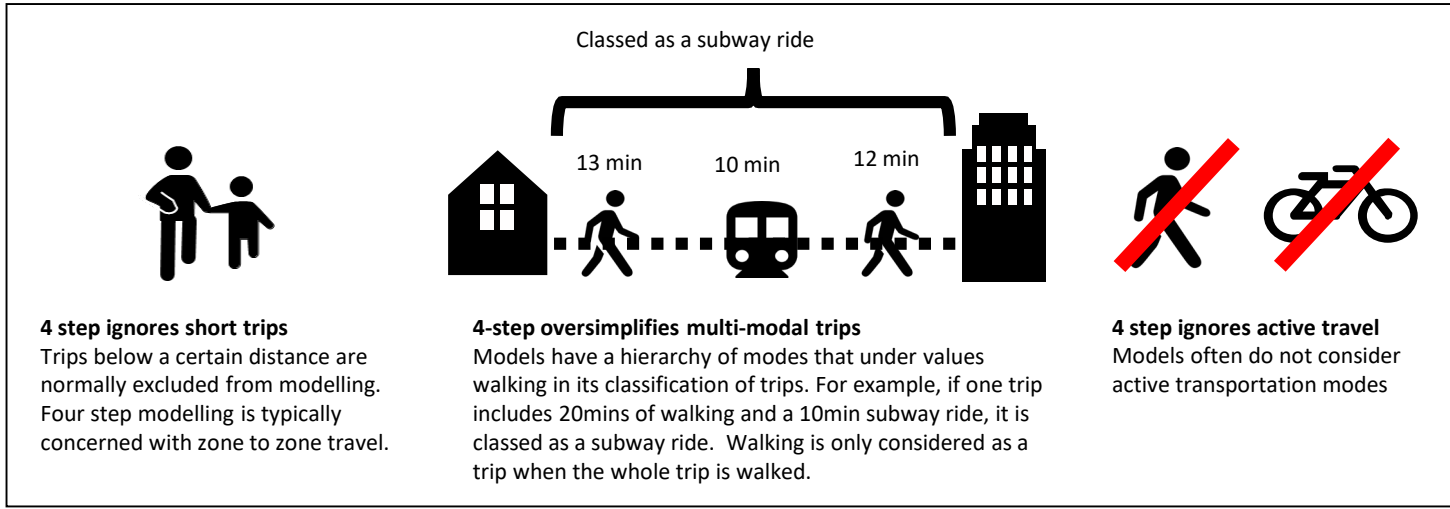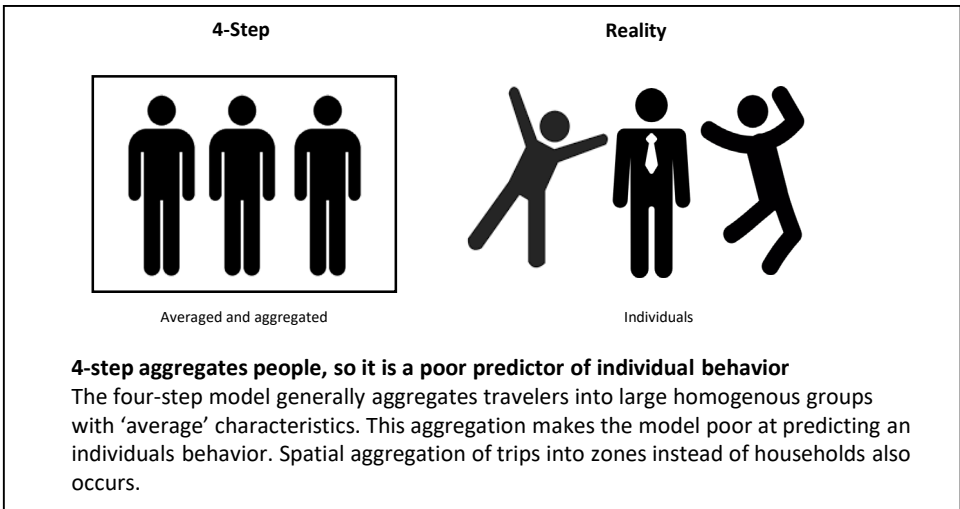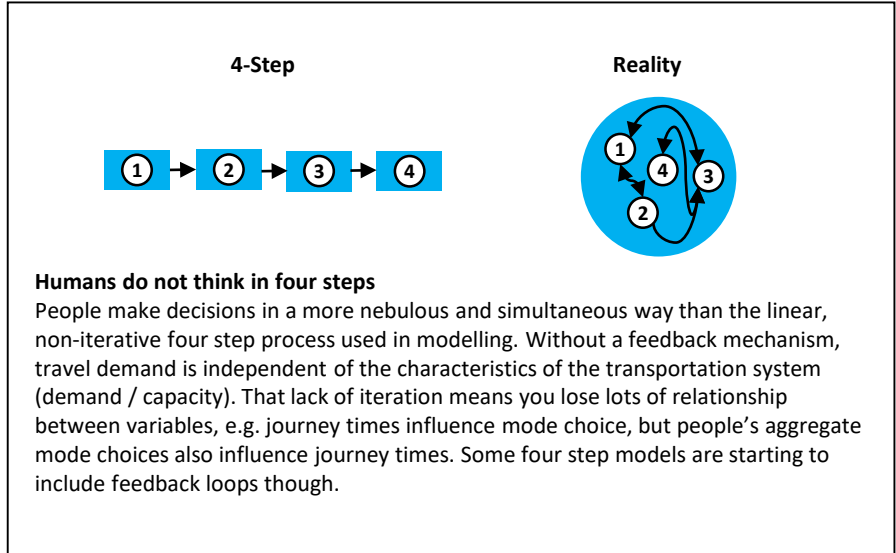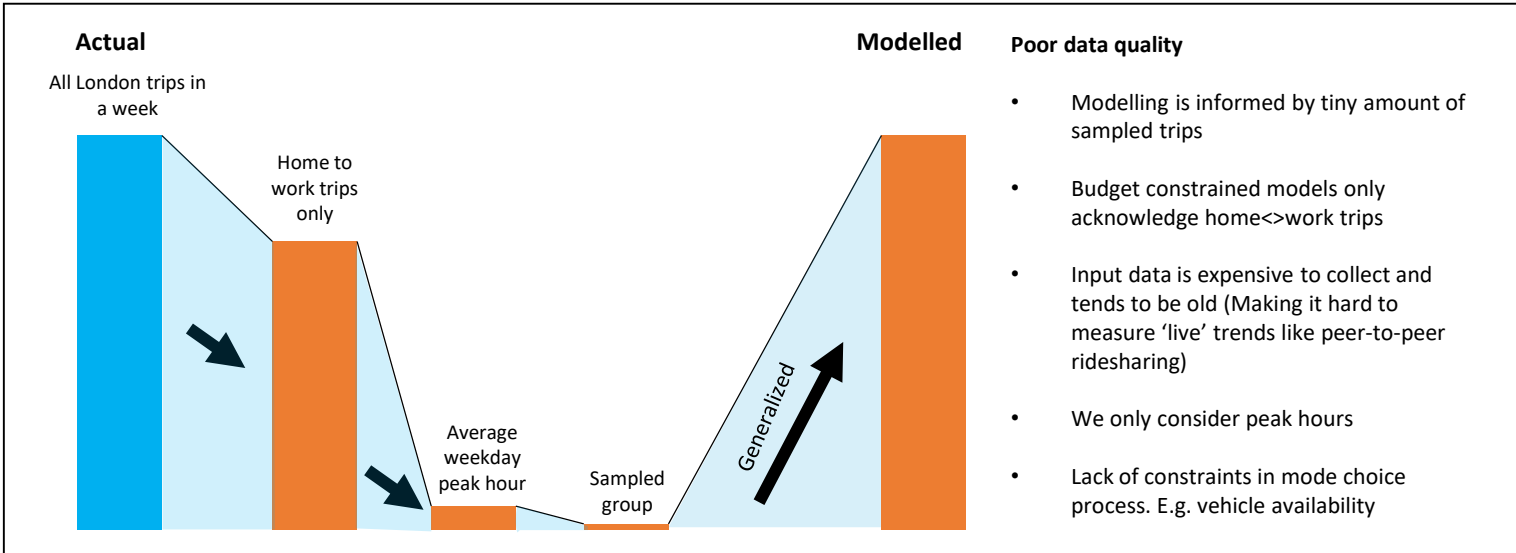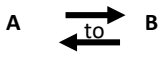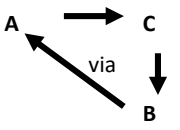Pedestrian planning and design
Density/Flow/Speed

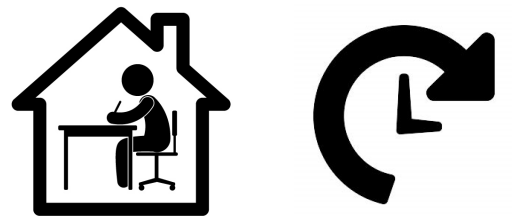Transport network and service attributes

Population and employ-ment forecasts

1 Trip Generation
Estimate the number of trips originating in or destined for a particular zone.

2 Trip Distribution
Quantity of movements between zones

3 Mode Split
Determine mode choice of those travelling between zones

4 Trip Assignment
Assign routes between origin and destination based on mode

Link and O-D flows, travel times, costs etc

Panel 1 (top left)

Actual   **Modelled**

All London trips in a week

Home to work trips only

Average weekday peak hour

Sampled group

Generalized

Poor data quality

- Modelling is informed by tiny amount of sampled trips

- Budget constrained models only acknowledge home<>work trips

- Input data is expensive to collect and tends to be old (Making it hard to measure 'live' trends like peer-to-peer ridesharing)

- We only consider peak hours

- Lack of constraints in mode choice process. E.g. vehicle availability

Panel 2 (top right)

4-Step   **Reality**

1 → 2 → 3 → 4

Humans do not think in four steps
People make decisions in a more nebulous and simultaneous way than the linear, non-iterative four step process used in modelling. Without a feedback mechanism, travel demand is independent of the characteristics of the transportation system (demand / capacity). That lack of iteration means you lose lots of relationship between variables, e.g. journey times influence mode choice, but people's aggregate mode choices also influence journey times. Some four step models are starting to include feedback loops though.

Panel 3 (bottom left)

4-Step   **Reality**

Averaged and aggregated   Individuals

4-step aggregates people, so it is a poor predictor of individual behavior
The four-step model generally aggregates travelers into large homogenous groups with 'average' characteristics. This aggregation makes the model poor at predicting an individuals behavior. Spatial aggregation of trips into zones instead of households also occurs.

Panel 4 (bottom right)

Classed as a subway ride

13 min   10 min   12 min

4 step ignores short trips
Trips below a certain distance are normally excluded from modelling. Four step modelling is typically concerned with zone to zone travel.

4-step oversimplifies multi-modal trips
Models have a hierarchy of modes that under values walking in its classification of trips. For example, if one trip includes 20mins of walking and a 10min subway ride, it is classed as a subway ride. Walking is only considered as a trip when the whole trip is walked.

4 step ignores active travel
Models often do not consider active transportation modes

4-Step / Reality

4-step ignores multi-leg trips
Humans tend to group activities to minimize travel; this is not recognized in traditional models. In four step only an A to B trip is possible; reality journeys tend to be more complex (A to B to C).

Manually intensive, slow processing
Model runs usually require significant manual intervention and 'calibration', meaning modelling a new scenario can take weeks to turn around
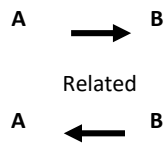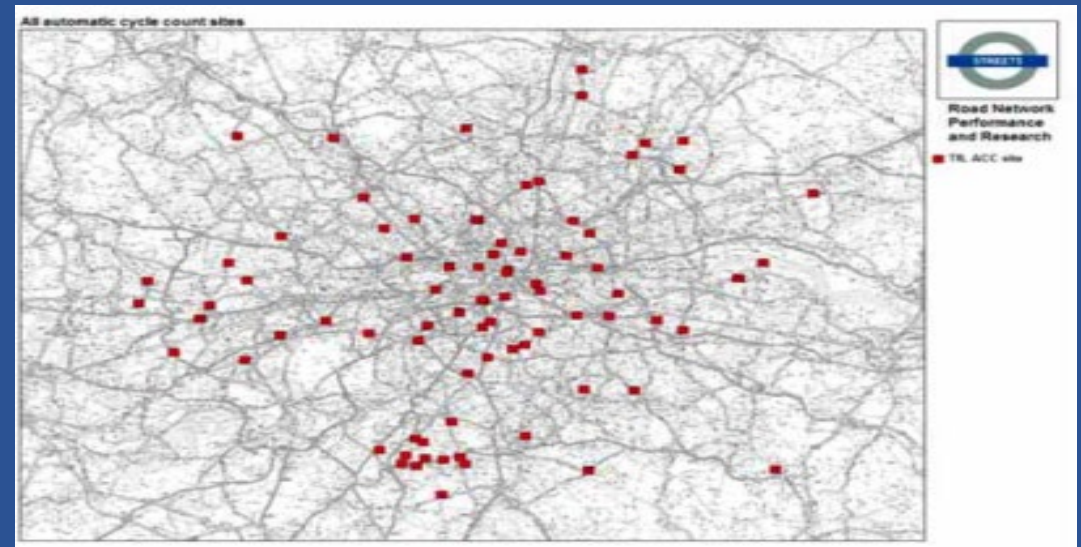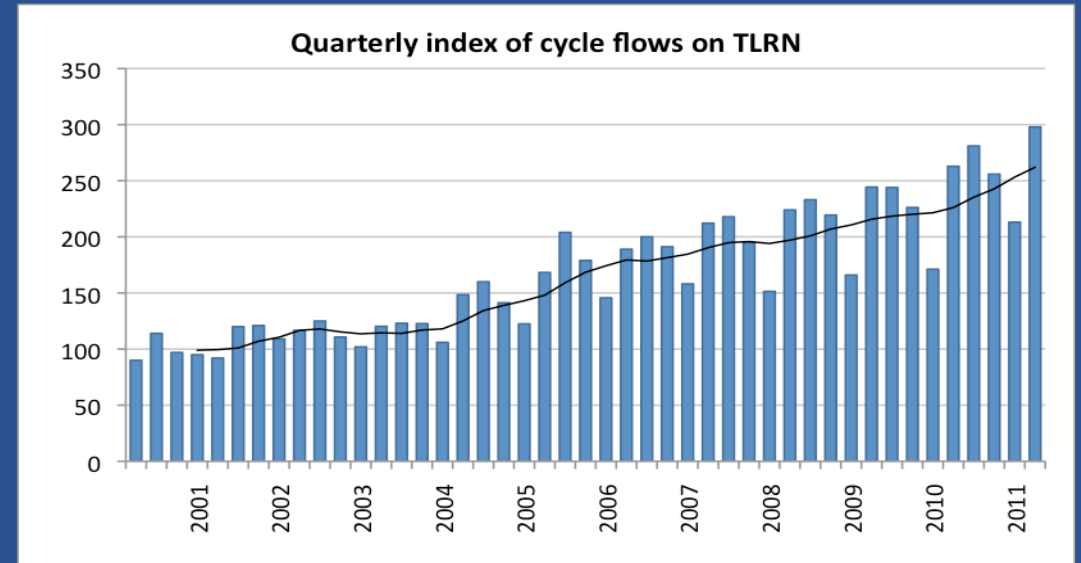
New working patterns
Model runs usually require significant manual intervention and 'calibration', meaning modelling a new scenario can take weeks to turn around

4-Step / Reality

Independent / Related

4-step ignores individuals' travel history
In a traditional model the mode chosen for a trip from A to B is independent of the mode chosen for the return journey (B to A). In reality, past travel history can influence future mode choice. For example if I drive to the shop I am likely to drive home.

New business models and technologies are not well reflected
New technologies such as drone deliveries and driverless cars will have an impact on movement patterns and demand levels, but 4-step modelling is not well equipped to deal with these and similar phenomena.

Quarterly index of cycle flows on TLRN

All automatic cycle count sites

3
From static…
to real-time

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4
From fixed...
to flexible
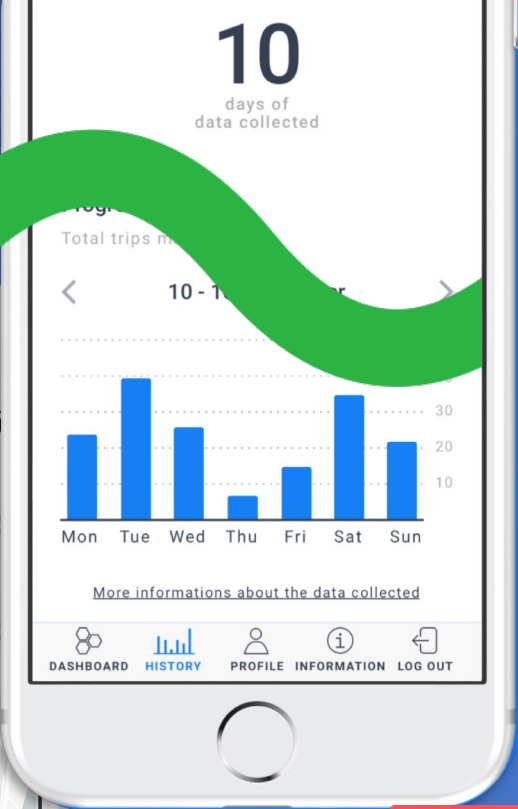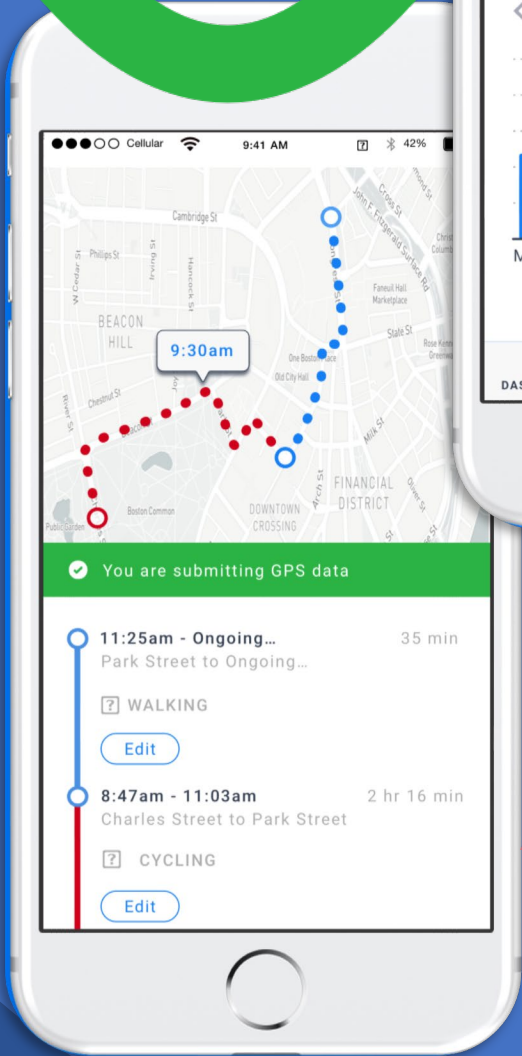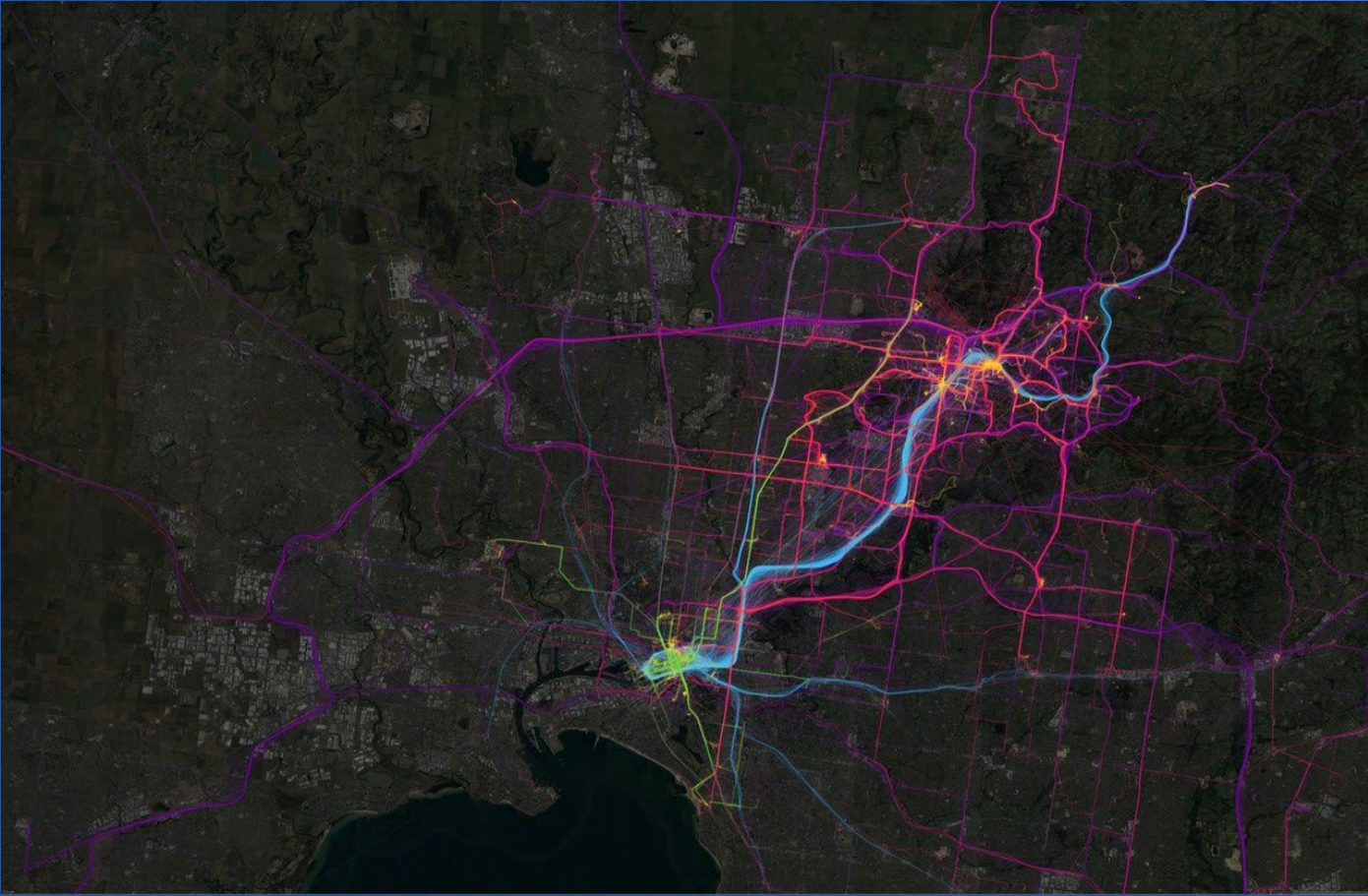
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We need to build flexible, adaptable infrastructure

ARUP
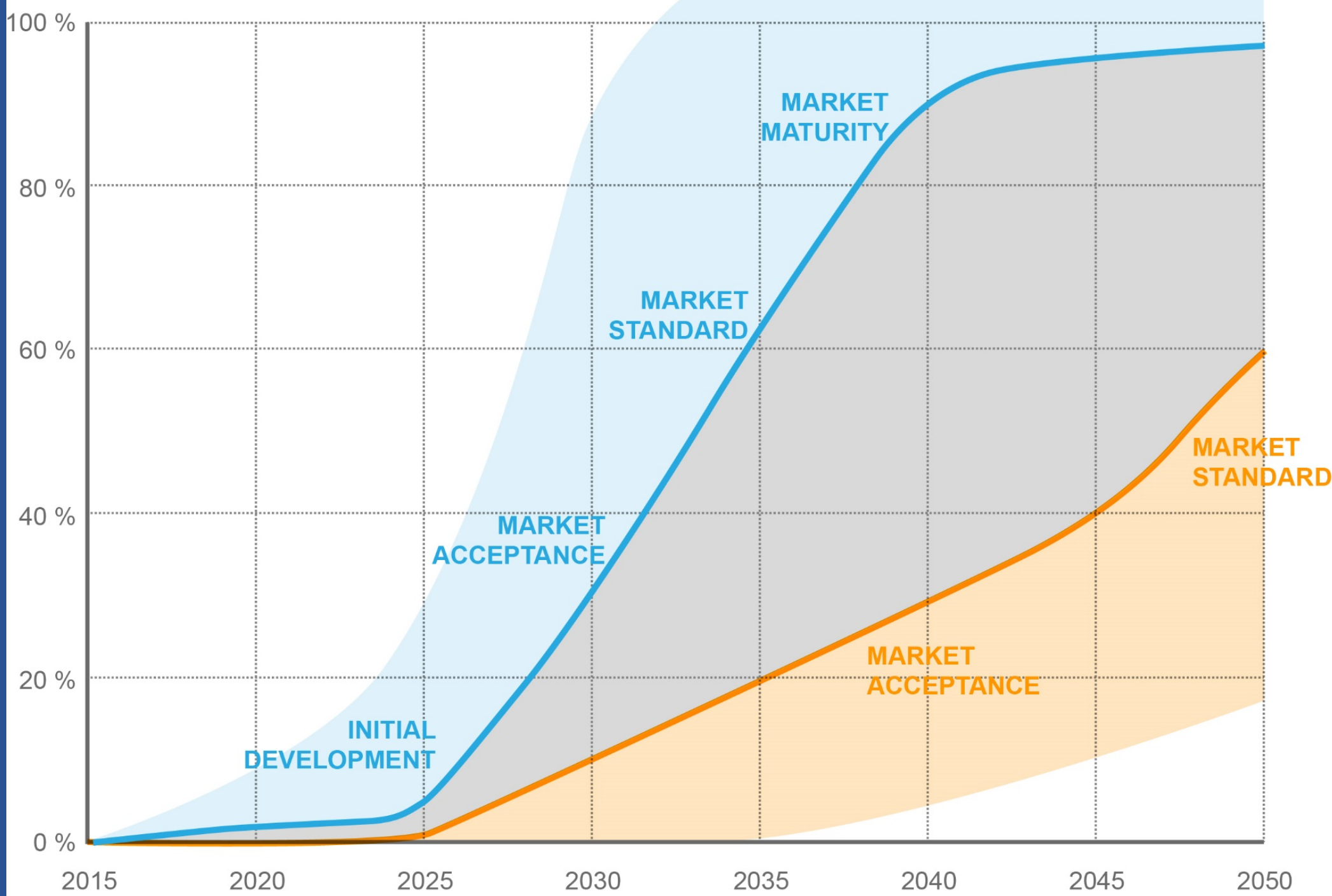
↱ **0.4 mi** `A5103`
Turn right on
Princess Road

`A5103` `Princ`

`A5103`

Athol Rd

Road South

`A6010  Wilbraham Rd`

4:23   28   15.0
min   mi

End

4

From fixed…
to flexible

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5
From deliverer...
to orchestra conductor

ARUP

Cities must become more purposeful policy makers, so that new technologies can improve our cities

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Privately
operated

Licensed

Franchised

Publicly
operated

PTALs

- Level 1a
- Level 1b
- Level 2
- Level 3
- Level 4
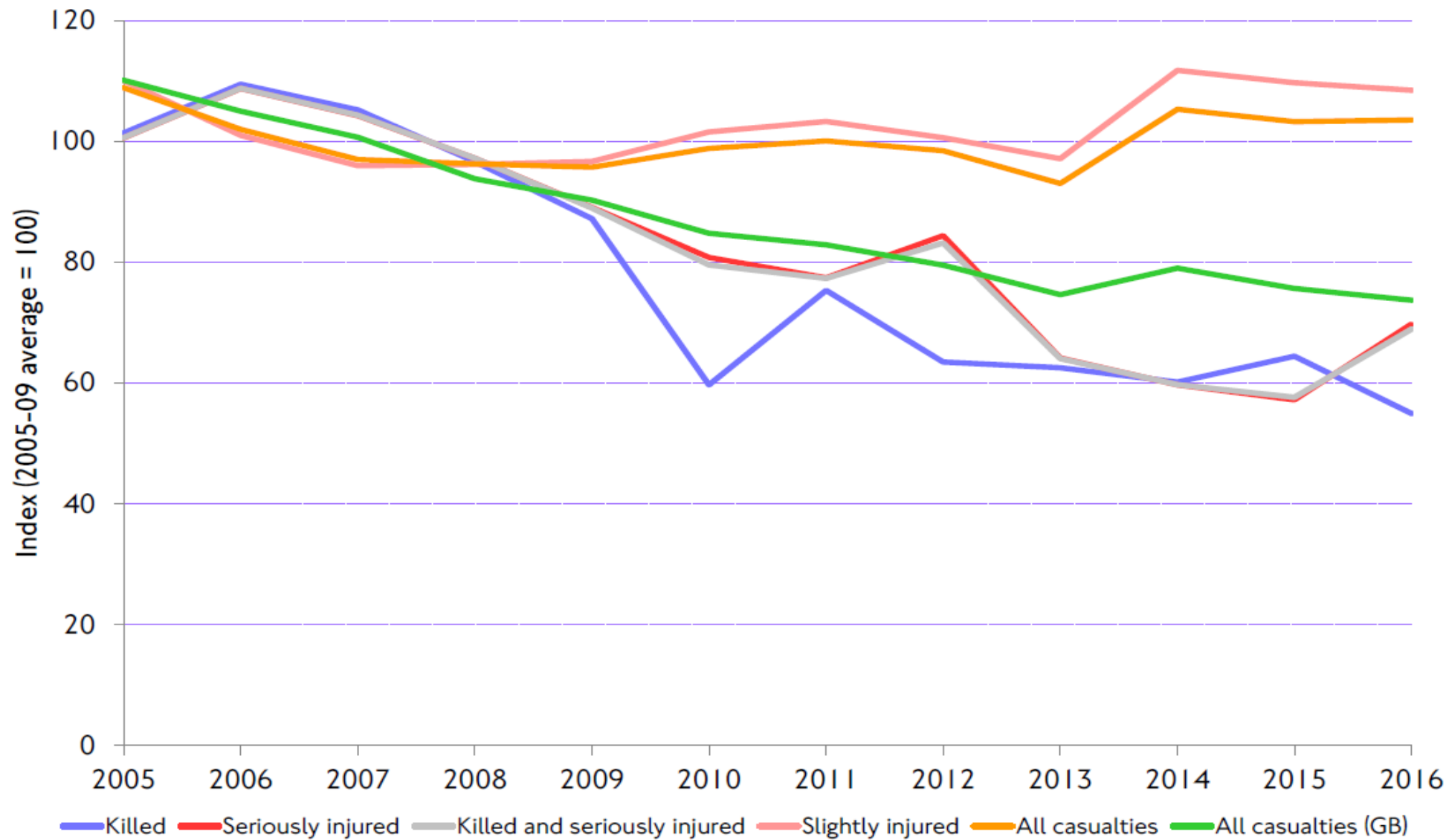- Level 5
- Level 6a
- Level 6b
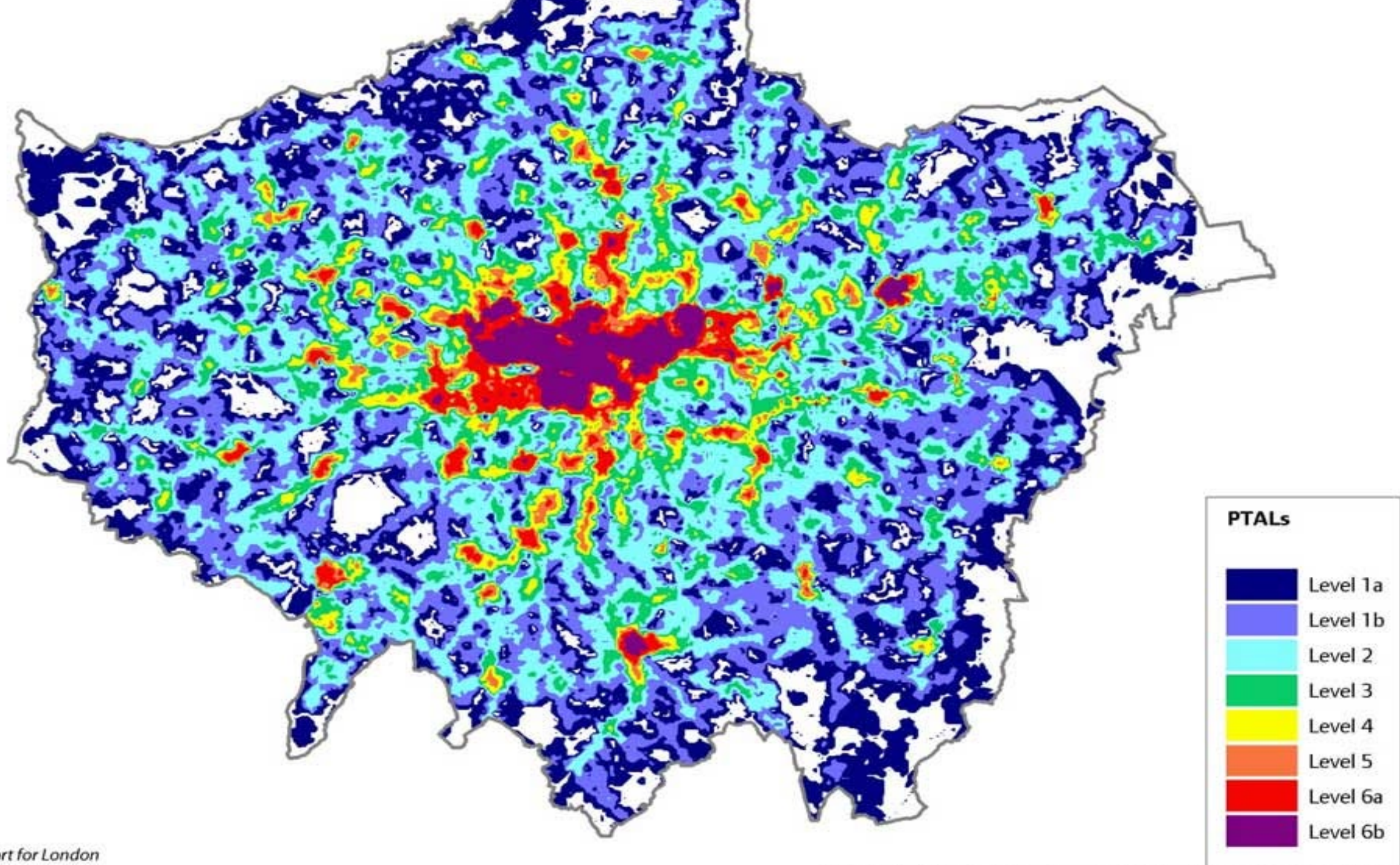
source Transport for London

Diagram: GLA. The London Plan - consolidated with alterations since 2004 (2008)
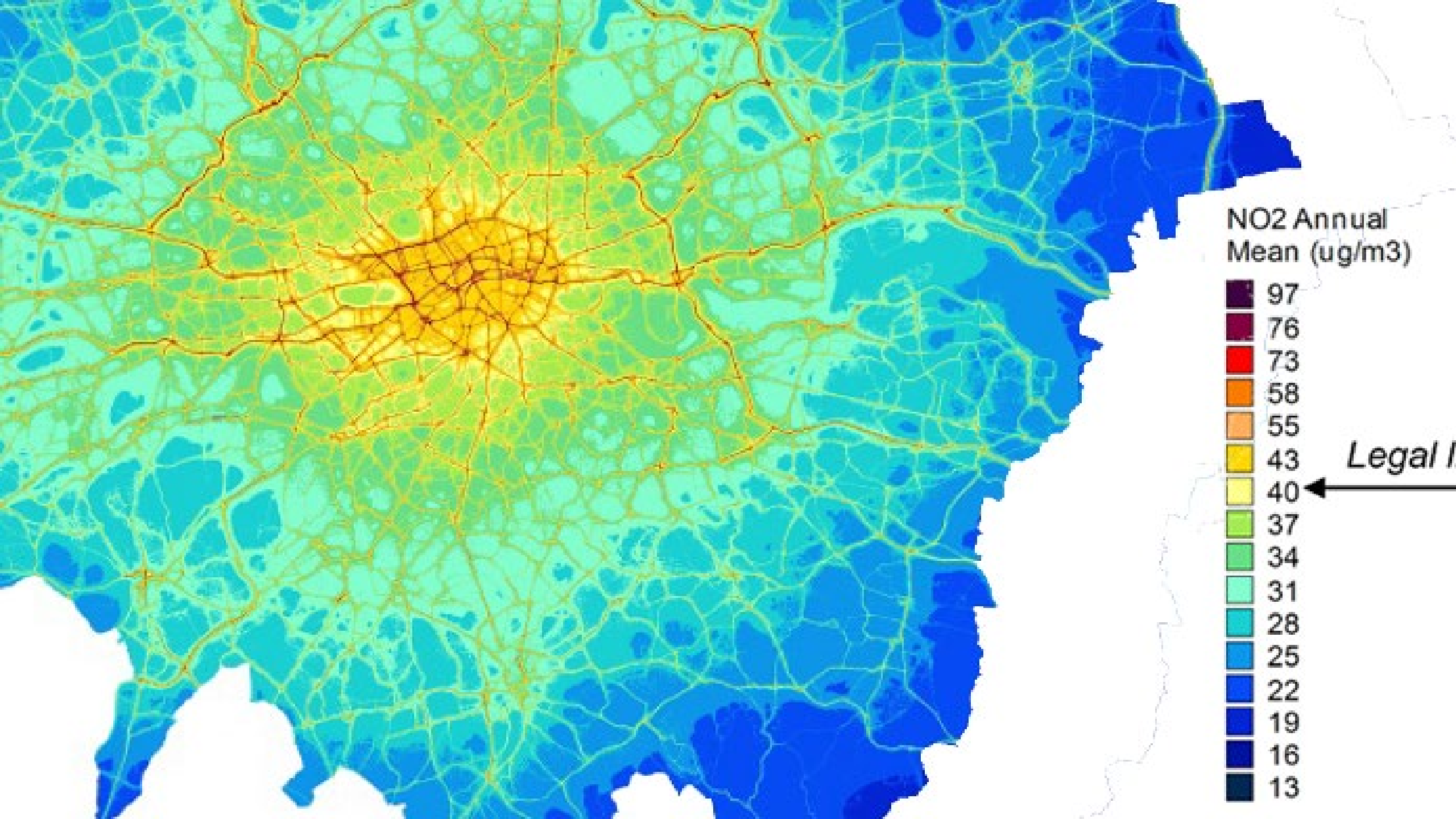
Figure 6.16   Long-term trend for road traffic casualties in London, by severity of injury. Index: 2005-2009 average baseline = 100.

NO2 Annual
Mean (ug/m3)

■	97
■	76
■	73
■	58
■	55
■	43
■	40
■	37
■	34
■	31
■	28
■	25
■	22
■	19
■	16
■	13

Legal l

Central London Ultra Low Emission Zone and the Extension to the North/South Circular Boundary

5
From deliverer...
to orchestra conductor

ARUP

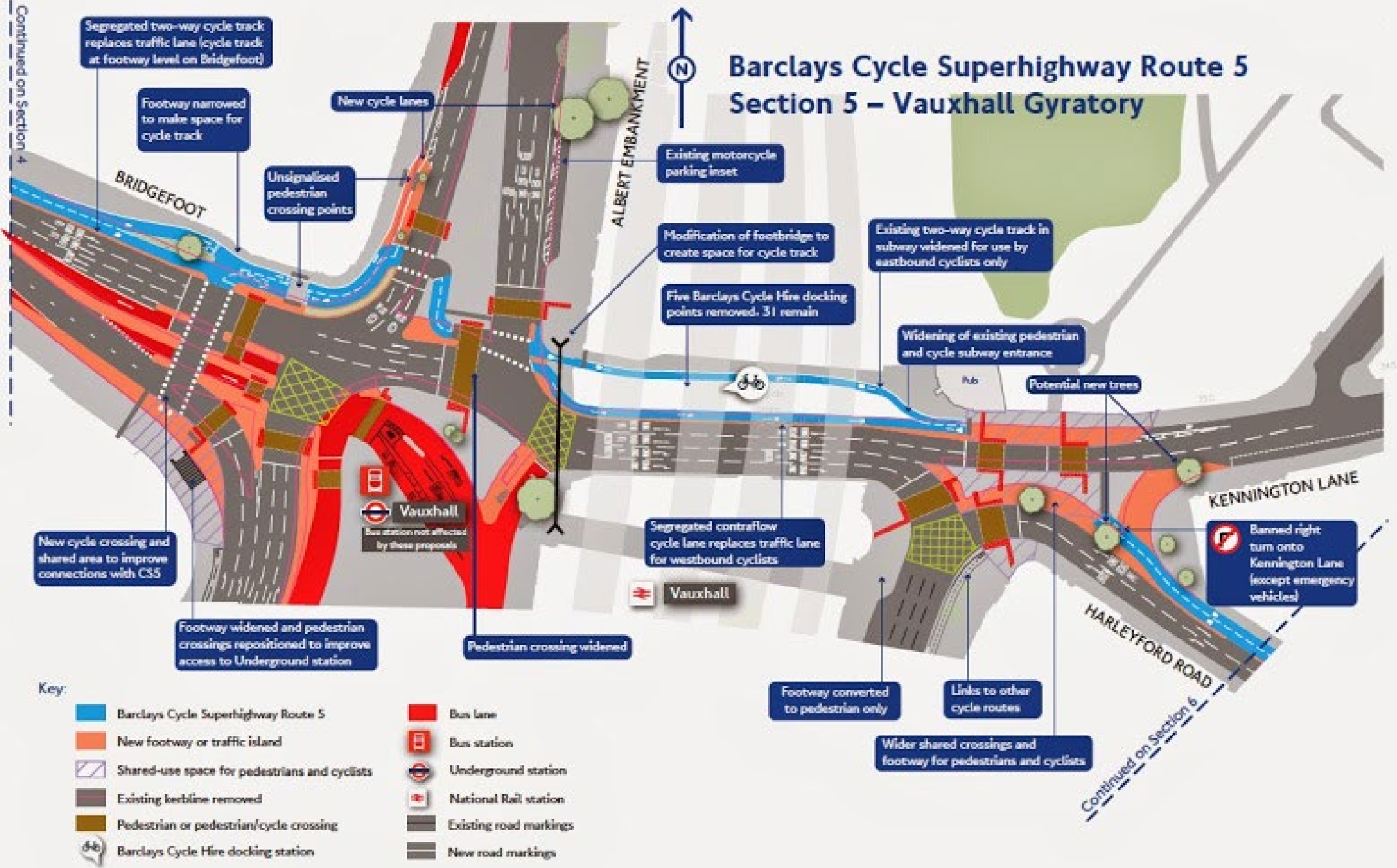# 6 From stakeholder engagement … to co-creation

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We can co-design 'from the grassroots' to define better transport solutions

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Barclays Cycle Superhighway Route 5
Section 5 – Vauxhall Gyratory

N

Segregated two-way cycle track replaces traffic lane (cycle track at footway level on Bridgefoot)

Footway narrowed to make space for cycle track

New cycle lanes

Unsignalised pedestrian crossing points

Existing motorcycle parking inset

Modification of footbridge to create space for cycle track

Five Barclays Cycle Hire docking points removed- 31 remain

Existing two-way cycle track in subway widened for use by eastbound cyclists only

Widening of existing pedestrian and cycle subway entrance

Potential new trees

New cycle crossing and shared area to improve connections with CS5

Segregated contraflow cycle lane replaces traffic lane for westbound cyclists

Banned right turn onto Kennington Lane (except emergency vehicles)

Footway widened and pedestrian crossings repositioned to improve access to Underground station

Pedestrian crossing widened

Footway converted to pedestrian only

Links to other cycle routes

Wider shared crossings and footway for pedestrians and cyclists

BRIDGEFOOT

ALBERT EMBANKMENT

KENNINGTON LANE

HARLEYFORD ROAD

Continued on Section 4

Continued on Section 6

Vauxhall
Bus station not affected by these proposals

Vauxhall

Pub

Key:

Barclays Cycle Superhighway Route 5

New footway or traffic island

Shared-use space for pedestrians and cyclists

Existing kerbline removed

Pedestrian or pedestrian/cycle crossing

Barclays Cycle Hire docking station

Bus lane

Bus station

Underground station

National Rail station

Existing road markings

New road markings

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Future

NEXT
BUS
5
mins

CAFE

ARUP

Chicklewood to Marble Arch (A5) 🚲 11

Park Royal to Hyde Park Corner (A40 – borough roads) 🚲 10

Tottenham to Liverpool Street (A10) 1

2 🚲 Ilford to Aldgate (A118 – A11)

3 🚲 Barking to Tower Hill (A...

4 🚲 Woolwich to Tower Bridge (...

5 🚲 Lewisham to Victoria (A20 – A202)

6 🚲 Penge to Bank (Borough roads – via Camberwell and Elephant and Castle)

Heathrow to Hyde Park Corner (A4 – borough roads) 🚲 9

Kingston Vale to Westminster (A3 – A3205 – Vauxhall Cross) 🚲 8

South Wimbledon to Bank (A24 – A3) 🚲 7

ENFIELD
BARNET
HARROW
HILLINGDON
BRENT
HARINGEY
WALTHAM FOREST
REDBRIDGE
HAVERING
CAMDEN
ISLINGTON
HACKNEY
BARKING & DAGENHAM
EALING
CITY OF WESTMINSTER
KENSINGTON & CHELSEA
HAMMERSMITH & FULHAM
CITY
TOWER HAMLETS
NEWHAM
HOUNSLOW
SOUTHWARK
GREENWICH
BEXLEY
RICHMOND UPON THAMES
WANDSWORTH
LAMBETH
LEWISHAM
KINGSTON UPON THAMES
MERTON
SUTTON
CROYDON
BROMLEY

6
From stakeholder
engagement
… to co-creation

ARUP

From	To
1 Transport outcomes	… non-transport outcomes
2 Provider pays	… beneficiary pays
3 Static data	… real-time
4 Fixed infrastructure	… flexible
5 Public sector as deliverer	… 'orchestra conductor'
6 Stakeholder engagement	… co-creation with public

Thank you

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elizabeth.halsted@arup.com

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