**Elizabeth Line Committee**

**Date:** **25 July 2023**

**Item:** **Elizabeth Line Passenger Usage Insight**

---

**This paper will be considered in public**

## 1 Summary


1.1 This paper provides insight into passenger usage patterns on the Elizabeth line and their impact on other transport modes in London throughout the first full year of operation.

1.2 A separate paper has been prepared for the Committee to provide an update on our activities to implement the Elizabeth line benefits framework published by TfL in partnership with the Department for Transport, as Crossrail Joint Sponsors.

1.3 Further analysis will report the impacts of Stage 5c, which started operation on 21 May 2023. At the point of paper submission, it is too early to reliably report changes and patterns that have been/will be occurring.


## 2 Recommendation

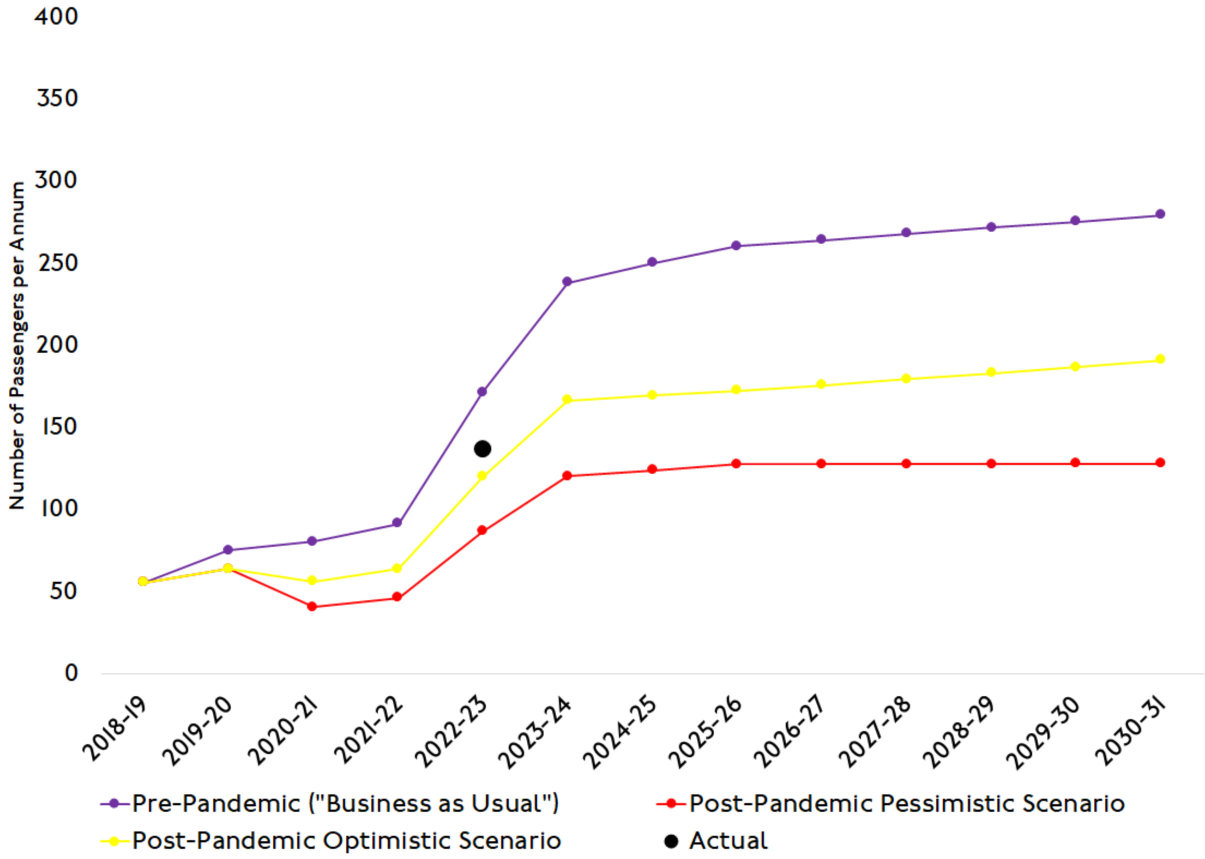
2.1 **The Committee is asked to note the paper.**

## 3 Passenger Demand

### Annual Passenger Journeys

3.1 The graph below compares pre and post pandemic passenger projections with the number of actual first year passenger journeys made on the Elizabeth line. During its first full year of operation, the Elizabeth line carried 150.7 million passenger journeys, with 137 million journeys being made during the 2022/23 financial year. Passenger demand is slightly below pre-pandemic forecasts that supported the final update of the business case and above a range of post-pandemic projections. Current planning scenarios, including pre-pandemic forecasts, indicate a range of 130 million to 170 million passenger journeys per annum.

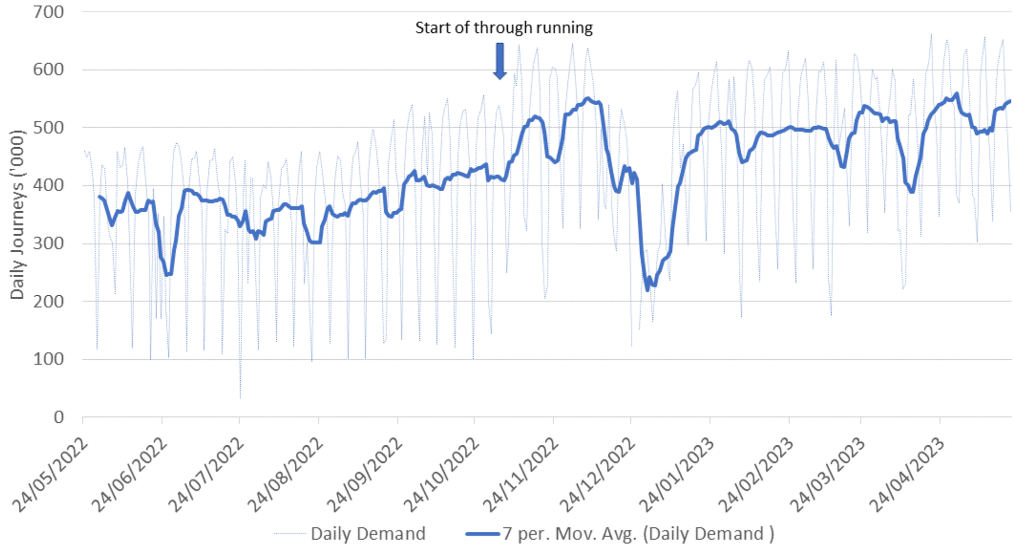
**Pre-Pandemic and Post-Pandemic Elizabeth Line Passenger Projections and First Year Actual Passenger Journeys (millions)**
Source: Analysis from Oyster/Contactless and Loadweigh and Railplan Forecasts




3.2 Were the number of passenger journeys observed since the start of east to west through running to continue for a full year, then annual passenger journeys would be 170 million per annum. A faster post pandemic recovery and the changes associated with Stage 5c could see this reach 200 million journeys per annum.

3.3 Based upon data from monitoring weeks in September 2022 and January 2023 that were unaffected by external events such as strikes, the Elizabeth line carried an average of 550,000 passenger journeys per mid-week day. The graph below shows daily Elizabeth line demand over the first full year of operation and it can be seen that the busiest days have seen almost 600,000 passengers per day. The start of through running which led to new direct journey opportunities, frequency increases, and changes in days/hours of operation drove an uplift of 100,000 daily passenger journeys.

**Daily Elizabeth Line Demand, First Year of Operation, Journeys 000's**
Source: Analysis from Oyster/Contactless and Loadweigh




3.4 Stations on the Elizabeth line have observed significant but expected increases in entries/exits and interchanges, as shown in the graph below, because of the new service. These are summarised as:

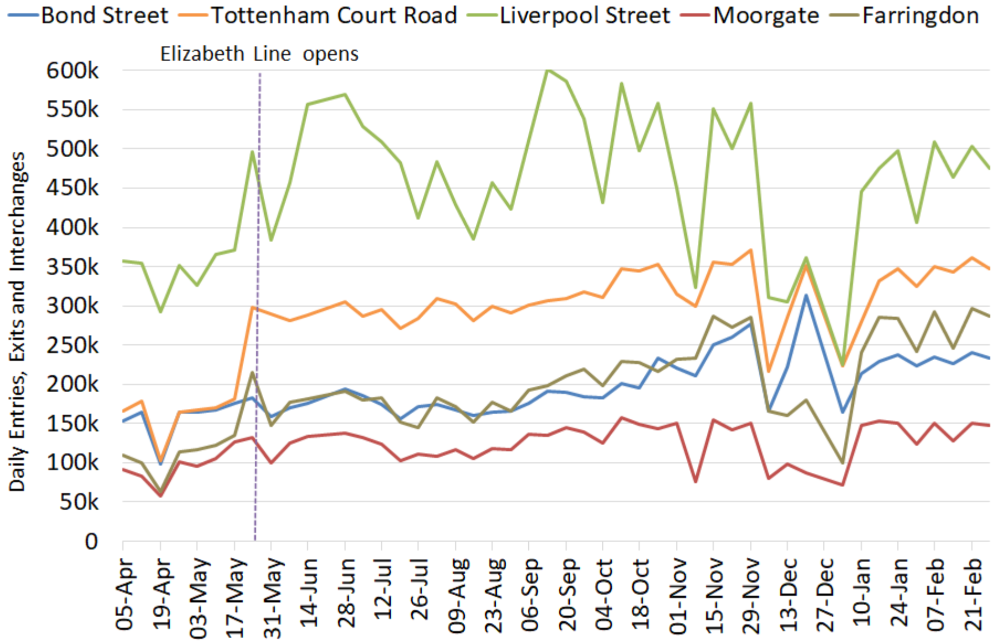
(a) Tottenham Court Rd: saw an increase from 110,000 to 175,000 passengers per day;

(b) Bond Street: saw an increase from 175,000 passengers to 230,000 per day; and

(c) Farringdon: saw an increase from 100,000 passengers to 280,000 per day.

**Number of Station Entries, Exits and Interchanges at Central Area Stations by Day**

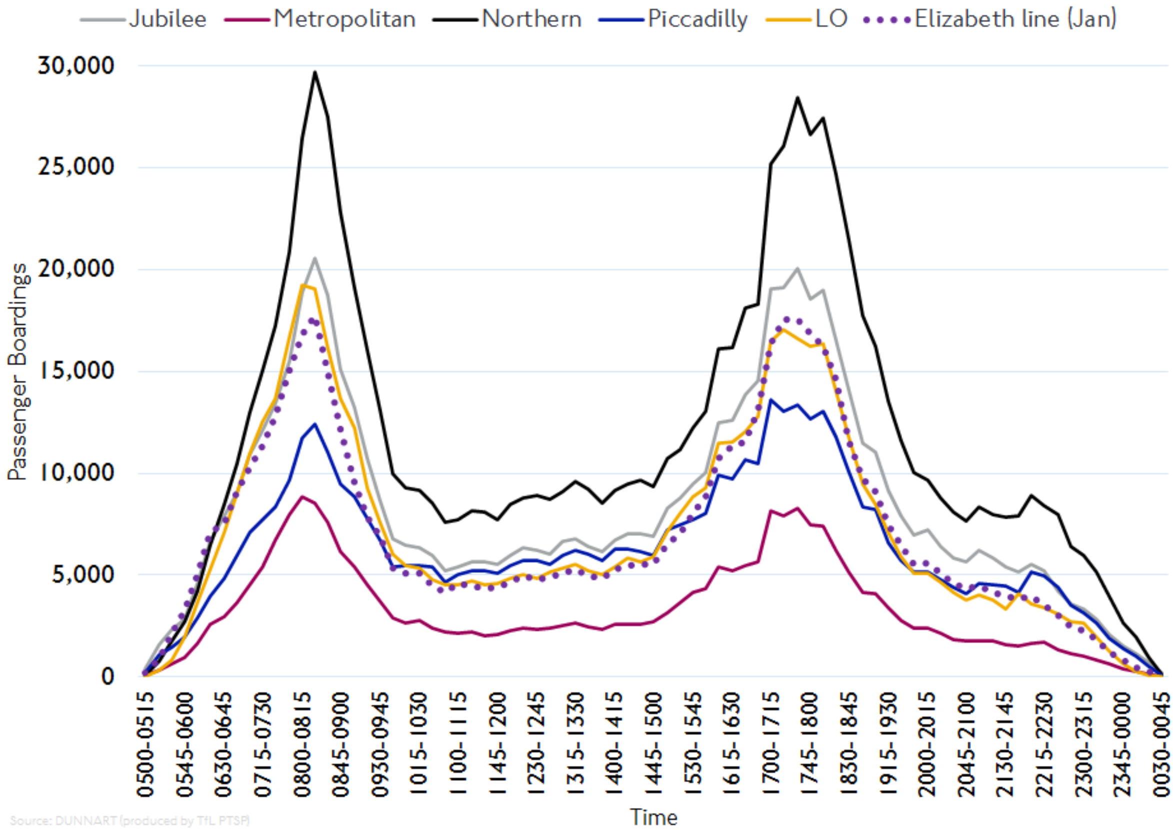
Source: “Dunnart” usage database




**Passenger Time of Travel Profile**

3.5 An average of 56 per cent of passenger journeys on Elizabeth line occur during weekday peak travel times (07:00 to 10:00 and 16:00 to 19:00) as shown in the following graph which presents the Daily Weekday Passenger Boardings by time of travel. This is higher when compared to London Underground (around 50 per cent) and reflects trends observed on National Rail services with a wider geographical reach more attractive to commuters.

**Daily Weekday Passenger Boardings by Time of Day**
Source: “Dunnart” usage data 23 January to 30 January 2023




3.6 The average route wide travel time profile masks several geographic variations:

(a) the Elizabeth line serves Heathrow Airport where only 32 per cent of journeys are made during traditional peak times;

(b) the route from Shenfield via Stratford has an earlier peak at 0700 as well as the later morning peak at around 0830, reflecting the high proportion of skilled manual and service-related commuting typical in that part of London; and

(c) in the central section just less than 50 per cent of passenger journeys take place during peak times.

### Day of Week Travel Profile

3.7 Passenger demand is highest on Tuesdays, Wednesdays, and Thursdays (560,000 to 614,000 passengers) with the quietest working day being a Monday (500,000 passengers). This fits the wider public transport network trends following the pandemic. Recent Elizabeth line demand growth has been greatest on a Thursday influenced by post pandemic activity trends.

3.8 Upon opening in May 2022, the Elizabeth line did not run on a Sunday. Since this commenced in November 2022, Sunday demand has grown rapidly and has reached 280,000 passengers per day. Saturday demand at 470,000 passengers per day, is only six per cent lower than the quietest working day of Monday.

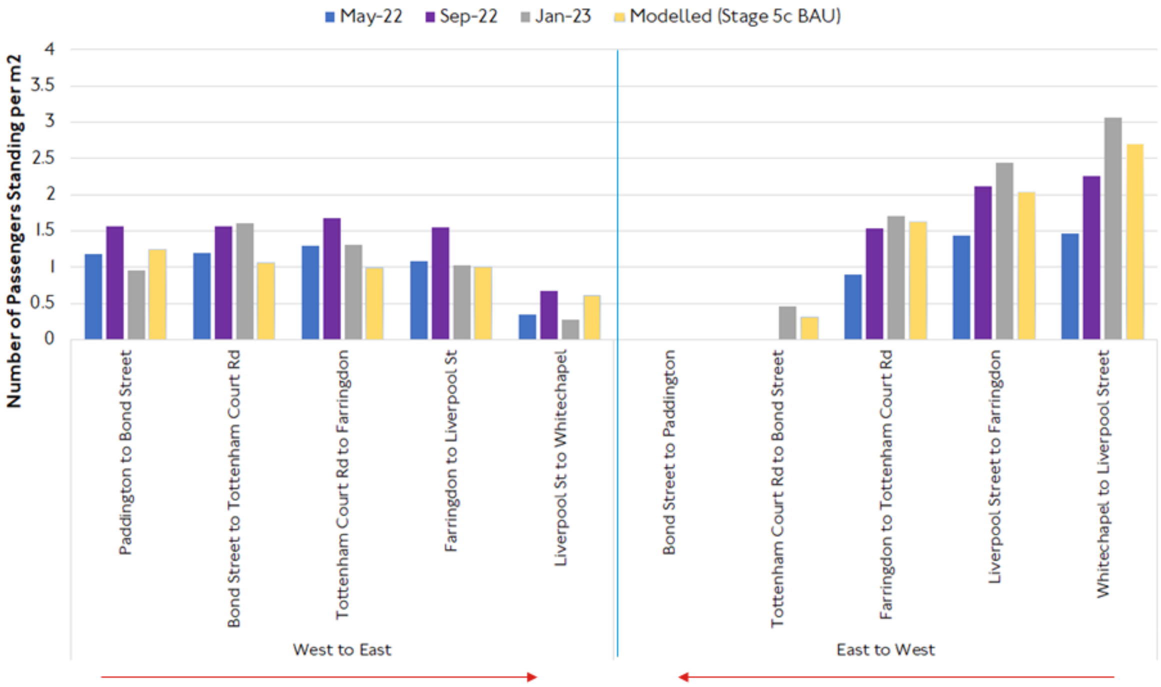
# 4 Occupancy

4.1 Occupancy on the Elizabeth line is a measure used to describe the levels of crowding on trains and is expressed as the number of passengers standing per metre of standing space (pax/sqm) during the busiest hour of the morning peak (Tuesday to Thursday). Elizabeth line class 345 trains have a notional capacity of 1,500 passengers which equates to all seats taken and usable standing space occupied to a density of four passengers/sqm. Data from the on-train passenger counting systems allows occupancy to be disaggregated into further detail to identify problems on specific trains or times of day.

4.2 Occupancy on the Elizabeth line is as expected when compared to pre-opening projections, both in terms of the location and extent of on train crowding. It indicates a well-used and busy railway; occupancy remains at or below three passengers/sqm at the busiest times suggesting sufficient capacity for both comfortable travel and future growth.

4.3 The graph below presents occupancy within the central section which is between one and 1.5 passengers/sqm between Paddington and Whitechapel (west to east at the height of the morning peak); and three passengers/sqm between Whitechapel and Liverpool Street (east to west in the height of the morning peak).

**Central Section Occupancy; number of passengers standing per metre of available standing space at the height of the morning peak (Mid-Week Tuesday to Thursday).**
Source: Observed from Dunnart and Modelled from Railplan Business as Usual Forecasts



4.4 On the eastern section, occupancy approaches three passengers/sqm from Maryland to Stratford (height of the morning peak); and from Canary Wharf to Whitechapel (height of the morning peak). On the Shenfield route towards central London passengers start to stand from Romford, and from Abbey Wood services depart with all seats taken and passengers from Woolwich and Custom House stand.

4.5 On the western section, the busiest point is between Acton Main Line and Paddington with an average of 2.5 passengers/sqm in the morning peak hour. Crowding varies dependent upon whether a service is from Reading/Maidenhead or Heathrow with Heathrow services injecting additional capacity for the inner stations between Hayes & Harlington and Paddington. Passengers will typically be standing from Slough on Reading/Maidenhead services at the height of the morning peak.

**Monitoring of Occupancy Levels**

4.6 Detailed analysis of occupancy hot spots has identified the following specific locations and times:

(a) 0815 between Maryland and Stratford;

(b) 0815 to 0900 between Canary Wharf and Whitechapel;

(c) 0800 around Ealing Broadway (eastbound);

(d) 1745 between Whitechapel and Canary Wharf; and

(e) 1800 around Ealing Broadway (westbound).

4.7 Capacity provision, both within stations and on trains, will be kept under review to inform further timetable changes where we can optimise benefits of the operating service. This will include monitoring the expected impacts of HS2 at Old Oak Common throughout its phased opening and especially while Old Oak Common is the temporary terminus.

## 5 Journey Times

5.1 Journey times have been transformed by the Elizabeth line and increases in demand have followed. The largest demand gains have been where journey times have fallen the most. Research into factors that drive customer experience and influence travel behaviour consistently reference journey time as the most important factor for passengers.

5.2 Analysis of a series of station-to-station pairs from Oyster/Contactless payments reveals the journey time reduction and observed demand response (including previously using other lines):

(a) Paddington to Tottenham Court Rd: 48 per cent journey time reduction to an average of 11 minutes and six times the number of daily journeys;

(b) Liverpool Street to Paddington: 25 per cent journey time reduction to an average of 18 minutes and twice the number of daily journeys;

(c) Stratford to Paddington: 37 per cent journey time reduction to an average of 25 minutes and nearly four times the number of daily journeys; and

(d) Paddington to Canary Wharf: 33 per cent journey time reduction to an average of 22 minutes and nearly four times the number of daily journeys.

5.3 TfL has undertaken an analysis of the demand response to changes in journey time (known as service elasticity) applying ‘big data’ approaches to a number of service changes across the network, including the Elizabeth line. Findings suggest the demand response following the changes in journey time brought about by the Elizabeth line is greater than the demand response observed for previously studied service changes. This is possibly driven by the larger absolute reductions in journey time, but also by the substantial improvement in travel comfort and ambiance. The ongoing impact of recovery from the pandemic is likely to drive part of this higher response.

5.4 Connectivity, especially in southeast London, has also dramatically improved. The Elizabeth line almost halves journey times from stations in southeast London to Central London: in 20 minutes, passengers can now travel from Abbey Wood to Farringdon, a journey that would have previously taken 39 minutes. There are 1.4 million more jobs across London and the Southeast now accessible within 60 minutes of Abbey Wood than before the central section of the Elizabeth line opened.

5.5 The improvements in journey time to central London via the Elizabeth line from Abbey Wood and Woolwich have also had an impact on the role the local bus network performs as a feeder. Bus boardings around Abbey Wood and Custom House stations more than doubled with the opening of Elizabeth line, and those at Woolwich increased from 28,500 to 31,500 per weekday.

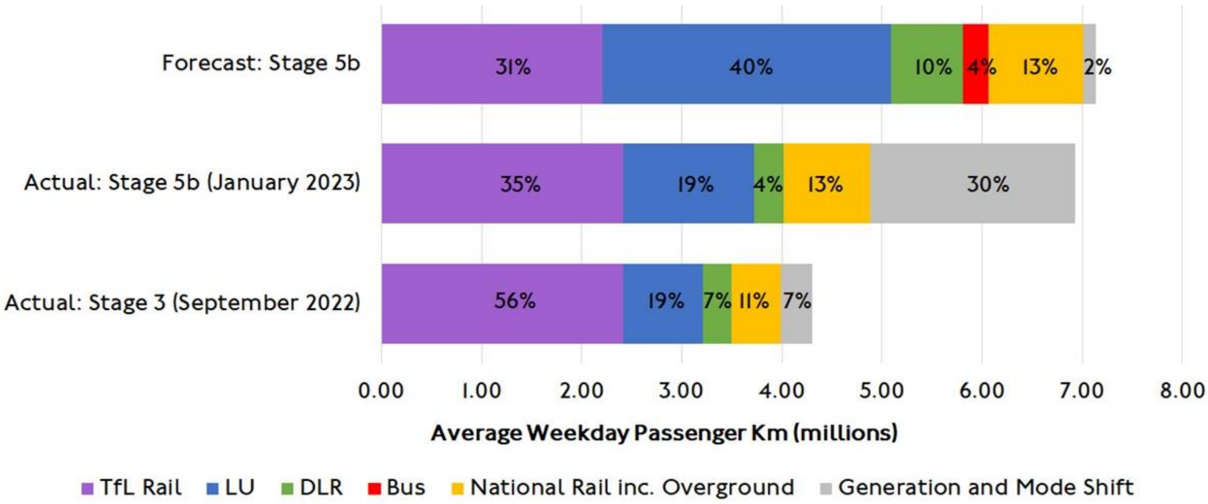
## 6 Abstraction

6.1 We have carried out extensive work to understand what portion of Elizabeth line demand is abstracted (that which was already travelling by public transport before but has now switched in whole or in part to Elizabeth line), and what has either shifted mode (e.g. from private car) or is generated (a journey that did not exist before but now does, thanks to the Elizabeth line). This helps us understand the impact of Elizabeth line on the economy and on TfL and National Rail revenue.

6.2 To do this, we need to estimate what would have happened in the absence of Elizabeth line and compared this to what we have seen happen instead. We have done this using the change from May 2022 to January 2023, and compared flows affected by Elizabeth line to those that are not, using Oyster and contactless payment data.

6.3 During this period, many other factors were also at play, including ongoing recovery from the pandemic, population change, service changes, fuel prices and fares changes. Our method allows us to account for some of these changes, but not all of them, and should therefore be treated as an estimate.

**Source of Elizabeth Line Average Weekday Passenger Kilometres, Tuesday to Thursday from September 2022 and January 2023.**
Source: Observed from Dunnart and Oyster/Contactless and Modelled from Railplan Business as Usual Forecasts




6.4 The graph above shows the source of Average Mid-Weekday Passenger Kilometres using Elizabeth line in September 2022 and January 2023 and compares this to the pre-opening forecast. The estimates are that:

(a) 35 per cent of Elizabeth line demand came from the previously existing TfL Rail service (Shenfield to Liverpool Street and Paddington to Heathrow/Reading);

(b) 19 per cent of Elizabeth line demand transferred from London Underground. This is concentrated in particular locations; demand on the Central line at Ealing Broadway has reduced by around 40 per cent, and on the Bakerloo line demand between Paddington and Oxford Circus has reduced by five per cent. Overall, the biggest transfers are from the Central line (37 per cent of the Underground abstraction), Jubilee line (24 per cent), and Piccadilly line (18 per cent);

(c) four per cent of Elizabeth line demand has come from the DLR, partly masked by demand growth from its own timetable enhancements;

(d) 13 per cent of Elizabeth line demand transferred from National Rail services, mainly South Eastern and Great Western; and

(e) the remaining 30 per cent of Elizabeth line demand is 'new':

(i) We believe most of these trips are *generated* (i.e. these customers would not have made these trips without the existence of the Elizabeth line).

(ii) Some of these trips may arise from *mode shift* from non-public transport (e.g. private car). Our forecasts suggested that this would be a small proportion.

(iii) Our analysis to date cannot determine the split between mode shift and trip generation, but this will be one of the subjects of the ongoing evaluation study.

6.5 Our estimate of the large portion of new trips (i.e. not travelling in May 2022 before the Elizabeth line opened), relative to our forecasts, is supported by the observed growth in demand at core Elizabeth line stations, that cannot be explained by decreases at surrounding stations (such as around Woolwich, Canary Wharf and Tottenham Court Road).

6.6 Of the trips we classify as generated, we believe that a significant portion of the generated demand can be viewed as "accelerated recovery" where the rate of recovery from the pandemic has been higher where the Elizabeth line is now available. We see some pieces of evidence for this hypothesis:

(a) the response to the better journey times provided by Elizabeth line is stronger than we would normally expect;

(b) the speed of the demand response to the journey time improvements, particularly for trips from the Shenfield branch to central London; and

(c) the difference between the forecast and observed abstraction (as opposed to the total demand, which is close to forecast). The forecast assumed a steady state in travel habits, with more of the demand coming from LU/DLR than we observed in reality. This implies that those customers could have used LU/DLR for these journeys but chose not to.

6.7 Taken together, these results suggest that a proportion of these 'new' trips were 'ready to travel', i.e. they had chosen not to use existing services but responded quickly to the change in the network. This is most likely if the customers in question were already travelling and have increased the frequency of their trips, e.g. additional days in the office for 'hybrid' workers.

6.8 In practice, it is not possible to tell the difference between pandemic recovery and any other type of demand growth, especially as there will have been significant churn in the travelling population in the more than three years since the pandemic began.

6.9 In either case, the transformation in connectivity, journey times and comfort has accelerated demand growth towards (and in some cases beyond) pre-pandemic levels. Overall, the Elizabeth line is attracting an estimated 140,000 additional journeys in London each weekday than otherwise would have been the case.

6.10 Bus demand as a feeder to the wider Elizabeth line has also increased substantially in response to the journey time reductions. Bus boardings around stations on the Western section have increased by 15 per cent, on the Eastern section by 13 per cent, and on the Central section outside Zone 1 by 22 per cent.

This is partially offset by bus boardings around Elizabeth line stations in Zone 1 decreasing by eight per cent on average.

6.11 TfL will continue to keep services under review as the impacts of abstraction from the latest Elizabeth line timetable change settle and ensure the appropriate response to changes in demand patterns. A more comprehensive study of abstraction is planned as part of the wider post opening study over the next two years. This will isolate the array of background factors and build a picture of what may have happened without the Elizabeth line. Extensive passenger surveys will be conducted later this year to understand how and why passengers' travel behaviour has changed. This will assess the displacement from other modes including travelling by car or bike.

**List of appendices to this report:**

None

**List of Background Papers:**

None

Contact Officer: Patrick Doig, Acting Chief Finance Officer
Email: Patrick.Doig@tfl.gov.uk