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Executive Summary

This report explains the information contained within the Station Usage file (Station Usage 2009-10.xls). The report provides guidance to the methodology followed during the process of creating this file for financial year 2009/10.

Station Usage data consists of estimates of the total numbers of people:

- Travelling from or to the station (entries & exits); and
- Interchanging at the station (interchanges).

Information is given for all the national rail stations around England, Scotland, and Wales based on tickets sales data. These results are the most recent in a series DeltaRail have supplied since 1997/98. The spreadsheet is in a similar format to those previously provided.

Station Usage data is generated from the O-D Matrix. In 2008/09 the O-D Matrix was integrated with the production of MOIRA Replacement's Demand Matrix (MOIRA is the rail planning tool used by the rail industry). This has brought substantial benefits as MOIRA Replacement's Demand Matrix includes an estimate of journeys and revenue made on zonal products sold by Passenger Transport Executives (PTEs), to provide a more complete representation of travel on the national rail network. This was previously a major deficiency of the O-D Matrix and Station Usage.

A thorough programme of checks has been undertaken on the Station Usage data. Results of these checks are listed in the Station Usage spreadsheet that accompanies this report, and further details are given in Section 7. Users of Station Usage information should take note of the limitations of this dataset, outlined in Section 9.

Contents

1 Introduction

DeltaRail has provided a series of Station Usage data for the rail industry in previous years. This report accompanies the Station Usage data for 2009/10. It gives details of the process and outputs in producing the Station Usage file for financial year 2009/10, on behalf of the Office of Rail Regulation (ORR).

DeltaRail are providing the ORR with an MS Excel file, "Station Usage 2009-10.xls" containing entries, exits and interchanges made at stations throughout England, Scotland and Wales, for the financial year 1st April 2009 to 31st March 2010. For the entries and exits, figures are split into the three main categories of the available ticket products (Full, Reduced, and Season).

2 MOIRA Demand Matrix – Base Data

2.1 Overview

The Origin Destination Matrix (O-D Matrix) produced for the ORR is created from the MOIRA[1] Replacement Demand Matrix. In previous years, the O-D Matrix has been created directly from LENNON[2] ticket sales, with the addition of infills for London Travelcards and Airport links. The use of the MOIRA Replacement Demand matrix is a significant change in the creation of the O-D Matrix from 2008/09. The O-D Matrix is now consistent with MOIRA which is the rail industry's principal planning tool, and now includes an estimate of journeys and revenue made on zonal products sold by Passenger Transport Executives[3] (PTEs) and so provides a more complete representation of travel on the national rail network.

2.2 Underlying Base Data - LENNON

The underlying matrix of ticket sales and associated journeys and revenue used in the current MOIRA model is derived from LENNON. It is based on an extract from LENNON, produced by Atos Origin, of total sales revenue and journeys for the year, broken down by flow (origin and destination National Location Code (NLC)), route code and by product type (CTOT). However, as there are known omissions in this data in respect of Transport for London (TfL) and PTE zonal tickets, and non-National Rail tickets on some airport services, there needs to be a "matrix infilling" exercise undertaken to estimate a complete origin-destination matrix.

Infilling is required as there are some journeys/revenue which do not appear in the underlying matrix, related to particular ticket types. There are three main such cases:

- Tickets with non geographical destinations, e.g. zonal products, Rovers
- Tickets sold at some non National Rail (RSP: Retail Settlement Plan) outlets, e.g. newsagents
- Tickets which do not appear in LENNON at all. This includes some Train Operating Company (TOC) tickets on airport flows, also for those TOCs which fall outside the Rail Settlement Plan.

Certain tickets with destination codes that are not national rail stations are included in the MOIRA Replacement demand matrices, being mapped to the corresponding rail station. These Rail Links usually include a third party element, such as to a bus

[1] MOIRA is the rail industry's tool for forecasting the impact of timetables on passenger revenue

[2] LENNON is the rail industry's ticketing and revenue system

[3] It should be noted that for convenience and clarity, the term 'Passenger Transport Executives' (PTEs) is used in this report, though they are officially now designated Integrated Transport Authorities and Strathclyde Partnership for Transport.

zone, or tourist attraction. The MOIRA Replacement demand matrix includes the journeys and the net revenue associated with such tickets.

Data excluded from the MOIRA Replacement demand matrix is set out in Appendix 3.

2.3 Ticket Type Definitions

Within the base demand matrices, journeys and revenue have been sub-divided into the following four types, each of which is further split by First & Standard Class:

1. Full: all walk-up undiscounted single or return tickets, whether or not issued with a status discount (child, railcard etc)
2. Reduced: all walk-up discounted single or return tickets, whether or not issued with a status discount (child, railcard etc)
3. Advance: all advance-purchase tickets
4. Seasons: all multi-use tickets

2.4 Infills for London Travelcards, Major Urban Areas (PTE) & Airports

There are certain areas within the underlying matrix where demand and revenue are under-estimated, in particular:

- **Within London Travelcard area.** Whilst the underlying matrix includes an estimate of journeys made on Day Travelcards / Travelcard seasons purchased at National Rail stations, it does not include a significant number of national rail trips made using Travelcards purchased at Tube stations, travel shops and newsagents.

- **Within Passenger Transport Executive (PTE) areas.** The underlying matrix excludes virtually all rail trips made on PTE-sponsored tickets, which are usually zonal and often multimodal.

- **Trips to/from Airports.** The underlying matrix includes many trips to/from airports, but excludes all Heathrow Express journeys, and some tickets sold for Gatwick Express, Stansted Express and other airport operators.

There are also other ticket sales which are not included in the underlying matrix, but these are insignificant and disparate in nature and so the matrix infilling covers the three flow types identified above. It should also be noted that journeys with no associated ticket sales such as staff travel, and particularly fare evaders, are not including in the origin-destination matrix.

The two major “infills” are for the London Travelcard area (sales made by Transport for London (TfL)), and for PTEs, since in both cases a substantial proportion of the rail journeys made use multimodal Travelcard type of tickets. The TfL infill has been undertaken based on the process used within current MOIRA for the last two years. The major urban area (also referred to as “PTE”) infill is based on the methodology used in the Department for Transport’s (DfT) Network Modelling Framework (NMF), updated in light of new PTE products becoming available.

The third infill, for Airports, estimates the significant number of rail journeys on Gatwick and Stansted Express, made on tickets sold outside of the RSP system i.e. not sold by National Rail outlets. Journeys on Heathrow Express are excluded from the MOIRA Replacement Demand Matrix.

2.5 MOIRA Replacement Documentation

A full description of the process of creating the demand matrix for MOIRA Replacement is contained in the report: ‘MOIRA Replacement, Stage: MS-5-1, Demand Matrix Documentation, Version: 0.2’ dated August 2009.

3 Summary of Results

The following table gives the total number of entries, exits, and interchanges made over the whole network for 2009/10, compared with the two previous years.

Table 3-1: Entries, Exits and Interchanges for 2007/08 to 2009/10 (millions)

Year	Entries	Exits	Entries & Exits	Interchanges
2009/10	1,065.39	1,065.39	2,130.78	153.33
2008/09[4]	1,073.75	1,073.75	2,147.51	146.39
2007/08	1,024.60	1,025.16	2,049.76	142.63

Overall, the decrease in entries and exits is around 0.8% in 2009/10, compared with the previous year. Note that figures for 2008/09 include a retrospective adjustment to some PTE-sold journeys, reflecting a change in their calculation methodology.

These changes, and indeed any comparisons between the data year on year, need to be viewed with the knowledge of significant improvements in the overall methodology over time, particularly the inclusion of the London Travelcard, PTEs and Airline infills.

3.1 Overview of the Entries and Exits Results

In this section we set out a summary of the overall entries and exits results. The spreadsheet contains entries and exits results for 2,525 stations, compared with 2,518 last year. The tables below show the stations no longer in station usage this year, and the new stations that have been added.

In 2009/10, no stations were removed, but seven stations were added. Of these, five were new. Stone station has also been reinstated, having reopened to passengers. British Steel Redcar, which was removed from the station usage figures for 2007/08 on account of the closure of the nearby industries, has been reinstated since it still has a limited train service and ticket sales to/from the station have been recorded in 2009/10.

[4] A change to the PTE infill calculation methodology was implemented for 2009/10. Figures for 2008/09 have been adjusted retrospectively to enable like-for-like year-on-year comparisons to be made

Table 3-2 – Stations in 2008/09 but not in 9/10

NLC	Name	Comment
		No stations

Table 3-3 – New Stations added in 2009/10

NLC	Name
1316	Stone
1847	Corby
5566	Ebbsfleet International
7222	Stratford International
7932	British Steel Redcar
8931	Laurencekirk
9586	Imperial Wharf

The table below shows data for the ten stations with the highest numbers of entries and exits for 2009/10.

Table 3-4: Top 10 stations based on the entries and exits made for 2009/10

NLC	Station Name	0910 Entries & Exits	0809 Entries & Exits	Change	Rank Last Year
5598	London Waterloo	86,397,666	87,930,076	-2%	1
5426	London Victoria	70,224,543	70,157,115	0%	2
6965	London Liverpool Street	51,596,155	55,103,416	-6%	3
5148	London Bridge	48,723,068	49,703,152	-2%	4
5143	London Charing Cross	36,459,945	36,659,932	-1%	5
1444	London Euston	30,068,092	27,499,986	+9%	7
3087	London Paddington	29,104,198	29,302,758	-1%	6
1127	Birmingham New Street	25,267,757	25,191,945	+0%	8
6121	London King's Cross	24,817,616	24,641,427	+1%	9
9813	Glasgow Central	23,809,949	23,867,850	-0%	10

The total journeys made at one of the top ten stations account for a total of 426 million, 0.8% less than the 430m journeys made last year. The top ten stations account for 20% of all entries and exits, compared with 20% in 2008/09.

3.2 Overview of the Interchanges Results

In all, around 153 million interchanges are estimated to have been made among National Rail operated services (interchanges between rail and tube or other modes are excluded). This is an increase of 4.7% compared to the 2008/09 results (146 million). This increase will partly reflect the inclusion of Oyster Pay As You Go data relating to journeys in the Greater London area (see Section 7.1 for details). The ten top stations are listed in the table below.

Table 3-6: Top 10 stations based on the interchanges made for 2009/10

NLC	Station Name	0910 Interchanges	0809 Interchanges	Change
5595	Clapham Junction	20,520,598	16,354,822	+25%
5355	East Croydon	7,120,189	6,371,478	+12%
5148	London Bridge	7,060,751	4,971,470	+42%
5598	London Waterloo	5,466,424	4,587,154	+19%
5426	London Victoria	5,078,272	4,498,079	+13%
1127	Birmingham New Street	3,957,161	4,044,411	-2%
6121	London King's Cross	2,786,360	2,703,432	+3%
3149	Reading	2,617,998	2,688,530	-3%
6119	Finsbury Park	2,529,271	2,629,184	-4%
9813	Glasgow Central	2,284,406	2,148,398	+6%

Interchanges occurred at 523 stations in 2009/10 compared to the 520 stations in 2008/09. Stations appearing for the first time in 2009/10 and those not seen this time are listed below.

Table 3-7: Changes in Interchange Stations in2009/10.

	Interchanges 2009/10	Interchanges 2008/09
New		
Ebbsfleet International	25,036	
Carstairs	2,893	
Sellafield	193	
Colwall	20	
Stratford International	16	
King's Lynn	10	
Fishguard Harbour	2	
Old		
Clock House		4,891
Runcorn East		3
Stroud		2
Higham		1

The numbers in this table are estimated numbers for actual passenger interchanges made during the year. In some cases the numbers are extremely small.

We have not identified reasons for changes in the interchanging stations. However, it is important to note that interchanges can change significantly from year to year for a variety of reasons. Factors such as new service patterns and changes in journey times play a part. The number of interchanges is based on the rail industry ORCATS model, which predicts passenger choices of rail route and trains used. Refer to Appendix 1 for more information on the ORCATS allocation process.

4 Station Usage File Definition

This spreadsheet lists the entries, exits and interchanges made at stations throughout England, Scotland and Wales in the financial year 2009/10 (1st April 2009 to 31st March 2010). It also gives details about the entries and exits for different ticket categories. It contains data on entries and exits made at rail stations by passengers using the rail network. The fields included in the Station Usage file are:

Table 4-1: Station Usage File

Field	Description
Station (Name, NLC, TLC)	Station Name, NLC: National Location Code, TLC: Three Letter Code
District, County, Region, NUTS2 Code and NUTS2 Spatial Unit for the Station.	Station's geographical location.
Station Facility Owner (SFO)	The company that is the station facility owner (provided by Network Rail in 2008).
Station Group	Name of the Group where applicable. The user of this data may wish to filter on the 'Station Group' column, or create pivot tables, to investigate the results at a group level.
PTE Urban Area Station	Stations within the urban areas covered by PTE services are identified with a flag: 'PTE Urban Area Station'
London Travelcard Area	Stations within the Greater London area where a London Travelcard is valid are identified with a flag: 'London Travelcard Area Station'
London Joint Station	Joint stations which are served by both rail services and TfL services are identified with a flag: 'Joint TfL & TOC Station'
Entries (Full, Reduced, Season, Total)	Entries made at the stations split by ticket categories and in total
Exits (Full, Reduced, Season, Total)	Exits made at the stations split by ticket categories and in total
09/10 Entries & Exits	Sum of Entries and Exits for 2009/10
08/09 Entries & Exits	Sum of Entries and Exits for 2008/9
09/10 Interchanges	Total Interchanges made for 2009/10
Check	Fail if number of entries & exits combined is more than 20% higher or lower than figure in 2008/09
Check Detail	Flag indicates Growth or Decline, and where the change is ignored if less than 15,000 entries & exits
Check Reason	Identified reason(s) for failing the check

5 Entries and Exits Methodology

5.1 Overview

An estimate of the number of people entering and exiting each of the National Rail stations for the financial year 2009/10 is derived from the O-D Matrix created by DeltaRail for the ORR.

Each record in the O-D Matrix reflects an estimate of the actual passenger journeys undertaken on rail services in England, Wales and Scotland. The O-D Matrix contains the number of journeys for each flow, where a flow consisted of a unique origin, destination and route code combination.

The number of entries and exits is calculated for a particular station by summing all journeys starting at the station, and all journeys terminating at the station.

5.2 Methodology Changes

Improvements have been made to the O-D Matrix and Station Usage methodology in the last four years.

Between 2006/07 and 2008/09 the accuracy and usefulness of the O-D Matrix has been improved. This was achieved by applying new procedures on the way journeys with unknown origin and/or destination have been treated, and by including journeys that were previously excluded from the file or did not appear in the LENNON sales data. In summary, the main changes were:

- Adding in previously missing journeys, e.g. TfL sold Travelcards, and some airport link tickets (this is undertaken in the production of the MOIRA demand matrix).
- Rail Links such as PlusBus and Attractions. The rail element of these ticket sales is now included (this is undertaken in the production of the MOIRA demand matrix).
- Estimating the split of records for station groups, including London BR, into the constituent individual stations. This methodology was further refined for those groups with no ticket office at one or more stations within the group. (This processing is undertaken in the O-D Matrix),
- Via the integration with the process that creates the MOIRA Replacement Demand Matrix, PTE ticket sales are now included, in addition to TfL sold Travelcards, and some airport link tickets.
- The method for estimating passenger journeys from ticket sales has changed. This is a result of using the MOIRA Replacement Demand Matrix as a starting point. The MOIRA Replacement Demand Matrix does not disaggregate single journeys, and so when estimating passenger journeys all ticket sales have

been split equally into the two directions of travel. This will only have an impact on the O-D Matrix if there is more travel on single tickets away from a station compared to travel to the station, which is not likely to be material. Therefore in the Station Usage file, entries are the same as exits.

In 2009/10 further improvements have been made:

- Adding in data for journeys undertaken by Oyster "pay-as-you-go" in the London area (this is undertaken in the production of the MOIRA demand matrix). This applies to journeys made after 1 January 2010 (see Section 7.1).
- Refinement of the methodology used to calculate journeys undertaken using PTE tickets.

The change to methodology for PTE tickets has altered the overall number of journeys (and hence the number of entries and exits at individual stations). This has particularly affected Strathclyde PTE. The Station Usage statistics for 2008/09, both in this report and in the accompanying spreadsheet, have therefore been recalculated, to enable year-on-year comparisons to be made using like-for-like results.

5.3 Unknown Destinations

Ticket sales do not always tell us where a passenger is travelling, for example where the Origin or Destination is a London Travelcard. As in previous years, we have converted unknown destinations into an estimate of the actual stations that passengers are travelling to. The full detail of this part of the methodology appears in Appendix 2.

6 Interchanges Methodology

An estimate of the number of people interchanging at each station is obtained by combining the number of journeys made on each flow (from the O-D Matrix) with the information on passenger journeys taken from the Central Allocations File (CAF).

The CAF is an output of the ORCATS system which predicts passenger choices of rail route and train used, and determines the allocation of passenger revenue between TOCs. Since ORCATS is a model, the CAF contains estimates rather than actual journeys. However, it is used throughout the rail industry, so it is an appropriate source of data to use for this purpose. Since CAFs are updated with the timetable, not with financial years, no CAF will match the ticket sales data exactly. The December 2009 CAF in used in the creation of the 2009/10 Station Usage,

which relates to the timetable in operation for a substantial portion of the 2009/10 financial year.

The CAF contains:

- Origin and destination;
- Route alternatives for each origin and destination, including all interchange points;
- Ticket type data; and
- For each flow, the proportion of passengers who choose to travel on each route alternative as calculated by the ORCATS model.

An overview of the ORCATS allocation process can be found in Appendix 1.

7 Checks on Station Usage: Significant Growth or Decline

A check on the station usage figures is performed to identify all stations at which total Entries plus Exits has changed significantly since the previous year, and is contained in the station usage spreadsheet.

The results of this check show a 0.8% decrease in total entries and exits overall between 2008/09 and 2009/10. A significant change is defined as a deviation of more than +/-20% from the mean, i.e. if growth is more than 19.2% year on year or decline is more than 20.8%. Only stations whose entries and exits exceeded 15,000 were considered in this check. In total 153 stations failed the check; that is 7% of the stations whose total entries and exits exceeded 15,000.

Significant growth or decline will be as a result of a myriad of reasons (rail service changes, local population changes, housing or industrial changes etc). Some will be one-off changes e.g. events, or closure of an important employer. Some will be long term trends e.g. changes in housing. The stations experiencing significant growth are spread across the country. In some instances where stations are clustered together it has been possible to identify changes in service patterns e.g. the branch line from Derby to Matlock.

Table 7-0 shows the stations with the largest increases in total flow, not including flows of less than 15,000.

Table 7-0 – The Largest Increases in Station Usage

NLC	Station Name	0910 Entries & Exits	0809 Entries & Exits	Increase	Reason
5237	Maidstone Barracks	152,000	70	>1000%	Improved methodology used to allocate passengers within Maidstone BR group stations
1901	East Midlands Parkway	182,412	33,848	439%	New station in 2008
2004	Sellafield	361,974	68,958	423%	Usage restored to similar level to 2007/08. Reason for reduction in 2008/09 not known
9587	Shepherds Bush	1,014,896	247,534	310%	New station in 2008
1090	Aylesbury Vale Parkway	49,212	13,042	277%	New station in 2008
1074	Atherstone	40,006	10,630	276%	Improved train service introduced in December 2008

Table 7-1 shows stations with significant reductions in flow, again excluding total Entries & Exits of less than 15,000.

Table 7-1 – The Largest Decreases in Station Usage

NLC	Station Name	0910 Entries & Exits	0809 Entries & Exits	Decline	Check Reason
3346	Melksham	10,028	27,656	64%	Reason for decline not apparent
9968	Bowling	43,916	96,012	54%	Reason for decline not apparent
2922	Milnrow	55,406	102,598	46%	Station closed in late 2009 for conversion to Metrolink
2925	Shaw and Crompton	213,480	385,260	45%	Station closed in late 2009 for conversion to Metrolink
2923	New Hey	26,360	47,036	44%	Station closed in late 2009 for conversion to Metrolink
2907	Oldham Mumps	224,428	386,626	42%	Station closed in late 2009 for conversion to Metrolink

There are a number of significant factors affecting the station usage figures in 2009/10, and these are described below. In addition there are many reasons why a station may fail the check, and these, including those provided in previous reports, have been listed below for completeness.

7.1 Oyster Use on Rail

In London, the Oyster smartcard has been in use since 2004 on Underground, bus and DLR services. The Oyster product has been extended to rail services within the Greater London area, initially only on limited routes and Train Operators, and most recently in January 2010 to all Train Operators' services within the Greater London area.

Oyster is a Transport for London smartcard which can hold either a Travelcard, or a pre-paid balance that allows the user to 'Pay-as-you-go' (PAYG). For 2008/09, data for journeys undertaken using Oyster was excluded from the O-D Matrix. Where Oyster had been extended to rail services we saw a decline in passenger usage in the Station Usage numbers, as passengers switching to Oyster PAYG were not included in the O-D Matrix. This did not reflect an actual decline in passenger usage. It just reflected the fact that the passenger was now using a different ticket and journeys made on these tickets are not in Lennon, the O-D Matrix or the station usage numbers.

From January 2010, Oyster PAYG was extended to cover all rail services within Greater London. Also from January 2010, data for journeys undertaken by Oyster PAYG has been included flow by flow within Lennon, and is therefore also included in the 2009/10 O-D Matrix, enabling a more complete picture of rail travel in the London area to be provided.

An overview of the extension of Oyster onto rail services within Greater London since 2004:

- Chiltern: Oyster accepted to Amersham on the Amersham line (which runs in parallel to the Metropolitan line) from the introduction of Oyster in 2004. Oyster extended to West Ruislip in January 2008.
- c2c: Oyster extended to Dagenham Dock and Rainham in January 2008.
- First Great Western: Oyster extended to West Drayton and Greenford in September 2008.
- National Express East Anglia: Oyster extended to St James Street and Stamford Hill in January 2008.
- London Overground: took over the rail routes previously run by the rail operator Silverlink in November 2007. The operator changes from a franchised rail operator with tickets captured in Lennon, to a TfL-owned franchise offering Oyster PAYG.
- All operators: In January 2010 Oyster PAYG can be used for virtually all journeys on National Rail services wholly within the Greater London area.

7.2 Chiltern Stations

The switching from rail operator tickets to Oyster PAYG had produced a decline in station usage across the Chiltern stations within Greater London, both along the lines where Oyster has been extended in January 2008, and along the line to Amersham where Oyster has been accepted since the introduction in 2004. The inclusion of Oyster PAYG data in the 2009/10 O-D Matrix and Station Usage results has reversed this apparent decline.

7.3 London Travelcard Area Stations

All stations within the Greater London area where a London Travelcard is valid can be identified by the flag: London Travelcard Area ='London Travelcard Area Station'. Estimates of passenger journeys on rail services made using a London Travelcard are included in the ODM and the station usage.

7.4 Joint Rail & TfL Stations

Joint stations are stations which are served by both rail services and TfL services i.e. Underground or DLR. These stations can have both a TfL and a TOC ticket office, or they may have just a TfL or just a TOC ticket office. Special treatment of the ticket sales at these stations is important to ensure a realistic estimate of passengers using rail services. Passengers travelling on Underground or DLR services should not be included. These stations are identified on the station usage by the flag: London Joint Station = 'Joint TfL & TOC Station'.

The treatment of the Joint Stations is slightly different in the MOIRA Volume Matrix, than the approach used in the O-D Matrices in previous years. Within the MOIRA Volume Matrix, an estimate of the number of travellers using rail (as opposed to other modes i.e. tube or DLR) is made. Ticket sales at the joint stations are therefore scaled down, which produces fewer rail journeys than previous years, but a better estimate of actual rail journeys and consistent with MOIRA Replacement.

In addition, there are a number of stations that MOIRA treats in the same way as Joint Stations. These are identified by the flag: London Joint Station = 'MOIRA Joint Station', e.g. Lewisham and Greenwich. These stations are not classified by the TOCs and TfL as a 'Joint Station', but they are the same: they are served by both rail and Underground/DLR services.

7.5 Thameslink Central London Stations

Allocation of flows to/from London BR and London Travelcard including Zone 1 across London stations has been problematic for the cross-London Thameslink route. In particular Farringdon, City Thameslink and Elephant & Castle. The MOIRA Volume matrix treats all sales to London stations in Zone 1 as London BR. Ticket sales will be recorded in Lennon to individual stations, and group stations. For example: Farringdon (0577) and London BR (1072). In previous years ticket sales to individual stations e.g. Farringdon (0577) were preserved, and then subsequently ticket sales to London BR were allocated across the London stations. This change in methodology has exposed some deficiencies in the assumptions we have used (from the London Travel Area Survey, LATS) on how passengers travel to/from London stations. For station usage since 2008/09, we have adjusted the usage figures to give a better estimate by reviewing the original ticket sales to the individual central London Thameslink stations. The 2009/10 O-D Matrix has not been adjusted, and so we recommend that when considering journeys to the Thameslink stations that all stations in zone 1 be considered jointly.

7.6 New Stations

Stations that are newly opened, or have been opened within the past few years, can reasonably show significant growth. The main examples are shown in Table 7-2 below.

Table 7-2 – New Stations in 2008/09 showing significant growth in 2009/10

Station	NLC	County
Aylesbury Vale Parkway	1090	Buckinghamshire
East Midlands Parkway	1901	Leicestershire
Alloa	9883	Clackmannan
Mitcham Eastfields	5069	Greater London

7.7 Group Stations

Edenbridge group station consists of Edenbridge (5473) and Edenbridge Town (5359). In 2007/08 both of these stations had a ticket office. The ticket office at Edenbridge is no longer open, and there were very few ticket sales attributed to this station in 2008/09. Therefore in the allocation of passenger flows between the two Edenbridge stations in the ODM, does not represent an accurate estimate of passenger journeys. The 2008/09 station usage figures were amended by apportioning usage of the two stations similarly to 2007/08. For 2009/10, we have used the MOIRA demand matrix to apportion journeys between the two stations in the Edenbridge group.

Maidstone group station comprises Maidstone Barracks (5237), Maidstone East (5115) and Maidstone West (5222) stations. Maidstone East and Maidstone West stations both have tickets offices, whereas Maidstone Barracks does not. It is not therefore possible to apportion journeys accurately to Maidstone Barracks station based on ticket sales. Maidstone Barracks and Maidstone West are consecutive stations on the same line, whereas Maidstone East is on a different line. The MOIRA demand matrix has been used to apportion journeys over the two different lines, although this is still likely to give an inaccurate split of journeys between Maidstone Barracks and Maidstone West. Results for these stations have been apportioned using the London Area Travel Survey (LATS 2001), giving a split of 79% to Maidstone West and 21% to Maidstone Barracks

7.8 Other Impacts on Station Usage

7.8.1 Gating Schemes

Installation of ticket gates can significantly affect not only the usage figures at that station, but also those at neighbouring stations. The gates help to ensure that customers purchase tickets, but customers may also alter their travel patterns to avoid gated stations. We would expect travel patterns to be most affected in the months following the installation of the gates.

7.8.2 Change in Service Pattern

Alterations in service frequency or stopping pattern would be expected to alter station usage figures. This is particularly apparent where a group of consecutive stations show similar increases or decreases. Again, this can be a long-term trend.

7.8.3 Ticket Issuing Facilities Changes or Product Changes

Some London stations have both underground and National Rail trains operating. LENNON does not capture tickets sold by London Underground, only those sold by TOCs. Changes in ticket facilities provided by TOCs, for example the provision of ticket machines, can therefore increase the ticket sales captured by the system.

Product changes can have an effect on passengers' purchasing patterns at rail outlets thus affecting station usage data. For example, the introduction of Oyster cards at rail outlets can affect stations inside the Travelcard boundary in the London area.

7.8.4 Engineering Work

Significant engineering work can alter customers' travel patterns.

7.8.5 Tourism

Stations near to tourist attractions may show significant changes in usage as a result of weather, promotions or other factors, which affect tourists' journeys.

7.8.6 Special Stations

Some stations serve a particular activity or business. Some fluctuation in usage of such stations is reasonable. Such activities include:

- Racecourses
- Sports Events
- Exhibition Centre Glasgow
- Airports

7.8.7 Trend of Growth or Decline

For stations with a history of growth or decline, it is reasonable to expect this trend to continue. There are many possible reasons for these trends, such as demographic and employment changes.

7.8.8 Changes in the Sales of Individual Ticket Types

Miscoding of ticket information entered into LENNON can alter station usage results, although this would not be reflecting an actual change in customers' journeys.

8 Regions, Counties and Districts

For all rail stations, the District, County, Region and NUTS2 Region & Code are provided for the origin and destination to describe the geographical location.

The source of this data is:

- District or the Unitary Authority – ATOC (dated January 2008) and ORR (dated January 2008)
- District, County & Region – ONS[5] website (dated January 2008)
- NUTS2 Code and Description – ORR (dated January 2010)

[5] http://www.statistics.gov.uk/geography/geographic_area_listings/administrative.asp#04

9 Limitations of the LENNON data

The LENNON database captures ticket sales for the entire national rail network from many different input machines. It is as a consequence a very large data set. With all large data sources there will always be input errors resulting in a certain amount of invalid data. Generally such errors will be small, and are more likely to occur in the journeys rather than revenue fields.

We perform checks on the data, but due to the size and complexity of the dataset we are not able to validate each and every entry.

We have used similar information extensively in the last ten years or more, and have found the data to be reliable, particularly when examining the data at an aggregated level.

There are a number of areas where we know that LENNON does not capture the data correctly, or instances where it is not possible to derive passenger journeys from ticket sales data. These areas are expanded upon below.

9.1 Known Problems of Data Capture

The data in LENNON from which the O-D Matrix is derived is based on ticket transactions. In order for the data to be included in the O-D Matrix it must include an origin station and a destination station. However if this is not the case then the data will automatically be excluded.

Human error at the point the ticket sale is entered into the input machines will produce invalid data in LENNON.

9.2 Travelcards

As Travelcards are for multi-modal travel they allow the purchaser to make journeys on the rail system and on other modes. Equally, tickets purchased elsewhere on the local transport system will be valid for rail travel. Therefore LENNON gives only a partial picture of the rail travel in conurbation areas, such as: London, Birmingham, Glasgow, Leeds, Liverpool, Manchester, Newcastle and Sheffield.

The O-D Matrix contains reasonably robust estimates of journeys within London and other conurbation areas where travelcards are widely used. An infill for London Travelcards has been included in the O-D Matrix since 2006/07, and an infill for PTE tickets is included from 2008/09.

Refer to Section 3 of the report: 'MOIRA Replacement, Stage: MS-5-1, Demand Matrix Documentation, Version: 0.2' dated August 2009, for a detailed description of the 'London Travelcard Area Infill'.

9.3 Return and Single Journey Tickets

It is possible that on certain routes the cost of a return ticket could be lower than a single ticket. This leads to the cheaper return ticket being purchased even though the passenger has no intention of making the return journey by rail. This results in two journeys being recorded instead of one.

9.4 Multiple Tickets

It is possible to buy special cheaper tickets between certain stations for example under a promotion by one of the train companies. In these cases a local ticket may be bought to gain access to a main station and a second ticket bought for the rest of the journey. This results in two journeys being recorded in the O-D Matrix and will not accurately represent the journey undertaken.

9.5 Rail Staff Passes

Prior to the privatisation of the rail network, British Rail employees and their families were eligible to various levels of free or reduced rate rail travel. When the various rail companies were converted to private companies, this benefit often continued.

If you consider the network as a whole, the effect of staff passes is unlikely to be significant. However, it may be significant on certain routes, for example on routes out of Derby due to large concentration of companies in Derby relating to British Rail both pre and post privatisation.

9.6 Ticketless Travel

On every route on the network there will always be passengers who travel without purchasing a ticket. This is referred to as ticketless travel. As LENNON data is derived from ticket transactions it cannot reflect this travel.

9.7 Other Rail Systems

There are a number of rail systems in operation in the country that are not covered by LENNON. For Heathrow Express and Eurostar revenue and journeys data were not available.

In addition some tickets of franchised operators may be sold outside LENNON, for example Hull Trains, Grand Central and Wrexham & Shropshire. However, note that for the main two such cases, Gatwick Express and Stansted Express, data has been included since 2006/07.

9.8 Factors Affecting the Data

Although not relevant for this year, there are factors worth taking into account when considering generic annual data:

- Years may have been affected by industrial action such as 1994/95.
- Major incidents affecting services such as Southall, Ladbroke Grove and Hatfield.
- Adverse weather.
- Infrastructure changes e.g. ticket gating significantly increases revenue - more gates have been installed in recent years which will affect the data but which does not represent higher passenger numbers.

9.9 Journey Factors

Ticket transactions are converted into an estimate of the number of journeys made by applying a series of ticket type journey factors. Single and return tickets unambiguously translate into one and two journeys respectively, for season tickets, the factors used represent a rough historic estimate as set out in Table 10-1 overleaf.

Ticket periods of other lengths are converted to a number of journeys using a proportion of the monthly journey factor.

Therefore the journeys data in the O-D Matrix represents an assumed number of journeys made based on the ticket type sold and the above journey factors. In particular it should be noted that the journeys data has not been cross-checked against other data sources of the actual number of journeys made on the network.

These journey factors have been used within the LENNON system for a number of years at their current values. The source of the factors is unclear, and there is some indication that they were based on reasonable estimates of ticket use made in excess of fifteen years ago. It can therefore be argued that these journey factors do not provide an accurate estimate of the number of journeys that result on the rail system at present, or in any O-D Matrix.

Table 9-1: Journey Factors used in LENNON

Description	Journeys Per Issue
Single Journey Ticket	1
Return Journey Ticket	2
Return Journey 2 Persons	4
3 Day Return/ 6 Single Journeys	6
4 Day Return/ 8 Single Journeys	8
5 Day Return/ 10 Single Journeys	10
6 Day Return	12
5 Day Single	5
1.5 Journeys	1.5
Weekly Ticket	10.3
10 Day Return/ 20 Single Journeys	20
2 Weekly Ticket	22
Seasons-Variable Periods	***
Monthly Ticket	45
Not Used	0
3 Monthly Tickets	135
Not Used	0
6 Monthly Tickets	270
Summary Group Codes	***
Annual Ticket	480
8 Day Ticket	22
22 Day Ticket	44
14 Day Ticket	30
50 Journeys	50
10 Weeks	103

Appendix 1 – Overview of the ORCATS Allocation Process

This section gives an outline of the Central Allocations File (CAF), which is used in producing the interchange figures, and the ORCATS process which is used to create the CAF.

Most of the train tickets that are sold are inter-available – the customer has a choice of routes and operators. For example, when a customer buys a ticket to travel from Leicester to Leeds, that customer may travel on various combinations of East Midlands Trains, East Coast, CrossCountry Trains and Northern, and may interchange at Doncaster, Sheffield, Derby or Nottingham. LENNON captures the sale of the ticket, but unless the ticket has stringent route restrictions, the route actually taken by the customer is not recorded.

The route taken by any particular customer may never be known, but some route options are more attractive than others. The customer is more likely to choose a faster, more frequent service than a slower, less frequent one. This likelihood can be translated into the proportions of customers choosing each route option, on a particular flow. (A 'flow' represents all journeys from a given origin station to a given destination station, irrespective of the route taken.) The revenue received from all customers on that flow should be split between different operators to reflect the proportion of customers which each operator carried.

ORCATS was developed to model the choice made by the customers, and to allow revenue to be split between operators. It applies passenger choice modelling to the train timetable, to determine the relative attractiveness of different route alternatives. It then weights the results by journey mileage.

For any given timetable, ORCATS works out the possible routes between each origin and destination, and calculates the percentage of the passengers that are expected to choose each route based on the services in that timetable.

The output from ORCATS is the Central Allocations File (CAF). This lists the proportion of journeys on each flow (or origin-destination pair) estimated to be made by each route alternative. For journeys involving interchanges, each leg of the journey is listed. By combining this information with LENNON data, which contains actual ticket sales figures for all flows, the number of interchanges occurring at individual stations has been estimated.

Appendix 2 – Methodology: Non-Station Tickets

Ticket sales do not always tell us where a passenger is travelling. Ticket sales can be divided into the seven categories listed in table below. Ticket sales data has been converted into an estimate of the actual stations that passengers are travelling from/to.

The processing of ticket sales data is undertaken in the creation of the MOIRA Replacement demand matrix, and then subsequently in the creation of the O-D Matrix. For each of the flow categories, the table below states where the flow is processed: MOIRA or O-D Matrix.

Table A2-1: Categorisation of Ticket Sales in LENNON

Flow Category	Description	Processing
Category 1	Origin and Destination Stations Known	No processing required
Category 2	Origin or Destination a Group Station (excl. London BR)	O-D Matrix
Category 3	Origin or Destination is London Terminals	O-D Matrix
Category 4	Origin or Destination a London Travelcard including Zone 1	O-D Matrix
Category 5	Origin or Destination a London Travelcard excluding Zone 1	MOIRA Demand Matrix
Category 6	Origin or Destination a London Travelcard Boundary Zone	MOIRA Demand Matrix
Category 7	Non-National Rail Stations	MOIRA Demand Matrix

Category 1 – Origin and Destination Stations Known

Both the origin and destination were known stations so no further processing is required for such flows.

Category 2a – Origin or Destination a Group with all Stations Having a Ticket Office

In 2005/06 all origins or destinations that were a group station (with the exception of London BR) were changed to the major station within the group. For example, all ticket sales to or from Reading BR were recoded to Reading. This was clearly over-simplistic.

In 2006/07 the O-D matrix was based on the journeys from ticket sales to the individual stations within a group. We assumed that passengers travelling **to** the stations in a group would act in the same way as passengers travelling **from** the stations in that group. We believed that this was, in general, a valid assumption to make, and no bias would be introduced into the journey figures.

From 2007/08 onwards this process is still used where all stations in the group have ticket offices, so that the relative flows from the individual stations are credible.

For example, in 2006/07 the journeys between stations in the 'Manchester BR' group and Crewe and vice-versa are shown by the column "jnys" in the table below. First the proportion of journeys **from** each of the individual Manchester stations **to** Crewe is determined, as shown in column "%split".

Then these proportions are applied to both the 'Manchester BR to Crewe' and 'Crewe to Manchester BR' flows, giving the breakdowns to individual stations shown in column 'BR portion'. These are added to the base values to give "Total Journeys", before the 'Manchester BR to Crewe' and 'Crewe to Manchester BR' flows are deleted, to avoid double counting. The slight discrepancy between the Grand Totals is due to rounding error.

Table 9-1: Example of how we split journeys to/from a BR group of stations

Orig	Dest	Origin Name	Destination Name	Jnys	%split	BR portion	Total Jnys
2963	1243	DEANSGATE	CREWE	83	**0.32%**	85	168
2966	1243	MANCH OXF RD	CREWE	5,464	**21.03%**	5580	11,044
2968	1243	MANCH PICC	CREWE	19,733	**75.95%**	20152	39,885
2970	1243	MANCH VICT	CREWE	700	**2.69%**	714	1,414
0438	1243	MANCH BR	CREWE	26,533	**Remove**		
1243	2963	CREWE	DEANSGATE	207		1478	1,685
1243	2966	CREWE	MANCH OXF RD	2,262		97287	99,549
1243	2968	CREWE	MANCH PICC	8,017		351349	359,366
1243	2970	CREWE	MANCH VICT	343		12464	12,807
1243	0438	CREWE	MANCH BR	462,578	**Remove**		
			Grand Total:	525,920			525,918

The above methodology has been applied to all flows with more than 1,000 journeys in total leaving the individual group stations (i.e. not including the 'BR Group NLC to

destination' flow. For the smaller flows an average split is applied based on the flows with more than 1,000 journeys.

Category 2a – Origin or Destination a Group with some Stations Having no Ticket Office

For this class of stations the above process breaks down because the proportion of journeys **to** the group stations with no ticket offices will tend to be estimated as zero because the sales **from** those stations are necessarily zero. For these groups an alternative process is used which considers each origin station / group destination pair in turn and estimates the proportion of flow to each group station from the origin according to the existence or relative attractiveness of the service to each of the group stations.

Category 3 – Origin or Destination is London BR

This category contained all flows that had London BR as either the origin or destination. In order to assign an appropriate London station on flows where either the origin or destination is London BR (NLC=1072) or a London Travelcard involving Zone 1, we analysed responses from the 2001 London Area Travel Survey (LATS). For journeys from any given station, we established the percentage of passengers using each London terminus.

For example, if the flow was from Ashford International to London BR, we used our pre-generated table showing the percentage spilt between the alternative London termini for passengers starting at Ashford International. From this we apportioned the exits between London Bridge, Charing Cross, Victoria and other London termini.

Stations with small sample sizes were removed from the 2001 LATS data. Where there was insufficient data in the 2001 LATS to generate the split for a particular station, a similar process with the Non London Groups methodology was applied. Firstly for all the flows with more than 1000 journeys leaving London BR and having as a destination the particular station we used split factors as above. However, if the sum of journeys was less than 1000 we assigned to the flow the top origin from the London BR stations.

Category 4 – Origin or Destination a London Travelcard including Zone 1

All origins and destinations that were London Travelcard Zones that include Zone 1 were converted to 'London BR' under the assumption that they will travel to the same stations as point-to-point passengers and then transfer to another mode. The methodology set out above for Category 3 was then applied.

Category 5 – Origin or Destination a London Travelcard excluding Zone 1

This category contained all Travelcards that did not include Zone 1, for example Zone R2345 London.

For flows with origin or destination a London Travelcard (excluding zone 1) we use a set of assumptions based on survey responses from the 2001 LATS. They use the starting station to work out which stations it is possible for the passenger to be travelling to, and also give the proportion of passengers travelling to each of these stations. This is based on the assumption that a passenger holding a Zones 2-6 Travelcard would travel as far as Zone 2.

This processing is undertaken during the production of the MOIRA Replacement demand matrix.

Category 6 – Origin or Destination a Boundary Zone

All origins and destinations that were a London Travelcard Boundary Zone were converted to 'London Travelcard including Zone 1' under the assumption that a passenger travelling from or to a Boundary Zone will hold a Travelcard that includes Zone 1. The methodology set out above for Category 3 was then applied.

This processing is undertaken during the production of the MOIRA Replacement demand matrix.

Category 7 – Non-National Rail Stations

This final category contains all those flows in the original ticket sales data that do not fall into one of the above categories. Refer to Section 6: 'Data Excluded From the O-D Matrix' for a detailed description of this data and what has been included and excluded from the O-D Matrix.

This processing is undertaken during the production of the MOIRA Replacement demand matrix.

Appendix 3 – Data Excluded From Station Usage

Some of the LENNON data has been excluded from the MOIRA Replacement Demand Matrix, and subsequently from the O-D Matrix.

All the products that were classified into the 'miscellaneous' ticket pot were excluded. These products were:

- Car Parking
- Railcard Sales
- Penalty/Excess Fares
- Seat Reservations
- Sleeper Supplements.

Also excluded from the analysis were all the flows that had either an Origin or Destination that did not represent a geographical location (these are mainly "I codes"), e.g.

- Rover and Ranger Tickets (e.g. Anglia Plus)
- BritRail Tickets
- Gate passes usually used by staff
- Passenger Charter Discounts
- Headquarters Input Items, other than those which can be identified as TfL or PTE

Finally for flows that have either Origin or Destination a Private Settlement Code some are included and some are excluded.

- PTE tickets and TfL sold London Travelcard records from Lennon are removed, and replaced with an estimate of all rail travel using these tickets via 'infill's to the MOIRA demand matrix (refer to Section 2).
- PlusBus – all significant flows have been included since 2007/08 (refer to Section 2), and minor flows are excluded.
- Attractions – the rail element of the significant flows have been included since 2007/08, which include:
    - Bluewater Shopping Centre
    - Alton Towers
    - Whipsnade
    - Chatsworth House

All other flows involving Private Settlement are excluded, e.g. Irish Stations.

DeltaRail