



## Northern Line Extension (NLE) – PEDS analysis – PM peak

Ref: NLE PEDS 2013 PM peak

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### Introduction

The forecast impact of the extension of the Charing Cross branch of the Northern line to Battersea via an intermediate station at Nine Elms has been assessed using the Pedroute Strategic (PEDS) model. This model is used to analyse existing and future station operation based on passenger behaviour and demand.

Demand is taken from 2031 Railplan runs for the PM peak period (July 2013).

The base case and test case used in the model are summarised below:

Case	Base (without NLE)	Test (with NLE)
<b>PEDS PM peak</b>	NX300	NX328
<b>Key assumptions</b>	All of the consented development schemes within VNEB OA are built out according to their planning consents as of January 2013, with the exception of specific phases of Battersea Power Station.	This case assumes the completion of all the consented schemes as per their planning consents in January 2013, including all phases of Battersea Power Station, i.e. the provision of the NLE enables the remainder of the power station development. It also includes other sites within the VNEB OA which have yet to come forward with a planning application.
<b>Modelling inputs</b>	<ul style="list-style-type: none"> <li>2031 AM Northern Line Upgrade phase 2</li> <li>Revised demand matrix</li> </ul>	<ul style="list-style-type: none"> <li>2031 AM Northern Line Upgrade phase 2</li> <li>NLE</li> </ul>

Train service assumptions in the model also reflect those specified in the 2031 Railplan modelling for the scheme, including the updated assumptions on Northern Line Upgrade phase 2 (NLU2) service levels.

This note is focused on the impact of the NLE on the Northern line during the PM peak, and does not consider the impact of the NLU (phase 1 or 2) on the line. Separate assessments have been undertaken specifically on the impact of the NLU, and these have informed TfL's capital investment programme for providing additional capacity at stations, reflected in the current Business Plan.

Separate, more detailed assessments have also been undertaken looking at the impact of the NLE on Kennington station (on the Northern line) and Vauxhall station (on the Victoria line) due to their close interfaces with the NLE and the wider development of the VNEB OA. The impact of the NLE at these two stations is therefore not considered in this note.

### The PEDS tool

The Pedroute Strategic (PEDS) model is a useful tool for assessing delay and congestion at London Underground (LU) stations. The extent of congestion at individual stations can be measured together with an assessment of the delay and associated disbenefits that passengers would experience as a result of that congestion. The model uses a representation of walk links in the LU network and combines these with passenger flows. It then routes passengers through the station network allowing for congestion effects to reach equilibrium assignment.

The output of PEDS includes demand and delay on individual links including passageways, stairs, escalators, lifts and gatelines. The flows are presented in 15-minute periods for each link within the station. These flows can then be converted into Levels of Service (LoS) to provide a qualitative understanding of the quality of service provided to passengers.

Essentially, LoS is measure of passenger density and is divided into the following six categories:

LoS	Description
<b>A</b>	Free circulation.
<b>B</b>	Uni-directional flows and free circulation. Reverse and cross-flows with only minor conflicts.
<b>C</b>	Slightly restricted circulation due to difficulty in passing others. Reverse and cross-flows with difficulty.
<b>D</b>	Restricted circulation for most pedestrians. Significant difficulty for reverse and cross-flows.
<b>E</b>	Restricted circulation for all pedestrians. Intermittent stoppages and serious difficulties for reverse and cross-flows.
<b>F</b>	Complete breakdown in traffic flow with many stoppages.

LU standards (Station Planning Standards and Guidelines, 2012 edition) are designed to ensure that new infrastructure:

- provides sufficient space to allow for safe and comfortable passenger movement;
- is resilient to surges in demand;
- avoids the need for temporary station closures; and

- avoids making stations uneconomically large.

This typically means that mid-range performance in the LoS range for different parts of a station (between categories C and E) is generally considered suitable.

On the existing network, many locations operate with LoS somewhere between categories C and F at peak times due to the high demand on the system and the age and design of existing infrastructure. Whilst this means passengers do experience delay, as the network demonstrates each day during the peaks, for many locations it does not necessarily prevent effective operations continuing.

The acceptable LoS varies by link type. For example, the acceptable LoS for two-way passageways and staircases is C, whilst for one-way passages and stairways a worse LoS of D would be acceptable (due to there being less complex movements). The Station Planning Standards and Guidelines include more information on LoS.

## Results

The PEDS output on crowding levels for all stations on the Northern line is presented in the following table. This shows the worst LoS on any link in the station, for the busiest 15 minutes during the forecast 3 hour peak period. Where there is an adverse change in the worst LoS between the base case and test case at any given station, for the PM peak period, these stations are highlighted in the table.

Station	PM peak period	
	Base case (without NLE)	Test case (with NLE)
Edgware	C	C
Burnt Oak	C	C
Colindale	C	C
Hendon Central	D	D
Burnt Oak	C	C
Golders Green	F	F
Hampstead	C	C
Belsize Park	B	B
Chalk Farm	B	B
Camden Town	E	E
Mornington Crescent	B	B
Euston	F	F
Warren Street	D	D
Goodge Street	E	E
Tottenham Court Road	E	E
Leicester Square	F	F
Charing Cross	E	E
<b>Embankment</b>	<b>E</b>	<b>F</b>
Waterloo	F	F
Kennington	F	F
High Barnet	D	D
Totteridge & Whetstone	A	A
Woodside Park	A	A
West Finchley	A	A
Finchley Central	F	F
East Finchley	F	F
Highgate	F	F
Archway	C	C
Tufnell Park	C	C
Kentish Town	C	C
King's Cross St. Pancras	F	F
Angel	E	E
Old Street	F	F
Moorgate	F	F
Bank / Monument	F	F
London Bridge	E	E
Borough	F	F
Elephant & Castle	E	E
Oval	C	C
Stockwell	C	C
Clapham North	B	B
Clapham Common	F	F
Clapham South	C	C
Balham	E	E
Tooting Bec	D	D
Tooting Broadway	E	E
Colliers Wood	F	F
South Wimbledon	D	D
Morden	B	B

The assessment has indicated that the effect of the NLE has only a negligible impact on station crowding across the wider LU network. The only station where there was a worsening LoS due to the NLE is Embankment.

There are increases in flows at some stations, particularly those on the Charing Cross branch, but many of these stations are already operating at a high LoS, which is not worsened by the addition of the extension demand.

### **Embankment**

The only station that experiences a worsening in LoS is Embankment, where the gateline worsens from LoS E to F during the PM peak period. The change in LoS observed in PEDS is due to very a minor fluctuation in demand. The fluctuation between the scenarios increases entries and exits by less than 1.5% each. Even though the change is very minor, the base case LoS is very close to the threshold with the category below. Hence even this minor change results in a change in the LoS category.

PEDS does not respond to changes in demand by altering the configuration of in and out gates at the gateline. As a result a specific assessment of Embankment's gateline capacity has also been undertaken, which shows that the total gateline capacity is sufficient as there are fewer than the LU standard maximum of 25 passengers per minute per gate during the busiest 15 minute period. As is standard protocol, the station staff would manually set-up the gateline to serve the entry and exit flows depending upon the times of day. The assessment shows that the total number of gates they would require to meet the combination of flows is sufficient.

Overall there is no increase in delay within the station.

## **Conclusion**

Aside from Kennington station which is being assessed separately, there are no stations on the Northern line that are forecast to require specific interventions to mitigate the increased PM peak passenger flows generated by the NLE. The spread of the additional passengers generated by the NLE across the network means that changes in congestion at other stations is relatively marginal and is not forecast to worsen conditions to an extent that would justify additional station congestion measures.