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SKM

Transport for London

LONDON

Vauxhall Nine Elms Battersea

Opportunity area transport study

TRANSPORT STUDY REPORT

The DENVIL COOMBE Practice

Vauxhall Nine Elms Battersea
Opportunity Area Transport Study

TRANSPORT STUDY REPORT

Final Report

December 2009

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Executive Summary

Executive Summary

Introduction

This report presents the findings of the Vauxhall Nine Elms Battersea Opportunity Area Planning Framework (VNEB OAPF) Transport Study, commissioned by Transport for London (TfL) to inform the development of the OAPF being led by the Greater London Authority (GLA).

The study has been undertaken by Sinclair Knight Merz and the Denvil Coombe Practice with assistance from JMP, Roger Tym and Partners and Jacobs Consultants.

The Transport Study is a strategic study to address the main transport issues arising from five different development scenarios in the VNEB OA. It has been carried out in line with the Department for Transport's Transport Analysis Guidance (WebTAG) and Transport for London's Business Case Development Manual (BCDM) as appropriate.

Study Approach

The VNEB OAPF Transport Study has involved the following major work streams:

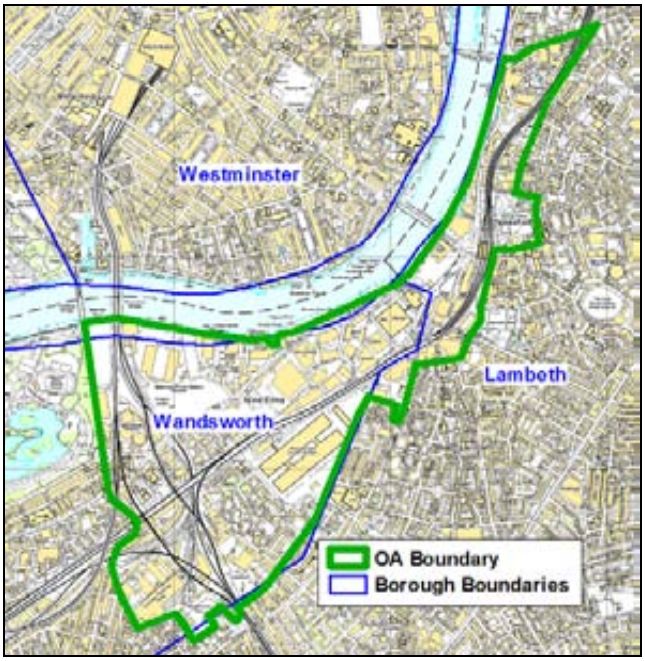
- development and use of transport forecasting methodologies entailing use of the London Transportation Study (LTS) model and public transport and highway assignment models (called VNEB-P and VNEB-H) developed from recent RAILPLAN and SATURN models;
- definition of a range of transport packages/initiatives for modelling in conjunction with a range of development scenarios established by GLA for the OAPF; and
- development and use of an appraisal process to assess the transport initiatives against study-specific, central Government and TfL objectives.

Consultation with key stakeholders has been a central feature of the study, and has included TfL Businesses, including Network Rail (NR) and London Underground (LUL), the London Boroughs of Lambeth and Wandsworth as well as Treasury Holdings and Ballymore (co-funders of the Transport Study). Stakeholders, where appropriate, have made contributions to the study, commenting on technical notes and draft reports, and attending workshops and presentations at key points throughout the study. All comments have been recorded and responded to accordingly and where appropriate included within the final report.

The VNEB OA

The London Plan identifies a number of OAs in London, capable of accommodating a significant number of new homes and jobs. The VNEB OA is located south of the River Thames between Lambeth Bridge and Chelsea Bridge and includes eight distinct character areas; Vauxhall, Nine Elms, Albert Embankment, Battersea Power Station, Stewarts Road, Patmore Estates, Spring Gardens and Queenstown Road.

The VNEB OA



The GLA undertook a development capacity study as part of the VNEB OAPF in June 2008, which sets out five development scenarios for the OA accommodating varying levels of residential, retail and employment development.

OA Development Scenarios

Scenario	Description	Employment	Dwellings	Population
1	Low density residential	8,000	4,200	10,200
2	Medium density residential	8,000	8,500	20,700
3	High density residential	8,000	16,000	38,900
4	High density residential + retail	12,000	16,750	40,700
5	High density residential + retail + office	27,000	16,750	40,700

To ensure that future year London-wide population and employment forecasts are held constant, the OA development, in effect, replaces future development elsewhere (in Lambeth and Wandsworth for OA Scenarios 1-4, and across the six CAZ[1] boroughs for OA Scenario 5). This 'balancing' of land use changes means that overall modelled transport demand changes little across London as a whole; demand growth due to OA development is counteracted by reduced growth in demand elsewhere in London.

[1] Central Activity Zone comprising parts of the London Boroughs of Lambeth, Wandsworth, Westminster, Camden, Southwark, Islington, Tower Hamlets and the City of London.

Existing and Future Transport Problems

At present, with the exception of the Vauxhall area, the OA is relatively poorly served by public transport and future committed schemes, whilst extensive for London as a whole, are unlikely to deliver significant benefits to the areas of the OA with lowest accessibility.

Public Transport Accessibility in the OA

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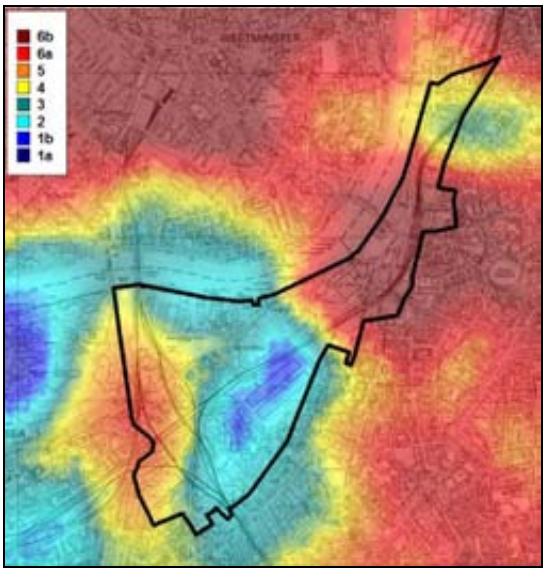

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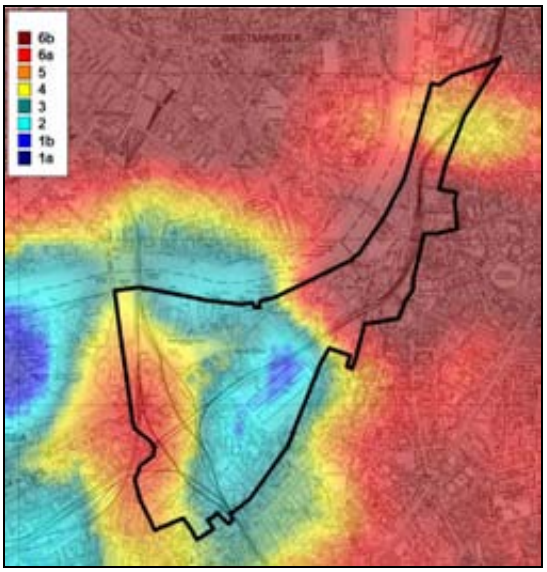


The public transport accessibility levels (PTALS) shown above are calculated using the distance from any given point to the nearest public transport stops and the frequency of service from those stops. The score is graded from 1-6 (including sub-divisions 1a, 1b, 6a and 6b) where 1a indicates extremely poor access to the location by public transport, and 6b indicates excellent access.

Options Studied

A range of initiatives were identified to provide varying levels of transport improvement for each of the five OA development scenarios. The initiatives were focussed on public transport and walking/cycling rather than traffic flow improvements. In relation to public transport, three types of scheme were studied; bus-only, light rail transit (LRT) and an Underground extension. No new NR schemes were identified, beyond the substantial service improvements already committed.

Transport Initiatives Studied

Mode	Schemes	Description
Walk/cycle	Cross river pedestrian bridge	A new pedestrian/cycle bridge across the Thames between Nine Elms and Pimlico
Bus	Service-level increases and new routes serving the OA	Increased service levels on existing bus routes and a number of new routes to serve OA development
LRT	New route from Waterloo to Battersea Power Station	LRT scheme along Albert Embankment and Nine Elms Lane to Battersea Power Station
Underground	Northern Line Extension (NLE)	Four different alignment and station location options to extend the Northern Line from Kennington to Battersea Power Station via Nine Elms or Vauxhall

The various transport initiatives selected were modelled in combination with the five levels of OA development to create a cross-section of representative development and to establish appropriate transport packages for appraisal, as illustrated below.

Transport and Development Packages Modelled

OA Scenario	Transport intervention	Walk/cycle bridge	Bus	LRT	Underground
1	High		●		
2	Medium		●	●	
	High	●	●		
3	Low 1		●		
	Low 2	●	●		
	Medium		●	●	
	High 1		●		BPS only
	High 2				Vauxhall & BPS
4	Low	●	●		
	Medium		●	●	
	High 1		●		BPS only
	High 2		●		Nine Elms only
	High 3		●		Nine Elms & BPS
5	Low	●	●		
	Medium		●	●	
	High 1		●		Vauxhall & BPS
	High 2	●	●		Nine Elms & BPS

Appraisal Results

Appraisal against Study-Specific Objectives

The transport packages were appraised against two study-specific objectives, namely:

1) to mitigate adverse impacts caused by development traffic, especially increases in congestion and adverse impacts on the environment; and
2) to ensure that the area's economic potential is realised by improving accessibility to the development sites by walking, cycling, public transport, taxi and goods vehicle.

This appraisal illustrated the inherent trade-off between improving public transport capacity and accessibility and providing road space for vehicular traffic in a congested network.

The appraisal resulted in short-listing of seven transport package and scenario combinations for full appraisal.

Shortlisted Schemes from Appraisal Against Study-Specific Objectives

OA Scenario	Transport intervention	Walk/cycle bridge	Bus	LRT	Underground
3	Low 2	●	●		
	Medium		●	●	
4	Low	●	●		
	Medium		●	●	
	High 3		●		Nine Elms & BPS
5	Medium		●	●	
	High 2	●	●		Nine Elms & BPS

Full Appraisal

The full appraisal of shortlisted schemes suggests that the better performing transport package for each OA development scenario is as follows:

- OA Scenario 3 – Bus-only package, possibly enhanced by a bus rapid transit facility along the route of the LRT scheme; and
- OA Scenario 4 and 5 – Bus package and the NLE.

In OA Scenarios 1 and 2, bus-based initiatives would probably be sufficient for the levels of development envisaged, although probably not without some improvements to interchange facilities at Vauxhall.

The appraisal demonstrates the inevitable trade-offs that must be made in selecting an optimum transport package for each development scenario.

Firstly, there are choices to be made between the costs and additional traffic and land use impacts of LRT schemes over the lower-cost, bus-only solution. The LRT scheme otherwise appears to perform well in terms of providing capacity to support the development in OA Scenarios 4 and 5 and it is questionable whether the bus-only schemes as tested in this study would provide sufficient capacity and overall public transport accessibility for these levels of development. However the impact of the LRT scheme on road traffic is considerable, reducing capacity on key strategic routes and reallocating road users along other key routes. The impact is considered to be too great to make this a feasible option.

Secondly, although the NLE package provides much greater overall transport user benefit than the LRT package, its substantially higher cost means that it has a less favourable overall economic result. However, funding contributions from the private sector could alter the economic case for the NLE substantially. If a funding package is identified that allows for the NLE to be delivered at no cost to public sector bodies (as is the expectation of GLA and TfL), the Benefit/Cost Ratio would change from just over 1 to over 3 (with OA Scenarios 4 and 5). This would make the scheme much more attractive to Government. In addition, of the options considered, the NLE offers the most significant relief to the Victoria line, and provides significant relief to Battersea Park station through a reduction

in boarding passengers in the morning peak. The NLE is the only scheme tested that can provide significant capacity on the network through the OA without adversely affecting Vauxhall Underground station or causing significant congestion on the road network.

Study Conclusions

Following appraisal of the range of solutions described herein and consideration of all the impacts associated with the development scenario and transport packages, the public transport initiatives required, beyond currently-committed schemes, to meet the future development needs of the OA are considered to be as follows:

- OA Scenarios 1 and 2 (low-medium density housing) would be sufficiently served by enhancements to existing bus services and new bus routes through the OA, with some improvements to interchange and passenger throughput facilities at Vauxhall Underground and NR stations.
- OA Scenario 3 (high density housing) would require additional capacity over and above enhancements to existing bus services and new bus routes through the OA. In addition, the impact on Vauxhall Underground station would be considerable and would require significant improvements to be made to the interchange and passenger throughput facilities at Vauxhall Underground, NR and bus stations, beyond the gate line capacity improvements that are committed, but unfunded in the TfL Business Plan.
- OA Scenario 4 (high density housing and major retail development) would require the addition of a high capacity transport intervention in conjunction with the bus service enhancements as described in OA Scenario 3. An extension of the Northern Line from Kennington to Battersea Power Station is considered to be the optimum solution at this time, assuming that the capital costs are privately funded. This would also relieve the additional pressure on Vauxhall Underground station sufficiently to reduce the need for investment in improvements beyond those in the current TfL business plan.
- OA Scenario 5 (high density housing, major retail and office development) would also require bus service enhancements and the NLE from Kennington to Battersea Power Station, based on the assumption that the capital costs of the NLE are privately funded.

The study has demonstrated that an LRT option from Waterloo to Battersea Power Station, whilst an attractive proposition for public transport users, would create significant traffic disruption along its route which would incur significant extra costs (not included in the concept examined herein) to mitigate. It would also require a dedicated depot facility with attendant adverse impacts on its surroundings that may be incompatible with the redevelopment concepts for the OA.

It has been suggested during consultations that a bus rapid transit facility could be developed as an alternative along the route of the LRT option between Waterloo and Battersea Power Station. This would avoid some of the costs and impacts of the LRT option, such as depot facilities, tracks and the

overhead power system. Despite this, however, it is still likely to result in substantial traffic and highway disruption and it may not provide sufficient capacity for OA Scenario 3, 4 and 5 levels of development.

Whilst it was not possible to model the full effects of the cross river pedestrian/cycle bridge (the model only accounts for pedestrians moving to and from public transport), it is clear that the bridge could attract a significant number of pedestrian and cyclist trips. Demand would increase commensurate with population changes in the OA, and overall the bridge would bring significant wider benefits in terms of public realm improvement and encouraging more walking and cycling in the area.

The appraisal results indicate the following key points:

- development levels equivalent to OA Scenarios 3, 4 and 5 would require more than the 'bus-only' public transport interventions studied;
- all development scenario/transport package combinations, except those including the NLE, would result in increased public transport passenger congestion at Vauxhall, in particular at Vauxhall Underground station;
- the NLE, however, would provide significant relief to this congestion; and
- traffic increases arising from all levels of OA development would put increased pressure on the Vauxhall gyratory and other local and strategic roads within the OA, but the remedial measures required would be subject to further study.

Complementary initiatives will need to be considered in all development scenarios as part of an integrated approach to transport enhancement in the OA. These have not been studied, costed or explicitly modelled in detail, but analysis of general trends from the transport modelling, station capacity analysis and the urban realm studies undertaken by the GLA for the OAPF suggests these measures would be appropriate (subject to more detailed study):

- pedestrian and cycling routes within the OA and to/from surrounding areas;
- a cross-river pedestrian/cycle bridge (Nine Elms-Pimlico);
- further passenger throughput (gate line and escalator) capacity at Vauxhall Underground station[2];

[2] Gate line enhancements at Vauxhall Underground station (as contained within the TfL business plan to 2017/18) are required (and assumed to be in place) for all development scenarios. This will need to be examined further in light of the proposed OA development, as will further additional passenger throughput capacity at Vauxhall Underground station in conjunction with a scheme to increase escalator capacity if deemed technically viable.

- crowd management/segregation for interchange between NR and Underground services at Vauxhall[3];
- increased station concourse capacity at Vauxhall NR station in line with the plans currently being put forward by Network Rail;
- platform and station throughput capacity enhancement at Battersea Park and Queenstown Road stations in line with the plans currently being put forward by Network Rail;
- improved crowd management for access and egress at Victoria Underground station; and
- wider traffic management measures, including restraints on car parking levels, to minimise traffic impacts.

The final Chapter of this report discusses funding sources, implementation and suggested next steps in continued preparation of the required public transport initiatives to enable growth and encourage long-term investment in the Vauxhall Nine Elms Battersea Opportunity Area.

[3] The need for improvement work at Vauxhall NR and Underground stations would be significantly reduced by the relieving effect of the NLE on patronage of Vauxhall Underground station and the Victoria Line in general.

1 Introduction

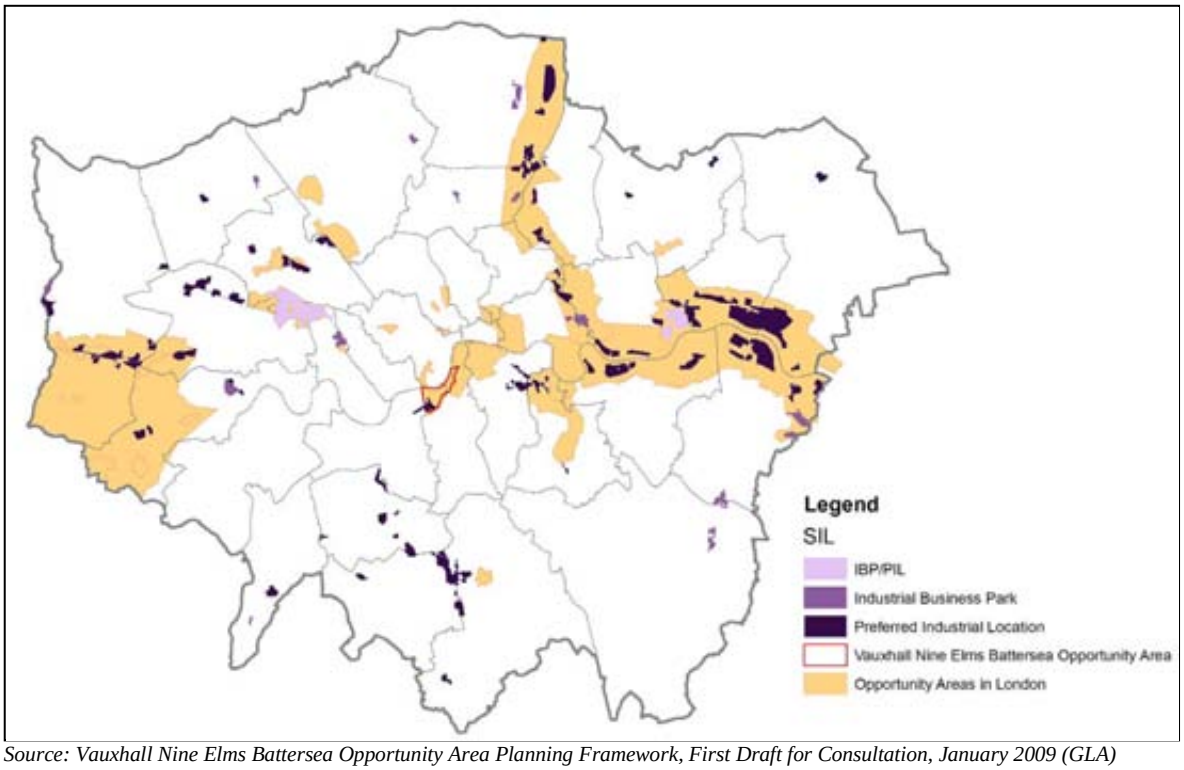
1 Introduction

This report documents the work of the Vauxhall Nine Elms Battersea Opportunity Area Planning Framework Transport Study, undertaken by Sinclair Knight Merz and The Denvil Coombe Practice with assistance from JMP, Roger Tym and Partners and Jacobs Consultants on behalf of Transport for London (TfL) and the Greater London Authority (GLA).

1.1 The Vauxhall Nine Elms Battersea Opportunity Area

The London Plan[4] identifies a number of Opportunity Areas (OAs) (Figure 1), capable of accommodating a substantial number of new homes and jobs. It states that strategic partners should work with the Mayor to prepare and implement spatial planning frameworks to guide future development in the OAs.

Figure 1 London Plan Opportunity Areas



Source: Vauxhall Nine Elms Battersea Opportunity Area Planning Framework, First Draft for Consultation, January 2009 (GLA)

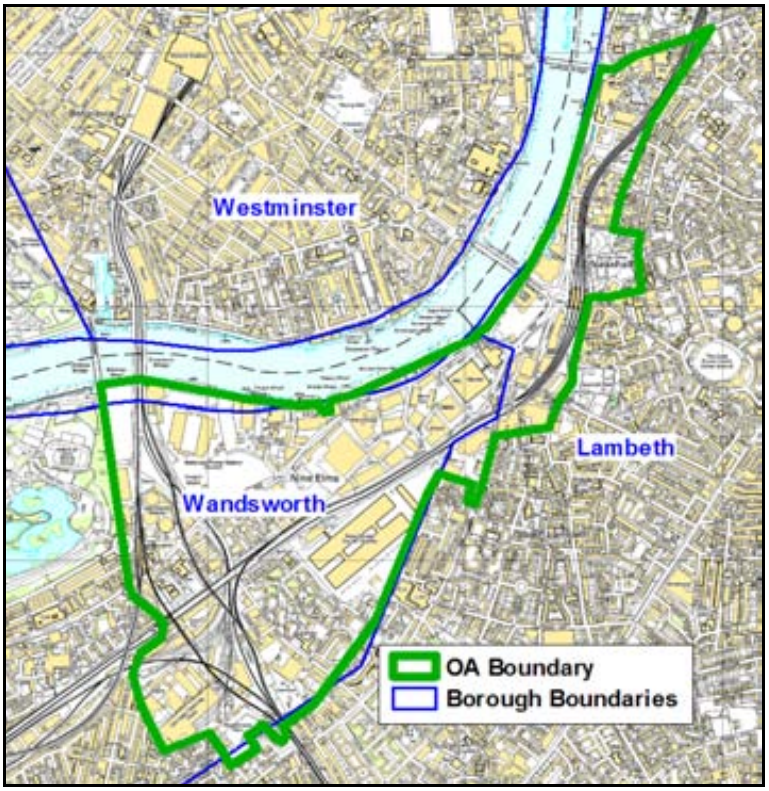
The Vauxhall Nine Elms Battersea (VNEB) OA is located south of the River Thames between Lambeth and Chelsea Bridges and includes Battersea Power Station, Nine Elms, Vauxhall and Albert Embankment. The GLA is leading the preparation of an Opportunity Area Planning Framework

[4] London Plan Consolidated with Alterations Since 2004, published in February 2008.

(OAPF) for the area in partnership with TfL, London Development Agency (LDA) including Design for London (DfL), the London Boroughs of Lambeth and Wandsworth, and English Heritage.

The VNEB OA straddles the London Boroughs of Lambeth and Wandsworth as shown in Figure 2.

Figure 2 Vauxhall Nine Elms Battersea Opportunity Area



1.2 Background to the Transport Study

The Transport Study was commissioned by TfL in May 2008 to be undertaken in parallel with the OAPF being led by the GLA. It has been carried out to the direction of TfL and GLA, in consultation with key stakeholders including the London Boroughs of Lambeth and Wandsworth and landowners Treasury Holdings and Ballymore. Both Treasury and Ballymore have contributed a proportion of the funds required to complete the Transport Study, however this final report and all associated findings remain the sole responsibility of TfL.

1.3 Report Structure

The report is structured as follows:

- Chapter 2 describes the context for the Transport Study;
- Chapter 3 summarises the current transport situation;
- Chapter 4 outlines the future transport situation;
- Chapter 5 presents options for transport solutions;

- Chapter 6 describes the option testing undertaken in the study;
- Chapter 7 describes the appraisal methodology;
- Chapter 8 presents the appraisal against study-specific objectives;
- Chapter 9 presents the full appraisal results; and
- Chapter 10 gives the study conclusions.

The following Appendices are included:

- Appendix A lists the reports and technical papers produced during the study;
- Appendix B shows the study work programme;
- Appendix C describes the consultation strategy undertaken during the study;
- Appendix D contains an analysis of station capacity; and
- Appendix E presents the economic results in WebTAG-compliant tables.

2 Context for the Transport Study

2 Context for the Transport Study

2.1 Objective

The objective of the VNEB OA Transport Study is to provide the context for and inform the direction of the transport elements of the OAPF. In doing so, the Study has assessed a range of transport initiatives against five development scenarios developed by GLA, (which set out a range of development capacity options) to arrive at conclusions on the most appropriate transport solutions to enable growth and encourage long-term investment in the OA.

2.2 Study-Specific Objectives

The following desired outcomes for transport initiatives associated with OA development were agreed with TfL, GLA and LDA:

1) to mitigate adverse impacts caused by development traffic, especially increases in congestion and adverse impacts on the environment; and
2) to ensure that the area's economic potential is realised by improving accessibility to the development sites by walking, cycling, public transport, taxi and goods vehicle.

2.3 Study Approach

2.3.1 Overall Approach

The study follows The Department for Transport's guidance on the appraisal of transport projects (Transport Analysis Guidance website, WebTAG).

2.3.2 Stakeholder Consultations

Four groups of key stakeholders were established for the Transport Study:

- Wider Stakeholder Group – OAPF steering group members including English Heritage, Design for London, LDA and key major landowners;
- VNEB Transport Group – representatives from the London Boroughs of Lambeth and Wandsworth and the relevant TfL businesses including Network Rail (NR) and London Underground (LUL);
- Borough Meetings – representatives of the London Boroughs of Lambeth and Wandsworth; and
- Developer Meetings – representatives of the developers Treasury Holdings and Ballymore (co-funders of the Transport Study).

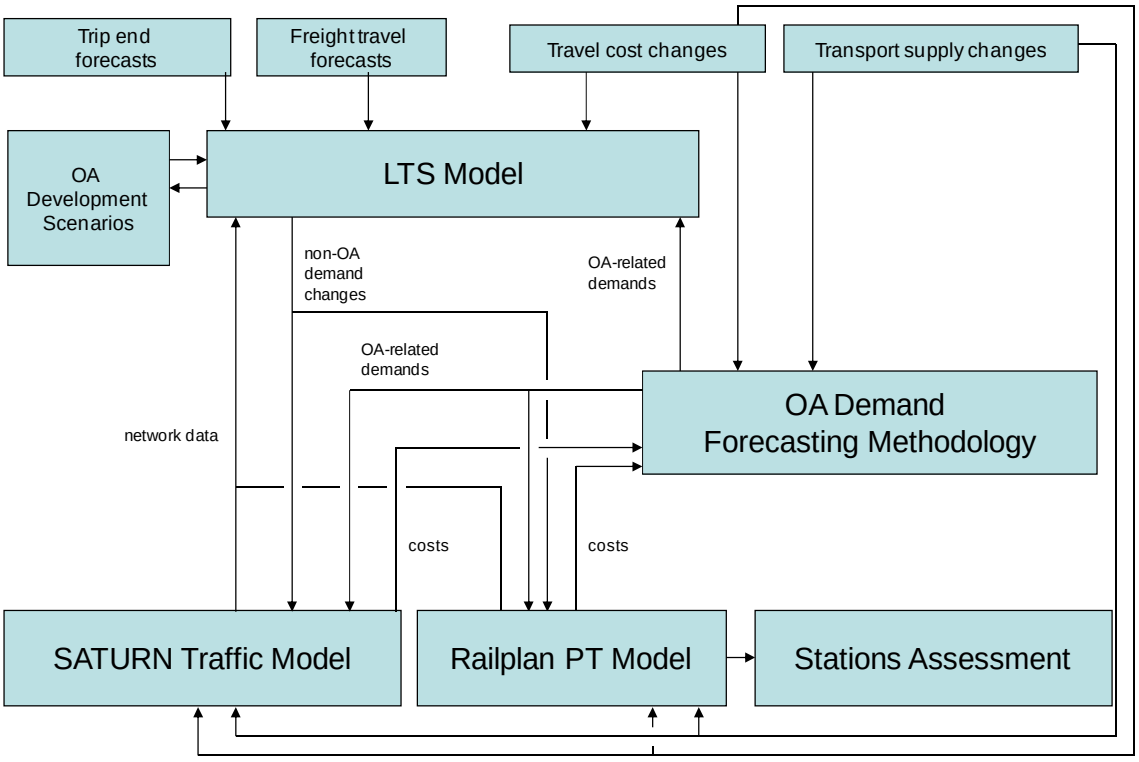
A consultation strategy was prepared at the outset of the project (see Appendix C). The stakeholder groups were consulted on outputs and progress as reported in Technical Notes issued for comment throughout the Study.

2.3.3 Transport Modelling

Transport modelling has been undertaken using the London Transportation Studies (LTS), RAILPLAN and SATURN models for overall demand, public transport and highway assignment modelling respectively. The overall approach is summarised in Figure 3. In outline:

- overall travel demand by mode was forecast using the LTS model as a basis;
- public transport flows were assessed using VNEB-P, an enhanced morning peak and interpeak RAILPLAN model developed specifically for the Study;
- traffic flows and congestion were assessed using VNEB-H, a morning and evening peak SATURN model developed for the study; and
- station patronage flows and congestion problems were assessed using observed data and the results of VNEB-P modelling.

Figure 3 VNEB OAPF Transport Modelling Approach



The VNEB-P and VNEB-H models underwent extensive development during this study, as summarised in Table 1.

Table 1 VNEB Transport Study Demand Forecasting Models

	VNEB-P Public Transport model	VNEB-H Highway model
Source	RAILPLAN 5.4 model	CRISTAL-H SATURN model
Modelled time periods	Morning peak 3 hours (7-10am) Inter peak 6 hours (10am-4pm)	Morning peak 1 hour (8-9am) Evening peak 1 hour (5-6pm)
Base year	2008	2008
Base matrix	LTS (public transport O-D matrix)	Partly from CRISTAL-H, partly from LTS
Validation	Meets WebTAG criteria except for a few nodes and links	Does not meet DMRB Volume 12 Section 2 Part 1 acceptability guidelines but was developed as rigorously as possible given the data available
Fitness for purpose	Suitable for providing forecasts and economic appraisal results for public transport schemes in the VNEB OA	Suitable to provide assessments of future changes in traffic associated with different levels of general development in the VNEB OA at a broad brush level

Full details of the development of VNEB-P and VNEB-H are provided in the relevant Model Validation reports.

2.4 Planning Policy Context

The overall planning context for Opportunity Areas (OA) in general, and for the Vauxhall, Nine Elms and Battersea OA in particular is set out in the London Plan (Consolidated with Alterations since 2004), published in February 2008. The London Boroughs of Wandsworth and Lambeth each make reference to the OA in their respective planning documents.

2.4.1 The London Plan

The London Plan establishes an integrated social, economic and environmental framework for the future development of London, looking forward 15-20 years. The plan sets out six key objectives:

1) To accommodate London's growth within its boundaries without encroaching on open spaces
2) To make London a healthier and better city for people to live in
3) To make London a more prosperous city with strong and diverse long term economic growth
4) To promote social inclusion and tackle deprivation and discrimination
5) To improve London's accessibility
6) To make London an exemplary world city in mitigating and adapting to climate change and a more attractive, well-designed and green city.

The Plan emphasises the importance of relating transport provision to spatial development. It notes that *'Spatial policies cannot be considered in isolation from their links to existing and proposed transport accessibility and capacity...'* (para 2.42).

The Plan sets out appropriate density ranges for various types of location, related to the index of public transport accessibility (PTAL). There is a clear implication that measures which increase the PTAL, or

otherwise demonstrate good public transport provision for a site may enable more intensive development.

Policy 2A.2 encourages intensification and mixed use development in OAs which are well served by public transport. The Plan reallocates the VNEB OA from the Central to the South West region of London, although the Sub-Regional Development Framework (SRDF) for Central London, published in May 2006, is still relevant in setting out the strategic policy objectives for the OA and identifying key issues affecting its development.

Policy 5E.2 sets out the policy context for the OA. This policy takes the potential future direction from the Central London SRDF (2006) and sets out an indicative employment capacity of 8,000 jobs and a minimum of 3,500 homes in the OA. The following broad policy directions are provided for the OA:

"At Vauxhall, good public transport coupled with strong traffic management, easier pedestrian movement, major environmental improvement and scope for intensification should increase housing and commercial capacity. Development further west should be related to existing and improved public transport capacity and be supported by effective pedestrian linkages. Important leisure and housing provision is anticipated at Battersea. A wider appraisal of London's wholesale markets has informed the potential for comprehensive renewal and intensification of this area. All development should help improve the degraded environment and strengthen links with the rest of central London. Subject to the other policies of this plan, good quality tall buildings in appropriate parts of the area will help reduce its perceived isolation, clearly signposting its transformation as an Opportunity Area.

"To achieve these objectives the historic Strategic Employment Location designation covering much of the area should be reviewed. Though there is evidence of demand, which in other parts of London would justify retention of industrial type uses, in this CAZ Opportunity Area retention of such an extensive area in low density, low value uses conflicts with wider strategic objectives for CAZ. The SIL should be rationalised through management of existing industrial type uses, retaining capacity for those which are of particular importance to CAZ and capable of operating more intensively, such as wholesale market and waste management provision. This will enable development of other, higher density, higher value uses to realise fully the potential of the area including greater employment opportunities."

The London Plan brought forward two important and significant policy changes in the VNEB OA. The first is extension of the CAZ south of the River Thames to include the VNEB, Waterloo and London Bridge/Bankside OAs. The second is the removal of the Strategic Industrial Location (SIL) designation from the central part of the OA as defined in the Mayor's Industrial Capacity Supplementary Planning Guidance (SPG) to the London Plan, published in March 2008.

Whilst the geographical boundary for the revised SIL is yet to be agreed with the Boroughs, the SPG clearly shows that at the Stewarts Road industrial area at the south west corner of the OA this level of protection has been pulled back across the central part of the OA.

The combination of these two policy shifts with sustained development activity in the OA has been a catalyst creating the momentum to produce an OAPF. The purpose of the spatial planning framework is to guide the delivery of development in the area within the plan period.

2.4.2 Wandsworth Unitary Development Plan

The Wandsworth Unitary Development Plan (UDP) was adopted in August 2003, before the publication of the London Plan, and therefore it pre-dates the concept of Opportunity Areas. Although the UDP remains the key planning document in force, the Council has issued a proposed submission for the Local Development Framework (LDF), in line with legislative changes.

Four of the Council's General Policies are of particular relevance:

- GEN2: The Council will promote regeneration ensuring that the scale of development is related to environmental capacity and the capacity of public transport and other infrastructure.
- GEN25: The Council will promote a sustainable relationship between development and transport. Through its land use policies it will seek to reduce the need to travel, especially by car. Maximum car parking levels will be applied.
- GEN26: The Council will support development proposals that contribute to a safe, accessible and integrated transport system. It will support development proposals that contribute to London's overall transport system and in particular it will support schemes for improved accessibility to/from adjoining areas, including central London and the Wandle Valley.
- GEN27: The Council will support development proposals for improved facilities that encourage greater use of public transport, cycling and walking.

The relationship between transport and land use planning is emphasised in the UDP. The council recognises the linkage between public transport accessibility and development density.

VNEB falls partly within the Council's Wandsworth Thames Planning Area (WTPA). Whilst the UDP does not set out specific proposals for VNEB as a whole, it recognises a number of the issues specific to the area and notes that the Government Office for London recognises Battersea and Nine Elms as priority areas. Nine Elms is also identified as one of the Borough's Industrial Employment Areas (IEA).

2.4.3 Wandsworth LDF

As stated above the Wandsworth UDP is to be replaced with a Local Development Framework (LDF), currently under development. The LDF, together with the London Plan, will comprise the development plan for the borough. It is being prepared in stages, the timing for which is outlined in the

Local Development Scheme, which is currently being updated. The first document prepared for the LDF is the Core Strategy, which outlines the Council's spatial vision and guiding planning principles as well as a spatial strategy, core policies and a monitoring and implementation framework. The Strategy was submitted to the Secretary of State on 20th March 2009. It will be subjected to public hearings due to be held in July 2009. In the meantime the submitted version is regarded as part of Wandsworth's emerging policy and will be given due weight and taken into account in decisions on planning applications.

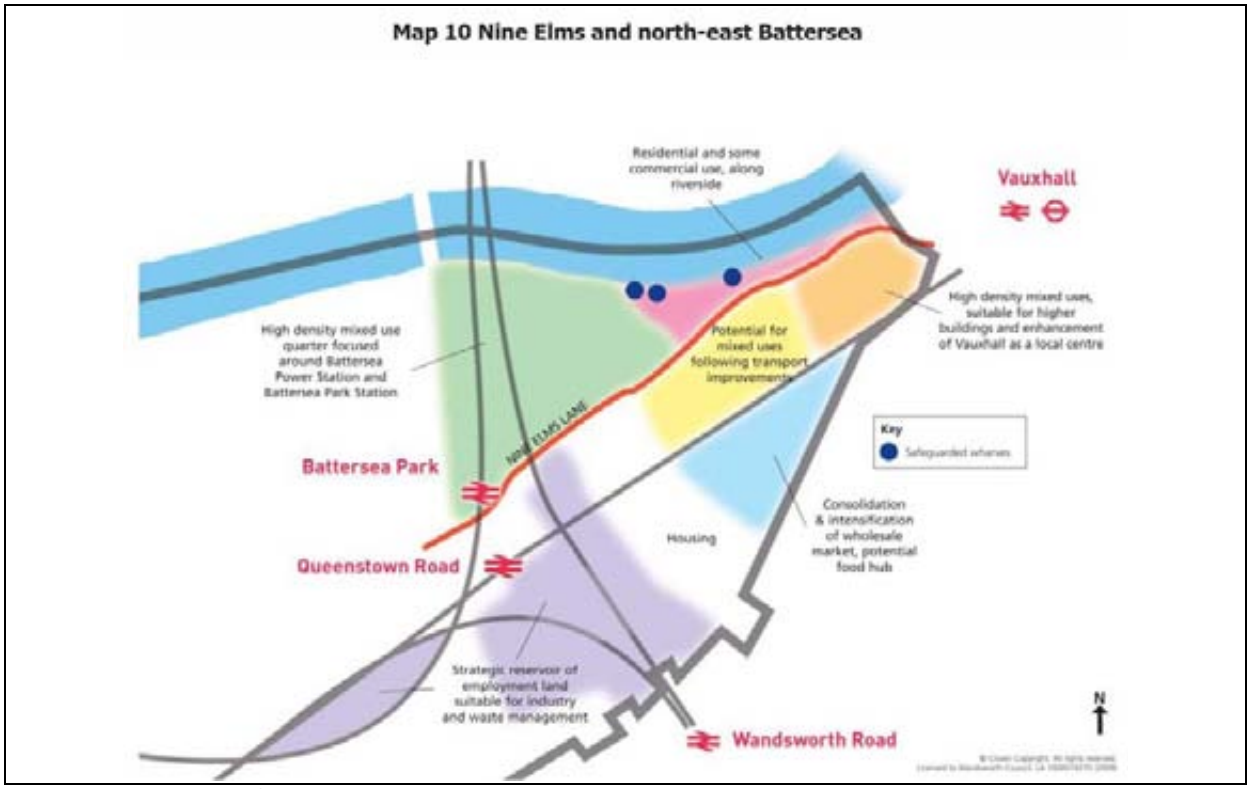
The Core Strategy recognises that even where there is good public transport provision there may not be sufficient spare capacity to cater for growing demand. It states that the Council will support proposals to improve public transport capacity, particularly in areas already suffering from overcrowding and poor facilities and where considerable growth in passenger numbers can be expected. The Strategy recognises a need for significant improvement in public transport capacity in Nine Elms and north-east Battersea to unlock the potential of the OA. Proposed Policy PL5 reinforces the linkage between public transport capacity and housing density.

The Core Strategy recognises the need for planning policy to respond to the specific needs and issues of individual areas and this is reflected in the spatial strategy (core policies for places). Core policies for the Nine Elms and north-east Battersea area are outlined in Policy PL11, which considers the possibilities for using S.106 funding for transport projects, and notes a possible approach for VNEB. Whilst recognising the continuing need to preserve employment, the proposed LDF recognises the rezoning of VNEB into the CAZ and the change in emphasis in the London Plan, and takes a softer line than the UDP on balancing employment against the need for housing growth. A summary of PL11 is provided below and illustrated in Figure 4:

- high density mixed use development will be promoted around Battersea Power Station and nearby sites, with improved public transport links;
- redevelopment will be sought along the riverside to provide new homes and jobs;
- intensification of the wholesale market within the NCGM site and development of a food hub will be supported, enabling release of land near Vauxhall, in particular the Flower Market site, for high density housing;
- high density mixed use development will be promoted around Vauxhall;
- improvements to public transport will be sought;
- the Stewarts Road/Silverthorne Road area will be retained as an employment and industry area;
- the Council will work with the GLA and Lambeth on developing the Opportunity Area Planning Framework to guide the comprehensive redevelopment of the whole area and to ensure that adequate infrastructure is available, including significant new public transport provision and strategic sustainable energy infrastructure;

- funding will be sought from planning obligations linked to developments on sites within the opportunity area; and
- development in the VNEB OA (including part of Vauxhall in Lambeth) within the Central Activities Zone (CAZ) should aim to meet targets of at least 8,000 jobs and 3,500 homes by 2026.

Figure 4 Wandsworth's Core Strategy for Nine Elms and north-east Battersea



Source: London Borough of Wandsworth Core Strategy (submission version), March 2009

2.4.4 LB Lambeth Planning Policy

The Lambeth UDP was adopted in August 2007 and is therefore aligned to the overall context of the London Plan.

Only the northern portion of VNEB falls within the Borough, thus there are fewer specific references to the OA in the UDP. Lambeth's general planning policies reflect the London Plan, whilst those relating to OAs make less specific reference to VNEB. Lambeth is currently working on the production of its LDF, and has not yet published a public consultation draft of its core strategy. However, Lambeth has produced a Supplementary Planning Document (SPD) (Draft, June 2008) to guide regeneration of the Vauxhall area. The SPD aligns with the Lambeth UDP and the OAPF. It presents a planning framework within which Lambeth Council can assess proposals for new development and is the result of a collaborative process between Lambeth Council, the GLA, Transport for London, Wandsworth Council and the local community. The strategic objectives of the SPD are:

1) **Managing Development Opportunity** – responding to the London Plan development targets and commercial development demand through defining a hierarchy of development and appropriate infrastructure step change.
2) **Character, Identity and Sense of Place** – ensure that new development fosters a strong identity and sense of place, building upon and protecting the existing character and historic environment, focused upon a heart in Vauxhall Cross.
3) **Diverse Mixture of Uses** – deliver an appropriate, sustainable and varied mixture of uses to support the community, encourage vibrancy, and establish character while meeting local need.
4) **Access, Connections and Legibility** – develop an accessible, legible, and accessible environment that overcomes the existing physical barriers of the railway viaduct and highways to secure integrated communities.
5) **Public Realm, Streets and Spaces** – provide an accessible public realm, streets, and public spaces that are active, safe, and form the heart of the community.
6) **Sustainable Development** – deliver development that is sustainable.

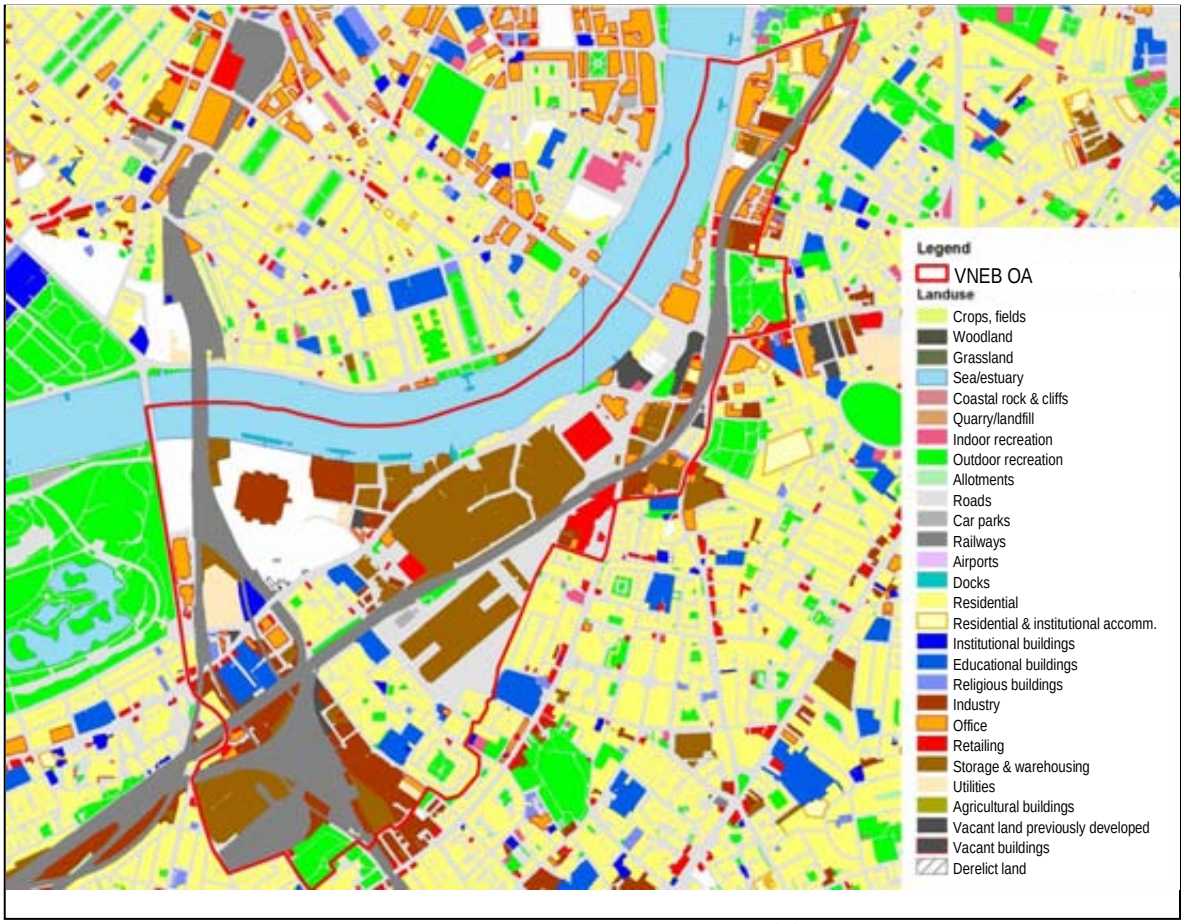
3 Understanding the Current Situation

3 Understanding the Current Situation

3.1 Land Use in the OA

Land use in the VNEB OA is indicated in Figure 5. Notable land uses are the large areas of storage and warehousing, New Covent Garden Market (NCGM), Battersea Power Station, elevated rail infrastructure and office development in the northern part of the area. Residential use is limited to St George's Wharf and an area of social housing located in the south-west of the OA.

Figure 5 Land Uses



Source: Vauxhall Nine Elms Battersea Opportunity Area Planning Framework, First Draft for Consultation, January 2009 (GLA)

3.1.1 Population and Employment

The OA currently contains approximately 6,500 residents and over 26,000 jobs (Table 2).

Table 2 Existing Employment and Population in the OA (estimated 2008)

Area	Employment	Population
OA in Borough of Lambeth	13,180	1,680
OA in Borough of Wandsworth	13,200	4,800
OA Total	26,380	6,480

Source: Roger Tym and Partners, VNEB Opportunity Area, Draft Technical Report November 2008

According to the 2001 Census the average household size in Lambeth was 2.2 persons and 2.21 in Wandsworth, compared to an England/Wales average of 2.36. A higher average household size of 2.34 persons has been assumed by GLA for the OA developments.

3.1.2 Industrial, Commercial and Retail Uses

Employment land uses in the OA include industry, office and retail uses.

The logistical and distribution uses in the OA are located on Nine Elms Lane, to the north and west of NCGM's Main Market site in the centre of Nine Elms and the Flower Market site to the west of Vauxhall. There is a range of office and warehouse uses on Albert Embankment and at Vauxhall, and a large Sainsbury's supermarket located on Wandsworth Road north of Pascal Street. The Vauxhall area is largely dominated by transport infrastructure, but there are some institutional office occupiers and smaller retail uses, there is also an increasing number of residential units, largely being delivered on the St George's Wharf Site.

3.1.3 Transport-Related Land Uses

In addition to the existing road network, large areas of land in the OA are dominated by transport facilities and supporting light industrial infrastructure, accompanied by storage and warehousing and significant areas of railway land and vehicle parking.

The Gatwick Express rail depot and a bus depot (with permission for expansion) are located on Silverthorne Road. Two coach parks operate in Nine Elms, one open to all operators and the other predominantly used by National Express, both are well-positioned for access to central London and Victoria Coach station. There is also a coach layover facility located along Albert Embankment.

Three key Thames wharves are located in the OA; Cringle Dock, RMC Battersea (Metro Greenham) and RMC Vauxhall. Cringle Dock and RMC Battersea are both in operational use, for waste processing and aggregates respectively. RMC Vauxhall whilst not currently in use is likely to become a construction site for the Thames Tideway sewer tunnel due for completion c. 2020.

3.1.4 Development Proposals

In recent years development pressure in the OA has been increasing. This is largely due to the area's status as an OA in the London Plan and its proximity to central London. The London Plan (consolidated with alterations since 2004) 2008 redefined the CAZ to include the VNEB area. As

outlined in Section 2.4, the emerging planning policies for Lambeth and Wandsworth also support significant growth in the area. There are a number of significant developments emerging including:

- redevelopment of the South Bank Business Centre;
- relocation of the United States Embassy to Nine Elms;
- redevelopment of New Covent Garden Markets; and
- redevelopment of Battersea Power Station.

Table 3 summarises the current known developments within the OA and their current status.

Table 3 Development Proposals in the OA

Key Development Sites	Borough	Status	Residential units (no.)	Office (m2)	Retail (m2)
81 Black Prince Road	Lambeth	Appeal Decision Pending	101	1,770	
Wah Kwong House (10 Albert Embankment)	Lambeth	Approved 25 Apr 2008	103*	0	125
Hampton House (20 Albert Embankment)	Lambeth	Approved 27 Mar 2008	242	655	
Texaco site (36-48 Albert Embankment)	Lambeth	Appeal Decision Pending	164	2,073	
St George's Wharf	Lambeth	Approved 1995, 99, 2001, 04/5	1,368	9,113	
Vauxhall island site	Lambeth	Pre-app 2008/09		TBC	
Vauxhall Bondway	Lambeth	Formal pre-app 2008/09	376	5,564	288
Vauxhall Sky Gardens	Wandsworth	Approved 2008	178	9,000	229
Market Towers	Wandsworth	TfL pre-app 2008	757	27,330	3,634
New Covent Garden Flower Market	Wandsworth	Master planning		TBC	
New Covent Garden Market (fruit & veg)	Wandsworth	Master planning		TBC	
US Embassy site	Wandsworth	Approved Sept 2009 (Stage 2 pending)	14	45-50,000	0
Ballymore site	Wandsworth	Master planning		TBC	
Nine Elms Post Office site	Wandsworth	Not known		Not known	
Tideway Industrial Estate	Wandsworth	Master planning		TBC	
Battersea Power Station (Treasury Holdings)	Wandsworth	Pre-app 2009	c 3,856	160,000	60,000
National Grid site	Wandsworth	Master planning		TBC	

**1 residential unit and 102 units of an 'aparthotel'*

3.2 Transport Facilities

The OA has a mix of transport infrastructure including strategic (TfL) roads, local roads and accesses, Network Rail and Underground services, London-wide and local bus services and walking and cycling routes.

Vauxhall NR, Underground and bus stations together constitute the main transport hub in the OA. Investments in a new bus station, improvement to the platforms of the NR station, a new access to the Underground station, re-working of the gyratory and pedestrian/cycle improvements have all improved public transport at Vauxhall in recent years. The Victoria Line, which serves Vauxhall, provides good accessibility to the Underground network but is considered to be close to capacity in the morning and evening peak periods.

Vauxhall public transport facilities serve an important local function in terms of connecting people in south London to jobs, goods and services in central London.

The Vauxhall gyratory is a key strategic traffic junction, linking south London and the South East to central, west and north London. It is also where the congestion charge zone begins, and it serves an important strategic traffic function for freight and servicing activities.

The western end of the OA is less well served for public transport with Battersea Park and Queenstown Road NR stations in need of renovation. Nine Elms Lane and Wandsworth Road are both important local bus routes connecting the OA to Victoria, the West End and Waterloo.

3.2.1 Walking & Cycling

Walking

The pedestrian network within the OA is poor and regularly segregated by arterial roads and rail infrastructure. Land use patterns also serve to reduce connectivity and private ownership of the river foreshore land has resulted in significant dislocation between the river and the residential hinterland to the south. The riverside walk is fragmented from Battersea Park to Vauxhall and lacks vitality along Albert Embankment. The land use mix, including light industrial uses, does not promote safety and security through urban design and generally makes for an unattractive pedestrian environment.

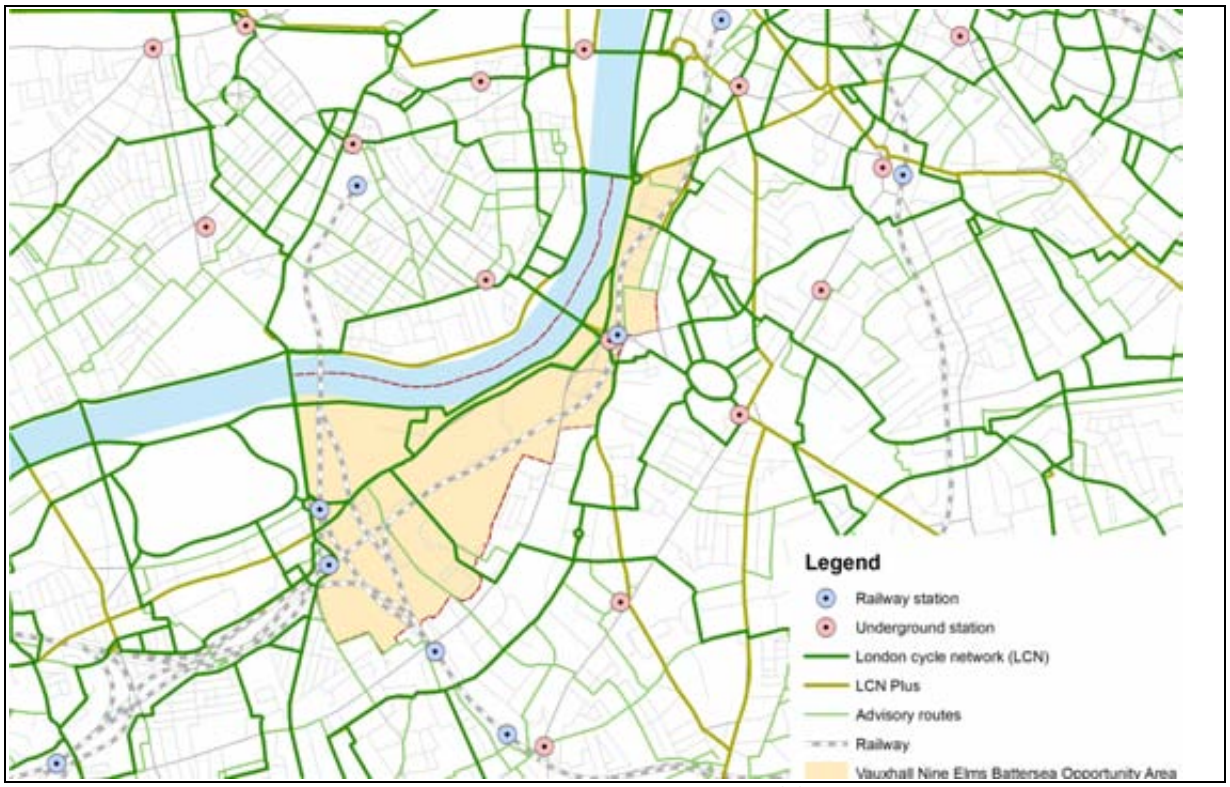
At many points the pedestrian environment is dominated by traffic and pedestrian routes are interrupted by highway and rail infrastructure. Connections to the main transport hubs exist however need to be enhanced.

Cycling

Cycle routes in the OA broadly follow the strategic highway routes and the river. The London Cycle Network includes several key routes through the OA, including Nine Elms Road, Albert Embankment, Queenstown Road and Wandsworth Road. However, there is a notable lack of north-south and north-west to south-east connectivity through the OA. The elevated railway structure through the OA also restricts cyclist movement. This will be a key constraint to improving connections to the existing residential hinterland to the riverside in order to accommodate the anticipated growth in alternative modes as a result of residential intensification in the OA.

Figure 6 illustrates the cycling network in the vicinity of the OA, showing the routes designated in the London Cycle Plan as London cycle network (LCN) and LCN-plus routes (an extension of the LCN covering the whole of London), and other advisory routes.

Figure 6 Cycle Network in the Vicinity of the OA

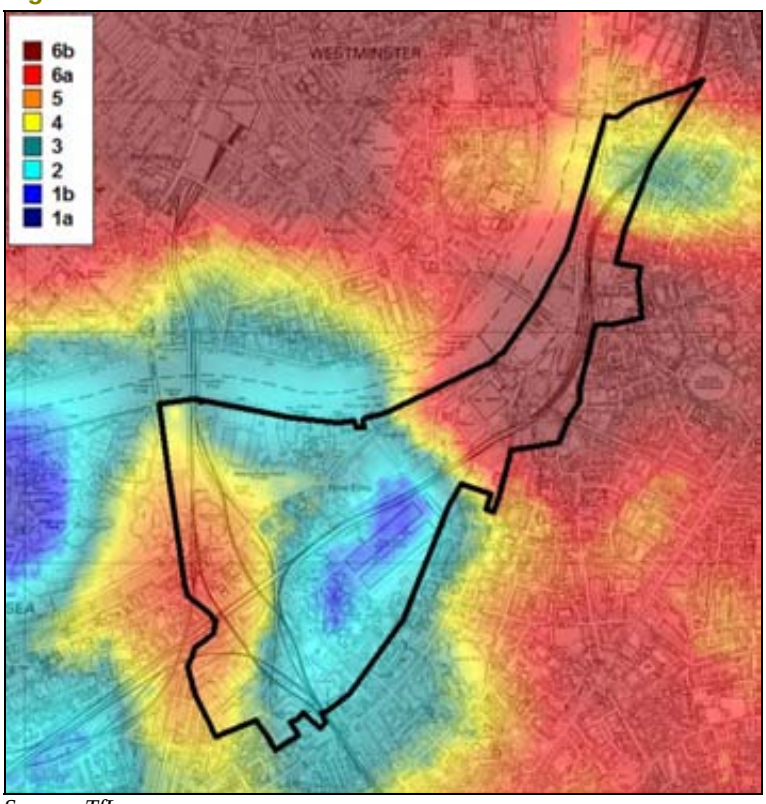


Source: Vauxhall Nine Elms Battersea Opportunity Area Planning Framework, First Draft for Consultation, January 2009 (GLA)

3.2.2 Public Transport

Public Transport Accessibility Levels (PTALs) give an indication of the relative density of the public transport network at a specific location. It effectively measures the combination of the distance to public transport services from a given point and the frequency of services. The results are expressed on a scale of 1 to 6 (including sub-divisions 1a, 1b, 6a and 6b) where 1a indicates extremely poor accessibility to the location by public transport and 6b indicates excellent access. The PTAL map (Figure 7) indicates a low level of accessibility for the southern/south western part of the OA. The level of accessibility is much better around Vauxhall Station and along Albert Embankment towards central London.

Figure 7 2006 PTALS in the OA

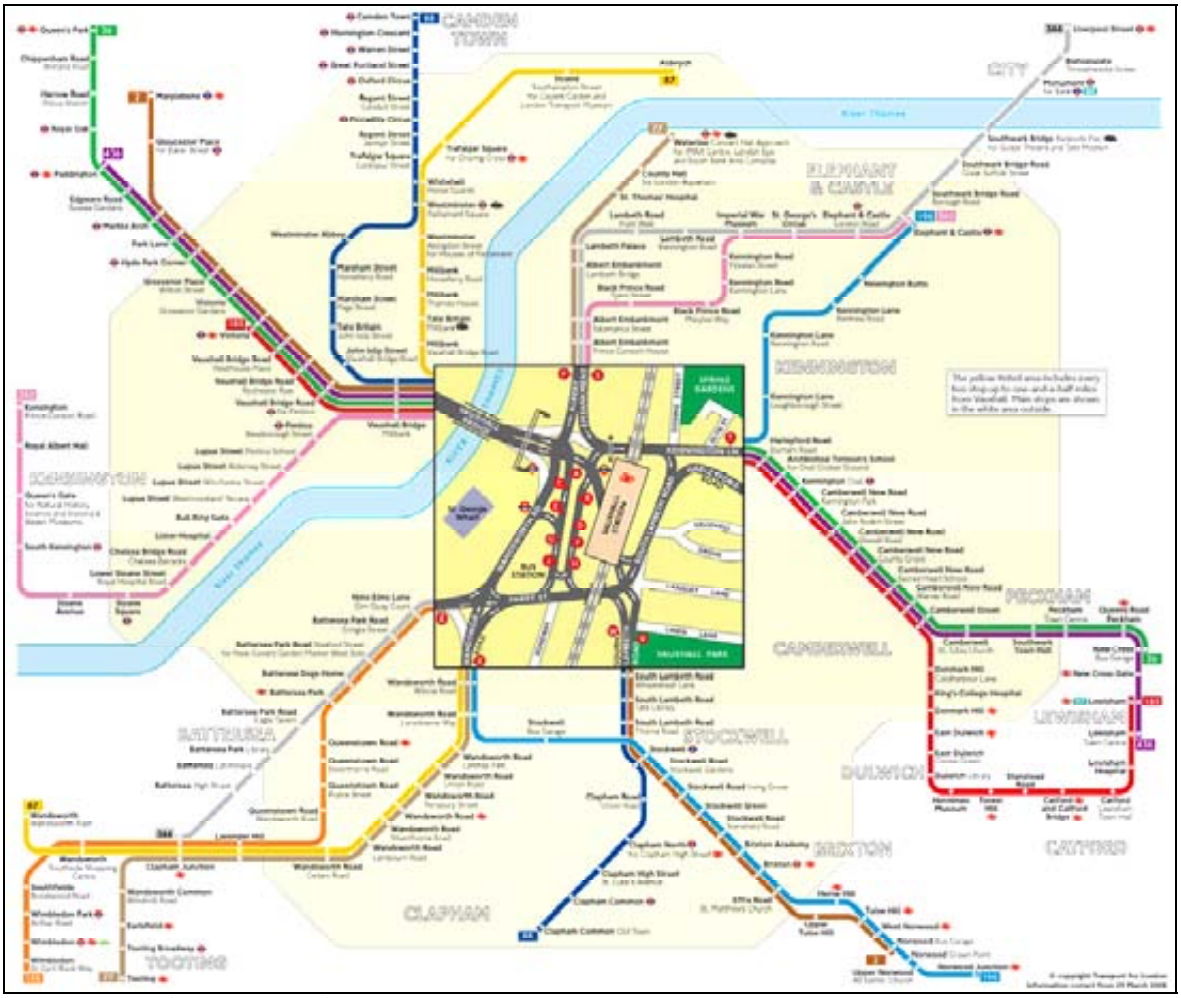


Source: TfL

Bus

The OA is currently well served by buses. The key bus routes within the OA include the 344, 156, 77, 360, 87, 88 and P5. The focus of bus activity is Vauxhall bus station, which provides access to a wide range of routes as well as serving an important function in terms of passenger interchange between bus, NR and Underground services (see Figure 8). A number of stops in the bus station are either at or reaching capacity whilst others have spare capacity.

Figure 8 Bus Routes from Vauxhall



Source: Transport for London www.tfl.gov.uk

Bus priority measures exist along many of the key routes in the OA, however there is potential for further improvement. The existing bus priority measures in and around Vauxhall are important in enabling buses to access and egress from the bus station.

There is a lack of north-west to south-east bus route connectivity across the OA, particularly in the Nine Elms area. Expansion of bus services for the OA is hindered by several factors largely relating to capacity and land availability:

- space for new terminating points, or capacity for additional services at existing points (which may be outside the OA);
- road capacity and room for extended bus stops and lanes, especially where new routes or enhanced services are introduced;
- capacity at bus stations; Vauxhall bus station already experiences high volumes of traffic, and Victoria is also served by a number of routes to and from the OA;

- depot/storage space for additional buses; and
- community opposition to using residential streets for bus movements and potential associated loss of residential parking.

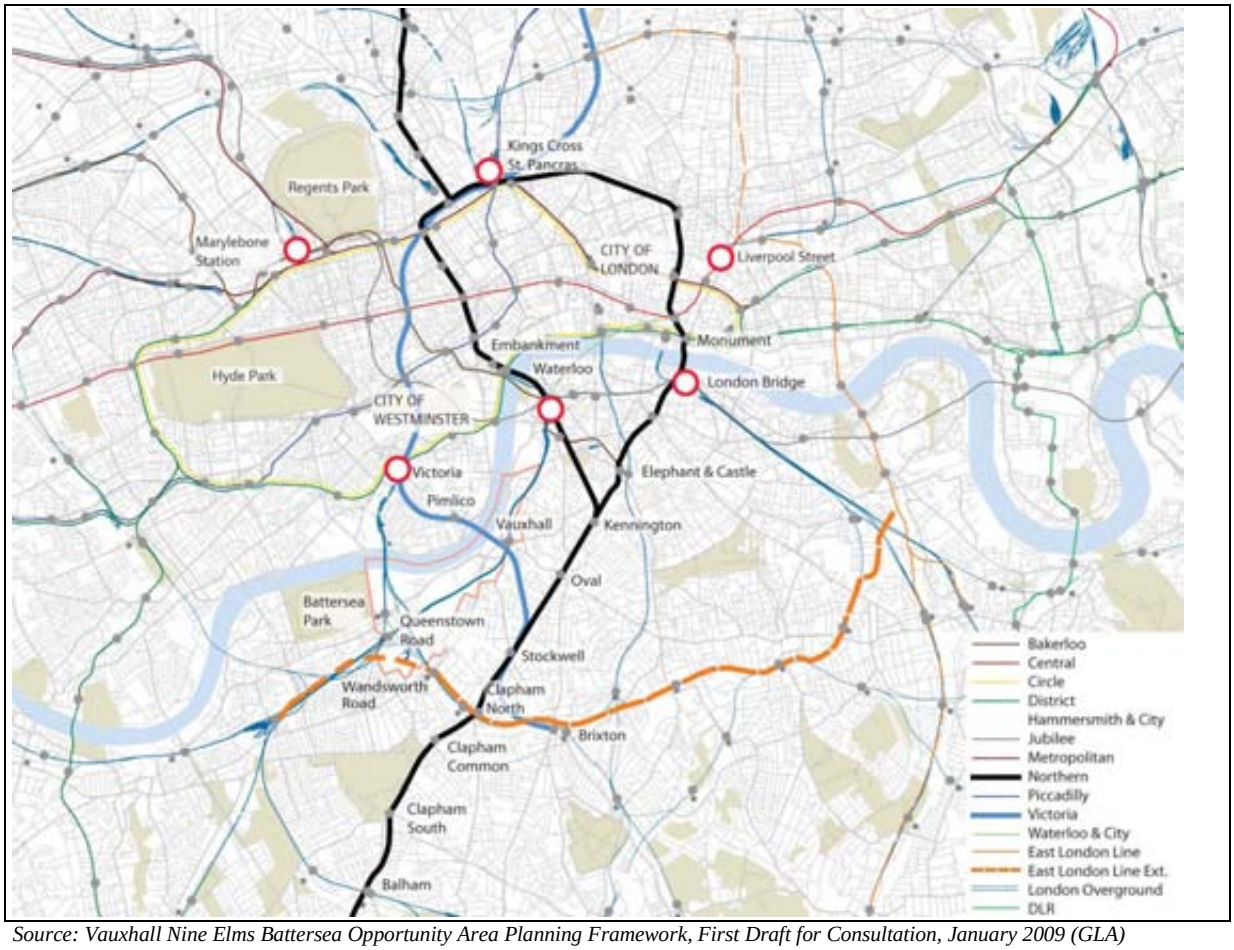
Underground

Vauxhall station on the Victoria Line is the only Underground station in the OA. The station and the Victoria Line in general experience congestion problems during peak times. The existing gate line and ticket hall are the main constraints, but escalator capacity is also a problem. The Victoria Line PPP upgrade will increase capacity on the line by around 20% by 2013. The current TfL business plan (to 2017/18) contains a commitment to expand the gate line capacity at Vauxhall, to bring it into line with escalator capacity, by 2017/18. Currently this scheme remains unfunded.

Rail

There are three NR stations in the OA; Vauxhall, Queenstown Road and Battersea Park as shown in Figure 9. Wandsworth Road Station is just outside the OA to the south.

Figure 9 Rail and Underground Network in the Wider Context



Source: Vauxhall Nine Elms Battersea Opportunity Area Planning Framework, First Draft for Consultation, January 2009 (GLA)

Vauxhall station is on the main line to Waterloo and operates near to capacity at peak times, both in terms of number of services and the level of passenger crowding. The interchanges between Underground (Victoria Line) and bus services at Vauxhall are also overcrowded in the peaks.

As summarised in Table 5 later in this Chapter, in the morning peak there are:

- twenty-one trains an hour inbound (and eighteen outbound) between Clapham Junction and Waterloo calling at Vauxhall only;
- eight trains an hour each way between Clapham Junction and Waterloo, calling at both Queenstown Road and Vauxhall;
- eight trains an hour each way between Clapham Junction and Victoria calling at Battersea Park station; and
- two trains an hour each way between London Bridge and Victoria calling at Wandsworth Road and Battersea Park.

Capacity constraints cause service problems on rail services. Vauxhall NR station has capacity limitations, particularly at the staircases between platforms and the main subway. There is limited scope to increase the number of trains operating to and from Waterloo and Victoria in the peaks. There are current plans to increase suburban train capacity by using longer trains, which will require lengthening of the platforms at Waterloo and Vauxhall (and other stations). Platforms at Vauxhall station will also need extending in order to accommodate longer trains on Windsor Line services. Lengthening of trains on inner suburban services is mainly designed to add capacity for passengers travelling to and from stations that are outside the OA.

The existing South London Line service makes poor use of capacity into Victoria Station (due to the maximum train size of 4 cars). There are plans (as part of Phase 2 of the East London Line extension) to re-organise South London Line services; however this will result in a reduction of services at Battersea Park Station.

River Bus

River bus services do not currently serve the OA, but are available at Millbank on the north bank of the Thames near Vauxhall Bridge and at Waterloo on the south bank. Piers at St George's Wharf and Battersea Power Station are planned as part of future development and may be used to enable an extension of services to serve the OA.

3.2.3 Highway Network

A number of primary routes converge at Vauxhall (Figure 10) including:

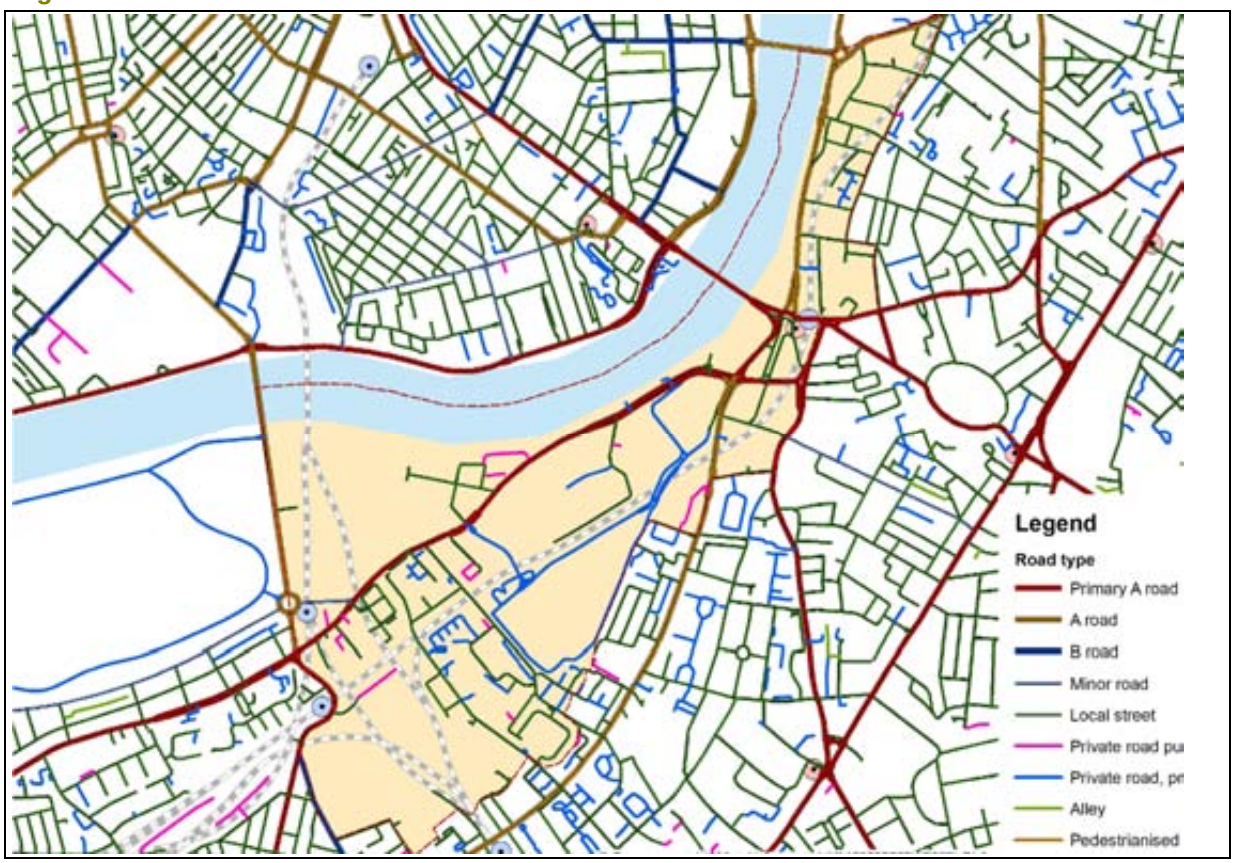
- Vauxhall Bridge (TLRN[5]);

[5] Transport for London Road Network

- Albert Embankment A3036 (TLRN);
- Nine Elms Lane A3205 (TLRN);
- Battersea Park Road A3205 (TLRN);
- Queenstown Road A3216 (SRN); and
- Wandsworth Road (Principal route).

These main roads converge at Chelsea Bridge, Vauxhall Bridge and Lambeth Bridge which link the OA to the north bank of the River Thames and central London.

Figure 10 Road Network in and Around the OA

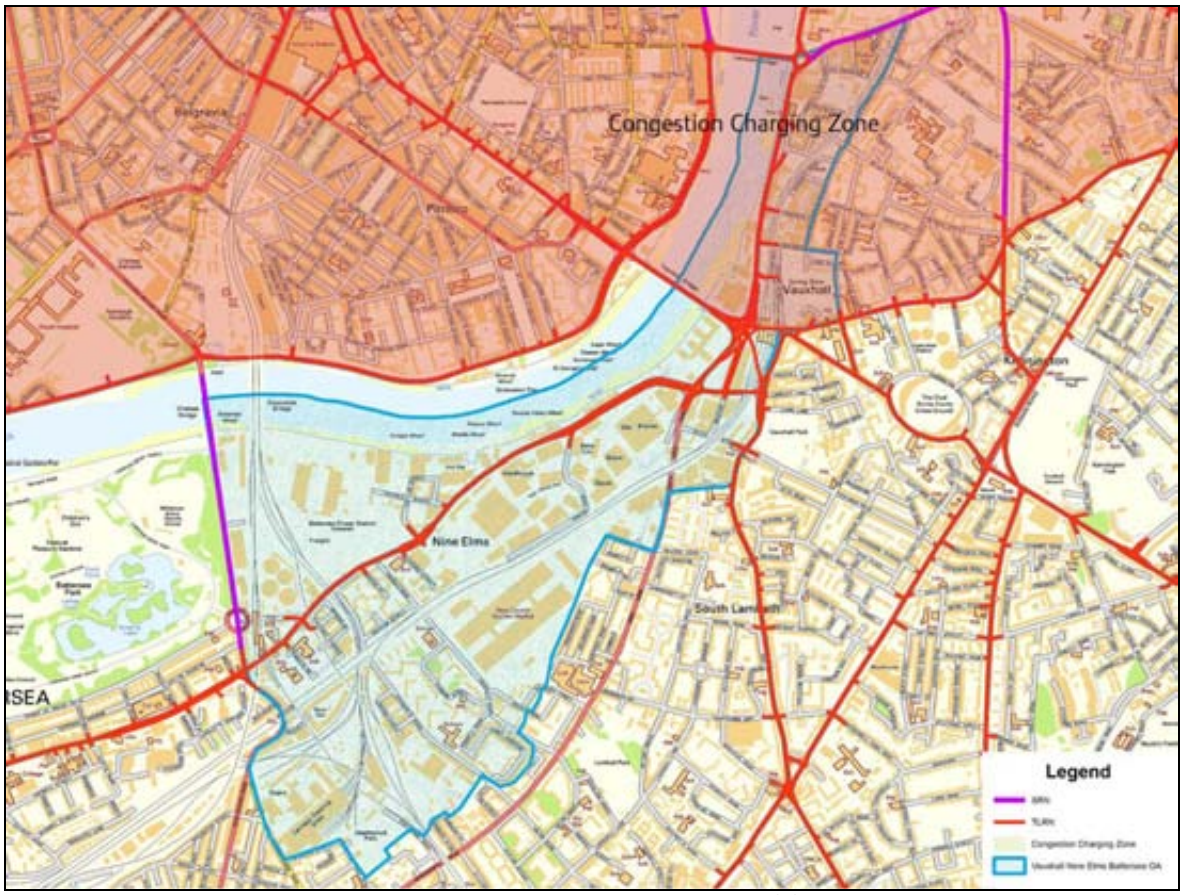


Source: Vauxhall Nine Elms Battersea Opportunity Area Planning Framework, First Draft for Consultation, January 2009 (GLA)

The boundary of the Central London Congestion Charging Zone (CCZ) crosses the OA at Vauxhall (Figure 11). It runs along Vauxhall Bridge, through Vauxhall Cross and up Kennington Lane. The areas to the north of this route (principally Albert Embankment) are in the CCZ, whilst the areas to the south are outside.

The Western Extension Zone[6] (WEZ) runs along the north bank of the river opposite the OA, but none of the OA itself is contained within this zone. Vauxhall Bridge is on the charge-free north-south through route between the CCZ and the WEZ, adding to its importance as a strategic traffic route.

Figure 11 Congestion Charging Zone



Source: Vauxhall Nine Elms Battersea Opportunity Area Planning Framework, First Draft for Consultation, January 2009 (GLA)

Other routes serving the OA include:

- Lambeth Road;
- South Lambeth Road;
- Kennington Oval ; and
- Kennington Lane.

The Nine Elms and Battersea area of the OA has surprisingly limited road access. Queenstown Road and Silverthorne Road are typical mixed use roads with three or four lanes. Development abutting the

[6] As of September 2009, The Western Extension Zone is under review by the Mayor of London and subject to consultation may be removed by the end of 2010.

northern portion of Queenstown Road is set back, however further south there are residential and commercial frontages with minimum set-back. There is a dedicated bus lane along much of Queenstown Road, but few sections have room for bus lanes in both directions.

To the north of the Waterloo main line, the main east-west route through the OA is Battersea Park Road and Nine Elms Lane. Part of Battersea Park Road is mixed use with commercial frontages, but it is mostly four lanes with either one or two dedicated bus lanes. Beyond Battersea Power Station, Nine Elms Lane becomes wider and commercial activities are set back further. The road continues as four lanes with two bus lanes with wider traffic lanes but narrow off-road cycle lanes.

There are no through routes within the triangle formed by Wandsworth Road, Silverthorne Road, Queenstown Road, Battersea Park Road and Nine Elms Lane. Although both Stewarts Road and Thessaly Road run north-south between Wandsworth Road and Battersea Park Road, the Victoria Main Line rail bridge prevents Stewarts Road from connecting to Nine Elms Lane and Thessaly Road has been blocked at the northern end to prevent through traffic by any vehicles larger than motorcycles. Despite the location of much of New Covent Garden Market (NCGM) on the south side of the Waterloo Main Line, all road access is from the north via entrances on Nine Elms Lane and bridges under the railway from Wandsworth Road. Therefore, all access within the central part of the Nine Elms and Battersea area of the OA is via the triangle of roads which consequently experience congestion and local journeys can involve relatively long detours.

3.3 Travel Demand and Levels of Service

3.3.1 Travel Patterns

Vehicle movement on key road links in the OA reflects travel into central London in the morning peak, and outward in the evening peak. Key arterials connecting to Vauxhall, Chelsea and Lambeth Bridges experience the greatest traffic volumes and areas of congestion. Elsewhere in the OA there are capacity constraints on sections of Battersea Park Road and Black Prince Road. The Vauxhall gyratory carries the greatest overall traffic volumes in the OA and significant congestion occurs there.

Passenger movements on public transport are dominated by the peak commuter flows in and out of central London in the peaks, especially on the NR and Underground networks.

Vauxhall bus, NR and Underground stations are an important interchange point for public transport users with substantial demand causing significant capacity problems.

3.3.2 Mode Shares of OA Travel

Estimated mode shares for travel to, from and within the OA in the morning peak are shown in Table 4. There are more inbound than outbound trips by all modes, reflecting the large employment and relatively small population in the area at present. About 50% of trips are by public transport, 25% by car and 25% by walk/cycle. Public transport and car both have a slightly higher share of inbound travel than outbound.

Table 4 Mode Shares in 2008 Forecast LTS Model

Direction	Car		Public Transport		Walk/Cycle		Total	
	Trips	%	Trips	%	Trips	%	Trips	%
Outbound	3,128	23%	6,445	47%	4,066	30%	13,639	100%
Inbound	6,460	26%	13,596	54%	5,233	21%	25,289	100%
Total	9,588	25%	20,042	51%	9,300	24%	38,930	100%

Source: LTS model results, 2008 morning peak 3 hour period.

3.3.3 Trip Volumes

Road Traffic

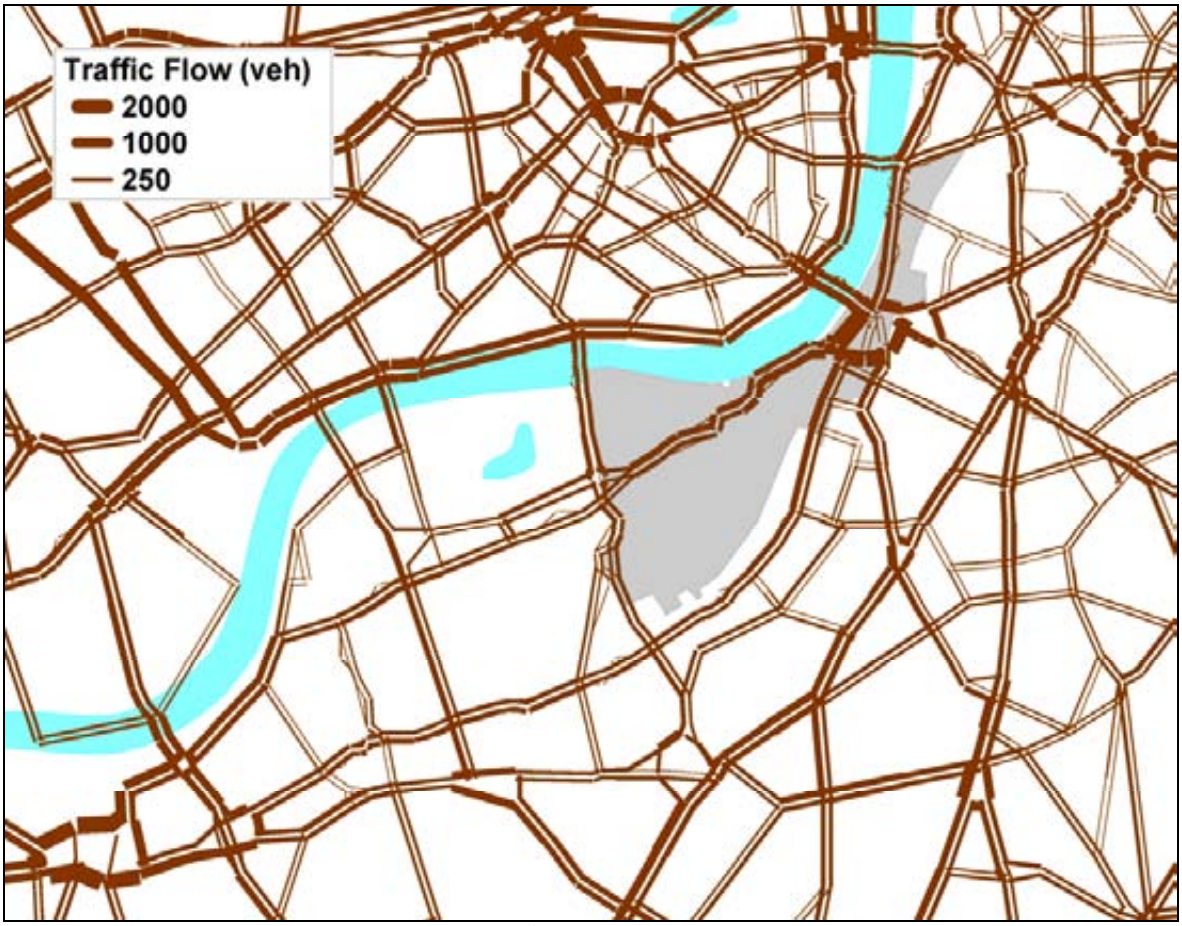
The heaviest traffic demand occurs in the morning peak hour. The following roads carry the greatest morning peak hour traffic volumes, expressed in passenger car units (pcu)[7] per hour:

- Vauxhall gyratory (Wandsworth Road, Parry Street and Kennington Lane) – 2,000-3,000 pcu/hour one way northbound;
- Vauxhall Bridge Road – 1,500 pcu/hour one-way northbound;
- Eastern section of Nine Elms Lane – 1,100 pcu/hour one way westbound;
- Albert Embankment – 1,200 pcu/hour (total of both directions);
- Durham Street and Harleyford Road – 1,450 pcu/hour (total of both directions);
- Kennington Lane (between Harleyford Road and Durham Street) – 1,100 pcu/hour (total of both directions);
- Lambeth Road/Albert Embankment roundabout – 1,000-1,400 pcu/hour northbound; and
- Queenstown Road (north of Queens Circus roundabout) – 1,000 pcu/hour one way northbound.

Modelled 2008 morning peak hour traffic flows in the vicinity of the OA are shown in Figure 12.

[7] Passenger car units - a unit of measure whereby large trucks and turning movements are converted to equivalent passenger cars using multiplication factors.

Figure 12 2008 Modelled Traffic Flows, Morning Peak Hour (8-9am)



Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than measuring individual flows or flow changes precisely.

3.3.4 Freight

Transport 2025 (TfL, 2006) estimates an increase in freight demand and servicing of 15 per cent to accommodate London's planned growth. The London Freight Plan (2008) presents a strategy to manage this growth in a safe and sustainable manner. The requirement for reliable and efficient freight movement needs to be balanced against the needs of transport users, the environment and quality of life.

There are several key land uses that generate notable freight activity to/from and within the OA. New Covent Garden Market's Main Market site in Nine Elms (south of the elevated railway line) is surrounded by expansive areas of tarmac used for servicing, delivery and leased car and coach parking. Ongoing market activity will ensure continued freight demand into the OA.

There is currently a rail based aggregates site in the Stewarts Road Industrial Area. The SPG to the London Plan on 'Land for Transport' notes the need to protect rail freight sites and refers to the role of TfL's 'Rail Freight Strategy: Rail freight Sites List Guidance Note' in identifying such sites and how

they should be considered in the planning process. This Note identifies the Stewart's Lane site as a 'key site'. If issues surrounding the quality of access to this site can be resolved, the site has the potential to accommodate expanded rail freight facilities. Retention of the aggregates site and development of rail freight facilities at this site would be compatible with local planning policies.

The Gatwick Express rail depot on Silverthorne Road may also provide an opportunity for improvement to rail freight distribution in the longer term due to its proximity to the waste and aggregates wharf at Cringle Dock/ RMC Battersea (Metro Greenham). However it is noted that no proposals have been submitted and that the site may not be suitable for rail freight.

The river provides a significant freight function in the OA. London Plan policy safeguards London wharves for cargo handling, river freight and waste handling. There are three safeguarded wharves in the OA[8]:

- Cringle Dock adjacent to Battersea Power Station, owned by Western Riverside Waste Authority and used as a waste processing plant;
- RMC Battersea (Metro Greenham), adjacent to Cringle Dock, currently in use as an aggregates wharf; and
- RMC Vauxhall (Middle Wharf) is also considered to be viable or capable of being made viable (one of the key factors for safeguarding in the Mayors policy). Whilst not currently in use there are proposals that this wharf will be made operational as a construction site for the Thames Tideway sewer tunnel up to c. 2020.

Intensification of residential and mixed use development presents a number of planning and transport related challenges in relation to ongoing freight activity within the OA. Given the strategic nature of the Transport Study, these issues have not been investigated. However, they will be considered in more detail in the OAPF.

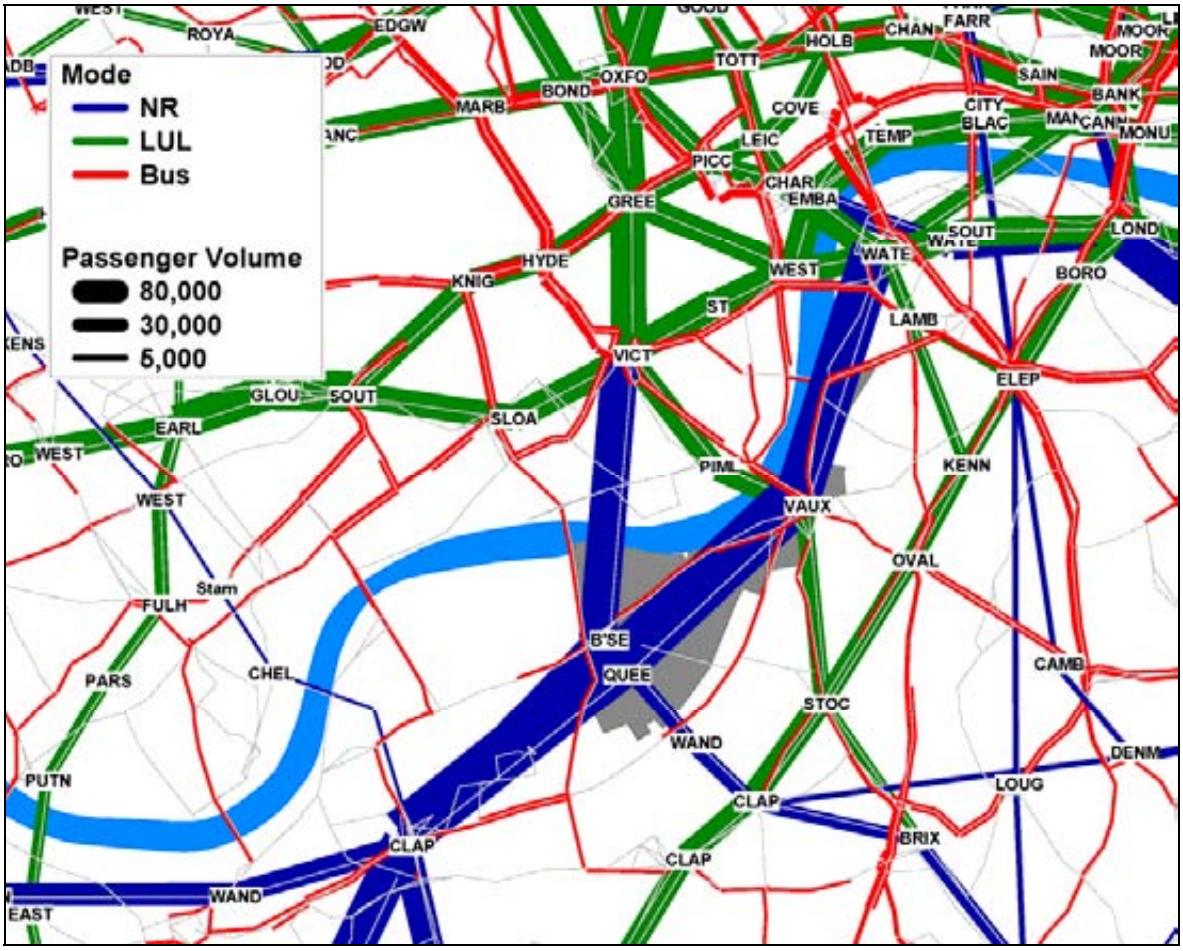
3.3.5 Public Transport

Modelled 2008 morning peak period public transport passenger loads are shown in Figure 13.

Passenger volumes are greatest on the NR network with large movements into Waterloo and Victoria Stations. Underground lines carry high volumes as well, especially in central London, and they are generally equally loaded in both directions. Bus services carry much lower volumes on individual links, but over a very extensive network.

[8] *Vauxhall Nine Elms Battersea Opportunity Area Planning Framework First Draft December 2008 (GLA).*

Figure 13 2008 Modelled PT Flows, Morning Peak Period (7-10am)



Source: VNEB-P model assignment results

Bus

Victoria, Vauxhall and Elephant and Castle stations are focal points for bus services and attendant bus passenger demand in the vicinity of the OA. Camberwell Green and Lambeth Town Hall are also significant foci and there are appreciable bus passenger flows inbound from Streatham to the south. Further away from central London in areas of lower density, bus demand declines rapidly.

Underground

The busiest Underground stations in central London in the modelled 3-hour morning peak period are Waterloo (69,000 boardings) and Victoria (57,000 boardings). Oxford Circus (39,000 boardings), Kings Cross (around 30,000 boardings) and Euston (25,000 boardings) also experience relatively high volumes. The lowest boarding numbers are at Warren Street, Pimlico and Oval Stations, in the order of 1,500, 2,500 and 2,500 respectively.

By comparison, Vauxhall Underground station has in the order of 6,000 boardings in the morning 3-hour peak period.

The segments of the Victoria Line north and south of Oxford Circus record the greatest flows in the 3-hour morning peak period:

- Victoria to Green Park (49,500 passengers northbound);
- Green Park to Oxford Circus (40,500 passengers northbound);
- Warren Street to Oxford Circus (47,000 passengers southbound); and
- Euston to Warren Street Station (49,000 passengers southbound).

On the Northern Line, the peak direction of flow near the OA is northbound. In the 3-hour morning peak period, passenger flows are highest on the Stockwell to Oval segment (29,000 passengers northbound, which includes passengers destined for both the Charing Cross and Bank branches) and the Waterloo to Embankment segment (approximately 22,000 passengers northbound). These volumes reflect the significant interchange function of these two stations. The Kennington to Oval link has comparatively low volumes (8,000 northbound and 1,000 southbound).

Rail

As stated in Section 3.2.2 there are four NR stations in or near the OA including Battersea Park, Queenstown Road, Vauxhall and Wandsworth Road. Vauxhall is the busiest of these four stations; with approximately 3,000 boardings and 8,000 alightings in the 3-hour morning peak period (the alightings include significant interchange movements to Underground services on the Victoria Line). The other stations have more alightings than boardings in the morning peak period, through their use for commuter trips into central London. Wandsworth Road has very low usage (modelled morning peak period volumes of just 20 boardings and 29 alightings). This station only has two platforms and is serviced by South London Line trains.

3.3.6 Public Transport Levels of Service

Service frequencies for public transport serving the OA are summarised in Table 5.

Table 5 Public Transport Service Frequencies in the OA, 2008 Morning Peak Period

Mode	Route	Services per hour each way Up/Down
Bus	2 West Norwood <> Baker St	9/9
	3 Oxford Circus <> Crystal Palace	8/8
	36 Queen's Park <> New Cross	10/10
	44 Tooting <> Vauxhall	6/6
	77 Tooting <> Waterloo	6/6
	77A Wandsworth <> Aldwych	-/-
	87 Wandsworth <> Aldwych	10/10
	88 Kentish Town <> Clapham Common	8/9
	137 Brixton <> Oxford Circus	11/11
	156 Wimbledon <> Vauxhall	8/8
	185 Lewisham <> Victoria	6/6
	196 Norwood Junction <> Elephant & Castle	5/5
	344 Clapham Junction <> Shoreditch	10/10
	360 Elephant & Castle <> Knightsbridge	5/5
	436 Paddington <> Lewisham	8/8
	452 Wandsworth Road <> Kensal Rise	7.5/7.5
	P5 Elephant & Castle <> Nine Elms	4/4
Underground	Victoria Line Brixton <> Victoria	26/26
	Northern Line Kennington <> Charing Cross	20/20
Rail	Clapham Junction <> Victoria (Calling at Battersea Park)	8/8
	London Bridge <> Victoria (Calling at Wandsworth Road and Battersea Park)	2/2
	Clapham Junction <> Waterloo (Calling at Queenstown Road and Vauxhall)	8/8
	Clapham Junction <> Waterloo (Calling at Vauxhall only)	21/18

Bus

Crowding has been applied to the bus mode during assignment however bus crowding ratios are currently not available as an output in Railplan. There are no particular crowding problems on bus routes serving the OA, but services between Vauxhall and Victoria attract high loads, suggesting they are used as an alternative to the busy Victoria Line.

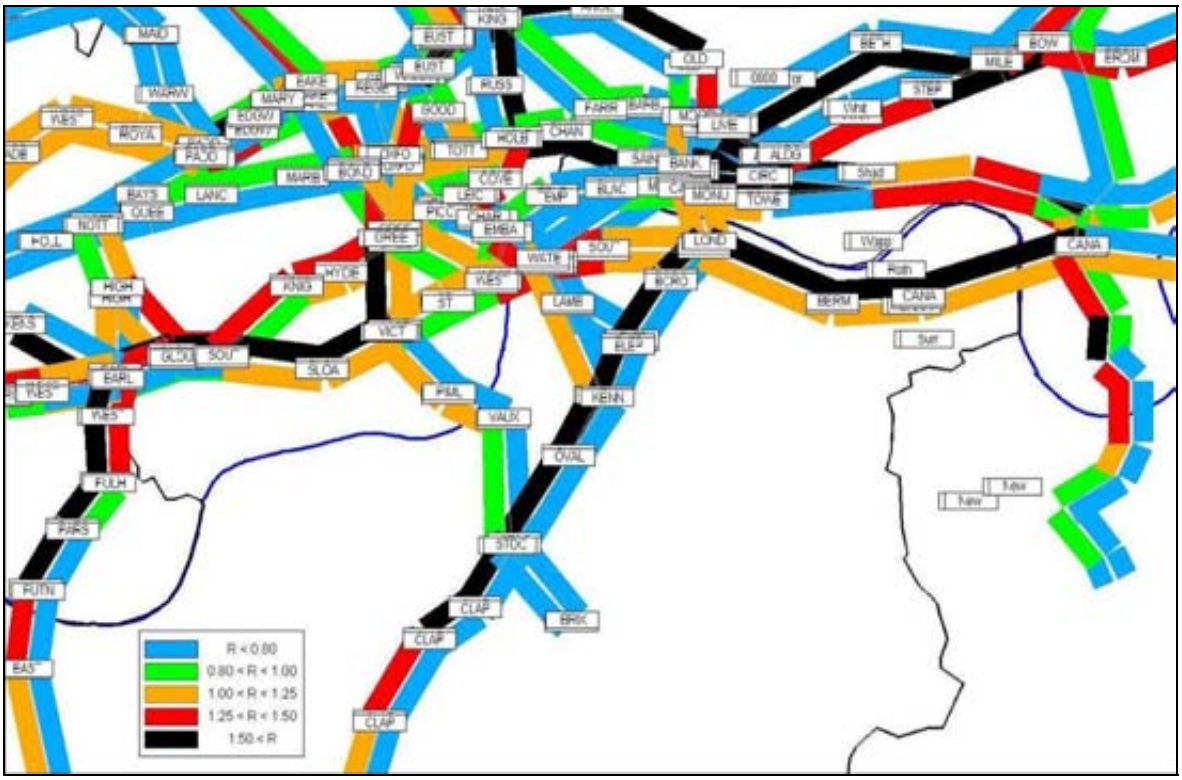
Underground

All public transport crowding plots in this report are calculated based on planning guidance capacity (PGC) ratio rather than crush capacity.

Figure 14 shows 2008 morning peak crowding ratios on Underground lines. The Northern Line from Clapham Common to Elephant and Castle and beyond has ratios greater than 1.5. Services south of Clapham Common are also highly utilised. Services from Vauxhall to Victoria and from Kennington

to Waterloo have ratios between 1 and 1.25. The Bakerloo Line experiences crowding in central London, ranging from 0.8 to over 1.25 between Baker Street and Oxford Circus.

Figure 14 Underground Crowding Ratios, 2008 Morning Peak Period (7-10am)



Source: VNEB-P model assignment results.

Rail

Figure 15 shows crowding ratios on NR services in the vicinity of the OA.

Several NR lines show crowding ratios over 1.5 in the peak direction:

- Elephant & Castle to Denmark Hill;
- Herne Hill to Brixton;
- Earlsfield to Clapham Junction; and
- Wandsworth Town to Clapham Junction

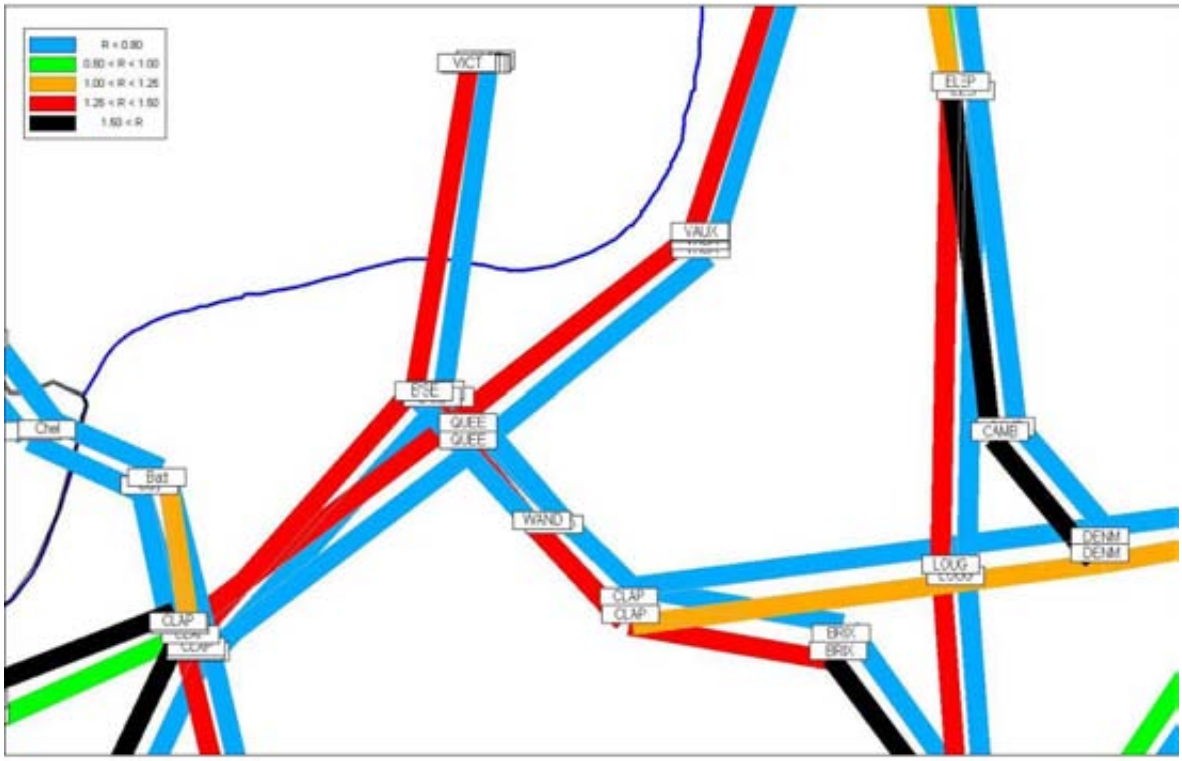
The following lines have crowding ratio between 1.25 and 1.5 in the peak direction:

- Clapham Junction to Waterloo;
- Clapham Junction to Victoria;
- Victoria to Brixton; and
- Herne Hill to Elephant & Castle.

Lines from Clapham High Street to east of Denmark Hill and from Clapham Junction to West Brompton also show some crowding (ratios between 1 and 1.25).

More people alight at Vauxhall from services into Waterloo than board, providing some relief, although the crowding ratio on these services remains unchanged.

Figure 15 Rail Crowding Ratios, 2008 Morning Peak Period (7-10am)



Source: VNEB-P model assignment results. Note that 'Batt' station north of Clapham Junction is used to denote different services through Clapham Junction itself and is the point at which London Overground and Southern services split.

3.3.7 Station and Interchange Conditions

As already stated NR and Underground stations in and around the OA perform important interchange functions, especially the Vauxhall stations.

Table 6 details the 2008 modelled station throughputs in the busiest morning peak hour. These figures have been derived from VNEB-P modelled flows, adjusted to observed flows from 2008 RODS data. The key flow is from the NR station to the Underground station, with significantly more people transferring from NR services to LUL services than *vice versa*. Appendix D contains a detailed analysis of station capacity.

Table 7 summarises the station characteristics and performance.

Table 6 Station Throughputs, 2008 Morning Busiest Peak Hour

Station	Movement	Pax/hr
Vauxhall (NR)	Boarders (incl Underground interchange)	2,000
	Alighters (incl Underground interchange)	5,700
Vauxhall (Underground)	Boarders (incl NR interchange)	5,800
	Alighters (incl NR interchange)	4,700
Vauxhall Interchange	NR to Underground	4,600
	Underground to NR	1,600
Battersea Park	Boarders	400
	Alighters	700
Queenstown Road	Boarders	300
	Alighters	600

Note: See Appendix D for details of derivation of these figures.

Table 7 Station Characteristics and Performance

Station	Characteristics and performance
Vauxhall (NR)	Station has eight platforms but with unequal patterns of use and main concentration on island platform 7/8. Provision of second staircase from this platform to subway has provided congestion relief. Two gated entrances to subway, with main bus and Underground interchange at western end.
Vauxhall (Underground)	Station has three escalators, each with capacity of 6,000 pax/hr, which currently operate as two down, one up. Station throughput currently constrained by barrier capacity of 7,500 pax/hr in and 4,500 pax/hr out. Currently operating within capacity.
Battersea Park	Station currently has five platforms but with uneven pattern of use. Platform 4 used by up services is narrow and has poor access, however this is currently not a major problem.
Queenstown Road	Station has two active platforms on an island. Relatively low levels of use and no particular problems.

4 Understanding the Future Situation

4 Understanding the Future Situation

4.1 OA Development Scenarios

The planning framework for the OA focuses on growth on key sites in the OA including Battersea Power Station, and extensive residential development centred on the Nine Elms area. These areas are expected to accommodate intensification of housing provision and mixed use development including retail, office and community uses.

The GLA carried out a development capacity study in June 2008 which identified the opportunity to accommodate up to 16,000 homes in the OA up to 2026. The study established three high density development scenarios, which deliver a range of 8,000, 12,000 or 27,000 jobs. All the development scenarios assume mixed use development throughout the OA, the lower estimate assumes office development and a small district centre at Vauxhall, the mid-range estimate assumes delivery of retail development at Battersea Power Station and the upper estimate assumes further development including a substantial quantum of office.

The development scenarios have been used as a basis for identifying the public transport, public realm and social infrastructure requirements to support the proposed intensification. Travel demand forecasts for 2026 have therefore been prepared for each of the five development scenarios to reflect the development capacity estimates, summarised in Table 8. It is assumed that development in the OA will occur in parallel with growth in London generally and that all development in the OA is complete by 2026.

Table 8 OA Development Scenarios

OA Scenario	Description	Employment	Dwellings	Population
1	Low density residential	8,000	4,200	10,200
2	Medium density residential	8,000	8,500	20,700
3	High density residential	8,000	16,000	38,900
4	High density residential + retail	12,000	16,750	40,700
5	High density residential + retail + office	27,000	16,750	40,700

All employment figures are net of any displacement effects overall.

More detail on the development capacity study and individual scenarios will be provided in the GLA's Draft Opportunity Area Planning Framework to be released in 2009.

4.2 Preparation of Land Use Projections

Land use data projections for the OA development scenarios were prepared for the LTS Model by Roger Tym and Partners under instruction from the GLA. The method used to produce the employment and population projections is similar to that used to produce the London wide LTS zone projections, that is, to apportion forecasts made at the London borough level to smaller spatial levels, whilst keeping the London-wide totals constant in a given year.

For the lower development scenarios, VNEB OA growth could be accommodated whilst keeping the individual Lambeth and Wandsworth Borough totals constant in a given year. To avoid excessive reductions in projected growth to other parts of Lambeth and Wandsworth, at higher levels of VNEB OA growth it was necessary to balance the totals across the two boroughs combined, or (in the case of the large employment increase in OA Scenario 5), across the six inner London boroughs, as summarised in Table 9.

Table 9 Method of Balancing Land Use Projections for OA Scenarios

OA Scenario	Population constrained to totals for:	Employment constrained to totals for:
1	Lambeth & Wandsworth individually	Lambeth & Wandsworth individually
2		
3	Sum of Lambeth & Wandsworth	Lambeth & Wandsworth individually
4		Sum of Lambeth & Wandsworth
5		Sum of Lambeth, Wandsworth, Camden, City, Southwark & Westminster

Balancing land use projections as described above has ensured that this study remains consistent with London Plan forecasts. However due to the different balancing methods employed for different levels of OA development, care should be taken when comparing the transport modelling results between scenarios.

Although consistent with the London Plan, this approach gives lower transport demand estimates than if the VNEB OA developments were to be considered as additional to general growth in surrounding areas. Additional analysis was undertaken using the LTS, VNEB-H and VNEB-P models to gauge the possible extent of this. The analysis showed that the reduced growth in surrounding areas, to offset growth in the VNEB OA, resulted in lower underlying modelled passenger and traffic volumes on the transport network compared to the future year reference case (with no OA development and hence no balancing of land use projections), to which the additional demand from OA development was then added.

It is apparent that although the differences in underlying traffic and passenger volumes are marginal over the majority of the affected areas, they are more concentrated on the transport links that subsequently receive additional demand from OA development. This may result in a more conservative estimate of the congesting effects of demand generated by OA development.

Despite this, it is considered that the borough-balancing assumptions do not significantly influence the results of the appraisals for the various transport packages because they are all carried out within each OA development scenario. However, it should be noted that, if OA development were to be considered as additional to London Plan total growth, the public transport and highway networks would be more congested, especially at the Vauxhall Underground and rail stations and on the Vauxhall gyratory and key link roads.

4.3 Travel Demand Forecasting Methodology

In establishing a detailed methodology for forecasting the future travel demand associated with OA development, a trip rate-based approach was examined but rejected in favour of using the LTS Model after detailed investigations into the latter, mainly because:

- the OA area is unlike any other previous development, as it is such a large area of brownfield land within the CAZ and being surrounded by very different land uses; and
- OA development is assumed to be replacing growth elsewhere in London, in order to accommodate growth within existing Borough housing and employment projections; and
- the implied trip rates from the LTS Model seemed the most reasonable.

LTS runs were specified to reflect the 2016 and 2026 reference (i.e. no OA development) cases and the various OA development scenarios in 2026. The LTS output matrices showed reasonable consistency with land use changes, but before importing them into the VNEB-P and VNEB-H assignment models, adjustments were made to trips to and from the OA to reflect an aspiration for larger household sizes accommodating more families with children than were reflected in the LTS input planning data.

LTS runs were completed for the 2016 and 2026 Reference Cases, for each of the five OA development scenarios and also for a variant of OA Scenario 5 which included an extension of the Northern Line to Nine Elms and Battersea Power Station (the primary public transport initiative) and associated bus packages.

The adjusted LTS trips were assigned to the networks in VNEB-P and VNEB-H to estimate the transport impacts of the future year Reference Cases, the OA development scenarios and various associated packages of transport interventions (described in Chapter 5).

4.4 Committed Transport System Changes

Key committed transport system changes are included in the 2016 and 2026 Reference Case networks, as summarised in Table 10. This is consistent with the agreed TfL Reference Cases for 2016 and 2026 as of September 2008 (see section 4.4 for further details on the Reference Case).

Table 10 Committed Transport System Changes

Mode	Committed changes
Rail	Crossrail 1
	Suburban train capacity/service increases (HLOS)
	Overground, NLL, WLR and ELL improvements
	CTRL, Heathrow and Gatwick expresses
Underground & Light Rail	Piccadilly Line Heathrow T5 extension
	Full PPP improvements to Underground lines
	DLR upgrades, extensions
Bus	Bus frequency increases (4% central, 2.5% other)
	Development area buses (Olympic Village, E London)
	Greenwich Waterfront & East London Transit
Highway network	Various committed road improvements across Greater London area (insignificant in the vicinity of the OA)

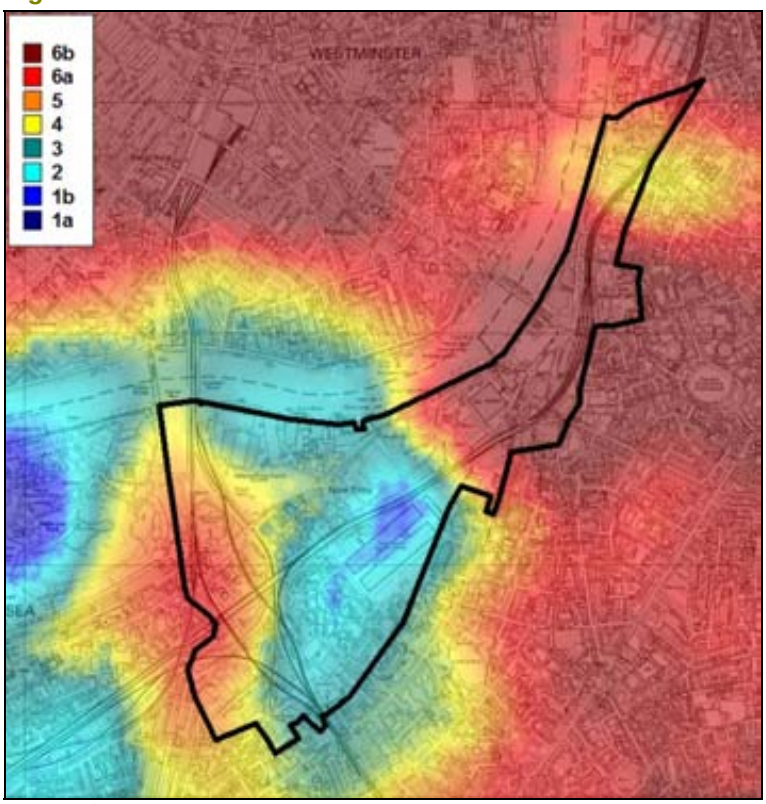
More details of the schemes mentioned can be obtained from TfL and are accurate as of winter 2009

As part of the HLOS suburban train capacity/service increases the platforms will be lengthened from 8 to 10 cars at Vauxhall, Battersea Park and Queenstown Road.

4.5 Future Public Transport Accessibility Levels

PTALs have been calculated by TfL for the OA in 2026 allowing for committed schemes (Figure 16). Compared with 2006 PTALS (Figure 7), committed public transport initiatives will have some effect on the OA, mainly due to increased service levels on existing public transport routes. However the basic pattern remains the same; large areas of the OA in the Nine Elms area will still have relatively poor access to public transport.

Figure 16 2026 PTALS in the OA



Source: TfL

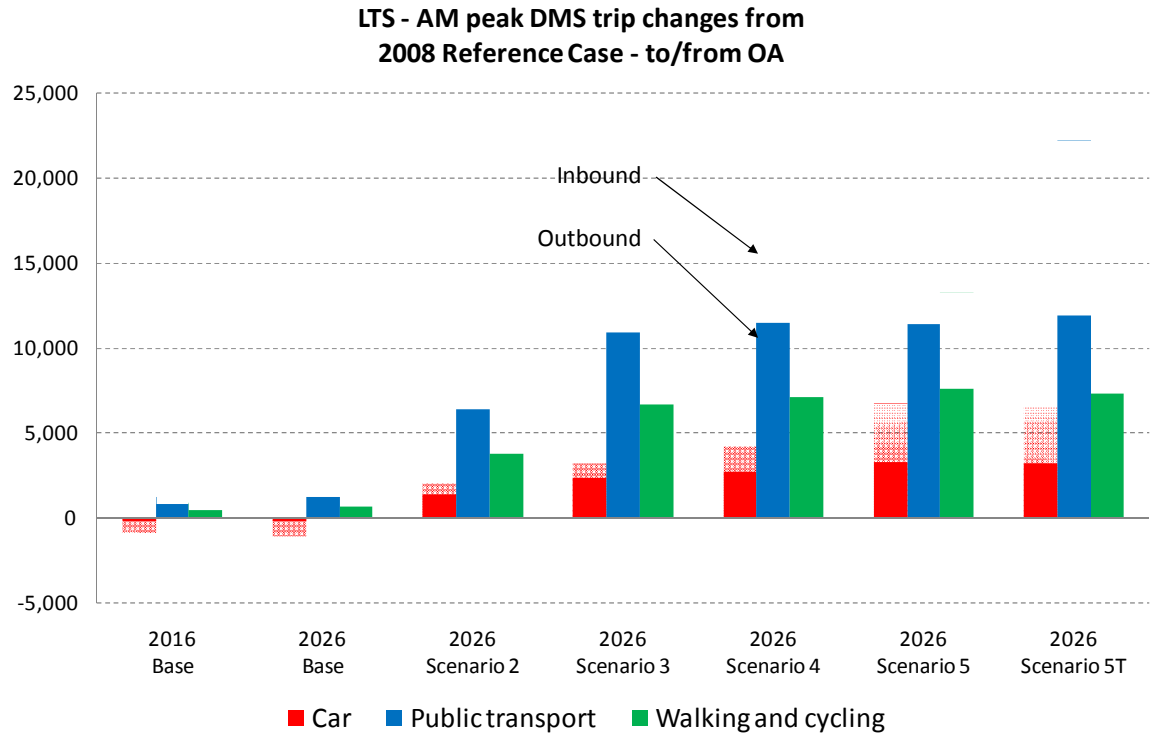
4.6 Future Travel Demand and Levels of Service

4.6.1 Mode Shares

The outputs of the LTS model for morning peak trips to and from the OA are illustrated in Figure 17, for the 2016 and 2026 Reference Cases, for OA Scenarios 2-5[9] and also for a modification of OA Scenario 5 (5T) that included an extension of the Northern Line to Battersea Power Station (the largest public transport initiative tested in this study).

[9] The LTS Model results for OA Scenario 1 appear to contain some inconsistencies that require more research to resolve. The forecasting results presented herein consequently exclude OA Scenario1.

Figure 17 Trip Changes To/from OA Zones Between 2008 and Future Year Scenarios



Firstly, the change in trips between 2008 and the 2016 and 2026 Reference Cases are small, reflecting the fact that there are no changes in land use in the OA.

Secondly, the mode share of trips to and from the OA is fairly consistent between all OA development scenarios, and the amount of travel increases consistent with the increasing density of development. In all scenarios there is an appreciable increase in public transport and walking/cycling trips. The modelled mode shares of additional trips generated by OA development are approximately 20% car, 50% public transport and 30% walking and cycling. This compares to present day levels of 25% car, 50% public transport and 25% walking and cycling.

The LTS Model generated car trips to and from development in the OA, in all scenarios, that were well within the planned residential parking capacity (an average provision of 0.5 parking spaces per new dwelling is assumed by the GLA in OA Scenarios 1 to 3 and 0.25 parking spaces per new dwelling in OA Scenarios 4 and 5), so no adjustment was deemed necessary to these trips.

A notable feature of the results is the significant increase in car trips into the OA between OA Scenarios 4 and 5 (for which the land use difference is an increase in employment of 15,000 jobs at Battersea Power Station, but notionally with only 250 additional parking spaces):

- there is a 1,900 increase in car person-trips to the zone containing Battersea Power Station between OA Scenarios 4 and 5, of which 900 are car person-trips to work, or about 750 vehicle trips); and
- the subsequent decrease in trips with OA Scenario 5T (which includes the NLE) is small – 400 person-trips split between car and walk/cycle (although the increase in public transport trips is more – 700 trips).

These changes reflect the fact that the LTS Model, on the one hand, does not recognise the intention to constrain parking with the office development and on the other hand generates a small demand changes from car to public transport when the Northern Line is extended. This is influenced by the LTS Model parameter values for various areas of London, for example between the central and inner areas as defined by the model. The model does not constrain the vehicle trips to available parking and therefore it forecasts demand as if sufficient parking were provided. The small demand change associated with the NLE is because the vast majority of car demand is for journeys to/from areas to the south and south-west, not areas served by the NLE.

To account for this the OA Scenario 5 LTS matrices were adjusted by manually transferring some of the inbound trips to Battersea Power Station from car to public transport. In the 2026 morning peak, for example, this was done by removing about 840 car vehicle trips with destinations at the Battersea Power Station development and replacing them with about 980 public transport trips (allowing for an average vehicle occupancy of 1.17) from the same origins.

4.6.2 Trip Volumes

Walking and Cycling

The LTS Model results indicate significant increases in walking and cycling activity to and from OA development. Much of this movement is between the OA and adjacent areas in Wandsworth and Lambeth, as well as across the Thames. These results bear out the expectation that walking and cycling will grow substantially into the future, and can provide high-level indications of the distribution of the demand, although it is not possible to separate walking and cycling because they are treated as one travel mode in the LTS Model.

Additional work would be required, both to quantify the extent of walking and cycling increases associated with OA development, and to identify improvement measures to accommodate, indeed positively encourage, the take-up of these modes.

Highway Traffic

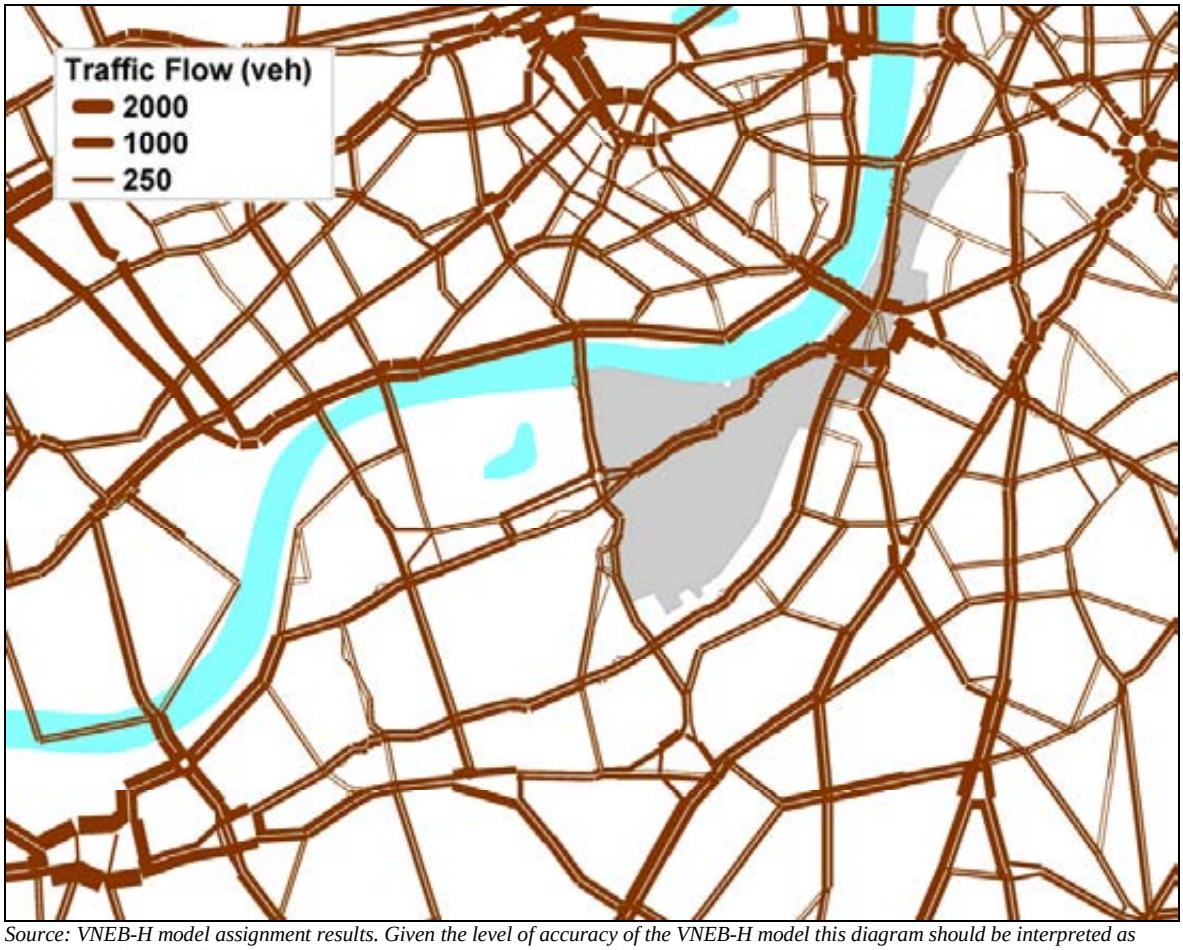
The VNEB-H Model results for the 2026 Reference Case show similar traffic flow patterns to the 2008 AM Reference Case in the OA area, which is to be expected as the Reference Case has retained development in the OA at 2008 levels with some balancing to retain overall London Plan development levels in the Boroughs of Lambeth and Wandsworth.

In the morning peak hour, increases are forecast on key routes such as Nine Elms Lane, Wandsworth and South Lambeth Road. The Vauxhall gyratory continues to indicate flows in the order of 2,500-3,000 pcus/hour.

The morning peak hour shows the 'worst case' or highest demand on the network. Evening peak flows are not illustrated herein but show similar patterns with a noticeable increase in the order of 250-500 vehicles in each direction between the 2008 and 2026 model runs on Nine Elms Lane.

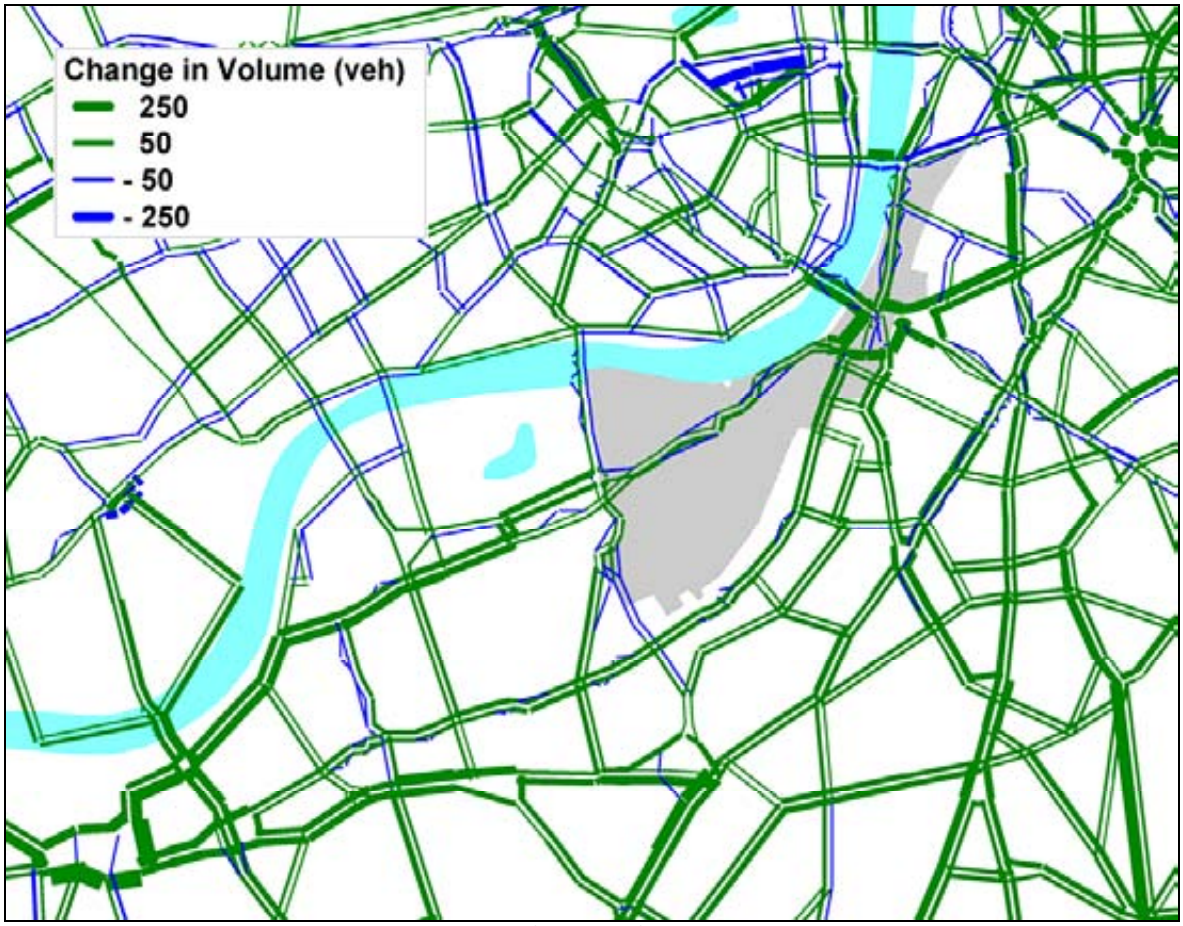
Morning peak hour traffic flows for the road network in the 2026 Reference Case are illustrated in Figure 18, whilst Figure 19 shows the change in volume between the 2008 and 2026 Reference Cases. Figure 20 to Figure 23 illustrate the change in peak hour traffic volumes on the highway network between the 2026 Reference Case and each of the OA Scenarios 2 to 5.

Figure 18 2026 Reference Case Traffic Volumes, Morning Peak Hour (8-9am)



Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than measuring individual flows or flow changes precisely.

Figure 19 Traffic Volume Changes, 2008 to 2026 Reference Case, Morning Peak Hour (8-9am)



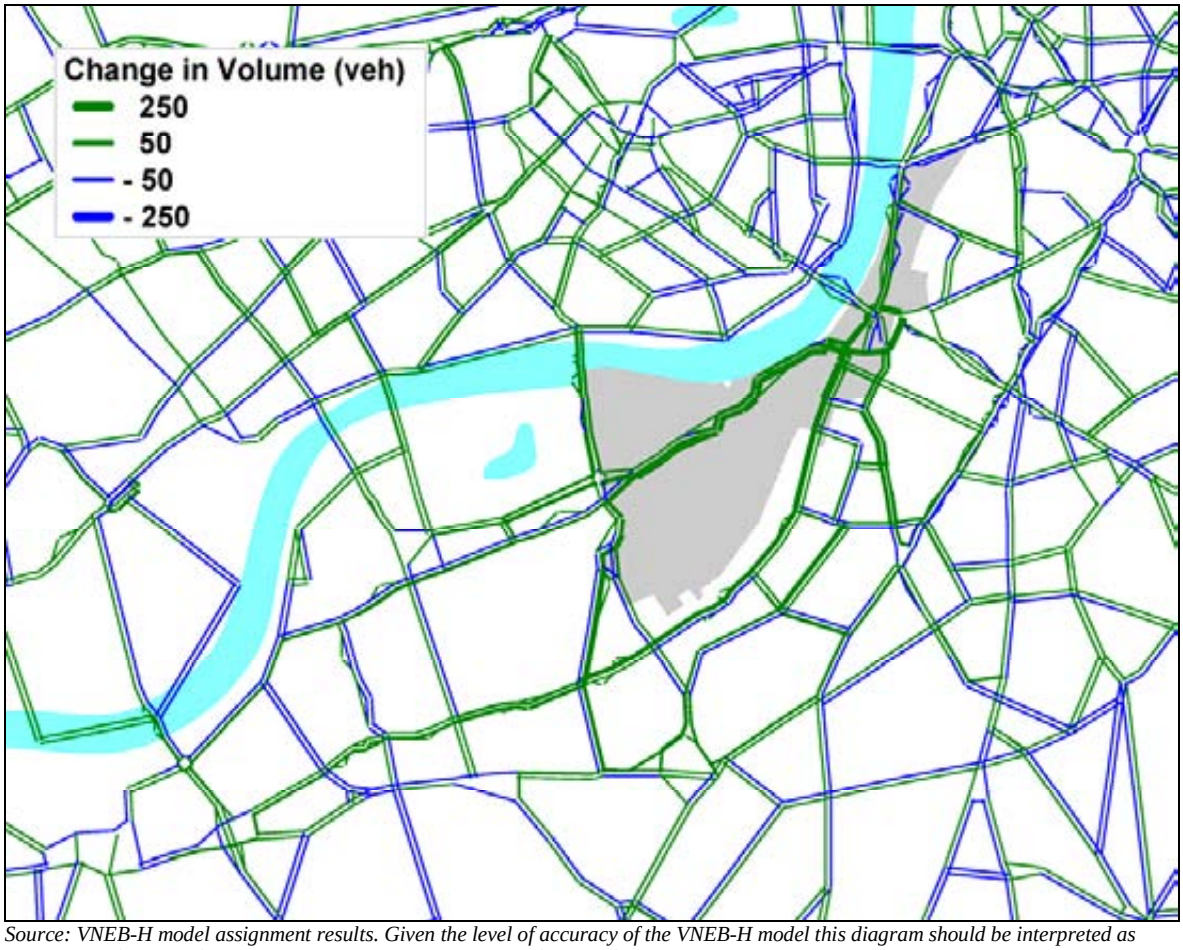
Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than measuring individual flows or flow changes precisely.

Generally modest traffic increases are forecast on roads in and around the OA (less than 250 vehicles an hour one-way), especially to the south and south east. Decreases are forecast for roads in the Chelsea area and to the west of the OA in Battersea. This is considered to be a result of the public transport improvements assumed in the Reference Case and the continued effects of the congestion charging zone, including the Western Extension which is now proposed to be removed[10].

More significant traffic flow increases are concentrated in and around the Vauxhall gyratory and Wandsworth one-way system, both of which are key traffic foci for movement in the area, related to the traffic importance of Vauxhall and Wandsworth Bridges.

[10] The Western Extension was, at TfL's direction, included in all future year modelling for the study; the announcement of its proposed removal came too late to be incorporated in the modelling specification.

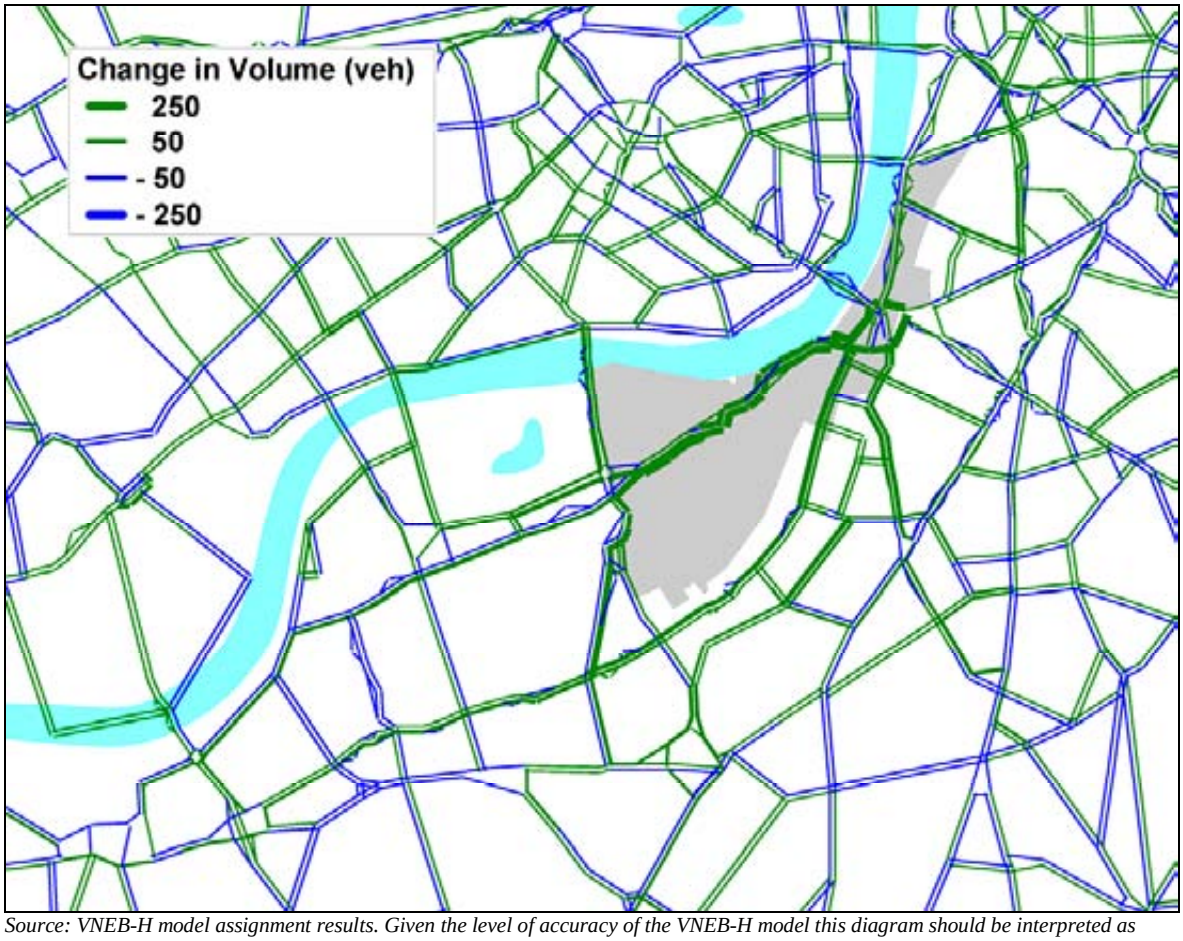
Figure 20 Traffic Volume Changes, 2026 Reference Case to Scenario 2, Morning Peak Hour (8-9am)



Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than measuring individual flows or flow changes precisely.

OA Scenario 2 forecasts relatively small traffic increases (around 50-100 vehicles an hour in each direction) on Wandsworth Road, Nine Elms Lane, Queenstown Road, Larkhall Rise and Kennington Lane.

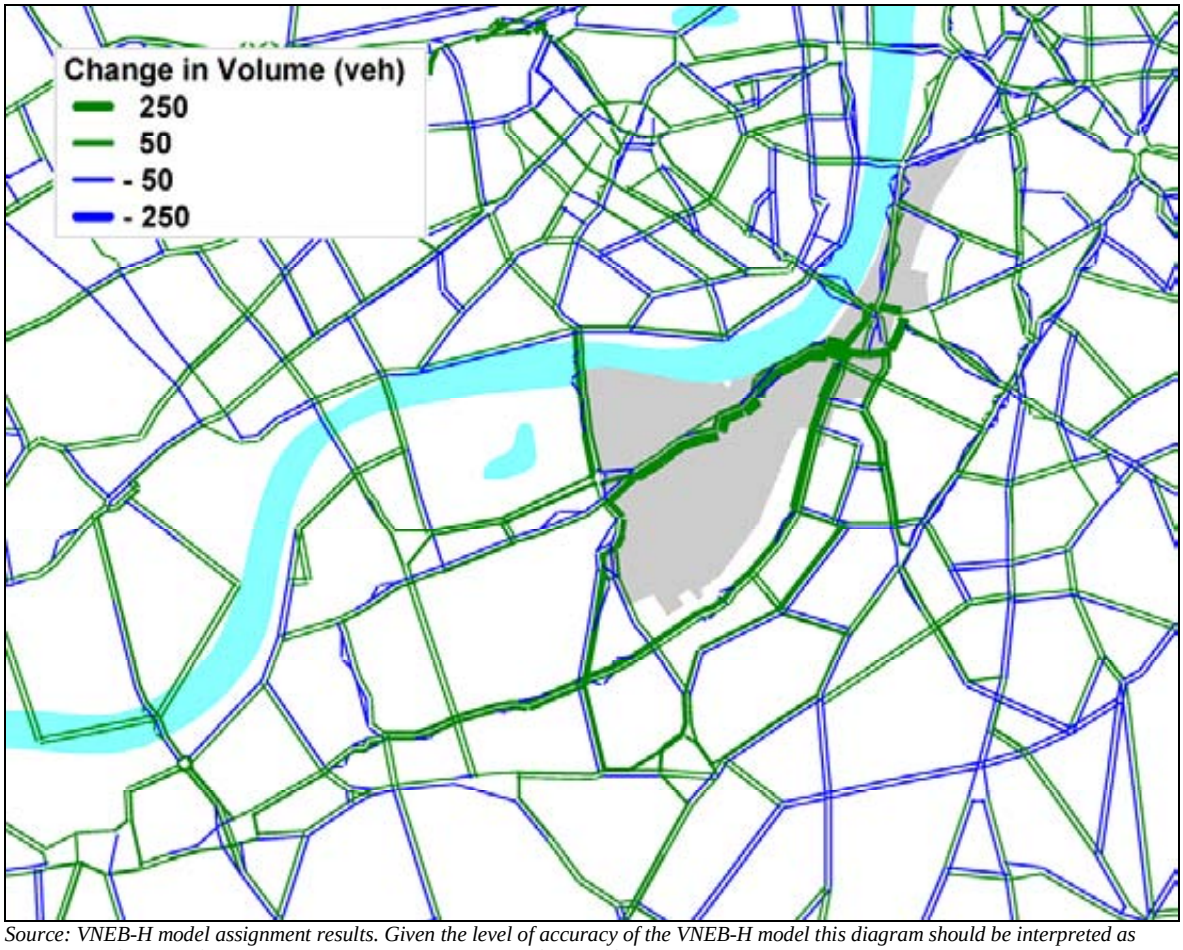
Figure 21 Traffic Volume Changes, 2026 Reference Case to Scenario 3, Morning Peak Hour (8-9am)



Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than measuring individual flows or flow changes precisely.

The increased development forecast in OA Scenario 3 (compared with Scenario 2) results in further traffic increases on Nine Elms Lane, Wandsworth Road, Queenstown Road, Larkhall Rise and Kennington Lane. These traffic increases have more widspread impact, with smaller traffic increases in roads on the north bank of the Thames.

Figure 22 Traffic Volume Changes, 2026 Reference Case to Scenario 4, Morning Peak Hour (8-9am)



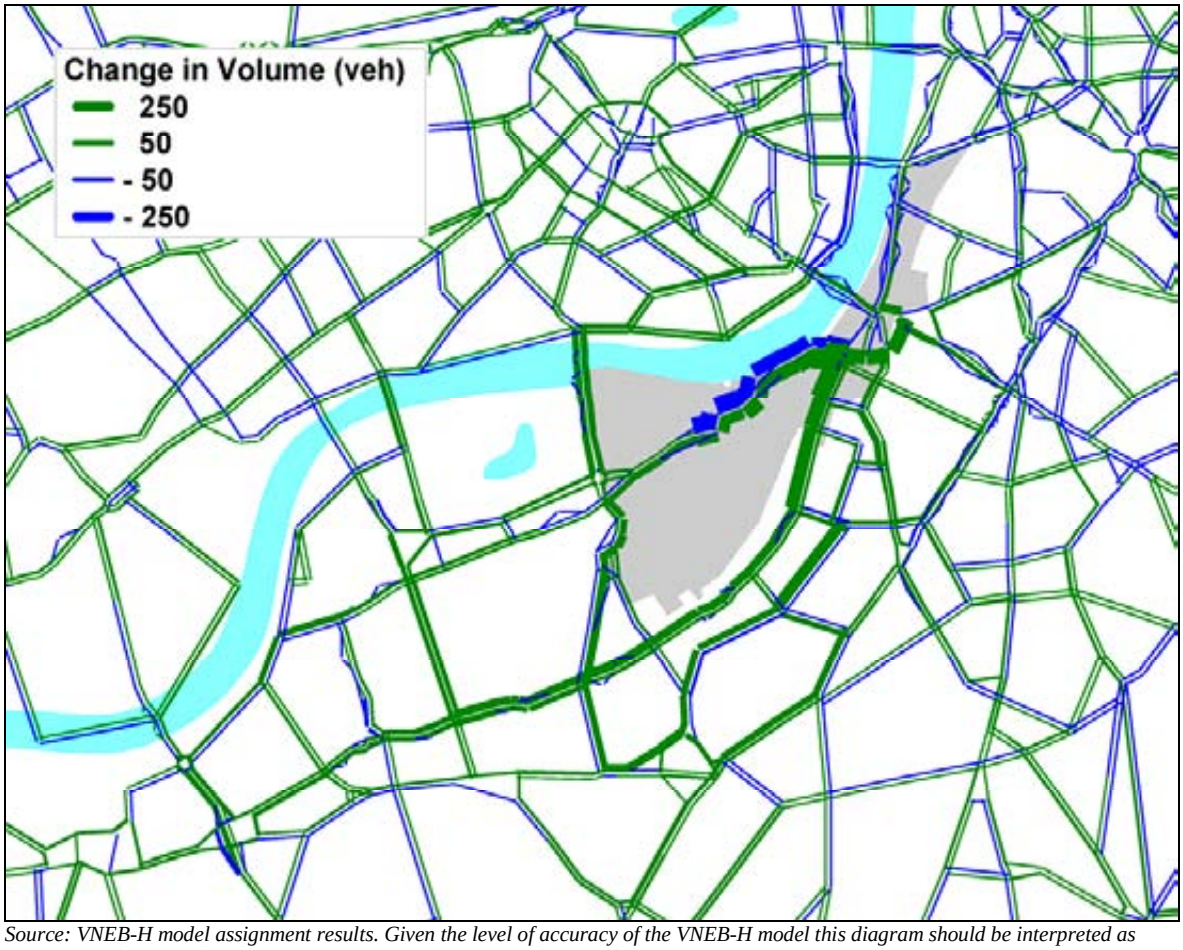
Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than measuring individual flows or flow changes precisely.

The increased development in OA Scenario 4 adds to further traffic increases on Wandsworth Road, Nine Elms Lane, Queenstown Road, Larkhall Rise and Kennington Lane. These traffic increases have wider impact as well, with smaller traffic increases on Chelsea Bridge, Chelsea Embankment and Grosvenor Road, on the north bank of the Thames.

At this level of development the traffic increases are more significant. It is important to note that the lack of NW-SW road access in the OA results in a concentration of demand increases on Nine Elms Lane and Wandsworth Road, with Larkhall Rise also seeing significant traffic increases. This will place increased traffic pressure on the Vauxhall gyratory.

Further afield, the traffic impact of the OA development is significantly dissipated with only nominal changes in traffic flow at Wandsworth, for example.

Figure 23 Traffic Volume Changes, 2026 Reference Case to Scenario 5, Morning Peak Hour (8-9am)



Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than measuring individual flows or flow changes precisely.

A key feature of the traffic changes with OA Scenario 5 is the re-routing of traffic northbound on Nine Elms Lane onto Wansdworth Road and Grosvenor Road. This is considered to be due to excessive delays at the Vauxhall gyratory caused by the increase in development traffic through the junction.

The employment increase at Battersea Power Station in OA Scenario 5 (compared to OA Scenario 4) results in more substantial traffic increases on Wandsworth Road and Nine Elms Lane (westbound). These increases extend further south and south west along Wandsworth Road, Queenstown Road, Larkhall Rise and even down to Clapham Road/High Street. Traffic flows also increase significantly on Chelsea Bridge and Grosvenor Road.

Summary of Highway Impacts of OA Development

The preceding diagrams generally show steadily increasing traffic changes associated with increased development levels in the OA, especially on Nine Elms Lane and Wandsworth Road, and indeed on other roads connecting to the Vauxhall gyratory, suggesting the need for improvements or alterations to the traffic system in this area. However the VNEB-H model is strategic in nature and the model

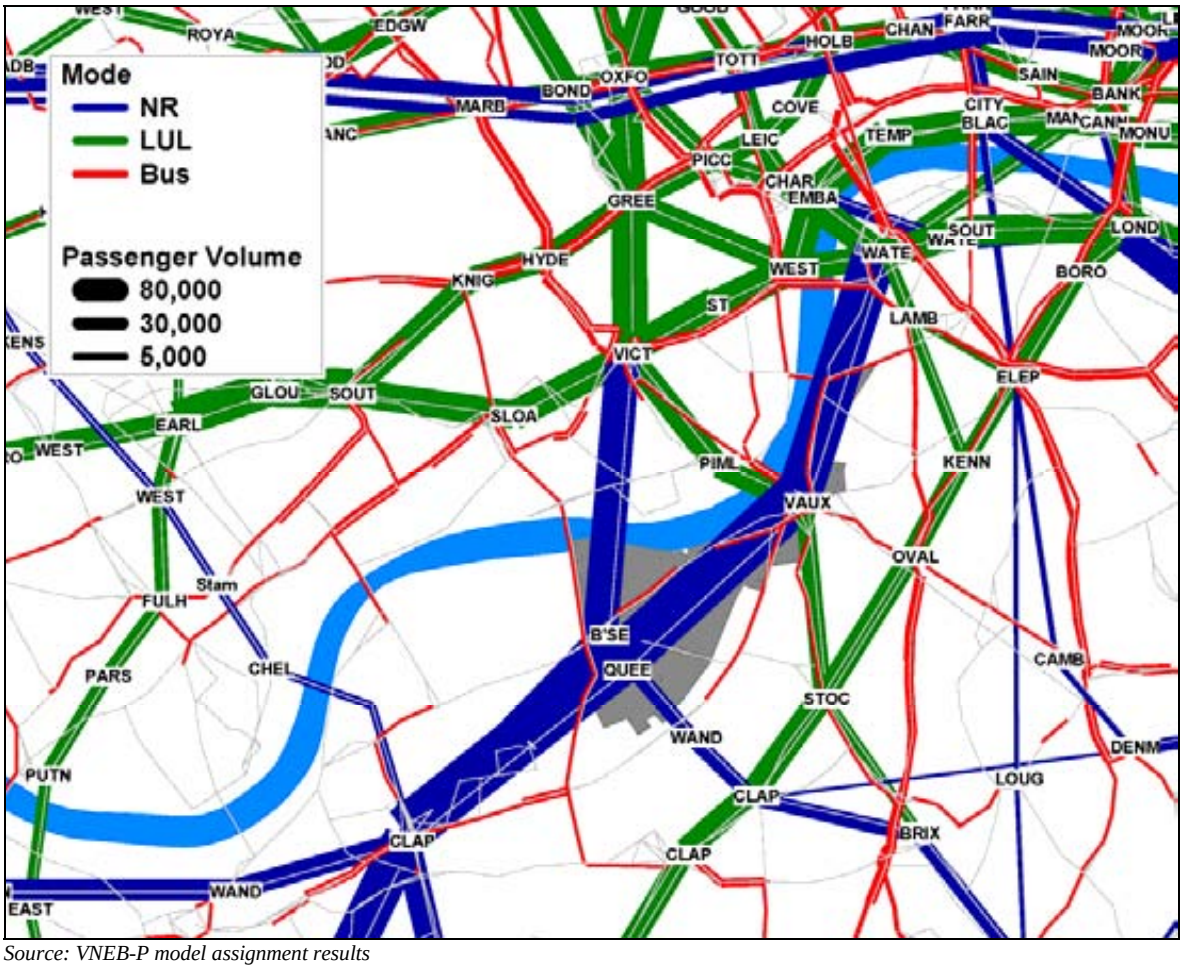
settings have not been adjusted to optimise traffic signals, nor to allow for the localised street works (new signals, etc) that may be associated with OA development, especially along Nine Elms Lane where most of the development would be concentrated. Further work would be required, including microsimulation modelling to assess these impacts in more detail as well as the appropriateness of any proposed mitigation measures.

Public Transport

The model outputs illustrated in Figure 24 show the forecast morning peak public transport passenger volumes in 2026.

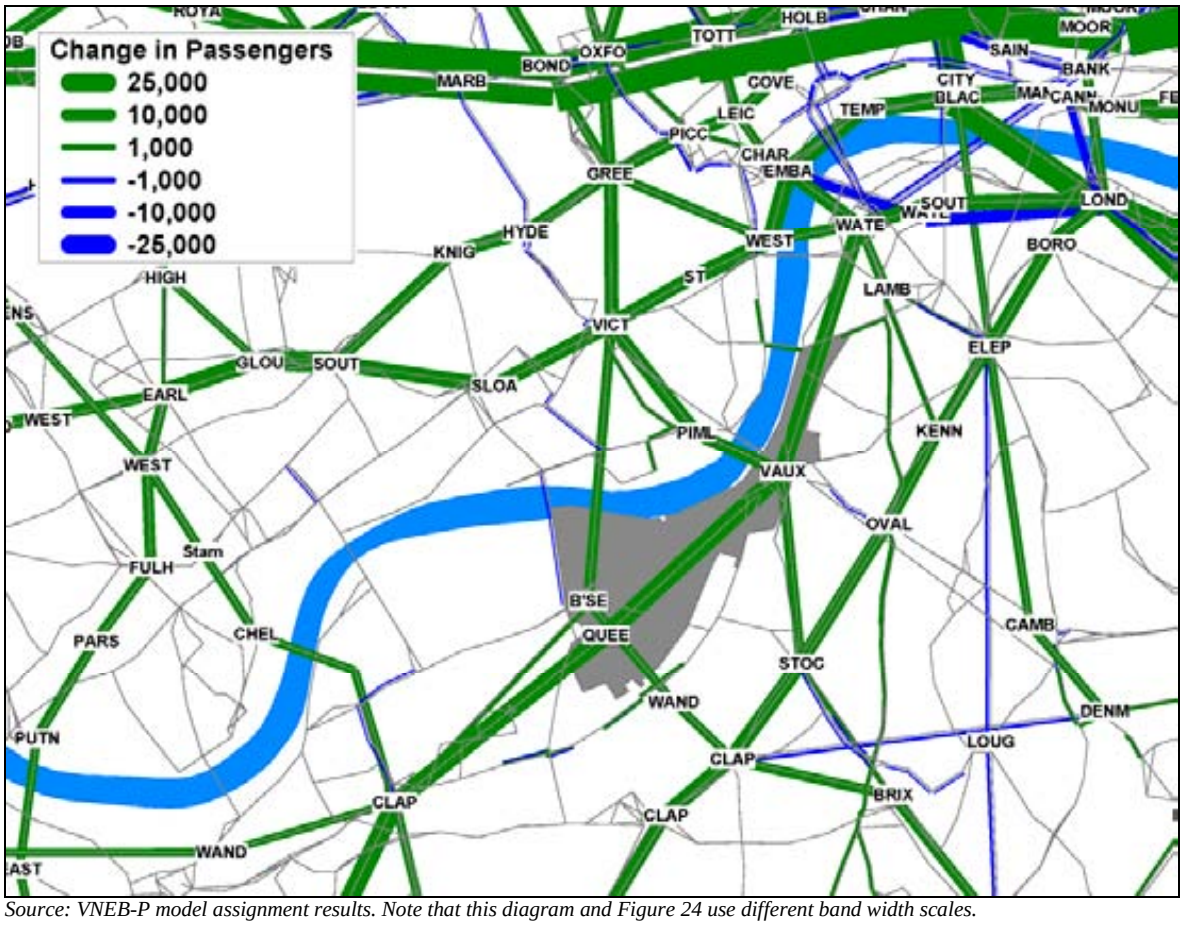
Figure 25 shows the difference between the 2008 and 2026 modelled volumes. Figure 26 to Figure 29 illustrate the variation between the 2026 Reference Case and OA Scenarios 2-5 respectively.

Figure 24 Public Transport Volumes, 2026 Reference Case, Morning Peak Period (7-10am)



Source: VNEB-P model assignment results

Figure 25 Public Transport Volume Changes, 2008 to 2026 Reference Case, Morning Peak (7-10am)

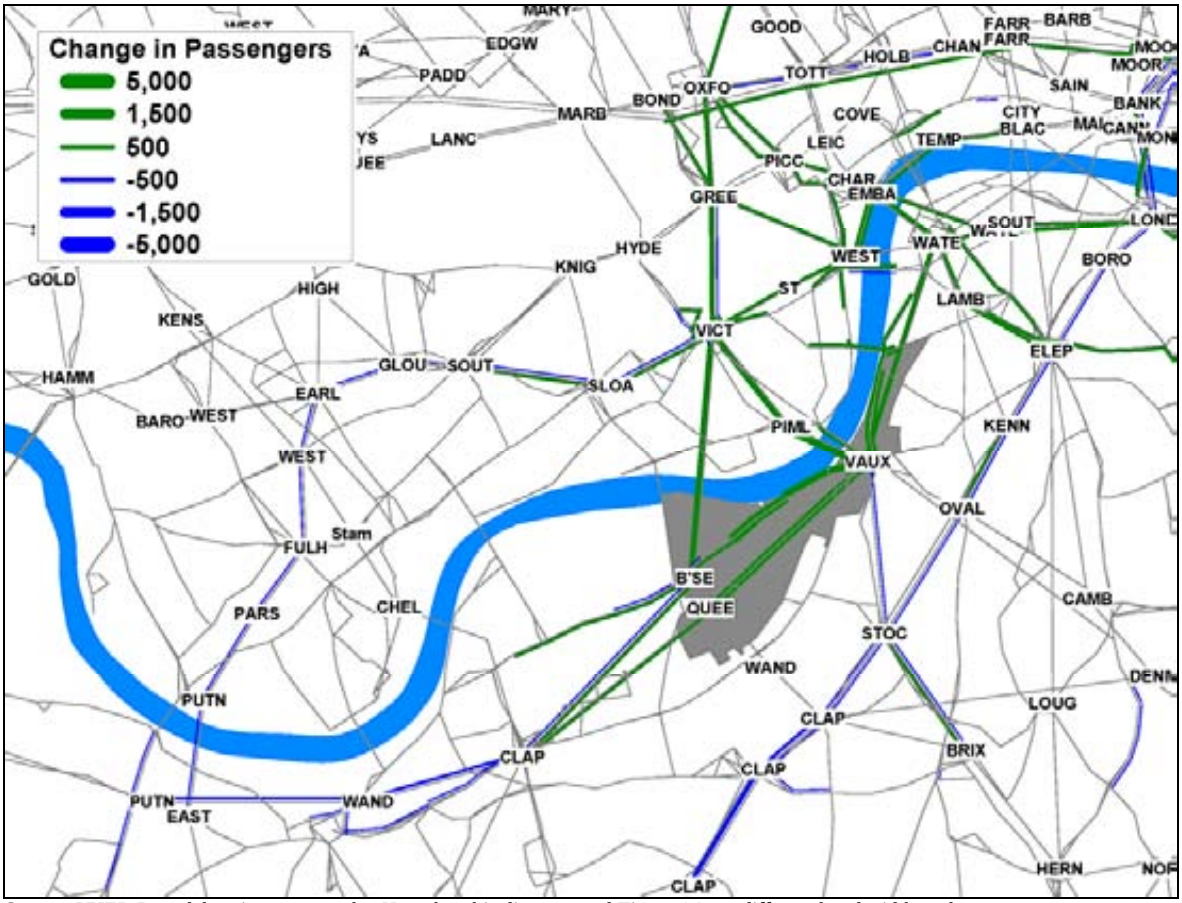


Source: VNEB-P model assignment results. Note that this diagram and Figure 24 use different band width scales.

Public transport patronage changes forecast between the 2008 and 2026 Reference Cases are substantial and influenced significantly by committed public transport improvements, especially Crossrail, South West Trains and Underground PPP improvements.

Increases are focused on the NR and Underground networks rather than on bus services.

Figure 26 Public Transport Volume Changes, 2026 Reference Case to Scenario 2, Morning Peak (7-10am)

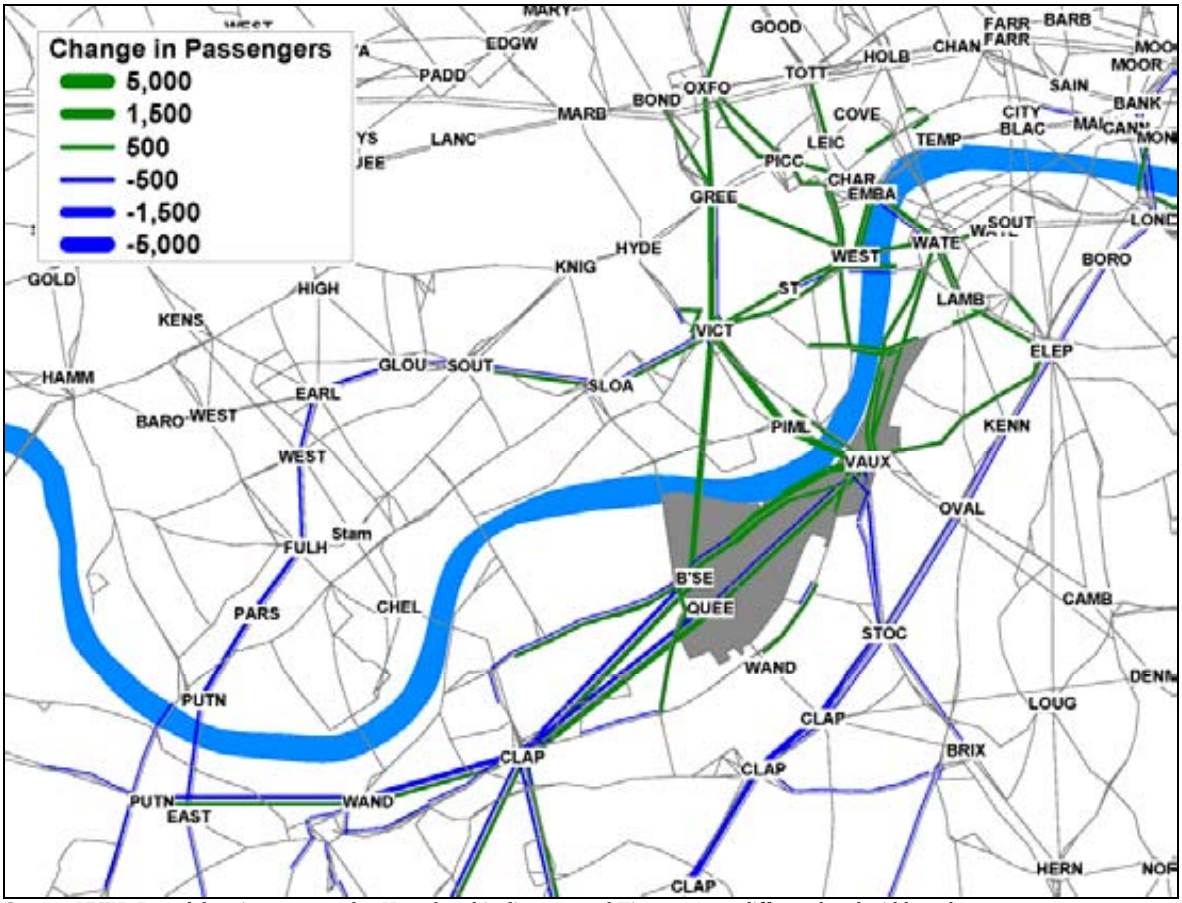


Source: VNEB-P model assignment results. Note that this diagram and Figure 24 use different band width scales.

The pattern of patronage changes due to OA Scenario 2 would be concentrated on routes between the OA and central London. Increases in passenger demand are evident on the Victoria Line and on NR services between Clapham Junction and central London (Victoria and Waterloo).

There would be increases in patronage on all public transport routes centring on Vauxhall interchange.

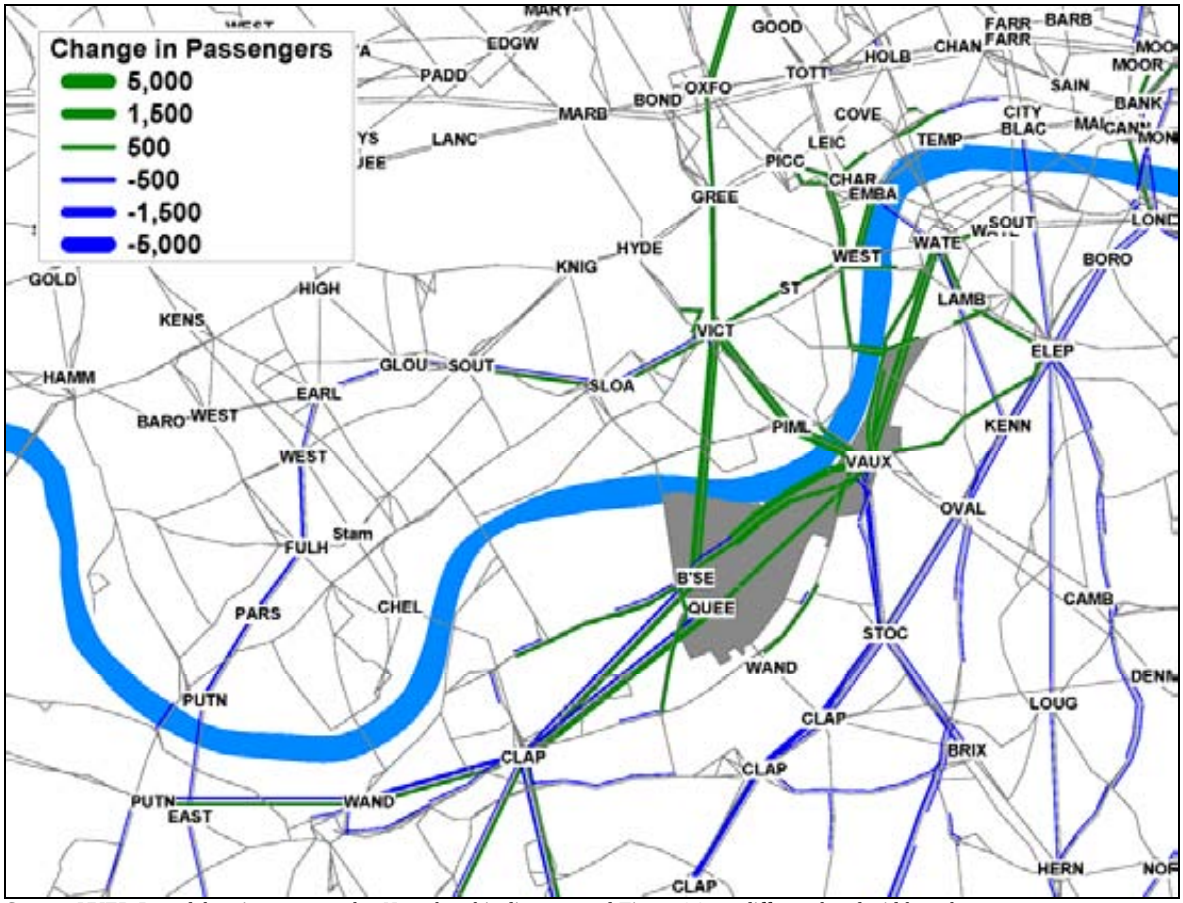
Figure 27 Public Transport Volume Changes, 2026 Reference Case to Scenario 3, Morning Peak (7-10am)



Source: VNEB-P model assignment results. Note that this diagram and Figure 24 use different band width scales.

Increased development over OA Scenario 2 would lead to further flow increases on public transport routes. There would be significant increases on public transport routes centred on Vauxhall interchange, and decreases are evident on NR services centred on Clapham Junction and on the Northern Line south of Stockwell. Increases would also be significant on NR and Underground services centred on Victoria and Waterloo stations.

Figure 28 Public Transport Volume Changes, 2026 Reference Case to Scenario 4, Morning Peak (7-10am)



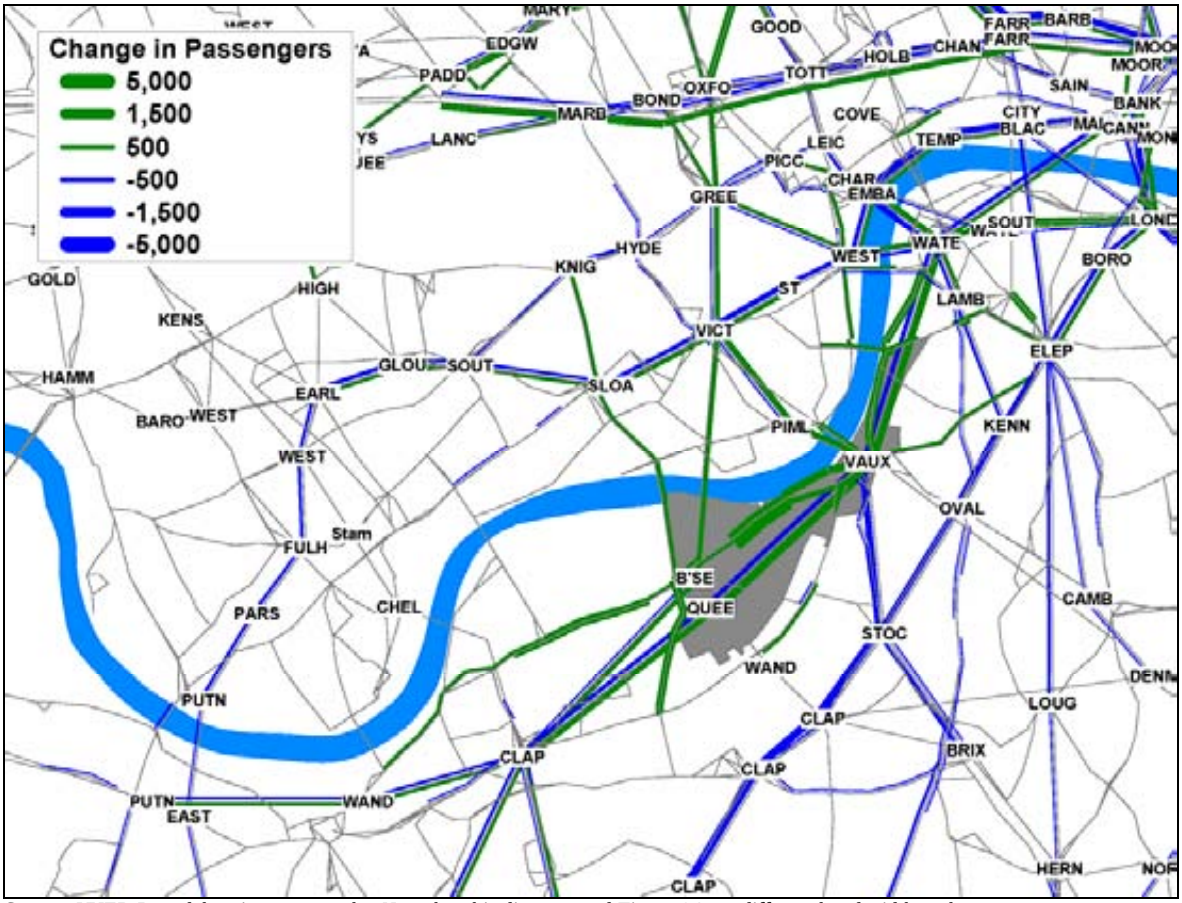
Source: VNEB-P model assignment results. Note that this diagram and Figure 24 use different band width scales.

Compared with OA Scenario 3, Scenario 4 would involve increased employment in the OA (centred on Battersea Power Station), which leads to significant increases in morning peak public transport patronage inbound to the OA as well as outbound.

The increases in patronage are again focussed on services through Vauxhall interchange (bus, Underground and NR). There would also be significant increases on services through Waterloo and Victoria stations.

These increases are offset by appreciable decreases on the Northern Line through Kennington and Elephant and Castle, on bus services from the south, and also notably on the District Line (Wimbledon branch).

Figure 29 Public Transport Volume Changes, 2026 Reference Case to Scenario 5, Morning Peak (7-10am)



Source: VNEB-P model assignment results. Note that this diagram and Figure 24 use different band width scales.

The substantial employment increase at Battersea Power Station in OA Scenario 5 (compared with Scenario 4) gives rise to large increases in public transport patronage in and around the OA. The increases are forecast to occur on buses (especially to/from the West End), NR (between Clapham Junction and Waterloo) and, to a lesser extent, Underground (especially the Victoria Line). Significant increases are forecast on all routes centred on Vauxhall.

4.6.3 Public Transport Levels of Service

The level of service for public transport routes is assessed using crowding plots and is considered in the context of service frequencies, which are outlined in Table 11.

Table 11 Public Transport Service Levels in the OA, 2026 Reference Case Morning Peak

Mode	Route	Services per hour each way	
		2008 (up/down)	2026 (up/down)
Bus	2 West Norwood <> Baker St	9/9	9/9
	3 Oxford Circus <> Crystal Palace	8/8	8/8
	36 Queen's Park <> New Cross	10/10	8/8
	44 Tooting <> Vauxhall	6/6	6/6
	77 Tooting <> Waterloo	6/6	6/6
	77A Wandsworth <> Aldwych	-/-	9/9
	87 Wandsworth <> Aldwych	10/10	6/6
	88 Kentish Town – Clapham Common	8/9	8/9
	137 Brixton <> Oxford Circus	11/11	15/11
	156 Wimbledon <> Vauxhall	8/8	6/6
	185 Lewisham <> Victoria	6/6	6/6
	196 Norwood Junction <> Elephant & Castle	5/5	5/5
	344 Clapham Junction <> Shoreditch	10/10	8/8
	360 Elephant & Castle <> Knightsbridge	5/5	5/5
	436 Paddington <> Lewisham	8/8	8/8
	452 Wandsworth Road <> Kensal Rise	7.5/7.5	-/-
	P5 Elephant & Castle <> Nine Elms	4/4	4/4
Underground	Victoria Line Brixton – Victoria	26/26	31/31
	Northern Line Kennington – Charing Cross	20/20	22/22
Rail	Clapham Junction <> Victoria (calling at Battersea Park)	8/8	12/12
	London Bridge <> Victoria (calling at Wandsworth Road & Battersea Park)	2/2	2/2
	Clapham Junction <> Waterloo (calling at Queenstown Road & Vauxhall)	8/8	8/8
	Clapham Junction <> Waterloo (calling at Vauxhall only)	21/18	21/18

Note: In addition to the service level changes noted above, Underground and rail services will also receive increases in vehicle capacity between 2008 and 2026 (3% for Underground due to new rolling stock and up to 50% for rail due to introduction of 10 and 12-car train services).

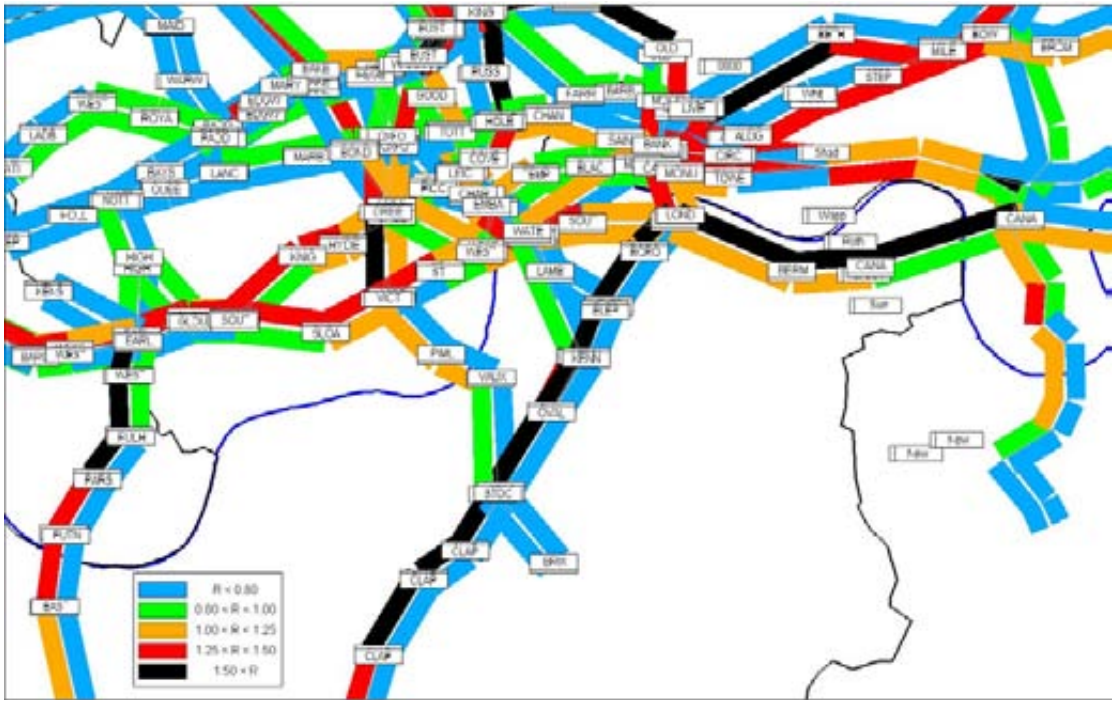
Bus

Crowding is undertaken within the assignment process in VNEB-P however crowding ratios are not currently produced for bus services in Railplan. However, as already shown in Figure 24 to Figure 29, there would be significant increases in patronage on bus services as a result of OA development. The increases are focussed on services that use Vauxhall bus station.

Underground

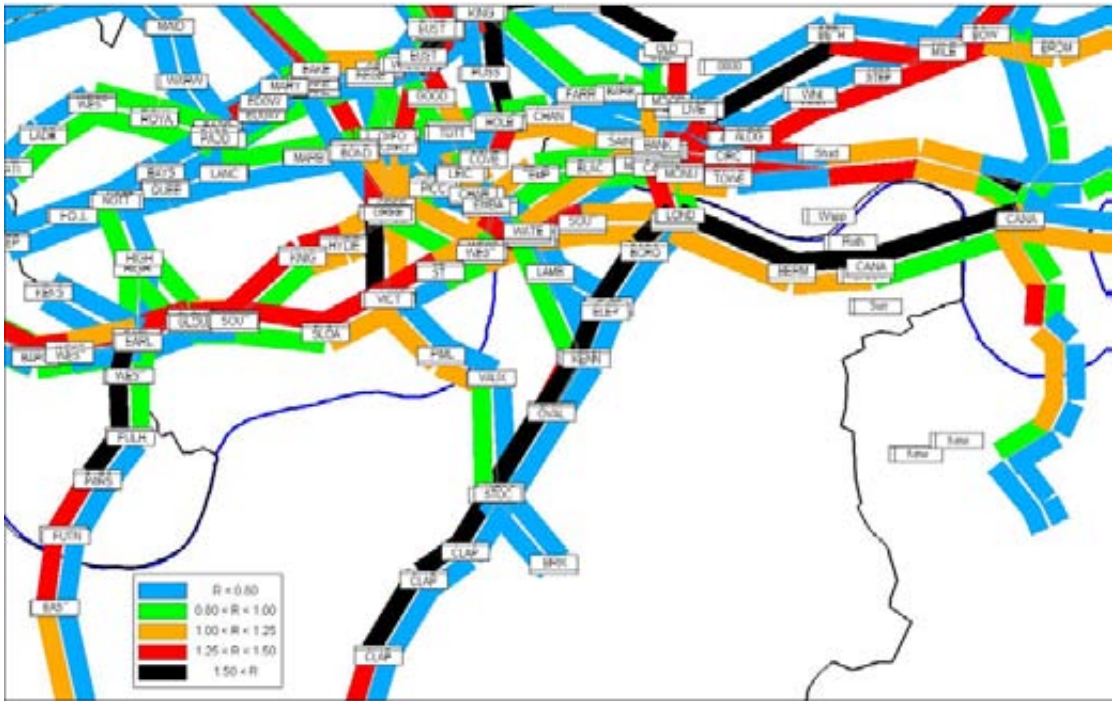
Figure 30 to Figure 35 show Underground crowding ratios with the 2026 Reference Case and the five OA development scenarios.

Figure 30 Underground Morning Peak Crowding Ratios, 2026 Reference Case



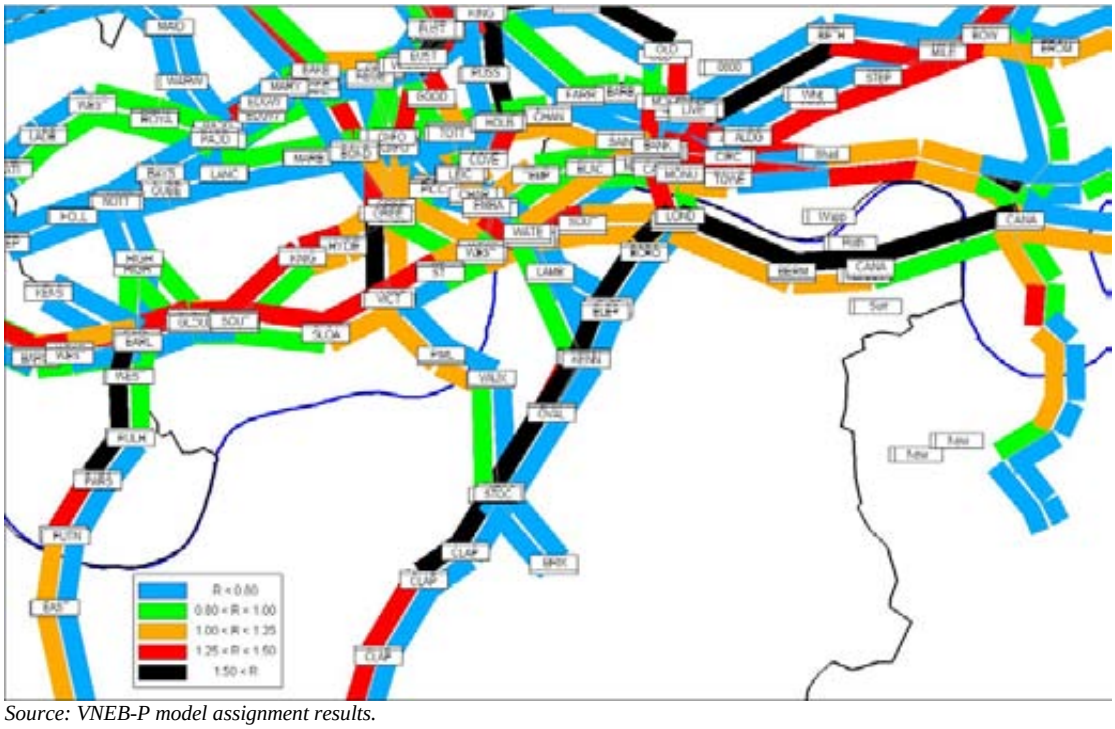
Source: VNEB-P model assignment results.

Figure 31 Underground Morning Peak Crowding Ratios, 2026 Scenario 1



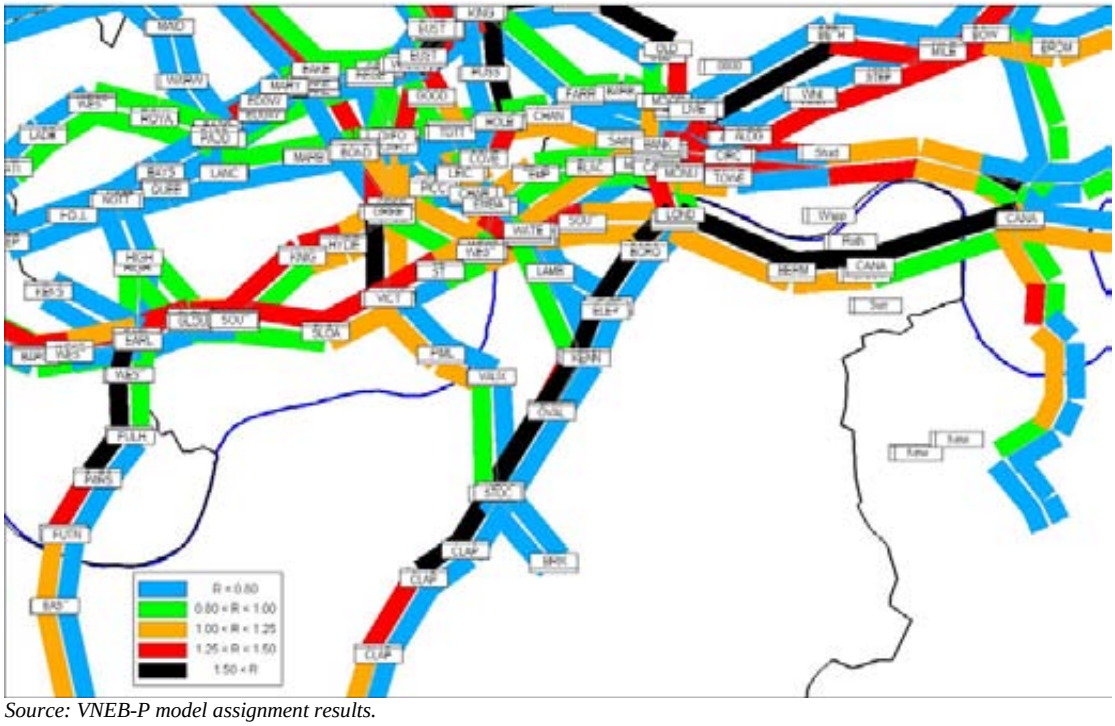
Source: VNEB-P model assignment results.

Figure 32 Underground Morning Peak Crowding Ratios, 2026 Scenario 2



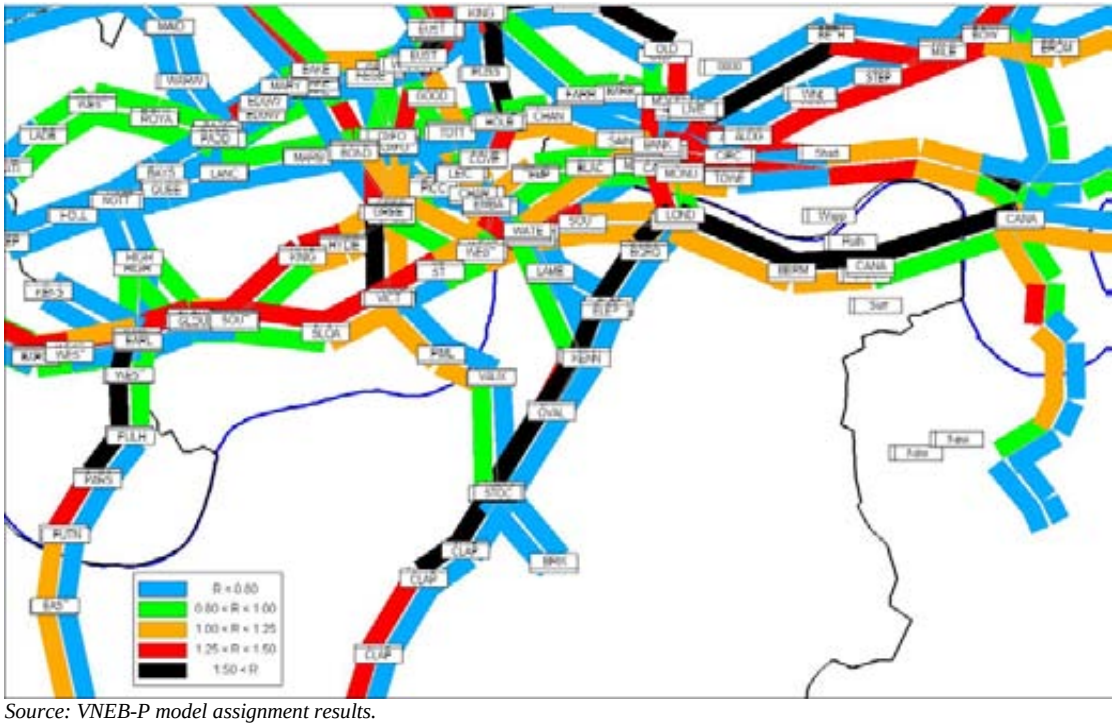
Source: VNEB-P model assignment results.

Figure 33 Underground Morning Peak Crowding Ratios, 2026 Scenario 3



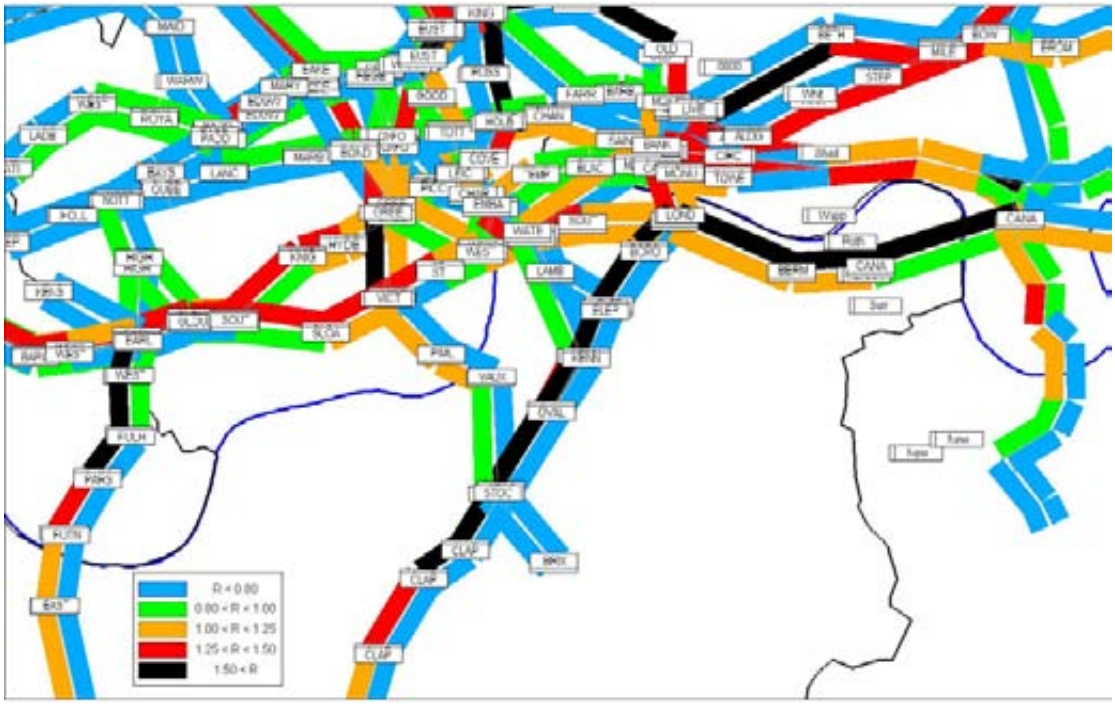
Source: VNEB-P model assignment results.

Figure 34 Underground Morning Peak Crowding Ratios, 2026 Scenario 4



Source: VNEB-P model assignment results.

Figure 35 Underground Morning Peak Crowding Ratios, 2026 Scenario 5



Source: VNEB-P model assignment results.

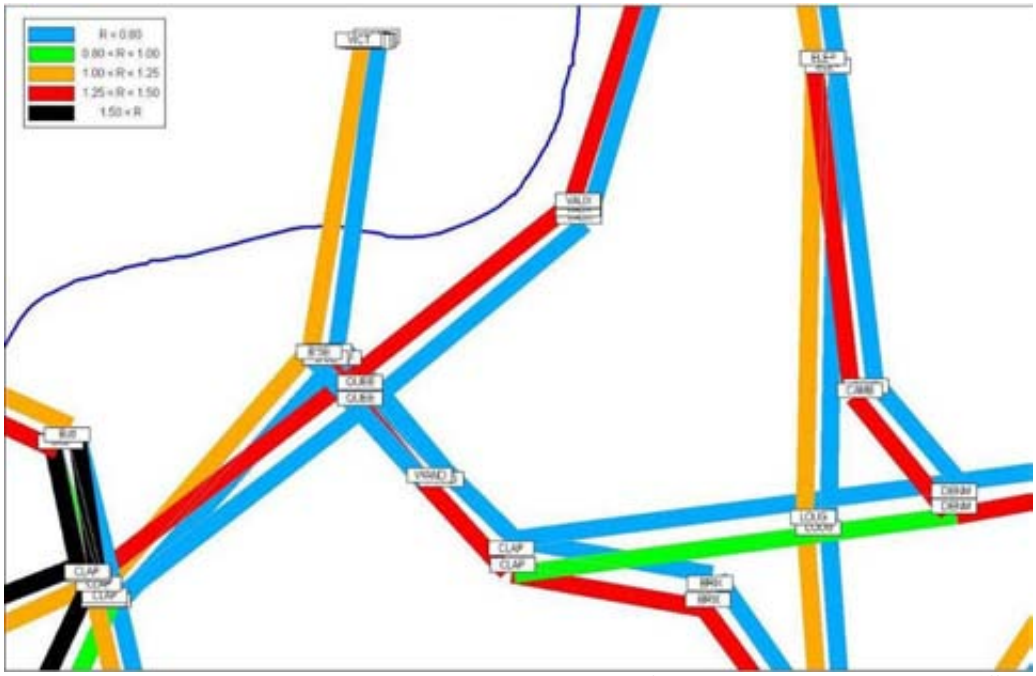
A few line sections show a reduction in crowding between the 2008 and 2026 Reference Cases; these are the District Line between Earl's Court and Victoria Stations, the Hammersmith and City Line between Paddington and Ladbroke Grove Station and the DLR south of Canary Wharf.

Underground crowding ratios remain remarkably constant with each of the OA development scenarios, perhaps not surprisingly as the existing Underground network does not serve the OA very directly, apart from the Victoria Line. In addition as discussed in Section 4.2, borough balancing has been applied to the development scenarios to ensure the Borough totals are held consistent with the London-wide totals which may also contribute to the consistency of crowding plots.

Rail

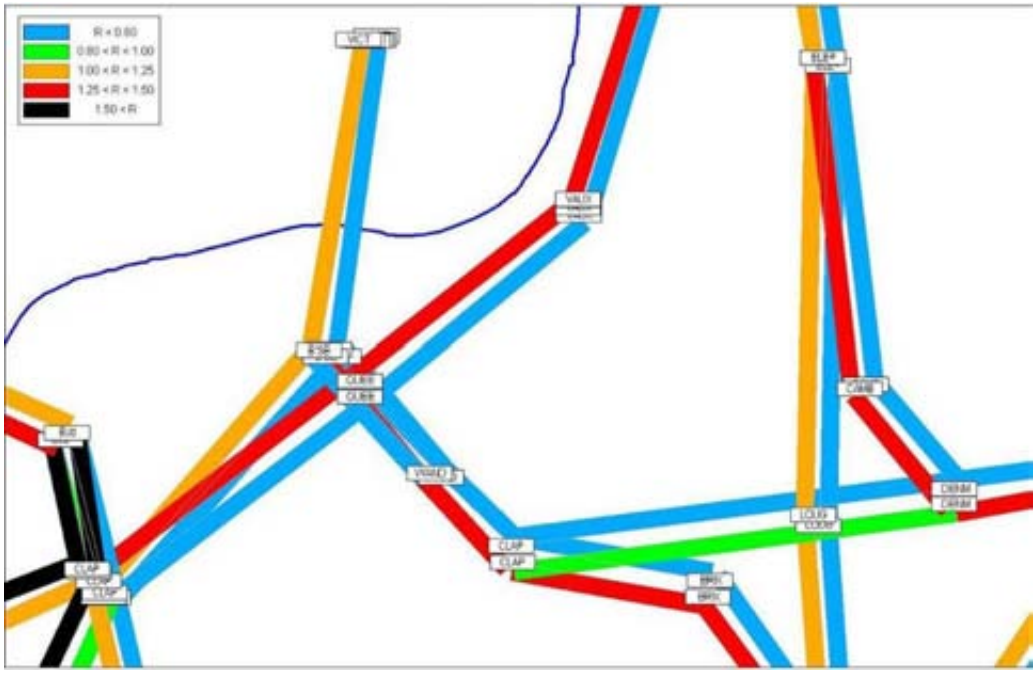
Morning peak crowding ratios on NR services are illustrated in Figure 36 to Figure 41, for the 2026 Reference Case and the five OA development scenarios.

Figure 36 Rail Morning Peak Crowding Ratios, 2026 Reference Case



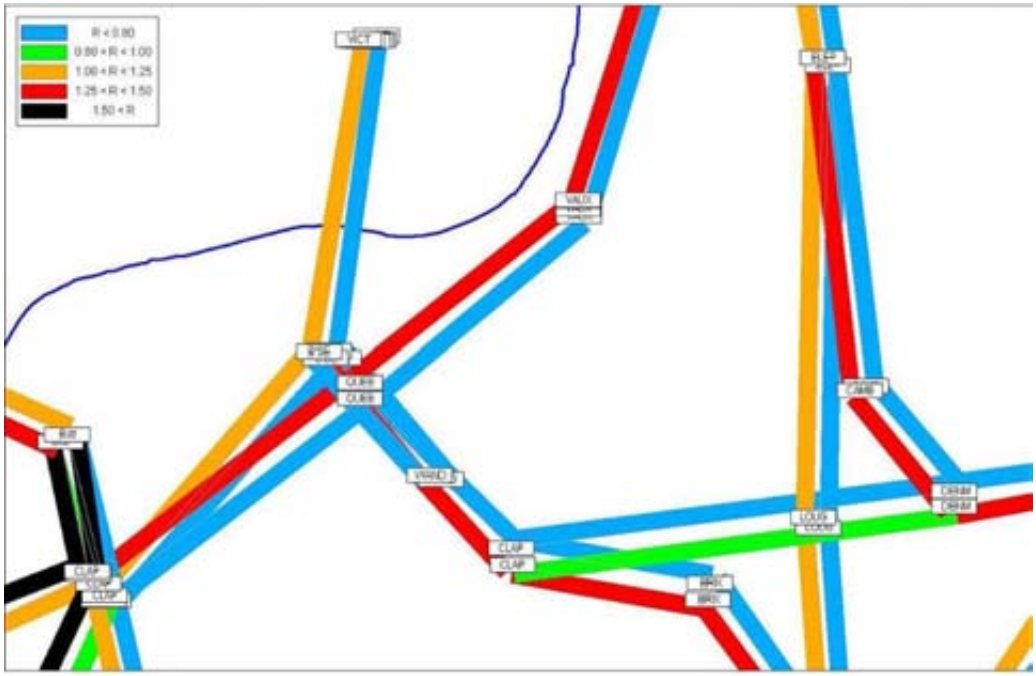
Source: VNEB-P model assignment results. Note that 'Batt' station north of Clapham Junction is used to denote different services through Clapham Junction itself and is the point at which London Overground and Southern services split.

Figure 37 Rail Morning Peak Crowding Ratios, 2026 Scenario 1



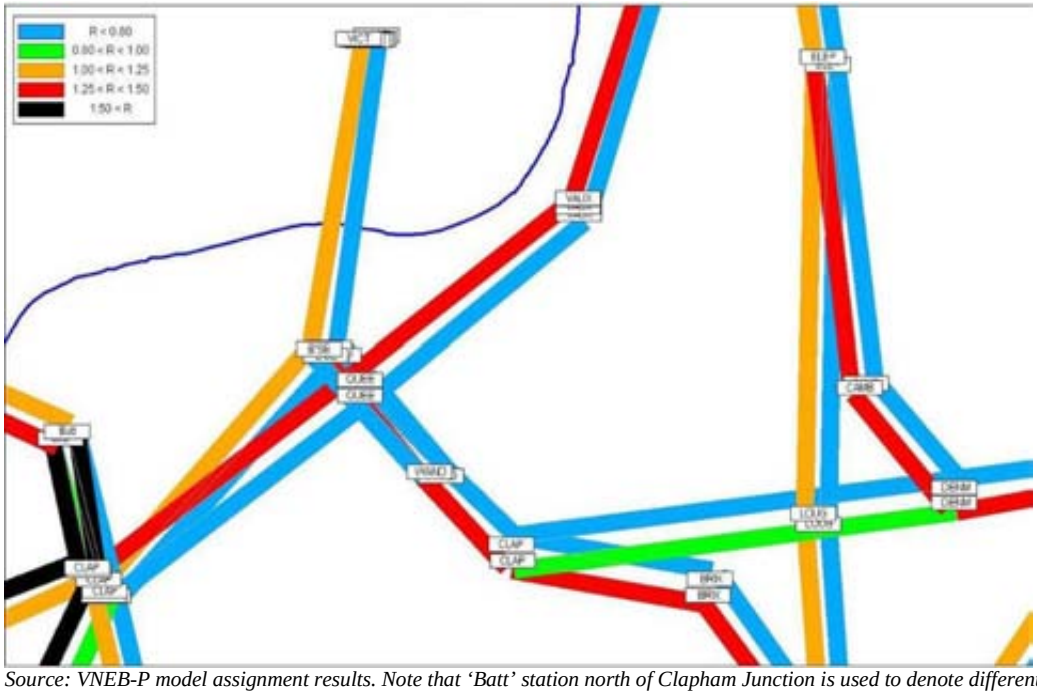
Source: VNEB-P model assignment results. Note that 'Batt' station north of Clapham Junction is used to denote different services through Clapham Junction itself and is the point at which London Overground and Southern services split.

Figure 38 Rail Morning Peak Crowding Ratios, 2026 Scenario 2



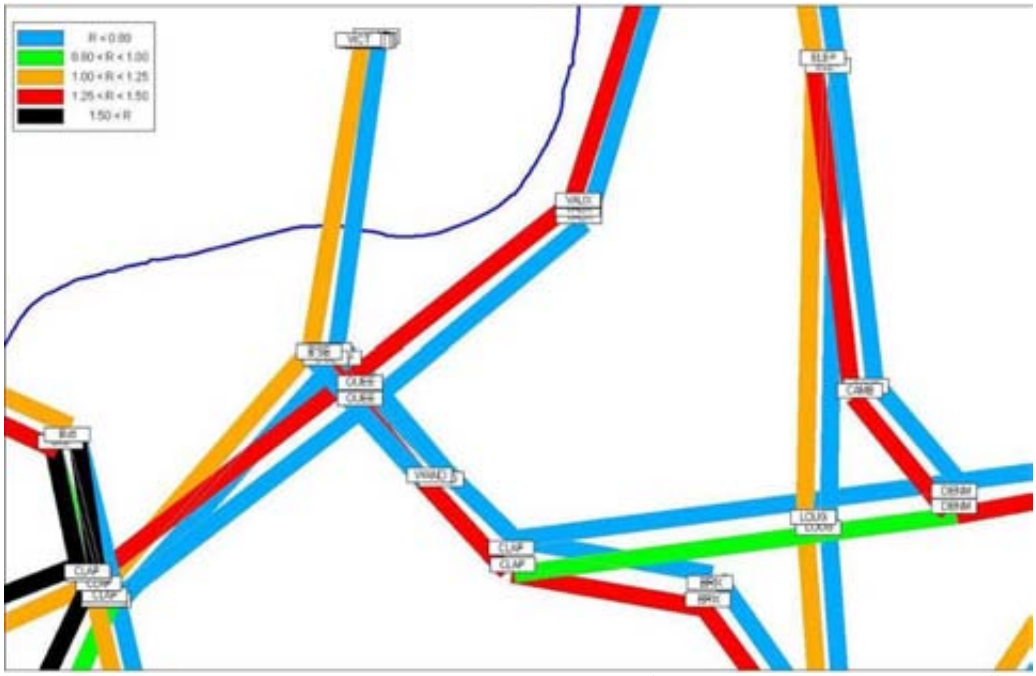
Source: VNEB-P model assignment results. Note that 'Batt' station north of Clapham Junction is used to denote different services through Clapham Junction itself and is the point at which London Overground and Southern services split.

Figure 39 Rail Morning Peak Crowding Ratios, 2026 Scenario 3



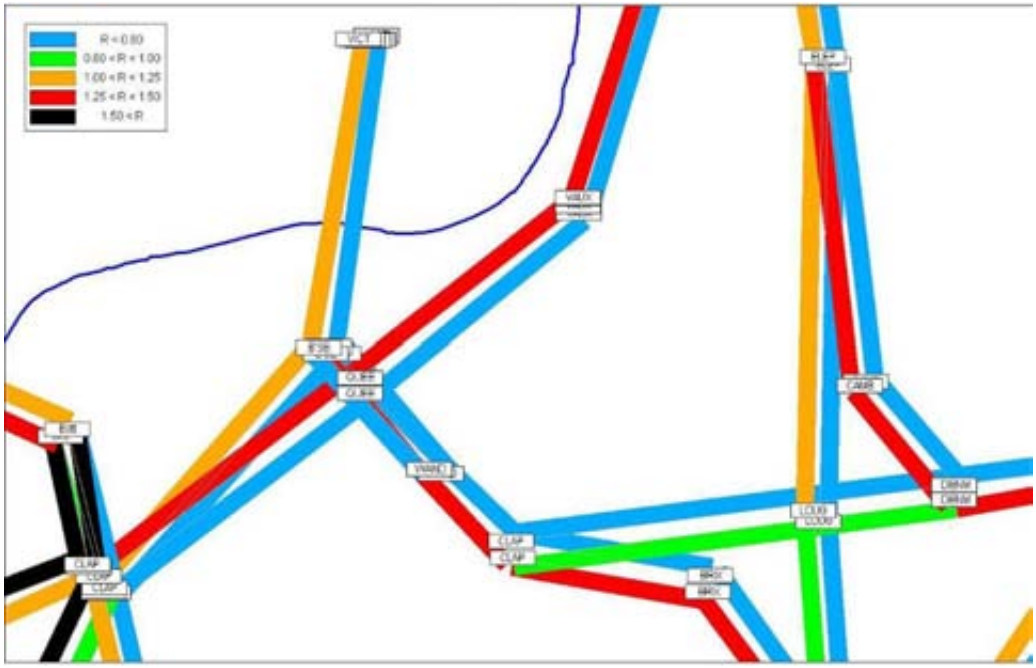
Source: VNEB-P model assignment results. Note that 'Batt' station north of Clapham Junction is used to denote different services through Clapham Junction itself and is the point at which London Overground and Southern services split.

Figure 40 Rail Morning Peak Crowding Ratios, 2026 Scenario 4



Source: VNEB-P model assignment results. Note that 'Batt' station north of Clapham Junction is used to denote different services through Clapham Junction itself and is the point at which London Overground and Southern services split.

Figure 41 Rail Morning Peak Crowding Ratios, 2026 Scenario 5



Source: VNEB-P model assignment results. Note that 'Batt' station north of Clapham Junction is used to denote different services through Clapham Junction itself and is the point at which London Overground and Southern services split.

Compared to 2008, rail 2026 morning peak crowding ratios are forecast to be:

- similar on Clapham Junction to Waterloo services (1.25 to 1.5);
- higher (1.25 to 1.5) on Clapham Junction to Victoria services; and
- substantially higher (over 1.5) between Clapham Junction and Battersea Park.

There are no discernible changes in crowding levels between the 2026 Reference Case and the different OA development scenarios.

4.6.4 Station and Interchange Conditions

In 2026, with the widespread and substantial increases in public transport patronage, substantial changes in the size and nature of passenger movements are forecast to occur at stations and interchanges in the vicinity of the OA.

Table 12 shows the changes in station interchange passengers for the busiest morning peak hour for the 2026 Reference Case compared with the 2008 Reference Case. Table 13 details the station characteristics and performance projected for the 2026 Reference Case. A detailed station capacity analysis is contained in Appendix D. This illustrates the forecast impacts of the development scenarios and transport packages at key stations and interchanges within the OA.

Table 12 Station Throughputs, 2026 (Reference Case) Busiest Morning Peak Hour

Station	Movement	2008 Pax/hr	2026 Pax/hr	% change 2008-2026
Vauxhall (NR)	Boarders (incl Underground interchange)	2,000	3,400	+70%
	Alighters (incl Underground interchange)	5,700	5,800	+2%
Vauxhall (Underground)	Boarders (incl NR interchange)	5,800	7,000	+21%
	Alighters (incl NR interchange)	4,700	6,300	+34%
Vauxhall Interchange	NR to Underground	4,600	4,800	+4%
	Underground to NR	1,600	2,200	+38%
Battersea Park	Boarders	400	1,100	+175%
	Alighters	700	600	+17%
Queenstown Road	Boarders	300	700	+133%
	Alighters	600	600	0%

The significant increases in boarders at NR stations (Vauxhall, Battersea Park and Queenstown Road) and in passengers transferring from Underground to rail services at Vauxhall, is primarily a result of the substantially-increased NR service levels attracting more patronage at these locations.

Table 13 Station Characteristics and Performance

Station	Characteristics and performance
Vauxhall (NR)	The 2026 Reference Case forecasts an increase in the number of boarding passengers on platforms 7/8, which will result in increased congestion and potential for conflict with alighting passengers on the staircases.
Vauxhall (Underground)	Improvements to the interchange are required with the current demand flows. In 2026, the number of boarding passengers is forecast to be in excess of the capacity of a single escalator, and thus it is important that all three escalators are in service. The number of alighters exceeds current gate line capacity. There are planned LUL measures to increase gate line capacity to match escalator capacity however this proposal is not scheduled to be implemented until 2017/18.
Battersea Park	Concentration of operation on platforms 3 and 4 would increase pressure on the stairs to platform 4. This would be worsened both by the overall increase in passengers using the up platform. The significantly higher proportion of boarders would worsen conflict with alighting passengers, especially at the stair head where space is limited.
Queenstown Road	A doubling in the number of boarders would be matched by a slight reduction in alighters, with a reversal of the predominant flow on the access stairs. However overall passenger numbers are relatively low and no significant problems would be anticipated

4.7 Transport-Related Problems

4.7.1 Walking and Cycling

The Public Realm Strategy set out in the First Draft for Consultation OAPF (January 2009) considers the existing physical barriers and severance in the OA and presents a plan for overcoming these obstacles to create new links and improve the aesthetic and amenity of the pedestrian environment. The Strategy establishes a set of key principles to guide improvement to the public realm.

The Public Realm Strategy incorporates improvements to the cycle network and many pedestrian amenity improvements will also benefit cyclists. The need for new pedestrian/cycle crossings on existing strategic routes is recognised within the strategy to ensure good quality linkages. An example of the types of improvement proposed is provided for Nine Elms Lane and Albert Embankment. These

roads perform a strategic traffic function within the city and the Strategy proposes changes to the character of these routes, for example to include segregated cycle ways, consolidated access, improved lighting, active frontages, landscaping, crossing points and wide pedestrian footpaths.

4.7.2 Public Transport

The 2026 VNEB-P Reference Case model (which excludes future OA development) tends to show a continuation and, on some parts of the network, worsening of public transport crowding identified in the 2008 Reference Case, but these trends are somewhat mitigated by the committed public transport improvements, which are substantial. Areas and links of high demand in the 2008 Reference Case are subject to increasing travel volumes and congestion. The following are the key public transport problems within the OA for the 2026 Reference Case:

- Congestion on the Underground, particularly the Northern and Victoria Lines. Crowding ratios are forecast to remain similar between 2008 and 2026 through the OA, with the Victoria Line between Vauxhall and Victoria showing crowding ratios in the order of 1 to 1.25. Note this 2026 Reference Case includes all committed upgrades such as Crossrail, and major PPP upgrades on the Underground network.
- Congestion between Clapham Junction and Vauxhall for NR services with crowding ratios over 1.5, and increased crowding on London Overground services to Willesden Junction and Southern services to Watford Junction from Clapham Junction.
- Continuing importance of modal interchange stations for bus services. Bus movement to Vauxhall remains important but does not change significantly between 2008 and 2026 VNEB-P Reference Cases. The forecasts show significant patronage increases on Wandsworth Road, Queenstown Road, Kennington Road and Battersea Park Road bus services.

4.7.3 Highway Traffic

There are relatively few areas within the OA where a significant exacerbation of existing traffic problems is forecast in 2026; the increases in traffic are generally small and the area is already congested at peak times. This is a considered to be due to the relatively small mode share of car in trips generated to and from the OA, and is a primary reason why the study has concentrated on improvements to public transport instead of highway capacity improvements. Despite this, it is recognised that even small increases in traffic can have significant impacts on already congested networks, including the operation of the bus network and attaining smoother traffic flows. This effect is highlighted by the reassignment effects resulting from OA Scenario 5 development as illustrated in Figure 23.

The key arterial routes within the OA connecting to the bridges would experience the greatest traffic volumes and highlight areas of congestion on Vauxhall, Chelsea and Lambeth Road Bridges. Outside these areas, the model also indicates capacity deficiencies on sections of Battersea Park Road and

Black Prince Road. The Vauxhall gyratory has the greatest overall volumes in the OA, both now and in the future.

4.7.4 Travel Demand Management

Provision of additional infrastructure is only one aspect of catering for future travel growth; the other mechanism involves initiatives that act to limit the demand for travel in the first instance. In line with London Plan directions, development in the OA will require policy mechanisms and initiatives to support a reduction in travel demand and promote sustainable travel behaviour. This would include parking provisions for development that limit car parking as a means of restricting access by car. Early provision of public transport services will also serve to reinforce sustainable travel behaviour and choices.

London is characterised by a relatively high level of public transport use and some aspects of travel demand management are passively enforced through the land form and transport network itself.

4.7.5 Freight

The Mayor's policy for safeguarding wharves along the River Thames states that OAPFs should consider opportunities for industrial intensification and industrial-led mixed use schemes, with a requirement for efficient public transport connections to support intensification and appropriate management of land use separation to maintain the economic viability and completion of industries. The Mayor's Supplementary Planning Guidance (SPG) on Industrial Capacity (March 2008) provides further direction on the implementation of mixed use schemes accommodating industrial activity within London.

The First Draft for Consultation OAPF, January 2009 assumes the long term protection of the three safeguarded wharves within the OA for freight and waste related activities. The approach to intensification and mixed use development in this area therefore requires careful consideration.., which will be taken forward in the Second Draft of the OAPF.

The Vauxhall gyratory is a key strategic traffic junction, linking south London and the South East to central, west and north London and serves an important function for freight, servicing and distribution activities. Congestion at the Vauxhall gyratory and other key intersections within the OA is likely to affect the reliability and efficiency of road freight movement.

It is also recognised that redevelopment in the OA creates wider strategic and sustainability concerns relating to the volume of goods that are currently delivered into the CAZ from the OA. Relocation of industrial and freight related uses from the OA may lead to displacement impacts on the strategic highway network. Future redevelopment will need to recognise potential conflicts between housing intensification and ongoing freight activity within the OA, particularly at NCGM and the protected wharves. The need to improve accessibility in the area, including through improved bus, pedestrian

and cycle facilities on Nine Elms Lane, is also likely to present some problems between conflicting user needs.

5 Options for Solutions

5 Options for Solutions

5.1 Process for Developing Transport Initiatives

Development of the transport options and packages initially considered the two study-specific objectives, namely:

- to mitigate adverse impacts caused by development traffic, especially increases in congestion and adverse impacts on the environment; and
- to ensure that the area's economic potential is realised by improving accessibility to the development sites by walking, cycling, public transport, taxi and goods vehicle.

The first study-specific objective was given limited emphasis because, as stated in the previous Chapter, the transport modelling suggested that traffic increases due to development would not be sufficient to warrant major strategic upgrades of the highway network; moreover, the committed public transport improvements throughout London in the Reference Case would clearly help limit the growth of highway traffic in general.

The study therefore concentrated on identifying and modelling a range of public transport schemes for each OA development scenario, to address the major issue recognised in the second study objective, namely the poor accessibility of much of the OA to public transport.

Initial transport modelling results were analysed to assess the future transport needs and gaps in service provision. A number of specific transport initiatives/schemes were then selected to address these needs.

Following guidance from TfL and GLA the transport initiatives were focussed on improvements to public transport and walk/cycle access. A consultative process was undertaken with key stakeholders to develop a list of suitable transport packages to be modelled in the study.

5.2 ‘Long List’ of Transport Initiatives

An initial ‘long list’ of transport initiatives was compiled through consultation with stakeholders. It should be noted that this was undertaken prior to the announcement of the 2009/10-2017/18 Transport for London Business Plan, which incorporated significant changes in funding for committed projects.

The 2026 VNEB-P Reference Case network as specified by TfL in September 2008 incorporates future committed schemes including Thames Gateway Bridge (TGB), Greenwich Waterfront Transit (GWT) and East London Transit Phase 2 (ELT). This was consistent with the agreed TfL Reference Case at the time. As announced by the Mayor in November 2008, these schemes lack funding and will not be progressed by the new Business Plan. These schemes are not located in the Area of Influence for this Study and it is considered that their inclusion would not materially affect the assessment of public transport in the OA.

The Mayor has also since announced that Phase Two of the East London Line extension will proceed, from Surrey Quays to Clapham Junction. This scheme has not been included in the VNEB-P Reference Case and could be the subject of further sensitivity testing

5.2.1 Walking and Cycling

The First Draft OAPF for Consultation, January 2009 includes a Public Realm Strategy that covers, amongst other things, walking and cycling linkages and accessibility within the OA and connections into the surrounding areas. These measures, along with other initiatives such as a restraint-based approach to car parking provision and promotion of 'car free' development, improved cycle infrastructure and facilities, the layout and design development for the wider OA as well as individual developments to maximise pedestrian and cycle connectivity and green travel planning in general will encourage walking and cycling.

Walking and cycling initiatives that are not directly assessed in this Transport Study but will be addressed in the OAPF First Draft for Consultation, January 2009, include:

- Improved cycle routes and infrastructure, including investigation of a cycle 'highway' through the OA;
- improvements to pedestrian connectivity and severance in the OA;
- improvements to walk connections to and from NR stations (e.g. Vauxhall and Battersea Park stations);
- a pedestrian and cycle bridge from Nine Elms across the Thames, to St George's Square in Pimlico; and
- a new public transport, walking and cycling link on Thessaly Road between Wandsworth Road and Nine Elms Lane, referred to as the 'Market Link'.

The last two abovementioned links would provide significantly improved connectivity into and through the OA as well as improving access to and from new developments, particularly those located in the Nine Elms area.

The cross-river pedestrian and cycle bridge was included in some of the VNEB-P model runs to assess its effect, although it is stressed that the results do not give a complete picture of potential bridge usage because the model does not include walk-only trips, only those that also use public transport.

5.2.2 Bus

Bus services have a key role to play in all OA development scenarios. TfL London Buses currently use an 18 month planning cycle, in which the inherent flexibility of bus services is used to change service levels and routes according to passenger growth and demand changes including new development. As such the new routes and services tested in this study should be regarded as indicative only and would be expected to be refined further in future studies, once more detail is known about development within the OA.

Although there are many bus routes centred on Vauxhall bus station, only two routes operate along Nine Elms Lane (where the majority of new OA development would be located):

- Route 344 (Liverpool Street to Clapham Junction); and
- Route 156 (Vauxhall to Wimbledon).

Other routes pass partially through the OA along Wandsworth Road, Queenstown Road and/or Albert Embankment, and further routes serve Vauxhall bus station.

Through consultation with TfL London Buses, it was established that any changes to bus routes and services in the OA should:

- provide enhancements to OA services;
- add new routes in expected corridors of demand increase;
- add a new route to an area of poor accessibility;
- require minimum alteration to bus infrastructure; and
- remain within the capacity of Vauxhall bus station.

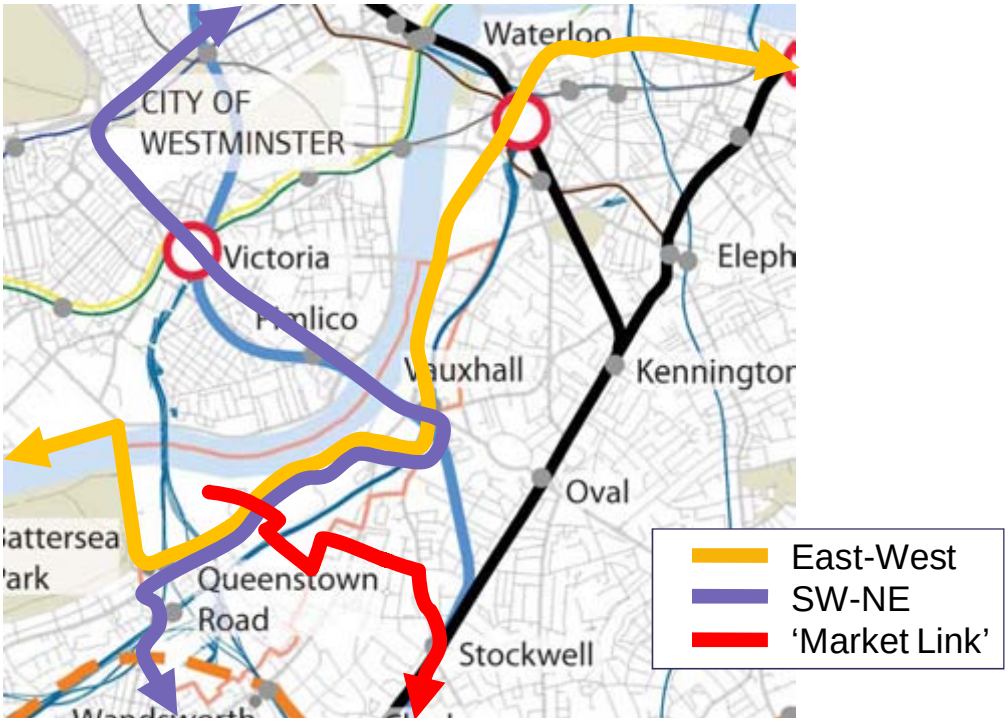
The bus network should complement the underground and rail networks, providing public transport links to areas not served by heavy rail, enabling short local journeys and providing interchange opportunities. It is also accepted that bus routes can provide some degree of relief to overcrowded Underground links, however TfL London Buses suggests this role is limited and should not be the major purpose of bus services.

As part of the consultation process a number of new bus routes and shuttle services were proposed by both Ballymore and Treasury Holdings. From these proposals and consultation with TfL Buses, the following indicative bus service improvement initiatives were identified for consideration in the OA (see Figure 42):

- service level increases of 10% and 20% on all existing OA bus routes; and
- three indicative new routes to improve coverage of services in the OA and connections to adjacent areas, namely:
  - SW-NE (Balham - Nine Elms - WC1)
  - SE-W (Kensington - Battersea - London Bridge)
  - NW-SE route using 'Market Link' (an extension of Route P5)

Given the geography of the OA and the spread of projected development, almost all of the current and proposed bus routes that serve the OA must pass through Vauxhall bus station. Consultation with TfL Buses has ensured that none of the combinations of service level increases for current routes and proposed new routes exceed the capacity of Vauxhall bus station.

Figure 42 Indicative New Bus Routes

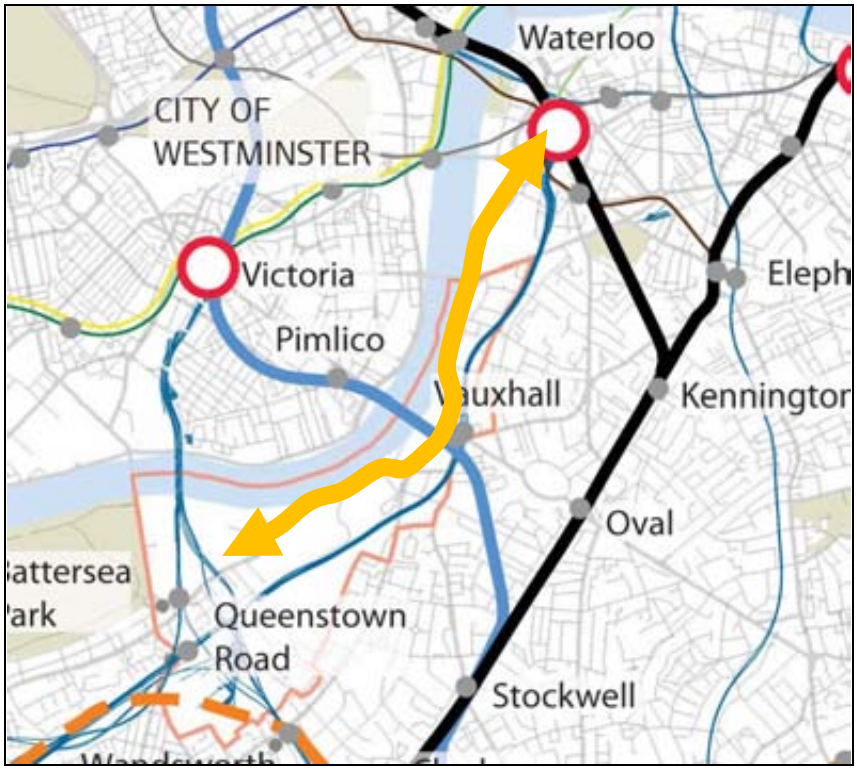


5.2.3 Light Transit

Following the Mayoral decision in late 2008 it was decided to discontinue the development of the Cross River LRT (CRT) scheme by TfL. Before that time a possible branch of the CRT scheme serving Battersea Power Station had been discussed, but after the CRT scheme was deferred, and cognisant of the need to test a mid-range public transport option between the bus-based initiatives and Underground or NR schemes, an indicative stand-alone LRT route was developed in consultation with TfL. The devised scheme followed a route along Nine Elms Lane and Albert Embankment to Waterloo Station, partly because of the strong travel desire line evident in this corridor but also because it follows a route that could conceivably be upgraded to accommodate it relatively easily.

The indicative route is proposed runs between Waterloo and Battersea Power Station along Albert Embankment and Nine Elms Lane, thorough the Wandsworth Road Section of the Vauxhall gyratory system (see Figure 43). No consideration has been given to the feasibility of this route in engineering terms. The location of stops and depot facilities has not been investigated in any detail. It is proposed that the scheme would be an entirely 'on street' operation, sharing space with general traffic. Whilst a LRT option has been considered in this study, a bus rapid transit (BRT) system could conceivably be developed along the same alignment, and may be worthy of further consideration. This would have many of the benefits (although not all) of LRT and would provide additional flexibility through interaction with 'regular' bus routes and allow for 'un-segregated' running where appropriate.

Figure 43 Indicative Light Rail Transit Route



5.2.4 Underground

The modelled 2026 Reference Case includes full PPP capacity improvements to Underground lines, including the Victoria Line. The pattern of public transport trips to and from the OA shows that the Victoria Line loading is likely to increase, particularly with OA residents commuting across the River to key central London destinations. However:

- the increased patronage on the Victoria Line may also increase congestion at other critical points on the network such as Victoria Station, especially with the larger OA development scenarios;
- improved walking, cycling and local public transport links to Vauxhall would be required; and
- improvements to Vauxhall Underground station, possibly beyond what is already planned, would be required to cope with the additional passenger throughput.

For the OA development scenarios with the higher numbers of residents and jobs (OA Scenarios 3, 4 and 5), alternative improvements to the Underground were considered including:

- Bakerloo Line extension from Elephant and Castle to the OA;
- Waterloo and City Line extension from Waterloo to the OA; and
- Northern Line (Charing Cross branch) extension from Kennington to the OA.

All these options have the effect of improving OA linkage to other parts of the CAZ and central London. Following initial investigations the Bakerloo and Waterloo & City Line extensions were ruled

out as they were considered unfeasible in terms of providing the most direct and cost effective link. The NLE proposal promoted by Treasury Holdings appears the most feasible option to consider in relation to the OA due to the fact that it:

- offers a more direct link to into central London particularly to Waterloo and the West End; and
- provides fairly good level of access to the City of London via interchange at Kennington and Waterloo.

Potential locations for new NLE stations/interchange points were identified as:

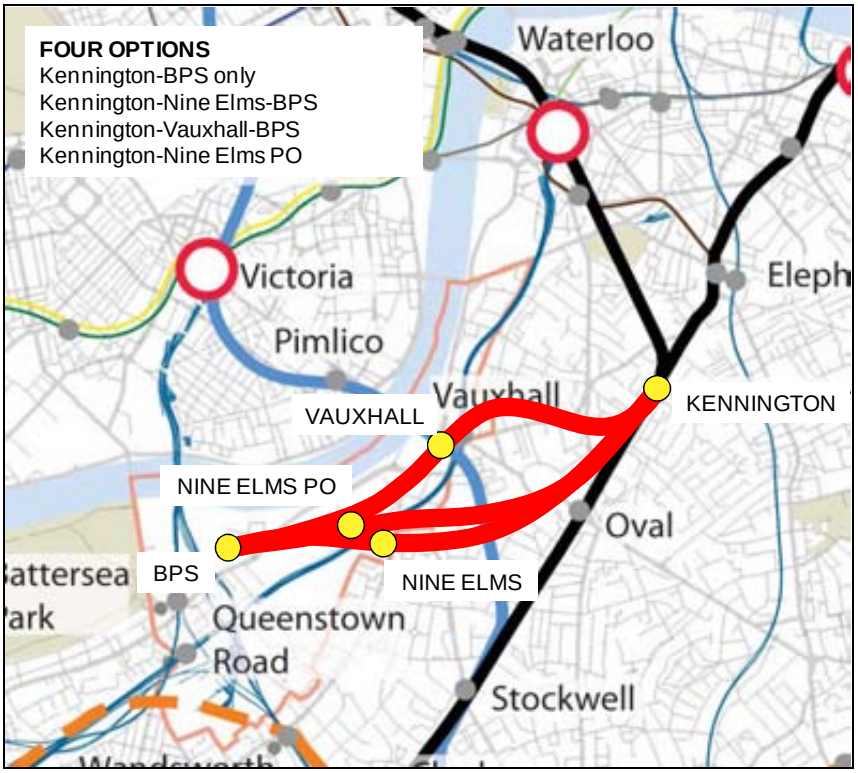
- Battersea Power Station (new station);
- Vauxhall (existing station);
- Nine Elms (new station by Sainsbury's on Wandsworth Road); and
- Nine Elms Post Office (new station on the current post office site in the centre of the OA).

A new station at Battersea Power Station is regarded as a minimum requirement as it falls in the area of lowest accessibility and is forecast to have the highest levels of development and could be designed to integrate with Nine Elms Lane bus services as well as Battersea Park and Wandsworth Road NR stations. A new station/interchange point at Vauxhall would provide additional capacity and facilitate interchange with the Victoria Line and NR services. A new Nine Elms station would provide improved public transport access in the OA south of Vauxhall and the railway lines and could also relieve pressure on the Victoria Line and at Vauxhall. There would also be potential for integration with Wandsworth Road bus services. The Nine Elms Post Office station was identified as potential alternative to Battersea Power Station for a 'one stop' option, as it is located in the geographic, rather than growth centre of the OA. It is located north of the railway line and could integrate with Nine Elms Lane bus services.

Four NLE alignment options were identified in conjunction with the various station sites, as shown in Figure 44:

- Kennington to Battersea Power Station with no intermediate stations;
- Kennington to Nine Elms and Battersea Power Station;
- Kennington to Vauxhall and Battersea Power Station; and
- Kennington to Nine Elms Post Office site, with no intermediate stations.

Figure 44 Northern Line Extension Options



There are some Underground improvements which were not able to be explicitly modelled as part of this study, specifically improvements in interchange and station facilities and/or throughput capacity. Basic analysis of station capacity has been undertaken (see Appendix D) to assess the effects of demand generated by OA development on NR and Underground stations in the vicinity of the OA.

5.2.5 Network Rail

The following NR schemes are included in the 2026 Reference Case:

- East London Line extension (Phase 1);
- South West Trains 50% capacity increase; and
- Southern 25% capacity increase (and re-organisation of the South London Line).

Four heavy NR schemes were considered for inclusion in the transport packages, but subsequently not considered further in the context of this study:

- additional and extended platforms at Wandsworth Road station (considered too remote to benefit OA development);
- single track shuttle train service between Victoria and Battersea Power Station (advised to be infeasible by NR);
- Crossrail 2, if an alignment in the southern end of the OA were feasible (the safeguarded route does not serve the OA); and

- Airtrack – services between Heathrow Airport and Waterloo running through the OA (without stopping at Vauxhall the benefit of these services for the OA was considered minimal).

As a result there are no candidate NR schemes for appraisal against OA development scenarios.

There are a number of NR improvements not able to be modelled using VNEB-P which may provide benefit to the OA, such as:

- amenity and capacity station improvements at Vauxhall, Queenstown Road, Wandsworth Road and Battersea Park; and
- capacity enhancement and improved interchange between Underground and NR services at Vauxhall.

Station capacity analysis using VNEB-P outputs has been undertaken (Appendix D) that indicates which stations are likely to have increased pressure from demand generated by the additional OA development, with a view to identifying possible solutions for further study.

5.2.6 Other Modes

Transport initiatives required to support the various levels of development in the OA will inevitably include a wide variety of measures, some of which are not directly relevant to the modelling, including:

- freight considerations;
- operation of the Vauxhall gyratory; and
- other transport-related issues, such as coach parking in the OA.

Freight matrices in the LTS Model are fixed for a given land use pattern; modelling therefore does not take account of changes in freight demand and movement. Given the importance of New Covent Garden Market (NCGM) and access to freight wharves, final plans will need to make provision for freight trips and in particular account for the effects of any displacement of current freight activity. This will require further study when individual developments come forward.

The availability of coach parking has been considered. There are currently two coach parks in Nine Elms, one open to all operators and the other predominantly used by National Express for layovers. Displacement of these facilities is likely to be resisted by operators and suitable replacements would need to be identified. The current TfL position is that it will be necessary to retain adequate coach parking and layover facilities in the OA.

The Transport Study focuses on public transport improvements to address the additional OA demand as alternatives to highway improvements, rather than relying on car. In addition, VNEB-H is a strategic model, and is therefore not a suitable tool to estimate the detailed operation of particular junctions. Chapter 6 includes an assessment of the general effects of the OA development scenarios on the highway network and key junctions, but further, more detailed studies will be required to

investigate the need for specific improvements, for example at Vauxhall gyratory and other key junctions.

Most of these issues did not influence the modelling and hence are not all covered in the transport option packages, but they have been taken into account in the consultation phase of this project.

5.3 Packaging of Options

The candidate transport schemes discussed above were packaged into a series of low, medium and high levels of transport intervention for each of the five OA development scenarios.

There is a conscious emphasis on bus initiatives, especially in the lower-density OA development scenarios, with light transit and Underground schemes in the higher-density scenarios. It was felt that a certain level of bus improvement would be a necessity for all of the proposed scenarios, therefore the decision was made that bus improvements should form the basis of each transport package.

The initial modelling results were also reviewed to assess the existing transport problems in the VNEB study area for 2008 and that forecast in 2026. The identified transport network deficiencies include:

- capacity constraints on the Underground Victoria and Northern lines;
- performance of Vauxhall bus, NR and Underground stations;
- lack of capacity at NR stations in the OA;
- capacity of bus services in the OA;
- with the exception of Vauxhall a relatively low level coverage in the OA by bus services, compared to other parts of central London; and
- continued highway capacity issues (similar to 2008 levels).

The proposed transport initiatives were reviewed to ensure that they addressed these identified deficiencies. As a result of extensive consultation with key stakeholders the transport packages considered for initial appraisal are detailed in Table 14.

Table 14 Transport Packages for Appraisal

	Development scenario	1			2			3					4					5			
	Transport intervention level	L	M	H	L	M	H	L1	L2	M	H1	H2	L	M	H1	H2	H3	L	M	H1	H2
Bus	10% capacity increase on OA routes			●		●															
	20% capacity increase on OA routes						●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	New route SW-NE (Balham-9 Elms-WC1)					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	New route SE-W (Kens-Batt-London Br)					●	●	●	●		●		●		●	●	●	●			●
	New route SE-W (Kensington-Vauxhall)									●		●		●					●	●	
	NW-SE route (extension of P5)						●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Light rail	Waterloo to BPS									●				●					●		
LUL Northern Line extension	BPS only *LUL/Treasury option 1*										●				●						
	Nine Elms PO site only															●					
	Vauxhall & BPS *LUL/Treasury option 3*											●								●	
	Nine Elms & BPS *LUL/Treasury option 2*																●				●
Other	Cross-river ped/cycle bridge						●		●				●					●			●
Road	Various connections within OA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Vauxhall gyratory improvements	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Identified transport issues that may be addressed by the transport initiatives																					
Capacity issues on the Victoria Line										○	○	○		○	○	○	○		○	○	○
Capacity issues on the Northern Line										○	○	○		○	○	○	○		○	○	○
Performance of Vauxhall Interchange											○				○	○	○				○
Capacity issues at National Rail Stations in the OA										○	○	○		○	○	○	○		○	○	○
Capacity of existing bus services in OA				○		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Relatively poor coverage of the OA by bus services						○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Poor access to rail (Vauxhall and/or Waterloo)						○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Road capacity issues											○	○			○	○	○			○	○

✓ *Note that these transport initiatives are not explicitly modelled.*

5.4 Costing of Schemes

The infrastructure, fleet and operating costs of the transport initiatives have been assembled in consultation with TfL.

Table 15 summarises the indicative costs of each candidate scheme or scheme package. Costs are expressed inclusive of optimism bias correction, applied in accordance with WebTAG guidance and in discussion with TfL, consistent with the level of detail to which the scheme costs have been estimated. It should be noted however that the assumed costs for the different transport initiatives have differing levels of certainty. Whilst significant work has been done by LUL to establish the costs of the different Underground options and the costs for new bus services are relatively well understood, the cost presented for the LRT scheme is much more indicative and should therefore be treated with a greater degree of caution.

Table 15 Estimated Scheme Development Costs

Scheme			Optimism bias correction (applied to Infra and Fleet costs only)	Rounded costs incl optimism bias			
				Infra £M	Fleet £M	Total £M	Op/maint £M/yr
Bus	10% capacity increase on OA routes		66%	1	0	1	2
	20% capacity increase on OA routes		66%	2	0	2	4
	New route SW-NE (Balham-9 Elms-WC1)		66%	2	0	2	5
	New route SE-W (Kens-Batt-London Br)		66%	3	0	3	5
	New route SE-W (Kensington-Vauxhall)		66%	2	0	2	3
	NW-SE route (extension of P5)		66%	0.2	0	0.2	2
Light Rail Transit	Waterloo to BPS		66%	120	40	160	2
LUL Northern Line Extension	BPS only	*LUL/Treasury option 1*	57%	600	70	670	8
	Nine Elms PO site only		66%	610	80	690	8
	Vauxhall & BPS	*LUL/Treasury option 3*	57%	990	70	1060	10
	Nine Elms & BPS	*LUL/Treasury option 2*	57%	730	70	800	10
Other	Cross-river ped/cycle bridge		66%	30	0	30	0.1

Depot and land costs included where applicable.

Recurrent costs are annual operating and maintenance costs

Bus operating costs are contract cost estimates, assumed to include any required capital/fleet costs

Optimism bias correction applied to infrastructure and fleet costs as per WebTAG Unit 3.5.9 and advice from TfL

Bus infrastructure costs include notional allowances for infrastructure improvements including bus priority measures. Where route enhancements are anticipated in relation to OA development a more detailed study would be required in order to quantify these needs more precisely. Bus fleet costs are not identified separately, but are included in the annual operating costs which reflect the cost to TfL of the contracts to provide the bus services.

LRT infrastructure costs are estimated from available comparable schemes and unit rates, as the scheme has not been developed in sufficient detail to enable estimation from more detailed construction quantities. The fleet costs are based on current vehicle costs elsewhere. Operating costs have been estimated using rates from similar schemes. All costs have been reviewed and endorsed by TfL's Light Rail Transit team.

The NLE infrastructure, fleet and operating costs were provided by LUL for the three options worked up in detail by Treasury Holdings and their consultants (the Battersea Power Station only, BPS/Nine Elms and BPS/Vauxhall options). The Nine Elms Post Office option costs were estimated based on a percentage of the BPS-only option costs.

The LRT and NLE schemes that require land purchase for depots or stations have an allowance for land included in the cost, using an indicative rate for land purchase in the OA (£4m per hectare) provided by the GLA. This rate has been applied to all potential stations in OA with the exception of Battersea Power Station, where the current owners of the site, Treasury Holdings have indicated that the land would be made available at no cost to the proposed NLE scheme.

6 Option Testing

6 Option Testing

6.1 Overview

The transport demand implications of the public transport packages listed in Table 14 were modelled using the VNEB suite of models which include the LTS, VNEB-P and VNEB-H models. This section discusses the results from the modelling and identifies the main impacts of the different transport packages.

6.2 Public Transport Accessibility Levels

The PTALs provided by TfL for 2026 (Figure 16) are derived from public transport accessibility indices (PTAIs) and are calculated for points on a 100m square grid across London[11]. There are 255 of these points in the OA, of which 68 are in the Borough of Lambeth and 187 in the Borough of Wandsworth. Changes to the public transport accessibility indices attributable to OA transport initiatives were calculated for the transport package combinations using the standard TfL calculation method[12]. Results are summarised in Table 16 and revised 2026 PTAL maps are given in Figure 45 for a representative selection of the transport packages.

Table 16 Average 2026 Public Transport Accessibility Indices for the OA with Selected Transport Packages

Average PTAIs	Reference case	Full bus package	Full bus package + LRT	Full bus package + NLE (BPS only)	Full bus package + NLE (NE+BPS)
Lambeth part of OA	40.6	45.9	48.3	45.9	46.6
Change from Reference Case		*5.4*	*7.7*	*5.4*	*6.1*
Wandsworth part of OA	14.6	19.1	22.2	21.8	22.1
Change from Reference Case		*4.5*	*7.6*	*7.2*	*7.6*
OA as a whole	21.5	26.2	29.1	28.2	28.7
Change from Reference Case		*4.8*	*7.6*	*6.7*	*7.2*

The Lambeth part of the OA has much higher public transport accessibility than the Wandsworth part, not only in the 2026 Reference Case but with all OA transport packages. This is because the accessibility of significant areas of the Wandsworth part is largely unchanged due to the land use (mainly the NCGM and the large areas of railway land) and the lack of direct walk links.

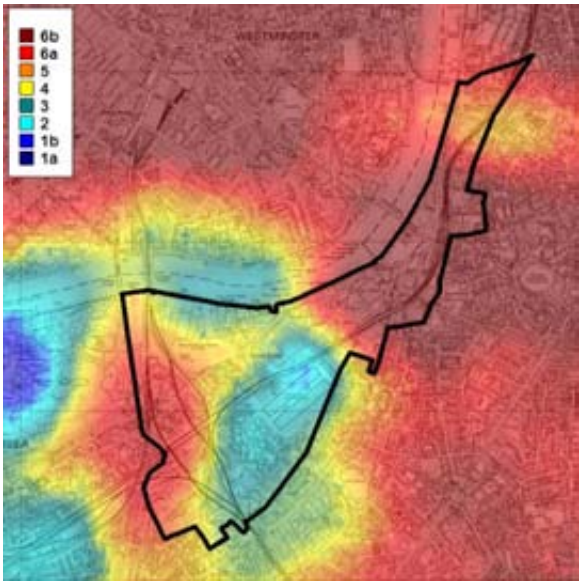
[11] The correspondence between the calculated PTAIs and the PTALs used for mapping purposes is as follows:

Public Transport Accessibility Level	1a	1b	2	3	4	5	6a	6b
Public Transport Accessibility Index range	0 to 2.5	2.5 to 5	5 to 10	10 to 15	15 to 20	20 to 25	25 to 50	50+

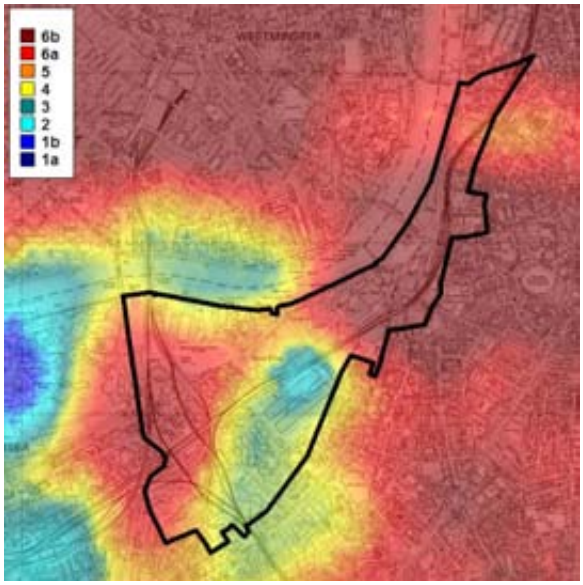
[12] PTALs are only able to represent the ability to reach public transport; they take no account of available capacity either on public transport services or at stations.

Figure 45 2026 PTALs with OA Transport Initiatives

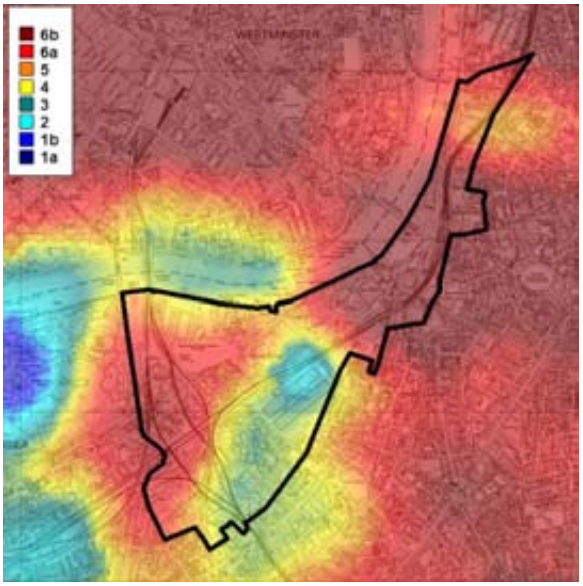
Bus-only package



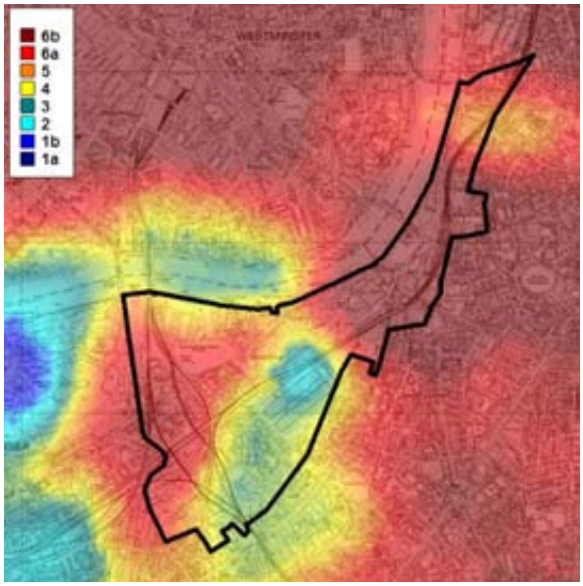
Bus package + Waterloo to BPS Light Rail Transit



Bus package + Northern Line Extension (to BPS only)



Bus package + Northern Line Extension (Nine Elms & BPS)



The accessibility calculations show that:

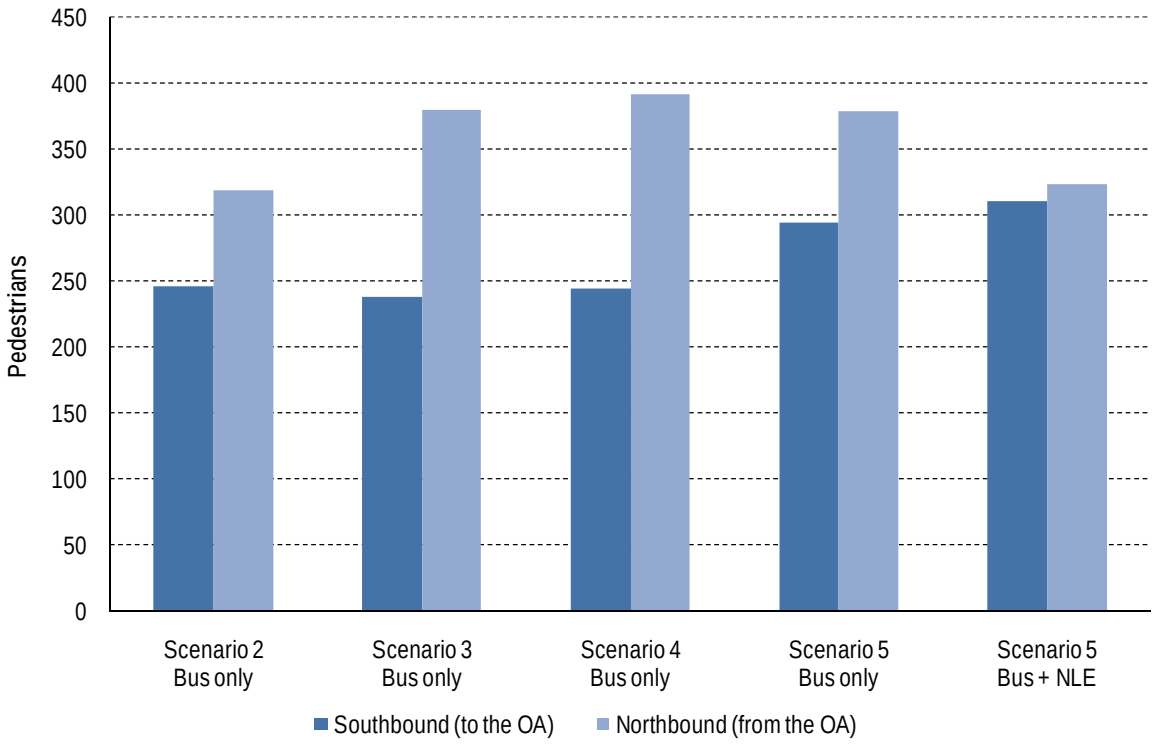
- the bus package has a consistent effect throughout the OA, increasing the average PTAI by around 5 points in both the Lambeth and Wandsworth parts;
- the LRT package gives rise to further improvements in public transport accessibility, also very similar in the Lambeth and Wandsworth parts of the OA; and
- the NLE package provides PTAI values similar to that of the LRT package in the Wandsworth part of the OA but smaller increases in the Lambeth part.

Each of the transport intervention packages indicate that there remains an area around the NCGM that suffers from low PTAL scores. NCGM will continue to operate as a market after redevelopment; however in the event of potential redevelopment of the NCGM measures to improve accessibility would need to be considered.

6.3 Walking and Cycling

The pedestrian and cycle bridge between Nine Elms and Pimlico was included in five transport packages modelled as detailed in Table 14. VNEB-P only models pedestrians who also use public transport, so it will undoubtedly underestimate use of the bridge by pedestrians and will not provide any indication of cycling usage. However the VNEB-P predicted pedestrian flows on the bridge are shown in Figure 46, for the OA scenario/transport package combinations in which it was modelled.

Figure 46 Nine Elms - Pimlico Bridge Pedestrian Flows, 2026 Morning Peak Period (7-10am)



Note: VNEB-P only models walking trips to/from public transport, so these figures should be regarded as underestimates of total potential usage of the bridge by walkers and cyclists.

The results indicate that, in the 2026 morning peak period (7-10am):

- the pedestrian bridge is forecast to carry in the order of 200-400 people in each direction;
- it would carry more people from the OA than to the OA;
- southbound demand would be similar for OA Scenarios 2, 3 and 4 with an increase of 17% in OA Scenario 5, this is associated with the additional employment in the OA;
- northbound pedestrian demand (out of the OA) is forecast to increase slightly between OA Scenarios 3, 4 and 5, commensurate with population changes in the OA; and
- the addition of the NLE would lead to a small increase in southbound trips across the bridge into the OA.

In addition to these modelled figures the bridge would probably also attract a significant number of walk-only trips and cyclists. More research would be necessary should the bridge proposal be taken further.

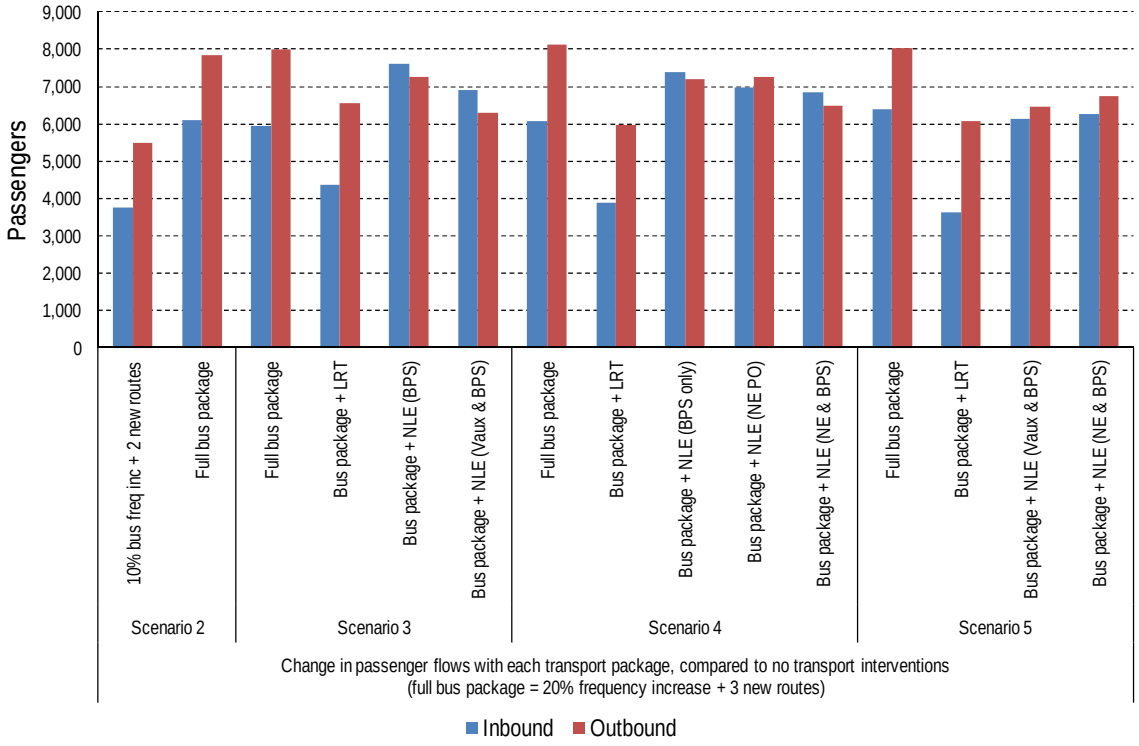
6.4 Public Transport

The public transport modelling results reported here are for assignment of a public transport matrix (derived from LTS Model runs) for each OA development scenario. The exception to this is OA Scenario 5 with the NLE, for which a further LTS run was undertaken to measure the demand changes (primarily trip redistribution) due to the NLE itself. The resulting changes were small but should be regarded as underestimates because the LTS Model does not forecast trip generation effects.

6.4.1 Bus

Every transport package tested for this study includes a variant of bus improvement. Figure 47 shows the changes in passenger flows on bus services crossing a cordon around the OA, for each transport package.

Figure 47 Bus Passenger OA Cordon Flow Changes, 2026 Morning Peak Period (7-10am)



From the results a number of general observations can be made:

- the full bus packages would have broadly similar changes in patronage levels in over all development scenarios;
- the forecast patronage levels for the full bus package are in turn significantly greater than for the 10% and 20% service level increases on existing routes;
- bus passenger flows are forecast to be lower in packages containing the Waterloo-Battersea Power Station LRT scheme, because the LRT scheme would attract some of the bus demand;
- there is no significant difference in the overall forecast bus passenger flows at the study area cordon between the different NLE options;
- outbound bus passenger flows from the OA are forecast to be largest where the transport package only contains bus improvements; and
- inbound flows on the bus cordon to the OA are forecast to be similar for the bus only and bus/Underground options.

6.4.2 Light Rail Transit

The Waterloo-Battersea Power Station LRT scheme has been tested with a low frequency (10 services per hour) service in OA Scenario 3 and high frequency (15 services per hour) in OA Scenarios 3, 4

and 5. Passenger flows along the proposed route are shown in Figure 48, whilst boardings and alightings at each of the five stops are summarised in Figure 49.

The modelling results indicate the following for the LRT scheme:

- northbound passenger trips (from the OA) follow the same pattern in all OA scenarios. The flows are forecast to increase from Battersea Power Station to Vauxhall and a large number of boarders at Vauxhall results in the busiest link of the service between Vauxhall and Albert Embankment;
- southbound trips (to the OA) also follow the same pattern in all OA scenarios. The busiest link would be between Waterloo and St Thomas's and patronage decreases until Vauxhall where a significant number of boarders use the LRT through to Nine Elms and Battersea Power Station;
- the busiest LRT stop is forecast at Vauxhall, with significant boardings also at the termini (Battersea Power Station and Waterloo);
- in all OA scenarios, the LRT scheme increases passenger throughput at Vauxhall LUL station.
- the Albert Embankment and Waterloo stops would generally have the largest numbers of alighters. In OA Scenario 5 there are also a large number of alighters at Battersea Power Station, reflecting the significant increase in employment in this part of the OA;
- southbound passenger flows to the OA would steadily increase between the development options as the employment increases between OA Scenarios 3, 4 and 5;
- northbound passenger flows are broadly similar between OA Scenarios 3, 4 and 5, consistent with the similar residential development; and
- patronage levels on parallel bus routes would generally decrease.

Figure 48 LRT Scheme Passenger Flows, 2026 Morning Peak Period (7-10am)

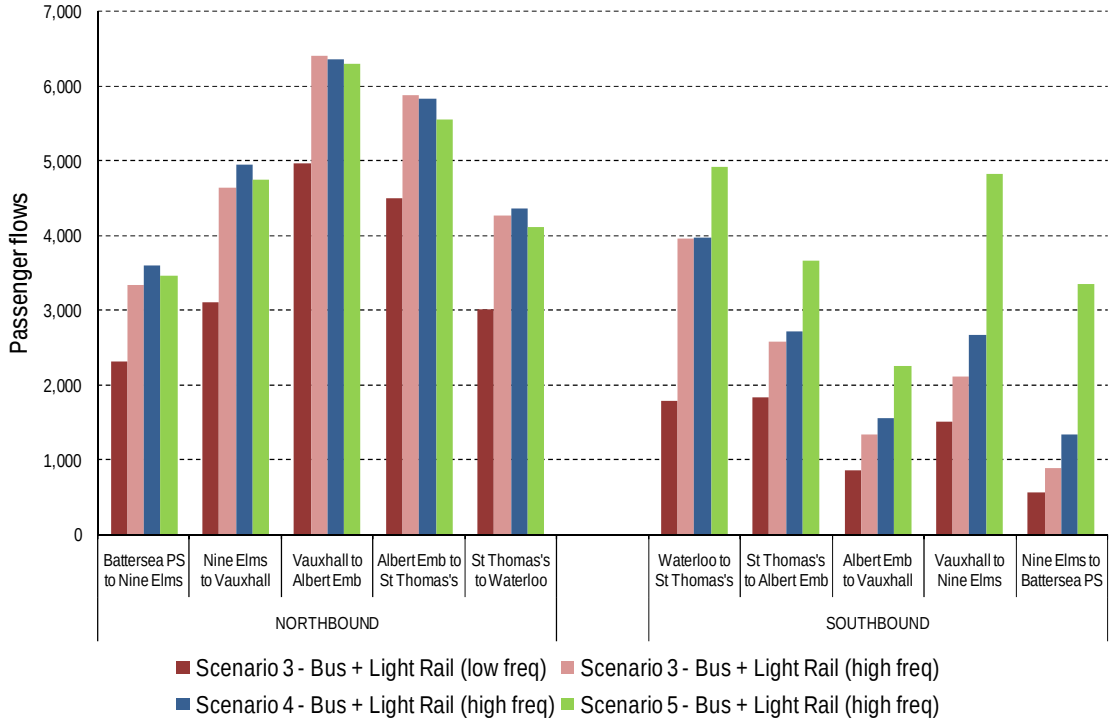
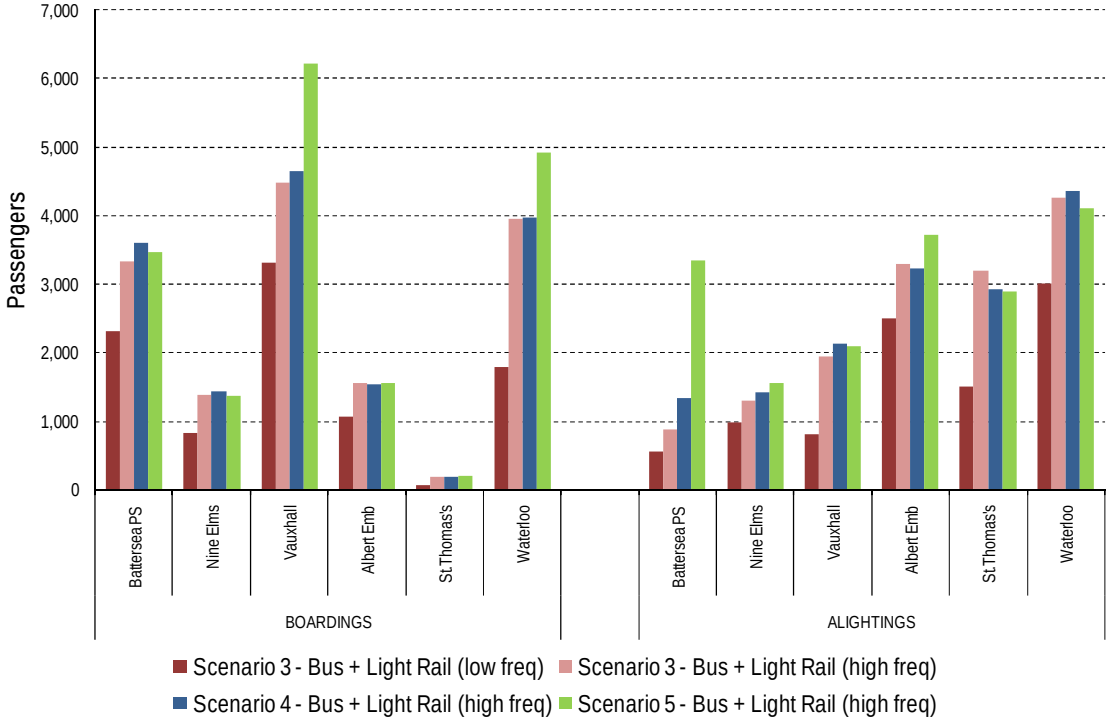


Figure 49 Boardings and Alightings at Light Rail Transit Stops, 2026 Morning Peak Period (7-10am)



The low frequency (10 per hour) LRT service modelled in OA Scenario 3 seems to operate under capacity constraint. Increasing the service level to 15 per hour gives a significant increase in passenger flows, to levels approaching those in OA Scenario 4. This suggests that the higher frequency is preferable; at least as far as passenger demand is concerned.

6.4.3 Underground

The effects of the transport packages have been assessed for the stations in and around the OA for the LUL Central Area Cordon and the Victoria, Northern, District and Piccadilly Lines.

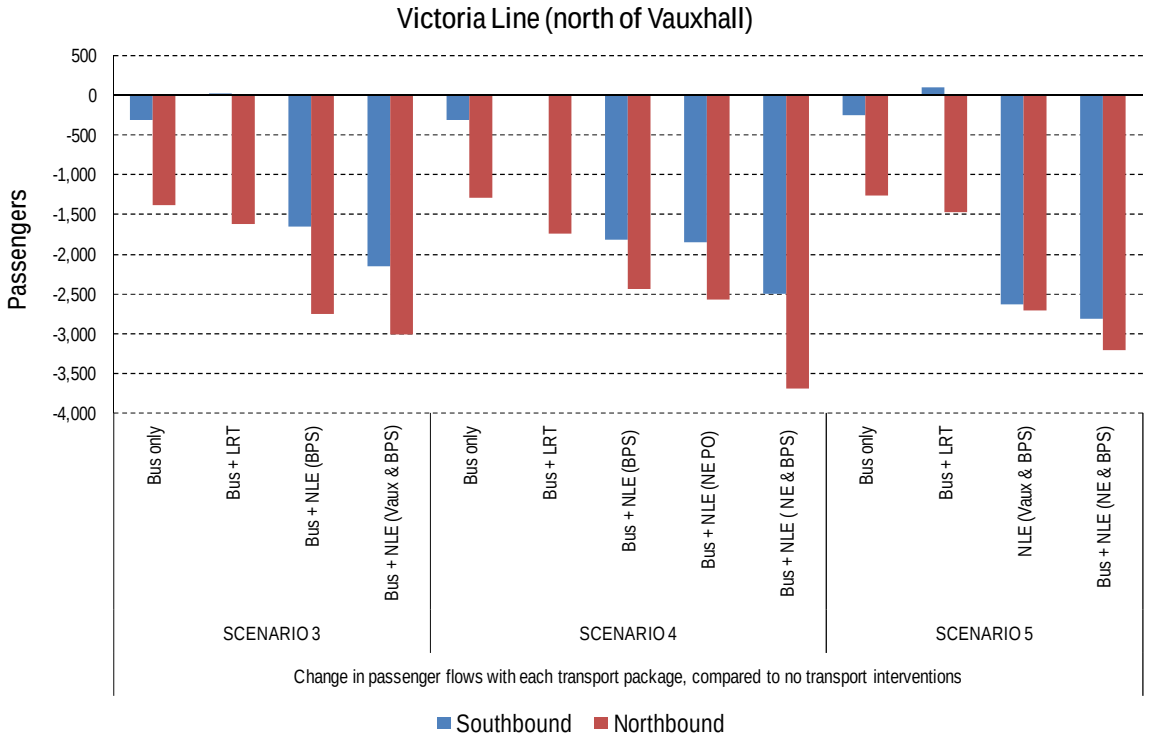
The LUL Central Area Cordon is made up of five screenlines: East, North, North West, West and South. Analysis of the transport package and OA development scenarios indicate that overall the flows across the Cordon would not change by more than ±2%, indicating the proposed OA developments would have a limited effect on the Underground across Greater London. There would be however, some localised effects on the southern cordon with transport packages that include the NLE and the Partial Separation of the Northern Line (PSNL) which is included in the modelling of the NLE. These effects are discussed in more detail later in this section.

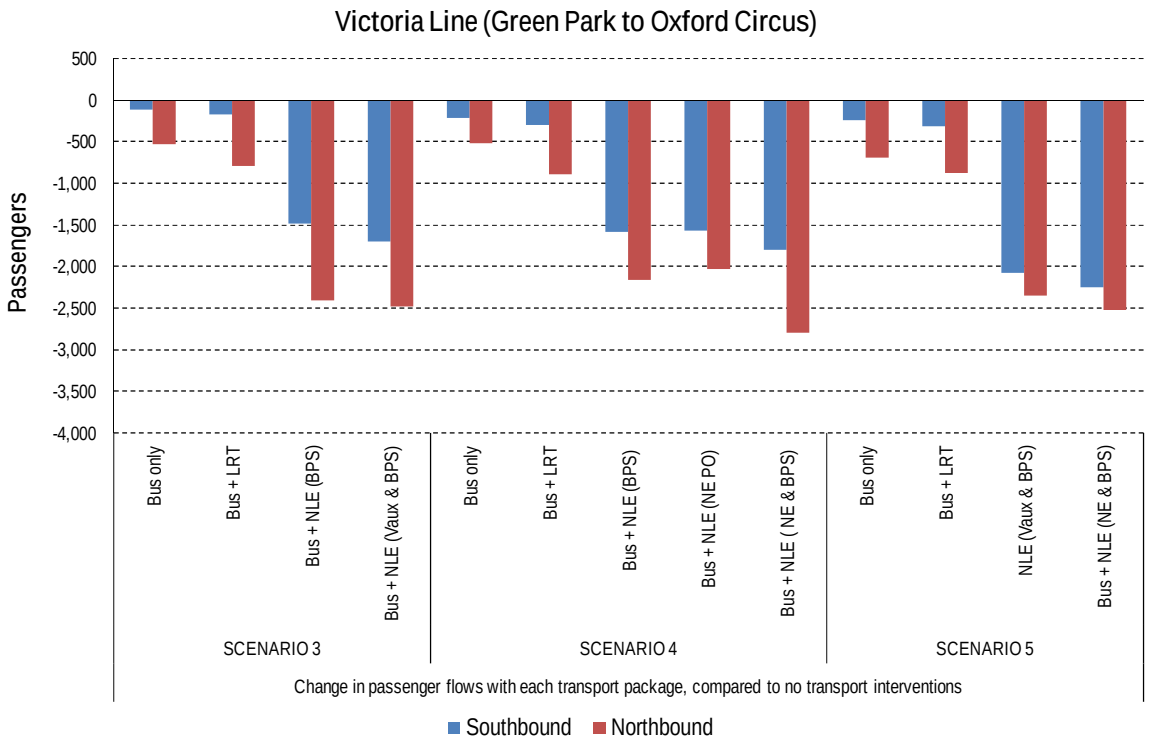
Modelling results for each of the Underground lines are summarised below.

Victoria Line

Figure 50 shows the modelled change in flows on the Victoria Line north of Vauxhall and also on the Green Park-Oxford Circus section (the most heavily-loaded section of the Victoria Line).

Figure 50 Change in Victoria Line Passenger Flows, 2026 Morning Peak Period (7-10am)





The results show that:

- Victoria line patronage is forecast to reduce in both directions for most of the transport packages tested;
- the NLE package is forecast to have the greatest effect on the Victoria Line, with morning peak patronage decreases of 3,000 or more trips northbound and 1,500-3,000 southbound;
- the bus and/or LRT options would provide significantly less relief than NLE options, with decreases of about 1,500 passengers northbound and much smaller changes in southbound flows;
- the reduction in northbound Victoria Line patronage would be greater in OA Scenario 4 than in Scenario 5, most likely due to the employment development in OA Scenario 5 attracting trips that, in Scenario 4, are destined for jobs in central London; and
- further north on the Victoria Line, on the busiest section (between Green Park and Oxford Circus) the flow reduction due to all VNEB transport interventions is less than it is south of Victoria, although it remains significant.

Overall the NLE in particular would have a significant effect on the Victoria Line. The Victoria Line can currently accommodate around 50,000 passengers each way in the peak three hours and the planned PPP upgrade works will increase this to about 60,000. Although usage of the line close to Vauxhall is forecast to be well below this level; trip patterns would be such that these trips would add to demand on the most crowded sections of the line as well, particularly north of Victoria.

As shown in Table 17, Victoria Line flows are reduced by up to 9% south of Victoria, and up to 6% north of Victoria when the NLE and partial separation of the Northern Line are modelled together. The NLE alone (i.e. without partial separation of the Northern Line) would result in reductions of 5% south of Victoria, and up to 2% north of Victoria. Some of these reductions would also extend to the District Line east of Victoria.

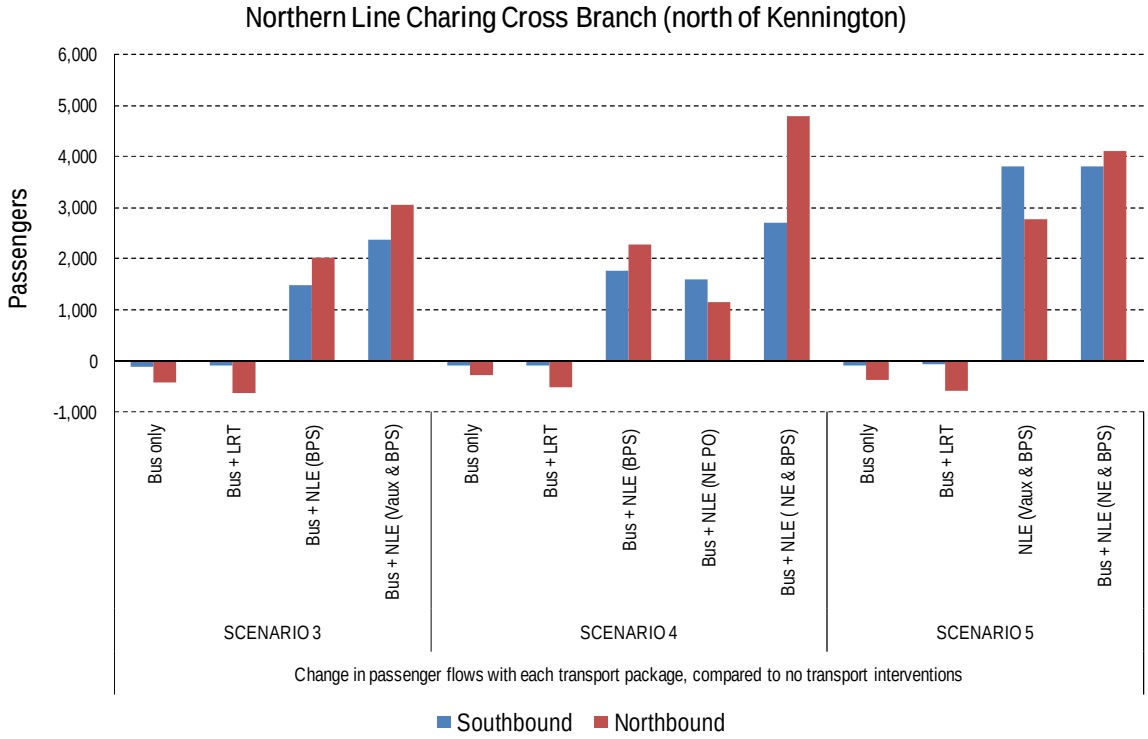
Table 17 Effect of NLE on Victoria Line Flows

	From	To	Change in 2026 morning peak flow			
			S4	S4 no PS	S5	S5 no PS
Northbound	Stockwell	Vauxhall	-7%	-4%	-7%	-4%
	Vauxhall	Pimlico	-9%	-5%	-8%	-5%
	Pimlico	Victoria	-9%	-4%	-8%	-4%
	Victoria	Green Park	-6%	-2%	-5%	-2%
	Green Park	Oxford Circus	-6%	-1%	-5%	-1%
	Oxford Circus	Warren Street	-3%	-1%	-2%	-1%
	Warren Street	Euston	-4%	1%	-4%	1%
	Euston	King's Cross St. Pancras	-4%	3%	-4%	3%
	King's Cross St. Pancras	Highbury & Islington	-1%	0%	-1%	1%
Southbound	Highbury & Islington	King's Cross St. Pancras	0%	0%	0%	0%
	King's Cross St. Pancras	Euston	-1%	1%	-2%	1%
	Euston	Warren Street	-2%	2%	-2%	2%
	Warren Street	Oxford Circus	-2%	1%	-2%	1%
	Oxford Circus	Green Park	-4%	0%	-5%	0%
	Green Park	Victoria	-6%	0%	-6%	0%
	Victoria	Pimlico	-16%	-6%	-16%	-6%
	Pimlico	Vauxhall	-16%	-6%	-17%	-7%
	Vauxhall	Stockwell	-9%	-3%	-8%	-2%

Northern Line (Charing Cross Branch)

Figure 51 shows the modelled change in flows on the Northern Line (Charing Cross Branch) north of Kennington.

Figure 51 Change in Northern Line (Charing Cross) Passenger Flows, 2026 Morning Peak Period (7-10am)

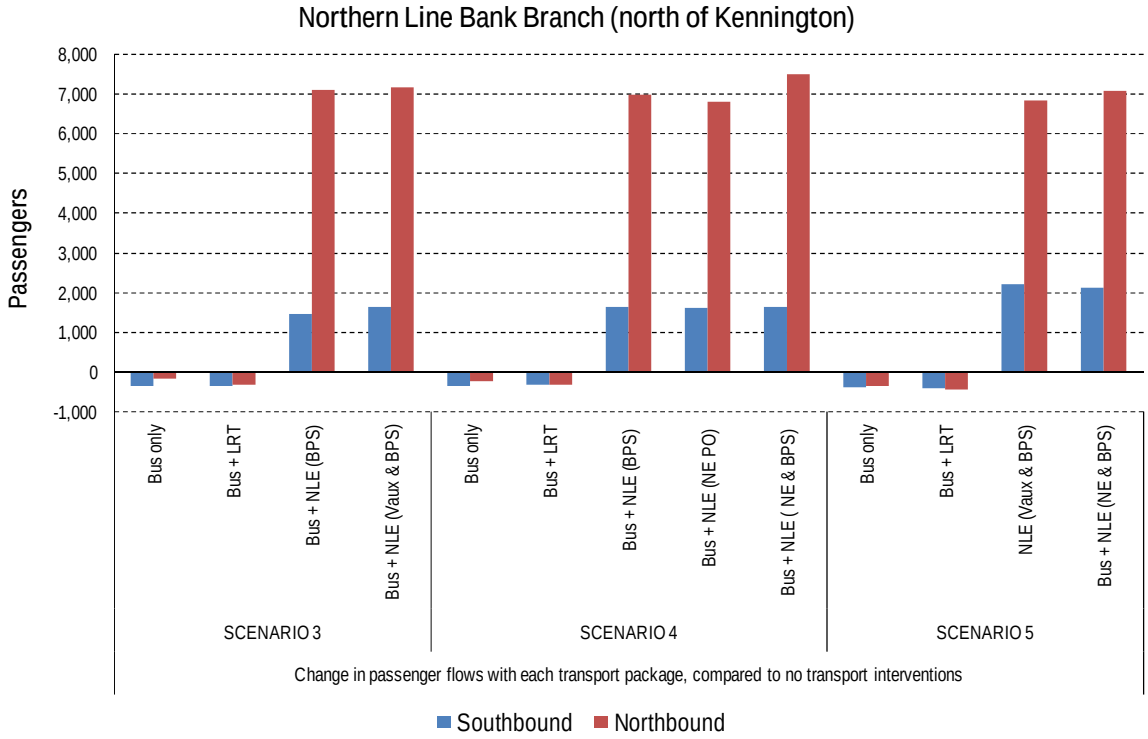


Bus and LRT transport packages would all result in slight reductions in passenger flows on the Northern Line, whilst the NLE options would predictably increase passenger flows significantly. The increase in northbound flows is most significant would be greater than that in southbound flows in OA Scenarios 3 and 4, whilst in OA Scenario 5, there would be a greater increase in southbound flows corresponding with the substantial increase in employment at Battersea Power Station.

Northern Line (Bank Branch)

Figure 52 shows the modelled change in flows on the Northern Line (Bank Branch) north of Kennington.

Figure 52 Change in Northern Line (Bank Branch) Passenger Flows, 2026 Morning Peak Period (7-10am)

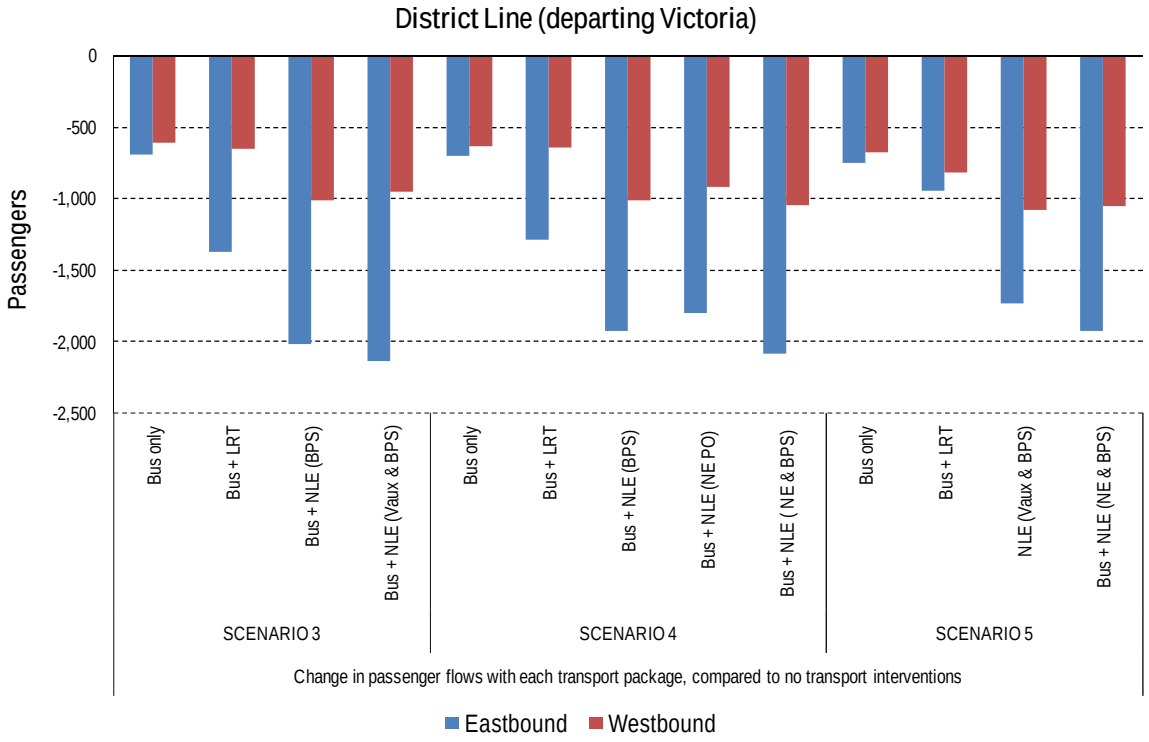


Bus and LRT transport packages would all result in very slight reductions in passenger flows on the Northern Line, whilst the NLE options would predictably increase the passenger flows on this branch significantly, primarily in the northbound direction. This increase in flows would mainly be attributed to the effects of the Partial Separation of the Northern Line.

District Line

Figure 53 shows the modelled change in flows on the District Line at Victoria.

Figure 53 Change in District Line Passenger Flows, 2026 Morning Peak Period (7-10am)



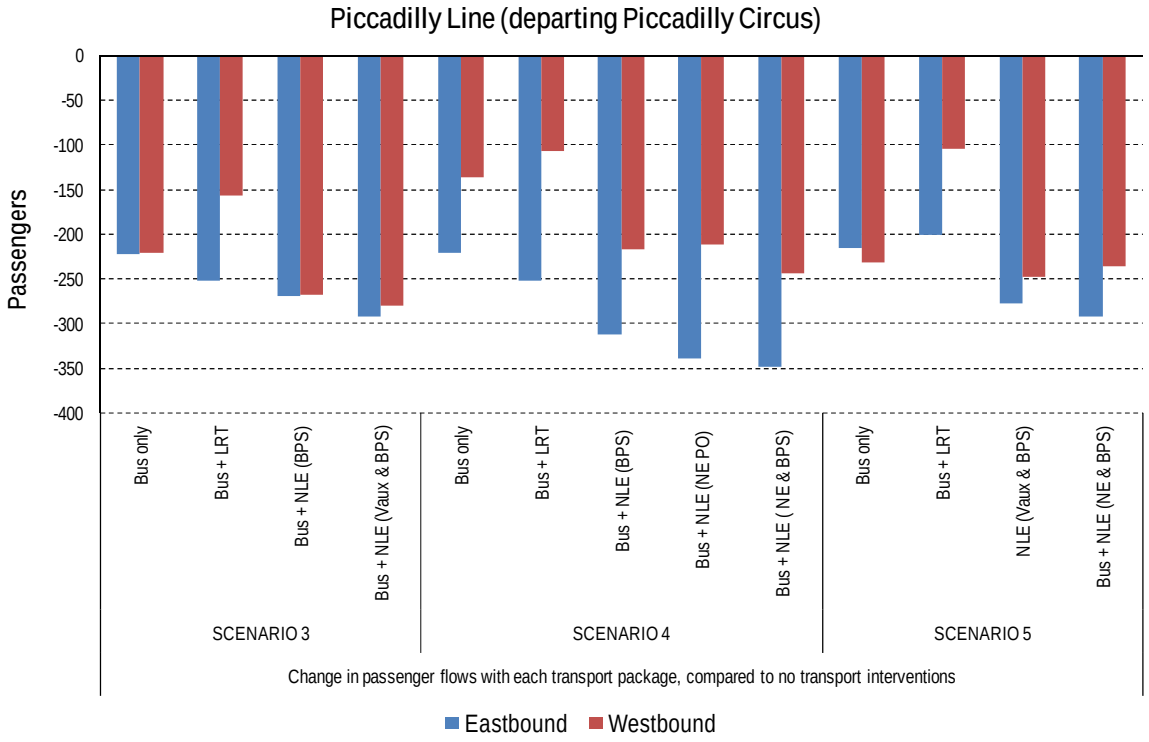
Appreciable patronage reductions are forecast on the District Line, with significant reductions in all OA Scenarios with the NLE, especially in the eastbound direction (which corresponds to the relief of the Victoria Line by the NLE).

Piccadilly Line

Figure 54 shows the modelled change in flows on the Piccadilly Line at Piccadilly Circus.

Relatively small but consistent patronage reductions are forecast on the Piccadilly Line in all the OA Scenario/transport package combinations tested, especially those including the NLE.

Figure 54 Change in Piccadilly Line Passenger Flows, 2026 Morning Peak Period (7-10am)



Patronage on the Northern Line Extension (NLE) Transport Packages

Four NLE options have been tested in conjunction with OA Scenarios 3, 4 and 5. Table 18 summarises the passenger flows for the OA Scenario/NLE option combinations tested.

Table 18 Northern Line Extension Passenger Flows, 2026 Morning Peak Period (7-10am)

NLE option			OA	Station 1-2		Station 2-3	
Station 1	Station 2	Station 3	Scenario	N/B	S/B	N/B	S/B
Battersea PS	Kennington		3	8,500	2,800		
			4	8,800	3,300		
Nine Elms PO	Kennington		4	6,800	2,700		
Battersea PS	Vauxhall	Kennington	3	8,100	2,600	9,900	4,200
			5	8,300	5,800	10,000	7,700
Battersea PS	Nine Elms	Kennington	4	8,000	3,000	13,000	4,900
			5	7,700	5,700	12,600	7,900

All NLE options to Battersea Power Station are forecast to attract 8,000-9,000 passengers northbound from Battersea Power Station in the 2026 morning peak. The Vauxhall station option would have flows of around 10,000 passengers from Vauxhall to Kennington, whilst the Nine Elms station option would have higher flows of nearly 13,000 passengers from Nine Elms to Kennington. The Nine Elms Post Office option would have the lowest patronage at nearly 7,000 passengers northbound.

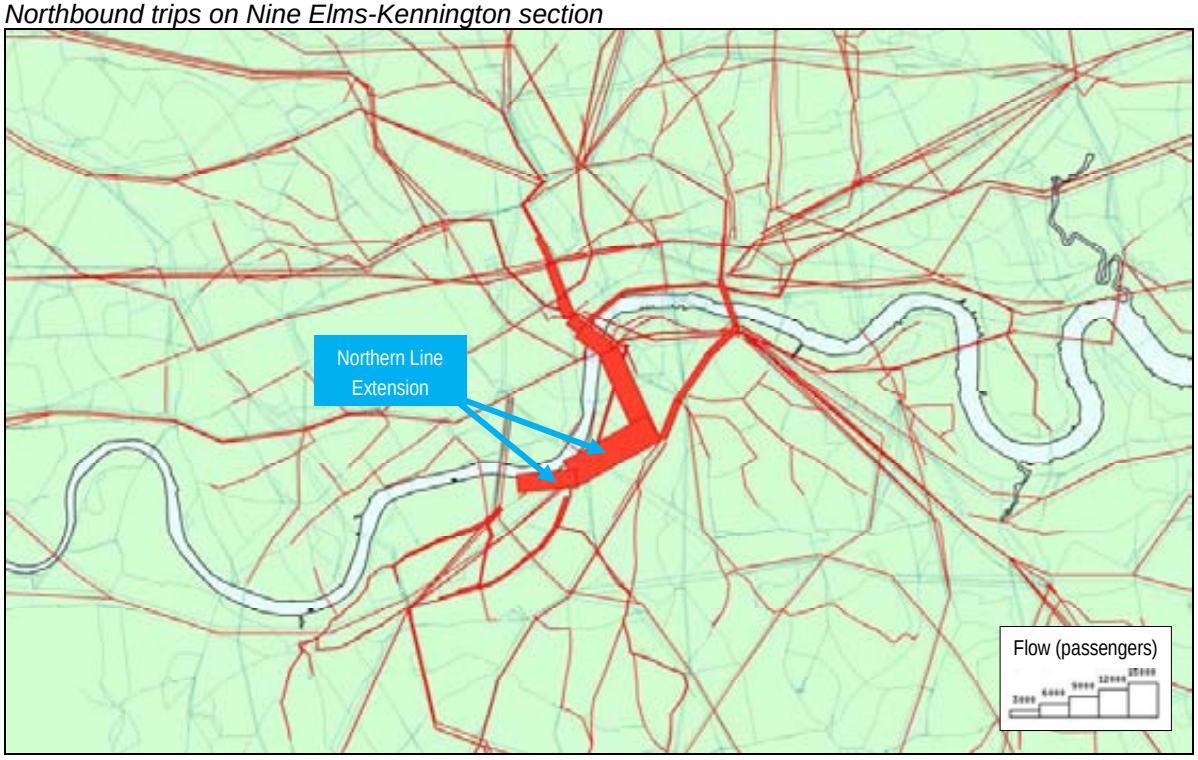
Southbound 2026 morning peak flows are forecast to be 30-40% of northbound flows, except in OA Scenario 5 where the southbound flows would increase commensurate with the increased employment at Battersea Power Station, to about two-thirds of northbound flows.

Figure 55 illustrates the paths taken by passengers using the Nine Elms-Kennington section of the NLE (northbound) and the Nine Elms-Battersea Power Station section (southbound) in the 2026 morning peak period, for OA Scenario 5. The results show the following:

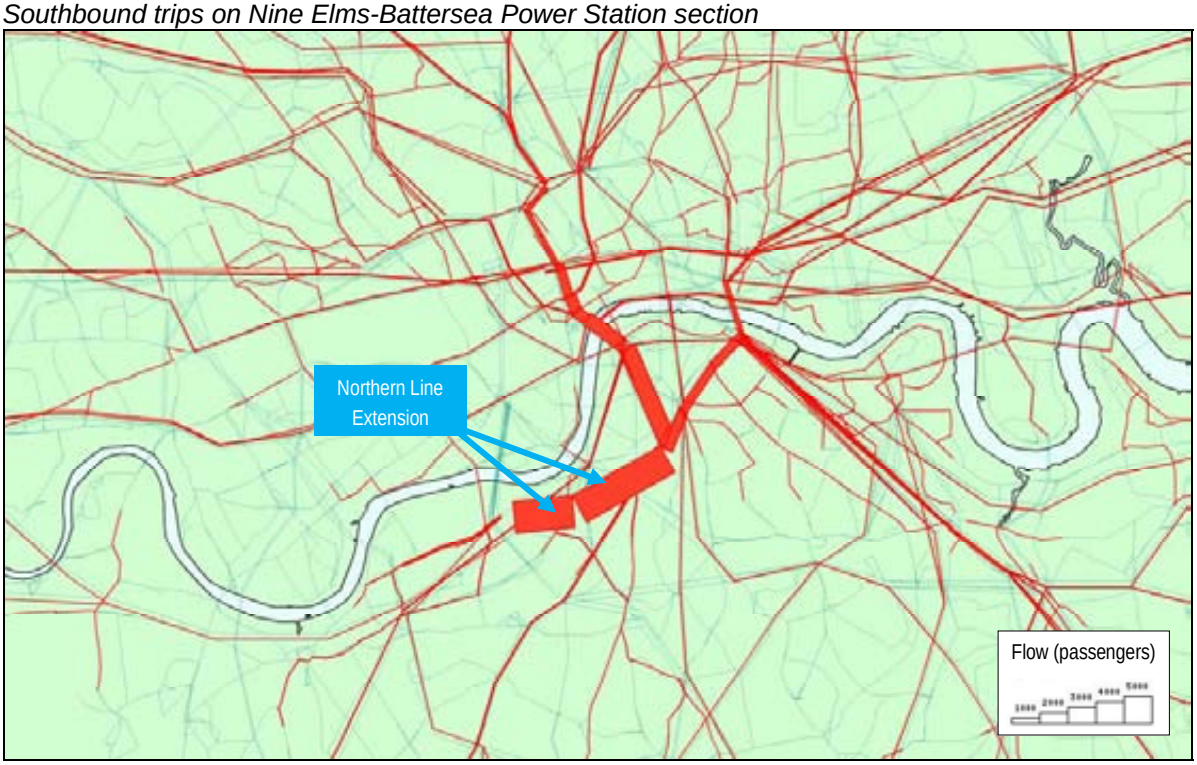
- **Northbound trips:** the majority of northbound trips board the NLE from adjacent areas in the OA, although there is some evidence of users from areas further south and south-west using buses to access the NLE, both at Battersea Power Station and Nine Elms. Most of the northbound users are headed for the West End (using the Charing Cross branch of the Northern Line, with some travel extending onto other Underground lines as well, notably the Piccadilly Line) and, to a lesser extent, the City (using the Bank branch).
- **Southbound trips:** The majority of southbound trips have a destination at Battersea Power Station with limited evidence of travel beyond there to the south-west, confirming the significant attraction of the Power Station development in OA Scenario 5 in terms of employment generation. The southbound trips are split between the Charing Cross and Bank branches of the Northern Line in similar proportion to northbound trips (i.e. the majority of trips using the Charing Cross branch). Most southbound trips are from within central London, with a minority coming from further afield (notably those using South Eastern train services into Waterloo and train services from the north into Euston or St Pancras).

Figure 55 Select Link Plots of Passenger Demand on the Northern Line Extension, 2026 Morning Peak Period (7-10am), OA Scenario 5

Northbound trips on Nine Elms-Kennington section



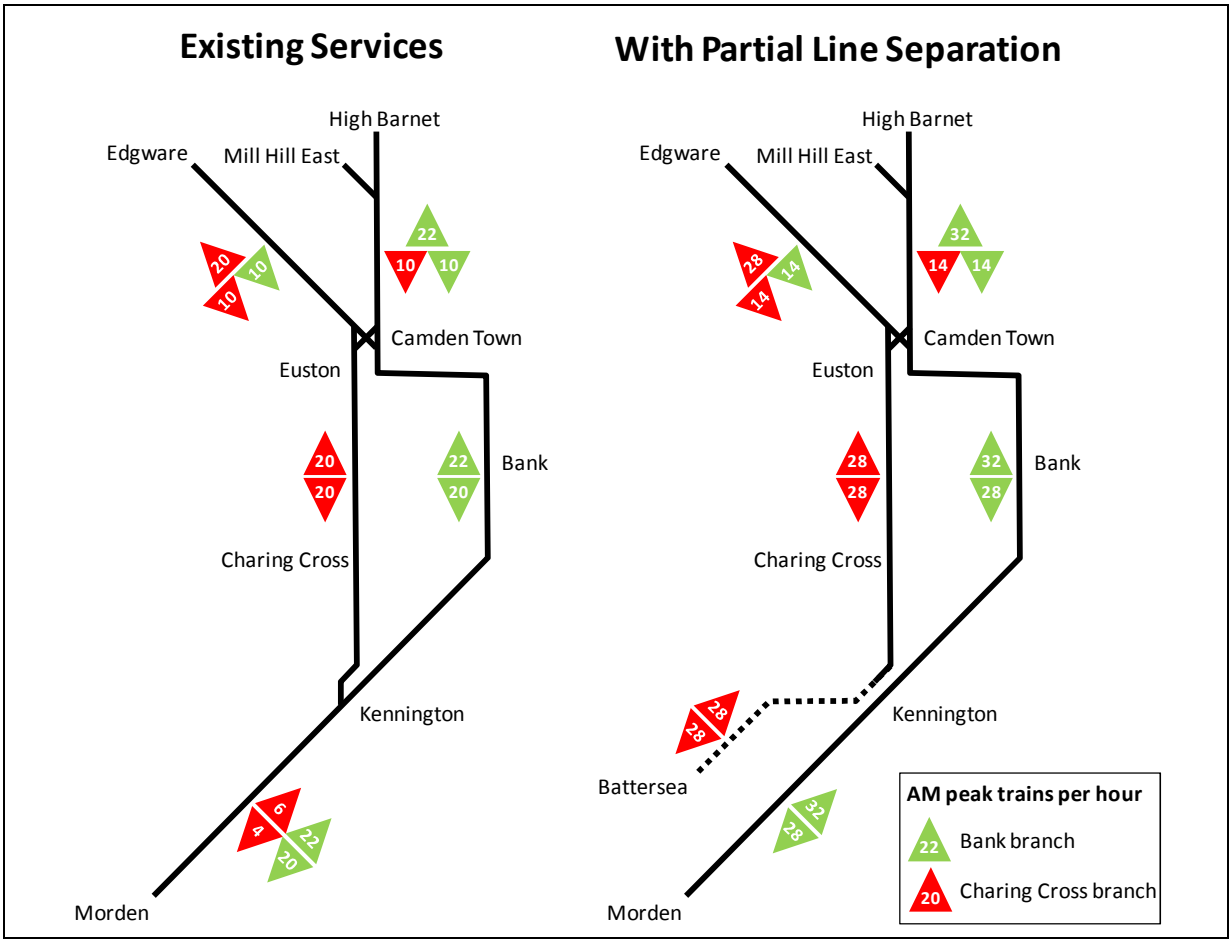
Southbound trips on Nine Elms-Battersea Power Station section



Effects of Partial Separation of the Northern Line

As advised by LUL, all NLE options modelled in this study included the Partial Separation of the Northern Line (PSNL), which would entail separation of the Charing Cross and Bank branches at Kennington and would enable an increase in peak hour service frequency from 20 to 28 trains per hour on the Charing Cross branch as shown in Figure 56. All NLE options have been coded with the resulting 28 trains per hour extended beyond Kennington.

Figure 56 Proposed Partial Separation of the Northern Line (PSNL)



The service changes facilitated by the PSNL would have wider patronage implications, beyond the effect of the NLE. The 2026 Reference Case network is based on the 2026 Mayor's Transport Strategy Reference Case (as it was defined in September 2008) and does not contain the PSNL. Therefore sensitivity tests were modelled for OA Scenarios 3, 4 and 5 (the only scenarios that include NLE options) to include the PSNL in each scenario's Reference Case.

Compared to the 2026 Reference Cases, the forecasts for the PSNL are similar in all three development scenarios, with reduced 2026 morning peak period flows on the Victoria Line between Stockwell and Highbury & Islington of 4,000-6,000 passengers in both directions and about 5,000 passengers eastbound on the District Line between Earl's Court and Tower Hill. A corresponding patronage increase is forecast on the Northern Line between Stockwell and Embankment with about 12,000 more passengers northbound and 4,000 southbound at Kennington.

Another sensitivity test was undertaken to assess the NLE without the PSNL, by extending to Battersea Power Station the Charing Cross branch services currently terminating at Kennington, thus reducing the frequency of services on the NLE from 28 to 15 trains per hour. Table 19 shows the forecast passenger volumes for the NLE with and without PSNL. Without the PSNL, northbound flows on the NLE are forecast to be reduced by about 16% and southbound flows by about 20%.

Table 19 Northern Line Extension With and Without PSNL, 2026 Morning Peak Period (7-10am)

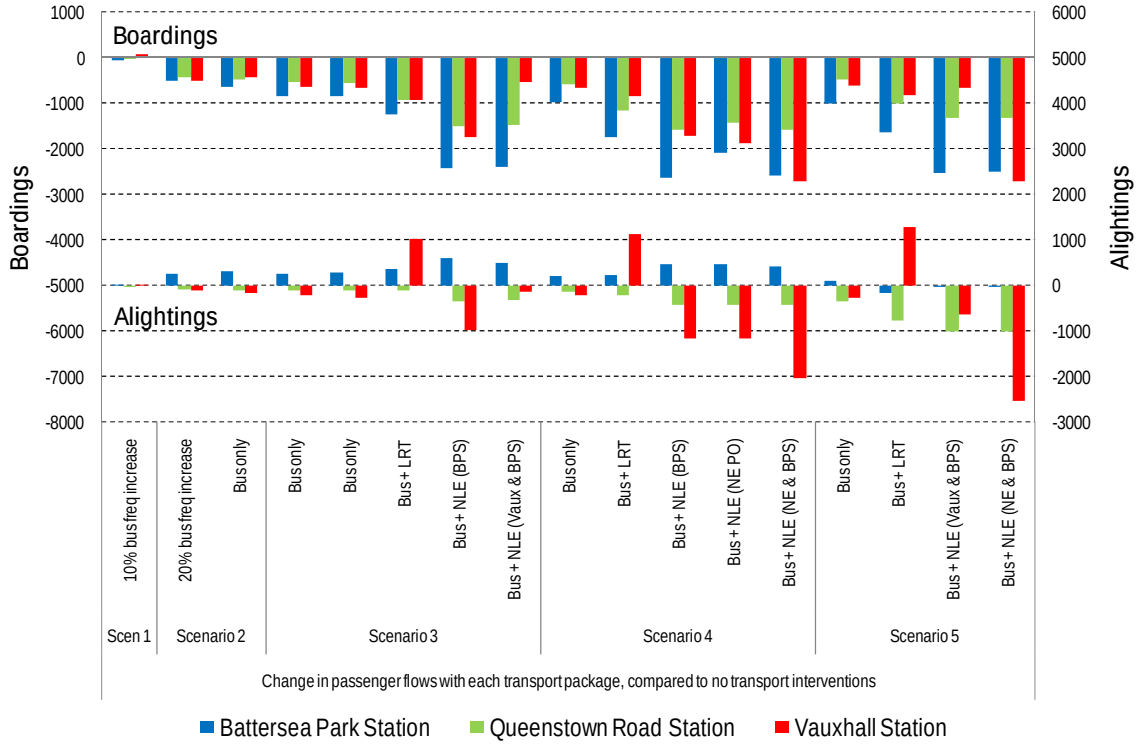
NLE Nine Elm & BPS in OA Scenario 5	BPS-Nine Elms		Nine Elms-Kennington	
	Northbound	Southbound	Northbound	Southbound
With PSNL - 28 trains per hour	7,722	5,741	12,610	7,865
Without PSNL - 15 trains per hour	6,563	4,715	10,461	6,093

Clearly, the increased service frequency facilitated by the PSNL would have a small, but still significant, effect on patronage of the NLE.

6.4.4 Network Rail

Whilst there are no NR improvements included in the OA transport packages, the transport packages tested would have some effects on NR patronage. Figure 57 shows how heavy rail boarders and alighters would vary between transport packages at the three NR stations in the OA (Battersea Park, Queenstown Road and Vauxhall).

Figure 57 Boardings and Alightings at OA NR Stations, 2026 Morning Peak Period (7-10am)



General observations for NR in the OA are:

- there would be reductions in 2026 morning peak boardings at all three stations, increasing progressively as the OA transport initiatives increase in scale, suggesting that the LRT and NLE options would attract city-bound passengers away from NR services;
- alightings would increase at Vauxhall with bus and LRT options (especially the LRT option in OA Scenario 5, apparently due to increased trips bound for Battersea Power Station), but would decrease significantly with NLE options; and
- the NLE options would generally reduce activity at all NR stations (they would relieve NR services).

6.4.5 Stations and Interchanges

The inclusion of additional development demand and the subsequent transport packages would have localised effects on the interchange stations within and impacted by the OA. The effects have been considered in more detail for the following key locations:

- Vauxhall;
- Victoria;
- Battersea Park; and
- Queenstown Road.

Full details of the station capacity analysis are given in Appendix D and a summary of the main effects is given in Table 20. The analysis has been done for the busiest morning peak hour.

Table 20 Station Performance Summary

Station	Impact of OA Scenarios	Impact of Transport Packages
Vauxhall	■ All OA Scenarios add further passengers to the 2026 Reference Case. This is forecast to be ~900 additional boarders in the peak hour in OA Scenario 5 at Vauxhall Underground station. ■ OA Scenarios 3 and 4 are forecast to have similar overall passenger numbers at the Vauxhall interchange with an additional 1450 pax/hr using the interchange compared with the 2026 Reference Case. OA Scenario 5 is forecast to add a further 750pax/hr to total an additional 2200 pax/hr in the peak AM hour compared to 2026 Reference Case. ■ The key incremental change between OA Scenarios 4 and 5 is in passengers leaving the Victoria Line station and this is forecast to increase by ~600 pax/hr. Very few of these are interchanging with NR. ■ In the peak hour, the planned LUL scheme to increase gate line capacity to match escalator capacity is necessary in the Reference Case, but would prove insufficient for the scenarios with additional development. ■ The additional flows forecast in all development scenarios would result in insufficient escalator capacity at the Vauxhall Underground station. The increase in alighters would restrict the ability of escalators to be reversed to accommodate the additional boarders. ■ Without increased escalator capacity, passengers would have to be held outside the station and the station would be 'exit only' during busy periods. ■ It is estimated by LUL that any scheme to increase escalator capacity at Vauxhall would cost over £100 million. LUL consider the scheme may not be desirable due to 'knock on' impacts further up the Victoria Line at Victoria Station. ■ The development scenarios are not forecast to have a significant impact on the number of passengers transferring from NR to Underground services.	■ The key problem at Vauxhall is the lack of spare capacity at the Underground station. The main constraint is the gate line which has insufficient capacity for the 2026 Reference Case demand. The escalators are also forecast to have insufficient capacity for the planned development scenarios. ■ Bus and LRT options offer little benefit in reducing the boarders and in particular alighters at Vauxhall Underground station. In some development scenarios, particularly those with the LRT scheme, the addition of a transport package results in a slight increase of passengers. ■ Transport packages which include the Northern Line Extension are forecast to give a significant reduction in the number of passengers using Vauxhall Underground station. In all cases passenger numbers are reduced to within current escalator (although not current gate line) capacity. ■ The transport packages do not result in any significant change in the number of interchange passengers between NR and Underground services at Vauxhall

Station	Impact of OA Scenarios	Impact of Transport Packages
Victoria	■ The development scenarios forecast similar levels of boarders and alighters from the Victoria Line to the 2026 Reference Case scenario ■ The development scenarios forecast similar levels of interchange passengers between Victoria Line and NR to the 2026 Reference Case scenario ■ There are small increases forecast in the order of 150-200 pax/hr in the interchange passengers between the Victoria Line and District line ■ All development scenarios are forecast to remain within the existing station capacity of 18,000 pax/hr (3 escalators), although this does mean effective crowd management and even spread of station use would be required ■ The Victoria Station Upgrade (VSU) has not been considered as part of this analysis. However the development in the OA may provide an additional justification for the programme of work.	■ The introduction of transport packages are forecast to result in small reductions in boarders and alighters in the order of 500-800 pax/hr from the Victoria line with options containing the NLE having the most effect ■ All transport packages are forecast to result in a small reduction in the number of interchange passengers from NR to Underground and between the District and Victoria lines ■ The transport packages are forecast to provide limited relief to Victoria Station when compared with the 2026 Reference Case scenario, due to the large number of users overall ■ Crowd management at Victoria Station would need to be effectively managed to ensure sufficient capacity is available for the projected flows
Battersea Park	■ The development scenarios forecast significantly higher numbers of boarders above the 2026 Reference Case, with OA Scenario 2 adding around 500 passengers, and Scenarios 3 and 4 over 1,000. ■ The forecast increase in alighting passengers is less marked except for OA Scenario 5 which adds over 800 passengers. ■ The levels of growth forecast place particular pressure on platform 4, where OA Scenario 5 represents a doubling of the 2026 Reference Case. ■ The constraints on both the width of platform 4 and the stairwell leading to the platform are likely to create an unsafe environment in the event of significant growth in passenger numbers.	■ Transport packages are forecast to be particularly effective in reducing the overall number of boarding passengers. The NLE scenarios are forecast to have the greatest effect in reducing boarding passengers for each scenario. ■ This reduction would be predominantly in the up direction. ■ There would also be an increase in alighters as Battersea Park becomes attractive as an interchange. This is less of a problem as the staircase configuration at Battersea Park is better suited for clearing alighters then dispersing boarders along the length of the platform.
Queenstown Road	■ The development scenarios forecast an increase in boarders of up around 500 in OA Scenario 4 and 400 in OA Scenario 5 ■ Alighters change less except in OA Scenario 5 where an increase of around 350 is forecast ■ Boarders are around double the number of alighters in scenarios 2,3 and 4, but roughly even in OA Scenario 5	■ The key effect of all transport packages is a reduction in the number of down alighters and up boarders ■ The net effect is that many packages forecast a reduction in passenger numbers to or below the 2026 Reference Case, but with a higher proportion of alighters

6.5 Road Traffic Effects

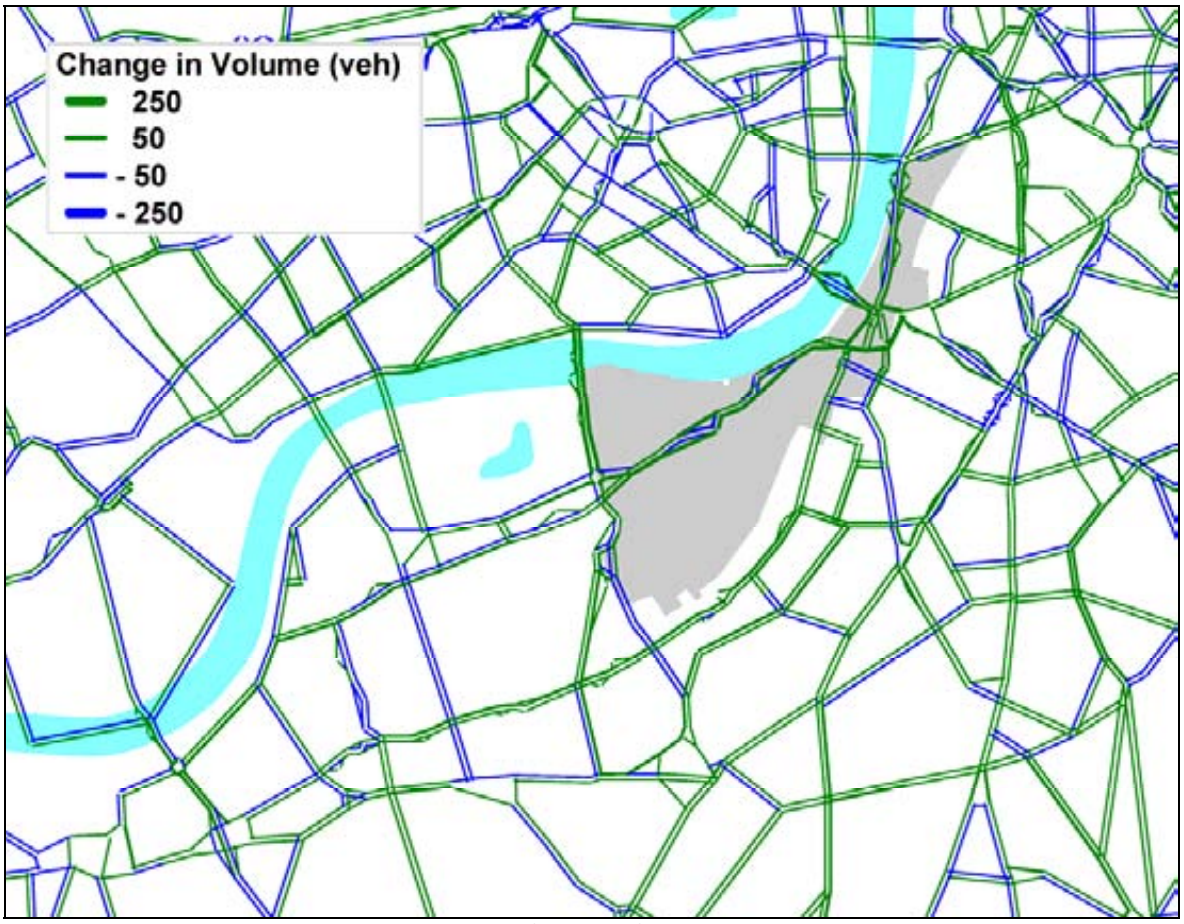
Traffic modelling of the transport initiatives has involved coding the changes in highway capacity attributable to the public transport scheme packages, and is thus primarily focused on the impacts of increased bus services and the LRT route.

Figure 58 to Figure 62 show the forecast traffic flow changes which would result from the Bus-only package in OA Scenario 4 and the Bus + LRT and Bus + NLE packages in OA Scenarios 4 and 5.

There would be small but widespread changes in traffic flow, mainly due to the changes in bus service levels and new bus routes which extend well beyond the immediate environs of the OA. Figure 59

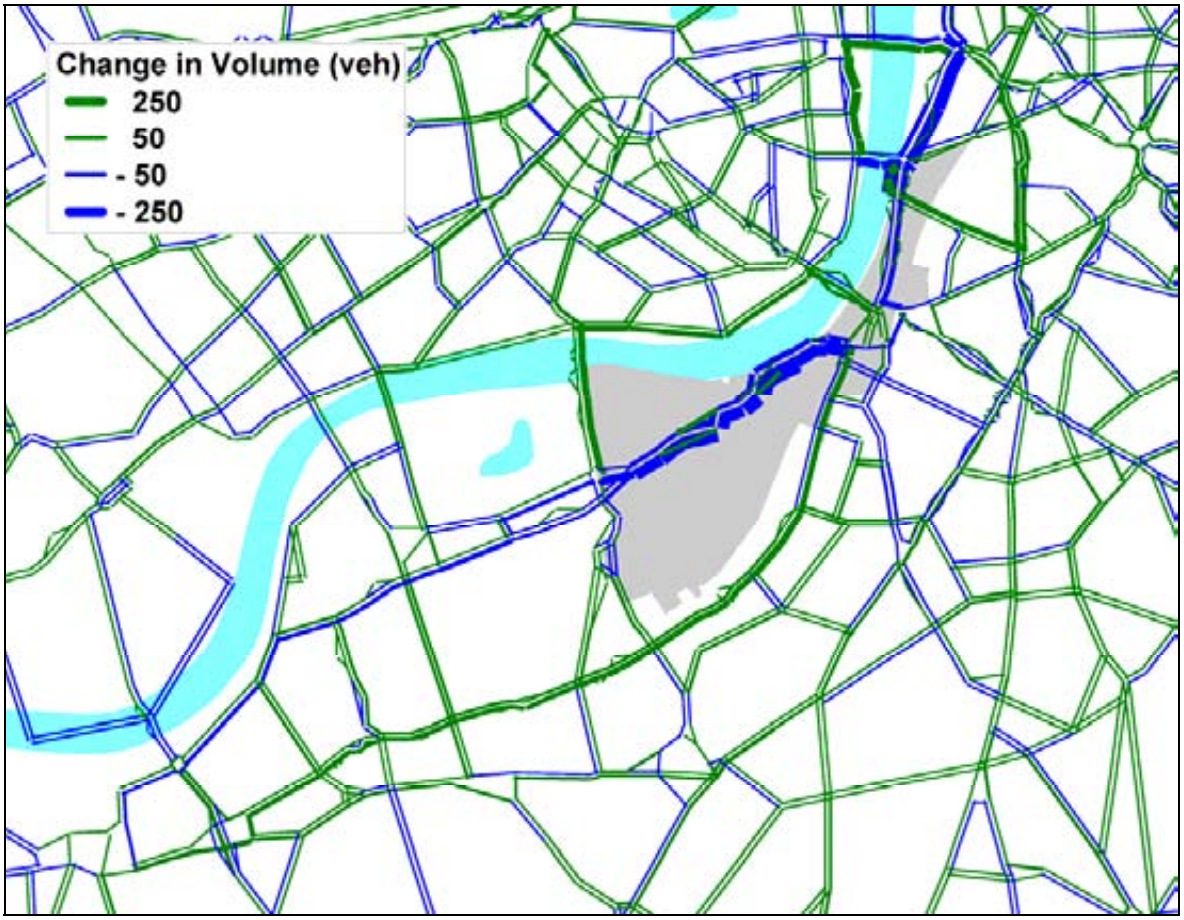
illustrates the effect of the LRT scheme in reducing the vehicular capacity of Nine Elms Lane and Albert Embankment.

Figure 58 Traffic Flow Changes Between Scenario 4 Bus-only Package and Scenario 4 Base, 2026 Morning Peak Hour (8-9am)



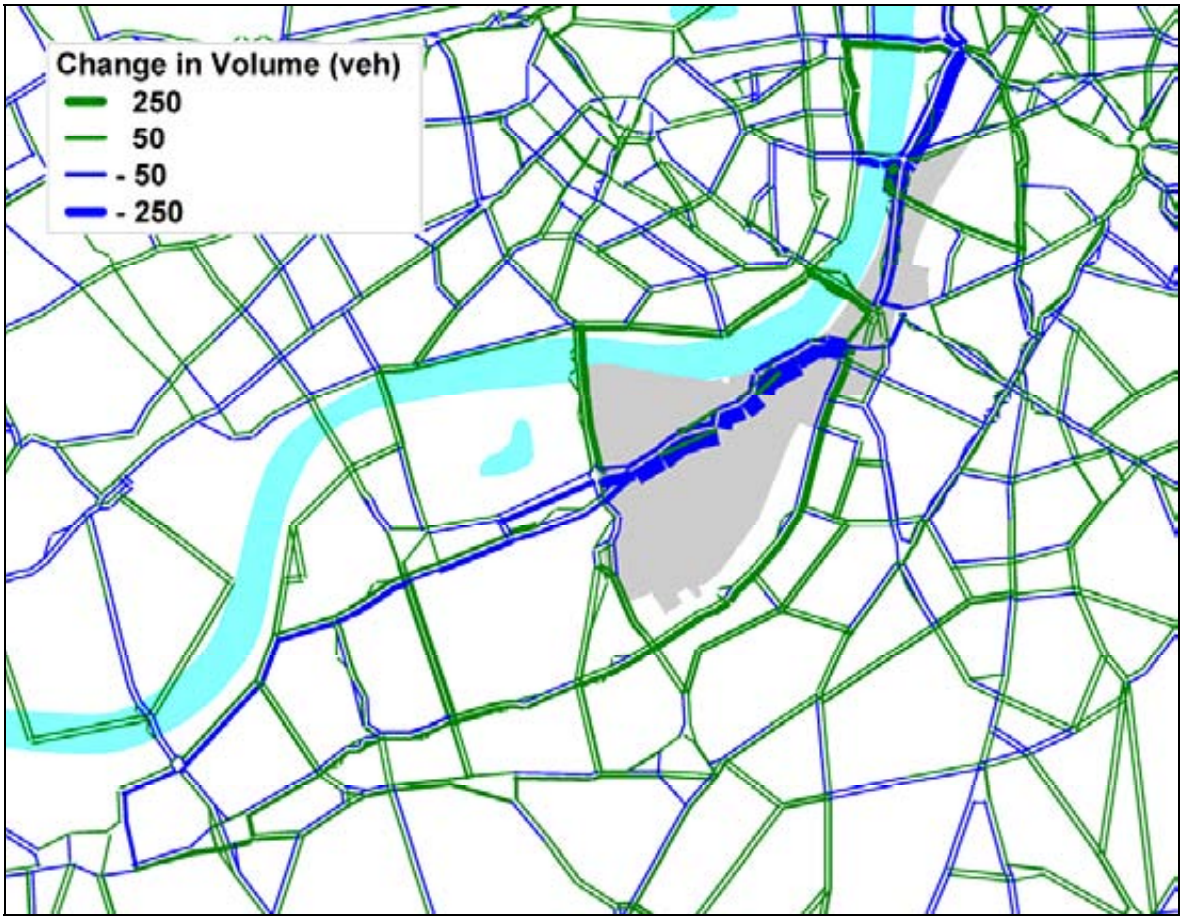
Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than representing individual flows or flow changes precisely.

Figure 59 Traffic Flow Changes Between Scenario 4 LRT Package and Scenario 4 Base, 2026 Morning Peak Hour (8-9am)



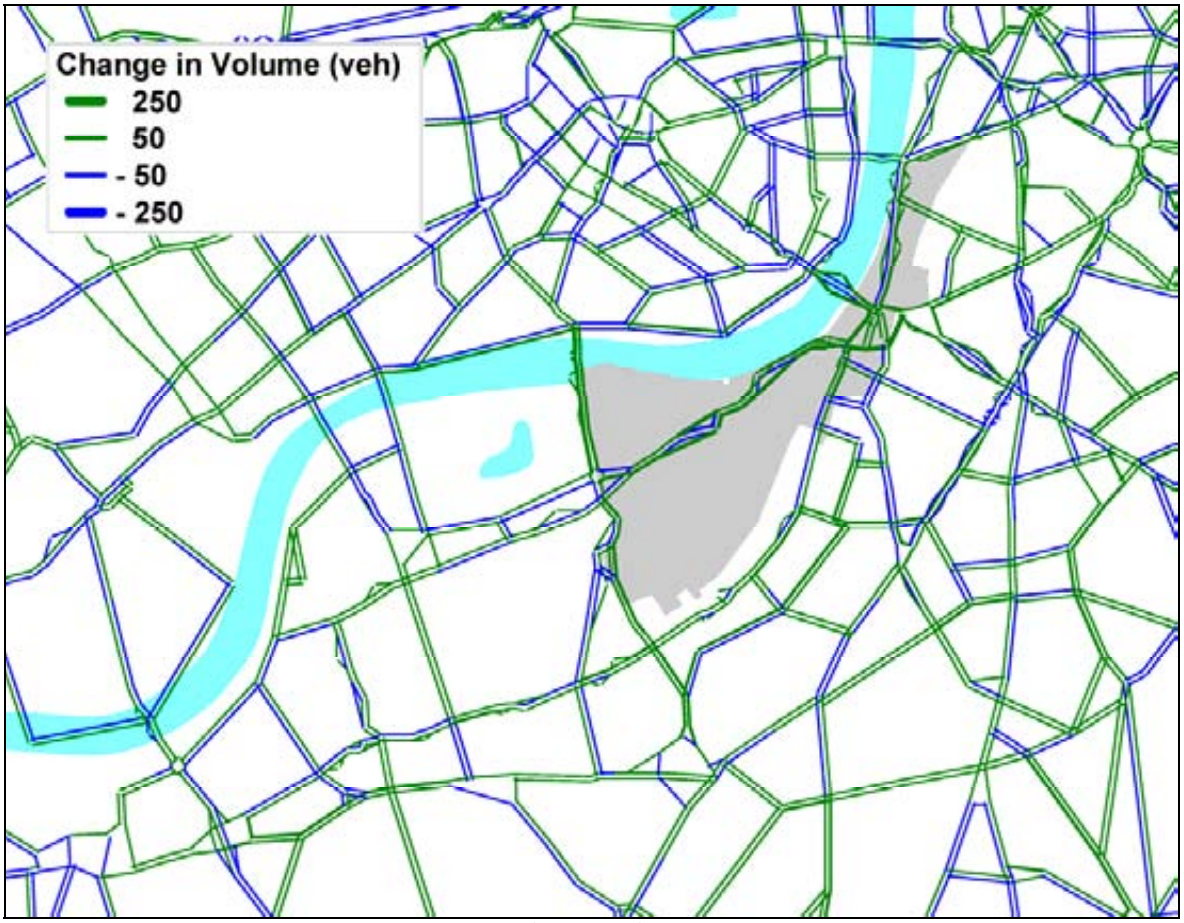
Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than representing individual flows or flow changes precisely.

Figure 60 Traffic Flow Changes Between Scenario 5 LRT Package and Scenario 5 Base, 2026 Morning Peak Hour (8-9am)



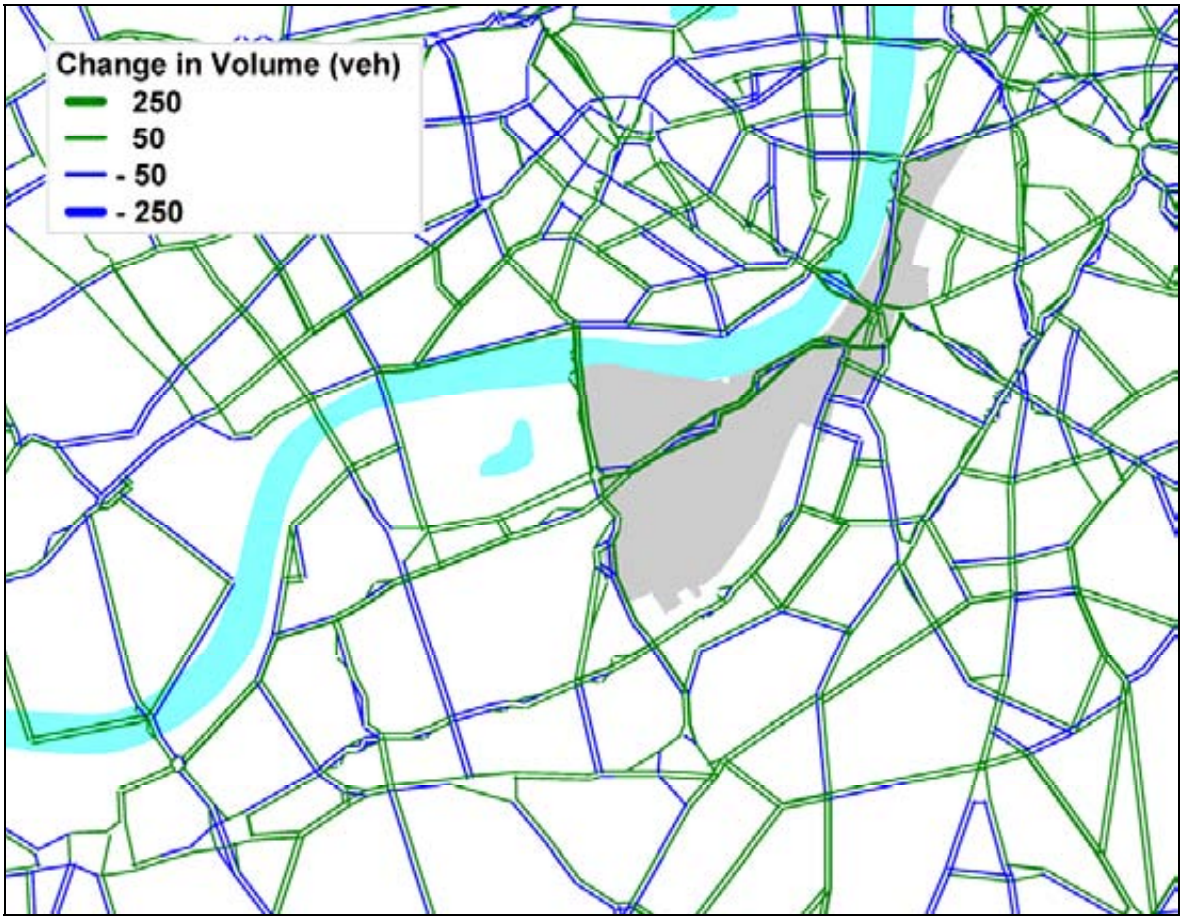
Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than representing individual flows or flow changes precisely.

Figure 61 Traffic Flow Changes Between Scenario 4 NLE Package and Scenario 4 Base, 2026 Morning Peak Hour (8-9am)



Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than representing individual flows or flow changes precisely

Figure 62 Traffic Flow Changes Between Scenario 5 NLE Package and Scenario 5 Base, 2026 Morning Peak Hour (8-9am)



Source: VNEB-H model assignment results. Given the level of accuracy of the VNEB-H model this diagram should be interpreted as illustrative of general flows rather than representing individual flows or flow changes precisely

6.6 General Conclusions

6.6.1 Bus

Bus patronage increases would be significant in all transport packages, and fairly consistent between development scenarios, reflecting the inclusion of bus service enhancements in all transport packages.

6.6.2 Light Rail Transit

The LRT option would reduce bus patronage significantly, partly due to the assumed removal of some bus routes along the LRT route. It would attract patronage levels approximately two-thirds of that forecast for the NLE.

The LRT scheme would attract NR users at Vauxhall and Waterloo bound for Battersea Power Station, especially in OA Scenarios 5.

It is conceivable that the LRT scheme could be replaced with Bus Rapid Transit (BRT) on the same route, which would offer some flexibility advantages as it could be used by existing route buses, but

may be limited in passenger carrying capacity compared with LRT or the NLE. Although not investigated in this study, it may prove worthy of further consideration.

The LRT route would have a significant impact on highway capacity along its length, requiring segregated sections that would result in a loss of one traffic lane in each direction on much of Albert Embankment and Nine Elms Lane. The modelling results indicate that significant re-routing of traffic would occur due to this.

6.6.3 Northern Line Extension

Patronage on the NLE is forecast to be higher than on the LRT scheme. Although it is a less direct route between Battersea Power Station and Waterloo, the NLE would provide a quicker service than the LRT, resulting in greater travel time savings per passenger.

The NLE – especially the Nine Elms/BPS option – would have significant potential to reduce passenger throughputs at rail stations (particularly Vauxhall, but also to certain movements at Battersea Park, Waterloo and Victoria).The NLE is also forecast to reduce Victoria Line flows by up to 9% south of Victoria, and up to 6% north of Victoria when the NLE and partial separation of the Northern Line are modelled together. The NLE alone (i.e. without partial separation of the Northern Line) would result in reductions of 5% south of Victoria, and up to 2% north of Victoria. Some of these reductions would also extend to the District Line east of Victoria.

7 Appraisal Methodology

7 Appraisal Methodology

7.1 Background

Appraisal of the transport packages documented in this report has been undertaken in line with guidance in TAG Unit 2.5 which specifies the approach, contents and methodology for a best practice appraisal process.

WebTAG specifies the appraisal process in four appraisal 'strands', as follows:

1) Achievement of Central Government objectives documented in the Appraisal Summary Table (AST). The populated AST outlines the contribution (or otherwise) of the proposal to the five Central Government objectives for transport (environment, safety, economy, accessibility and integration). This AST provides the basis for judging the overall value-for-money of the options in terms of achieving the Government's objectives, and is presented in Chapter 9.
2) An assessment of the degree to which the study objectives (local and regional) would be achieved. In the case of VNEB, this is interpreted as an appraisal of the transport packages against the study-specific objectives given in Section 2.2 herein, and is presented in Chapter 8.
3) An assessment of the extent to which the problems identified would be ameliorated by the options under consideration. In the case of VNEB, this is also covered by the appraisal against study-specific objectives presented in Chapter 8.
4) Supporting analyses of distribution and equity, affordability and financial sustainability, and practicality and public acceptability. These are of interest to the majority of stakeholders, including central and local government bodies and local transport providers (in terms of the financial sustainability of their operations), and are discussed in Chapter 9.

The overall aim of the appraisal was to establish the optimum transport package for each OA development scenario, to inform the OAPF.

The appraisal has been carried out in two stages. In the first stage, transport packages have been assessed against the study-specific objectives only. This appraisal is reported in Chapter 8 and enabled a shorter list of packages to be identified for full appraisal. This full appraisal is presented in Chapter 9 and includes all four appraisal strands listed above.

This appraisal is intended to provide indicative rather than precise results. It is intended as one part of a 'rounded' assessment and should only be taken in that context. Although the appraisal follows WebTAG guidelines and presents a BCR, this should not be regarded as the definitive recommendation as this appraisal is not an assessment of individual schemes themselves and looks only at packages of multiple schemes. Appraisals for each individual scheme would need to be undertaken before discrete schemes could be taken forward. In addition, this appraisal does not follow the methodology previously accepted by the DfT for Crossrail and other recent transport schemes and

therefore takes no account of the wider economic benefits (WEBs) such as agglomeration benefits that may be generated by each package.

7.2 Appraisal Frameworks

The framework for the appraisal against study-specific objectives is shown in Table 21.

Table 21 Appraisal Framework – Study-Specific Objectives

Objective	Sub-objective	Indicator	Source
To mitigate adverse impacts caused by development traffic, especially increases in congestion and adverse impacts on the environment.	Reduce noise	km of road with traffic increases > 25% km of road with traffic decreases > 25%	VNEB-H model VNEB-H model
	Improve local air quality	km of road with traffic increases > 10% km of road with traffic decreases > 10%	VNEB-H model VNEB-H model
	Reduce greenhouse gases	Change in greenhouse gas emissions - tonnes of CO2e/yr	VNEB-H model
	Reduce accidents	Change in personal injury accidents (pias) per year	VNEB-H model
	Reduce road congestion	Change in 2026 peak vehicle-hours/yr	VNEB-H model
		Change in traffic delays at key locations in the area of influence of OA development	VNEB-H model
To ensure that the area's economic potential is realised by improving accessibility to the development sites by walking, cycling, public transport, taxi and goods vehicle.	Improve public transport accessibility	Change in average PT Accessibility Index - for the OA as a whole - for the Lambeth part of the OA - for the Wandsworth part of the OA	PTAL methodology
	Improve walking and cycling accessibility	Change in walking and cycling provisions/linkages	Qualitative
	Improve taxi and goods vehicle accessibility	Change in 2026 peak HV & taxi-hours	VNEB-H model
		Change in traffic delays to taxis and HVs at key locations in the area of influence of OA development	VNEB-H model

The frameworks for the main appraisal against Central Government and TfL objectives are reproduced in Table 22 and Table 23.

Table 22 Appraisal Framework – Central Government Objectives

Objective	Sub-objective	Methodology	Indicator	Source
Environment – to protect the built and natural environment	Reduce noise	Aggregate length of roads where average daily traffic flow changes by more than 25% (same as initial appraisal)	km of road with traffic increases > 25%	VNEB-H
			km of road with traffic decreases > 25%	VNEB-H
	Improve local air quality	Aggregate length of roads where average daily traffic flow changes by more than 10% (same as initial appraisal)	km of road with traffic increases > 10%	VNEB-H
			km of road with traffic decreases > 10%	VNEB-H
	Reduce greenhouse gases	VNEB-H environmental outputs	Change in greenhouse gas emissions	VNEB-H
	Protect and enhance the landscape	Not relevant – refer to townscape below	Not assessed	N/A
	Protect and enhance the townscape	Assessments drawing on the contextual studies undertaken for the OAPF and the impacts of transport initiatives on relevant sites or areas	Impact on townscape	Qualitative
	Protect the heritage of historic resources		Impact on historic sites and resources	Qualitative
	Support biodiversity		Impact on natural resources	Qualitative
	Protect the water environment		Impact on water features and resources	Qualitative
	Encourage physical fitness	Change in number of people making walking and cycling journeys of more than 30 minutes/day	Change in number of people making walking and cycling journeys of more than 30 mins/day	Qualitative
	Improve journey ambience	Assessment of changes in traveller care, travellers' views and traveller stress attributable to transport initiatives	Change in traveller care, travellers' views and traveller stress	Qualitative
Safety – to improve safety	Reduce accidents	COBA default accident rates applied to changes in vehicle-km	Change in road accidents per year	VNEB-H
	Improve security	Assessment based on type and scale of transport infrastructure proposed	Change in traveller security	Qualitative
Economy – to support sustainable economic activity and get good value for money	Get good value for money in relation to impacts on public accounts	TUBA calculations: - economic benefits to users - private sector operator costs and revenues; and - scheme costs The TUBA results measure the extent to which the OA land use/transport combinations deliver economic improvements	Economic perfomance indicators including: - Benefit-cost ratio (BCR) - Present value of benefits & costs (PVB & PVC) - Net present value (NPV) Financial performance indicators including: - Transport operating cost changes - Fare revenue changes	TUBA
	Improve transport economic efficiency for business users and transport providers			
	Improve transport economic efficiency for consumer users			
	Improve reliability	Comparative analysis of congestion and crowding levels both in an overall sense (person- and vehicle-hours, average travel speeds) and at key points in the transport network, with and without the transport initiatives	Change in reliability indicators	VNEB-P
	Provide beneficial wider economic impacts	Appraisal of potential for changes in the number of employed residents (increased employment opportunity) in the area of influence of transport initiatives	Change in accessibility to employment opportunities in the OA and for OA residents	Qualitative
Accessibility – to improve access to facilities for those without a car and to reduce severance	Increase option values	Assessment based on range of opportunities created by the transport package in line with WebTAG guidance (e.g. >2,000 people served by a new rail service results in a 'strong beneficial' outcome)	Change in option values	Qualitative
	Reduce severance	Assess the degree to which identified severance issues are addressed by the transport elements, informed by the urban realm studies undertaken for the OAPF	Change in urban severance	Qualitative
	Improve access to the transport system	Estimation of PTALs with and without the transport initiatives – both for key locations in the OA and potentially across the area as a whole	Change in average PT Accessibility Index - for the OA as a whole - for the Lambeth part of the OA - for the Wandsworth part of the OA	PTAL methodology
Integration – to ensure that all decisions are taken in the context of the Government's integrated transport policy	Improve transport interchange	Passengers: Time spent in interchange at stations	Change in between-platform passenger hours	VNEB-P
			Change in between-station passenger hours	
		Freight: Commentary on changes in freight interchange facilities	Change in freight interchange facilities (including relocation)	Qualitative
	Integrate transport policy with land-use policy	Assessment of transport initiatives' compatibility with local plans and with the OAPF	Compatibility of transport initiatives with local plans and OAPF	Qualitative
	Integrate transport policy with other Government policies	Assessment of transport initiatives' compatibility with relevant government policies	Compatibility of transport initiatives with government policies	Qualitative

Table 23 Appraisal Framework – TfL Objectives

Objective	Methodology (based on WebTAG guidance)	Indicator	Source
Improve door-to-door journey times and reliability across our transport system	Comparative analysis of congestion and crowding levels both in an overall sense (person- and vehicle-hours, average travel speeds) and at key points in the transport network, with and without the transport initiatives	Change in 2026 AM peak PT passenger-hours	VNEB-P
		Reliability - change in PT crowded hours	VNEB-P
Engage people in the effective use of our system, with high	Operational issue not relevant to tranport option comparisons	Not assessed	N/A
Reduce CO2 emissions from ground transport and improve the energy efficiency of operations	TUBA outputs or VNEB-H (SATURN) environmental measurement outputs as appropriate (same as initial appraisal)	Change in greenhouse gas emissions - tonnes of CO2e	VNEB-H
Operate a safe and secure transport system	COBA default accident rates will be applied to changes in vehicle-km by road type as predicted using VNEB-H (same as initial appraisal)	Change in road accidents per year	VNEB-H
Deliver value for money	TUBA results used to measure the extent to which the OA land use/transport combinations deliver economic improvements	Economic perfomance indicators including: - Benefit-cost ratio (BCR) - Present value of benefits & costs (PVB & PVC) - Net present value (NPV) Financial performance indicators including: - Transport operating cost changes - Fare revenue changes	TUBA
Influence a shift towards more sustainable modes of transport	Mode shares from LTS model run results for each OA scenario, exploring the shift to public transport, walking and cycling	Public transport, car and slow mode shares	LTS
Support sustainable growth and regeneration	Extent to which the transport initiatives improve the sustainability of OA development	Change in sustainability of OA development - linked to PTALS	Qualitative
Provide accessible, affordable and inclusive links between communities and the employment, education and other opportunities London offers	Observations on the linkage between OA development and employment, education and other opportunities (primarily central London-focussed) facilitated by transport initiatives	Change in accessibility to employment opportunities in the OA and for OA residents - linked to PTALs	Qualitative
Improve the local environment in and around our transport system and enhance the urban realm	Assessments drawing on the contextual studies undertaken for the OAPF and the impacts of transport initiatives on relevant sites or areas	Change in local environment and urban realm	Qualitative
Ensure that the movement of freight and services within London is efficient and reliable	Changes in freight vehicle-hours and average speeds from VNEB-H model results, and assessment of key locations where traffic delay occurs	Changes in freight vehicle-hours	VNEB-H
		Change in average freight vehicle speeds	VNEB-H
		Change in traffic delays at key locations	VNEB-H

8 Appraisal against study-specific objectives

8 Appraisal Against Study-Specific Objectives

Results of the appraisal against study-specific objectives are presented in Table 24 to Table 27 for OA Scenarios 2 to 5 respectively.

Table 24 Appraisal Against Study-Specific Objectives, OA Scenario 2

[redacted]

Table 25 Appraisal Against Study-Specific Objectives, OA Scenario 3

Study-specific objective	Sub-objective	Indicator	*Development scenario* / *Transport package* / *Description*	Scenario 3 L1 Full bus package	L2 Full bus package + ped/cycle bridge	M Full bus package + LRT	H1 Full bus package + NLE (BPS)	H2 Full bus package + NLE (Vaux & BPS)
To mitigate adverse impacts caused by development traffic, especially increases in congestion and adverse impacts on the environment.	Reduce noise	km of road with traffic increases > 25%		3km	3km	4km	3km	3km
		km of road with traffic decreases > 25%		1km	1km	3km	1km	1km
	Improve local air quality	km of road with traffic increases > 10%		7km	7km	12km	7km	8km
		km of road with traffic decreases > 10%		4km	4km	10km	4km	4km
	Reduce greenhouse gases	Change in greenhouse gas emissions - tonnes of CO_2e/yr		80 tonne/yr	80 tonne/yr	510 tonne/yr	80 tonne/yr	80 tonne/yr
	Reduce accidents	Change in personal injury accidents (pia) per year		0.2 pia/yr	0.2 pia/yr	0.4 pia/yr	0.2 pia/yr	0.2 pia/yr
	Reduce road congestion	Change in 2026 peak vehicle-hours		0.1 m veh-hr/yr	0.1 m veh-hr/yr	0.4 m veh-hr/yr	0.1 m veh-hr/yr	0.1 m veh-hr/yr
		Change in traffic delays at key locations in and around the OA		Little material change compared to Base	Little material change compared to Base	Significant traffic impacts in vicinity of LRT route	Little material change compared to Base	Little material change compared to Base
To ensure that the area's economic potential is realised by improving accessibility to the development sites by walking, cycling, public transport, taxi and goods vehicle.	Improve public transport accessibility	Change in average PT Accessibility Index for the OA as a whole		4.8 increase	4.8 increase	7.6 increase	6.7 increase	7.2 increase
		- for the Lambeth part of the OA		5.4 increase	5.4 increase	7.7 increase	5.4 increase	6.9 increase
		- for the Wandsworth part of the OA		4.5 increase	4.5 increase	7.6 increase	7.2 increase	7.4 increase
	Improve walking and cycling accessibility	Change in walking and cycling provisions/linkages		No change from Scenario 3 Base	Cross-river link improves ped/cycle connection to inner London	No change from Scenario 3 Base	No change from Scenario 3 Base	No change from Scenario 3 Base
	Improve taxi and goods vehicle accessibility	Change in 2026 peak HV & taxi-hours		-0.01 m veh-hr/yr	-0.01 m veh-hr/yr	0.03 m veh-hr/yr	-0.01 m veh-hr/yr	-0.01 m veh-hr/yr
		Change in traffic delays to taxis and HVs at key locations in and around the OA		Model not suitable for assessing specific effects for taxis and goods vehicles				

Table 26 Appraisal Against Study-Specific Objectives, OA Scenario 4

Study-specific objective	Sub-objective	Indicator	*Development scenario* Scenario 4 *Transport package* L *Description* Full bus package + ped/cycle bridge	M Full bus package + LRT	H1 Full bus package + NLE (BPS)	H2 Full bus package + NLE (NE PO)	H3 Full bus package + NLE (NE & BPS)
To mitigate adverse impacts caused by development traffic, especially increases in congestion and adverse impacts on the environment.	Reduce noise	km of road with traffic increases > 25%	2km	4km	2km	2km	2km
		km of road with traffic decreases > 25%	1km	3km	1km	1km	1km
	Improve local air quality	km of road with traffic increases > 10%	7km	9km	7km	7km	7km
		km of road with traffic decreases > 10%	4km	8km	4km	4km	4km
	Reduce greenhouse gases	Change in greenhouse gas emissions - tonnes of CO_2e/yr	150 tonne/yr	350 tonne/yr	150 tonne/yr	150 tonne/yr	150 tonne/yr
	Reduce accidents	Change in personal injury accidents (pia) per year	0.4 pia/yr	0.6 pia/yr	0.4 pia/yr	0.4 pia/yr	0.4 pia/yr
	Reduce road congestion	Change in 2026 peak vehicle-hours	0.2 m veh-hr/yr	0.4 m veh-hr/yr	0.2 m veh-hr/yr	0.2 m veh-hr/yr	0.2 m veh-hr/yr
		Change in traffic delays at key locations in and around the OA	Little material change compared to Base	Significant traffic impacts in vicinity of LRT route	Little material change compared to Base	Little material change compared to Base	Little material change compared to Base
To ensure that the area's economic potential is realised by improving accessibility to the development sites by walking, cycling, public transport, taxi and goods vehicle.	Improve public transport accessibility	Change in average PT Accessibility Index for the OA as a whole	4.8 increase	7.6 increase	6.7 increase	6.6 increase	7.2 increase
		- for the Lambeth part of the OA	5.4 increase	7.7 increase	5.4 increase	5.4 increase	6.1 increase
		- for the Wandsworth part of the OA	4.5 increase	7.6 increase	7.2 increase	7.0 increase	7.6 increase
	Improve walking and cycling accessibility	Change in walking and cycling provisions/linkages	Cross-river link improves ped/cycle connection to inner London	No change from Scenario 4 Base	No change from Scenario 4 Base	No change from Scenario 4 Base	No change from Scenario 4 Base
	Improve taxi and goods vehicle accessibility	Change in 2026 peak HV & taxi-hours	-0.01 m veh-hr/yr	0.03 m veh-hr/yr	-0.01 m veh-hr/yr	-0.01 m veh-hr/yr	-0.01 m veh-hr/yr
		Change in traffic delays to taxis and HVs at key locations in and around the OA	Model not suitable for assessing specific effects for taxis and goods vehicles				

Table 27 Appraisal Against Study-Specific Objectives, OA Scenario 5

Study-specific objective	Sub-objective	Indicator	*Development scenario* Scenario 5 *Transport package* L *Description* Full bus package + ped/cycle bridge	M Full bus package + LRT	H1T Full bus package + NLE (Vaux & BPS)	H2T Full bus package + NLE (NE & BPS) + ped/cycle bridge
To mitigate adverse impacts caused by development traffic, especially increases in congestion and adverse impacts on the environment.	Reduce noise	km of road with traffic increases > 25%	3km	2km	1km	1km
		km of road with traffic decreases > 25%	1km	4km	2km	2km
	Improve local air quality	km of road with traffic increases > 10%	7km	11km	6km	6km
		km of road with traffic decreases > 10%	6km	11km	7km	6km
	Reduce greenhouse gases	Change in greenhouse gas emissions - tonnes of CO_2e/yr	340 tonne/yr	710 tonne/yr	120 tonne/yr	230 tonne/yr
	Reduce accidents	Change in personal injury accidents (pia) per year	0.5 pia/yr	0.8 pia/yr	0.3 pia/yr	0.4 pia/yr
	Reduce road congestion	Change in 2026 peak vehicle-hours	0.2 m veh-hr/yr	0.5 m veh-hr/yr	0.1 m veh-hr/yr	0.2 m veh-hr/yr
		Change in traffic delays at key locations in and around the OA	Little material change compared to Base	Significant traffic impacts in vicinity of LRT route	Little material change compared to Base	Little material change compared to Base
To ensure that the area's economic potential is realised by improving accessibility to the development sites by walking, cycling, public transport, taxi and goods vehicle.	Improve public transport accessibility	Change in average PT Accessibility Index for the OA as a whole	4.8 increase	7.6 increase	7.2 increase	7.2 increase
		- for the Lambeth part of the OA	5.4 increase	7.7 increase	6.9 increase	6.1 increase
		- for the Wandsworth part of the OA	4.5 increase	7.6 increase	7.4 increase	7.6 increase
	Improve walking and cycling accessibility	Change in walking and cycling provisions/linkages	Cross-river link improves ped/cycle connection to inner London	No change from Scenario 5 Base	No change from Scenario 5 Base	Cross-river link improves ped/cycle connection to inner London
	Improve taxi and goods vehicle accessibility	Change in 2026 peak HV & taxi-hours	0.01 m veh-hr/yr	0.06 m veh-hr/yr	-0.02 m veh-hr/yr	0.01 m veh-hr/yr
		Change in traffic delays to taxis and HVs at key locations in and around the OA	Model not suitable for assessing specific effects for taxis and goods vehicles			

The appraisal results demonstrate the inherent trade-off between improving public transport capacity/accessibility and increasing vehicular congestion and related effects. This is because all of the transport packages would entail on-street priority works for public transport to varying degrees, and also because no highway improvement measures have been included in the packages assessed.

All transport packages involve bus service improvements and additional routes which would increase bus traffic, with some minor impacts on other traffic. Transport packages involving the LRT scheme would result in the largest adverse traffic impacts, because the LRT scheme would require substantial dedicated road space. Packages that include the NLE would fare a little better, but would still produce negative traffic impacts overall due to the inclusion of buses.

The key traffic impacts for all transport packages in 2026 are forecast to be:

- increases in the length of roads where noise and air quality would worsen appreciably, not fully offset by decreases in the length of roads where they would improve;
- increased CO_2 emissions from traffic of up to 700 tonnes a year;
- increased peak period vehicle-hours, generally between 0.1 and 0.5 million pcu-hours a year; and
- marginally increased road accidents, generally around 0.5 personal injury accidents a year.

8.1 Conclusions from the Appraisal Against Study-Specific Objectives

8.1.1 OA Scenario 2

Appraisal of OA Scenario 2 transport packages indicates that the 20% increase in bus service levels would improve the public transport accessibility indices (PTAIs) by an average of 3.4 points, compared with 4.8 for the more comprehensive set of bus system upgrades (improved existing routes plus the new routes illustrated in Figure 42).

The public transport improvements would be offset by worsened traffic conditions caused by the road space taken for buses, giving rise to some negative traffic-related impacts that would be, not surprisingly, greater for the full bus-only transport package than they would be for the 20% service frequency increase.

It appears that a bus-only solution in some form would function satisfactorily, carrying significant patronage to and from the OA. The station capacity analysis suggests, however, that improvements might be required at Vauxhall to accommodate increased transfer and interchange activity there. The impacts at Vauxhall station are unsurprisingly less pronounced than those of the higher development scenarios and capacity limitations may be mitigated by bus based solutions.

8.1.2 OA Scenario 3

The bus packages in OA Scenario 3 are forecast to give rise to similar effects as in OA Scenario 2 already discussed, namely an average increase in public transport accessibility indices of 4.8, offset by worsened traffic conditions caused by the road space taken for buses.

The LRT scheme package would provide the best average PTAL increase, of 7.6 points, but would also give rise to significant negative traffic impacts due to the reduced traffic capacity on Albert Embankment and the Vauxhall gyratory. In addition to the congestion increases, noise, air quality, emissions and safety impacts would be all significantly greater than the NLE packages tested. Notably, the PTAL increase for the Wandsworth part of the OA (where public transport is presently far less accessible than in the Lambeth part) is the same for both the LRT and NLE packages.

8.1.3 OA Scenario 4

The bus and LRT scheme packages in OA Scenario 4 would give rise to similar impacts to those in OA Scenario 3, namely:

- for bus, an average PTAI increase of 4.8, offset by worsened traffic conditions caused by the road space taken for buses; and
- for LRT, an average PTAI increase of 7.6 but greater negative traffic-related impacts caused by the reduced traffic capacity on Albert Embankment and the Vauxhall gyratory.

All three NLE packages in OA Scenario 4 would result in near-identical road traffic impacts (given the fixed matrix approach to modelling). The two-station Nine Elms/Battersea Power Station scheme package would give the greatest PTAI increase of 7.2, which is marginally less than that for the LRT scheme (7.6). However as with Scenario 3 both the LRT and NLE packages would provide the same levels of PTAI increase in the Wandsworth part of the OA.

8.1.4 OA Scenario 5

The bus and LRT scheme packages in OA Scenario 5 would give rise to similar impacts to those in OA Scenarios 3 and 4, namely:

- for bus, an average PTAI increase of 4.8, offset by worsened traffic conditions caused by the road space taken for buses; and
- for LRT, an average PTAI increase of 7.6 but greater negative traffic-related impacts caused by the reduced traffic capacity on Albert Embankment and the Vauxhall gyratory.

The modelling of NLE packages in OA Scenario 5 includes estimation of mode shift and redistribution using the LTS Model. The extent of the estimated shift from car to public transport is not large, but it would give rise to marginally reduced negative traffic impacts compared with the same schemes in other scenarios.

8.1.5 Summary

The appraisal against the study-specific objectives points to the following candidate transport packages for further assessment, bearing in mind the need to retain a representative cross-section of the most effective options:

- OA Scenario 3
  - Bus package only
  - Bus + LRT
- OA Scenario 4
  - Bus package only
  - Bus + LRT
  - Bus + NLE
- OA Scenario 5
  - Bus + LRT
  - Bus + NLE.

These scenario/scheme combinations have been taken forward to the full appraisal.

Rather than test different NLE options, the Nine Elms/Battersea Power Station scheme has been selected as a representative example for comparative analysis. This option attracts higher patronage than the other NLE options, and it is the lowest cost two-station scheme (the Vauxhall/BPS scheme is longer and involves complex station construction at Vauxhall).

OA Scenario 2 (and, by inference, OA Scenario 1) would probably only justify bus service enhancements. As such the transport packages are generally less strategic as bus services are much easier and cheaper to provide than rail-based public transport modes.

9 Full appraisal

9 Full Appraisal

The full appraisal has been undertaken on the shortlisted transport scheme packages for OA Scenarios 3, 4 and 5.

9.1 Economic Appraisal Approach

WebTAG 2.5 specifies the approach, contents and methodology for a best practice appraisal process, which supports the government objective to "support sustainable economic activity and get good value for money". The degree to which VNEB transport packages achieve or contribute to this objective has been assessed in terms of Transport Economic Efficiency and Public Accounts. Due to the strategic and preliminary nature of this study, Reliability and Wider Economic Impacts have not been considered in this appraisal. Accident benefits are negligible (given the relatively small scale of traffic changes) and are not reported.

For the purposes of this appraisal, only the costs and benefits directly associated with the different transport packages have been considered. This means that the costs of implementing any additional enabling works have not been considered. This is particularly relevant for any additional work that may be required at Vauxhall Underground station and the associated cost. The decision not to include these costs was made to ensure as accurate a comparison as possible between different transport packages and to remove the uncertainty over the costs and feasibility of additional work (particularly at Vauxhall). These additional enabling works will however be taken into account when considering the conclusions and final recommendations of this study.

The main appraisal uses Transport User Benefit Appraisal (TUBA) software in line with WebTAG.

9.1.1 Transport Economic Efficiency Appraisal

The Transport Economic Efficiency appraisal requires the calculation of User Benefits. The approach taken in calculating the User Benefits for the VNEB Transport Study, as modelled in VNEB-P and VNEB-H models is explained below.

The TEE appraisal covers the following:

- consumer and business user benefits:
  - public transport and highway user travel time savings, for both consumer and business users (calculated from VNEB-P and VNEB-H model outputs and offset by public transport user charges); and
  - vehicle operating costs (calculated from VNEB-H model outputs split by vehicle type).
- private sector provider impacts
  - operating costs and revenues;
  - investment costs (assumed to be borne by local government for VNEB schemes); and

- private sector funding, including but not exclusive to development contributions (see below).

The present value of the sum of these benefits and impacts is used in the analysis of monetised costs and benefits which is discussed in Section 9.1.3.

Transport Economic Efficiency (TEE) appraisal results for the transport packages have been presented relative to the Reference Case for each OA development scenario, rather than against a 'no-development' Reference Case. The TEE results should not be used to compare the packages between different OA development scenarios. This is partly because, in the modelling of each development scenario, different approaches were used to balance population and employment growth in the OA against that projected outside the OA.

The effects of each transport package have been appraised within each development scenario (using as a reference case, the relevant development scenario without any transport interventions). Any fare revenue generated by the development itself is irrelevant to the appraisal of transport packages within a given development scenario; it is the incremental fare revenue generated by changes in transport use within a given development scenario that we are concerned with in the appraisal. This is consistent with the treatment of other costs.

Treatment of private sector funding

The appraisal results assume that all schemes are government funded, to provide a consistent baseline in line with WebTAG.

The private sector funding question is covered in the analysis of scenarios in which the larger transport elements – namely the LRT and NLE schemes – are assessed assuming 100% of the capital cost is covered by private sector funding.

Although private sector funding is in some cases used to cover the first few years' operating costs of new services, it would be highly unusual to expect private sector funding to cover the full present value of operating costs, which are projected over the 60-year evaluation period.

9.1.2 Public Accounts

In the Public Accounts (PA) appraisal, only "Cost to Government" is shown as a cost. It is too early to decide who would bear the costs of land, infrastructure, rolling stock and operation and who would receive the revenues. This appraisal currently assumes all costs are borne by, and revenues accrue to, Government. We have however considered the potential effect of private sector funding in reaching conclusions. The scheme costs have been set out in Chapter 5 and the calculation of the revenues is explained in 9.1.4 below.

The PA appraisal covers the following costs:

- local government funding (capital costs of transport schemes);

- Central Government funding (indirect tax revenues);
- direct revenue (fare revenue changes calculated from VNEB-P results); and
- private sector provider costs (public transport operating costs).

9.1.3 Analysis of Monetised Costs and Benefits (AMCB)

Present Value of Costs (PVC) and Present Value of Benefits (PVB) are brought together in the Analysis of Monetised Costs and Benefits (AMCB), which has been undertaken in accordance with WebTAG.

9.1.4 Summary

The user benefits have been calculated from the VNEB model results using TUBA, except the fare revenue and related public transport user charge calculations which have been estimated as follows:

1) Annual revenues by sub-mode were obtained from TfL's Annual Report for 2007/8, and a rate per passenger-km was estimated for each sub-mode (bus, Underground, DLR, and NR) using annualised passenger-km estimates from the calibrated 2008 VNEB-P model. This analysis demonstrated that the average revenue per passenger-km for bus is higher than the other modes, which reflects the higher fares paid by most bus users.
2) These estimated rates were applied to the VNEB-P modelled results for the relevant future year/scenario combinations to provide estimated annual revenues and their present values, from which the change in revenue was calculated between each of the transport packages and its associated 'base' case in each OA Scenario.
3) For all modelled scenario/transport package combinations assessed using a fixed public transport matrix, the public transport user charges were taken to be equal to the fare revenues. For the one scenario modelled with a variable matrix (the NLE option in OA scenario 5), the additional revenue compared to the same package modelled with a fixed matrix was halved to equate to user charges associated with new public transport users.

User benefits have been calculated for the following areas to remove modelling 'noise':

- in VNEB-P, the nine innermost London Boroughs (Camden, City of London, Hammersmith & Fulham, Islington, Kensington & Chelsea, Lambeth, Southwark, Wandsworth and Westminster); and
- in VNEB-H the area of influence of OA development as established during model development.

The results are given in Table 28, which summarises the TEE, PA and AMCB tables (given in Appendix E).

Table 28 Results of Economic Appraisal of Shortlisted Transport Packages

All figures (except BCR) in £m			Scenario 3		Scenario 4			Scenario 5	
			Bus only	Bus+ LRT	Bus only	Bus+ LRT	Bus+ NLE	Bus+ LRT	Bus+ NLE
Benefits	Consumer Users	PT travel time	826	1,016	785	861	1,313	1,223	1,217
		PT user charges	0	-10	-8	2	-32	30	-51
		Hwy travel time	-21	-147	-75	-189	-75	-204	-71
		Total	805	859	701	674	1,206	1,048	1,095
	Business User and Providers	PT travel time	551	678	523	574	875	815	811
		PT user charges	0	-7	-5	2	-21	20	-34
		Hwy travel time	-21	-195	-129	-335	-129	-262	-58
		Total	530	475	389	240	726	573	720
	Other Business Impacts	PT	0	0	0	0	0	0	0
		Hwy	0	0	0	0	0	0	0
		Total	0	0	0	0	0	0	0
	Accidents	PT	0	0	0	0	0	0	0
		Hwy	0	0	0	0	0	0	0
		Total	0	0	0	0	0	0	0
	Greenhouse Gases	PT	0	0	0	0	0	0	0
		Hwy	0	-2	-1	-2	-1	-2	0
		Total	0	-2	-1	-2	-1	-2	0
	Present Value of Benefits (PVB)	PT	1,378	1,677	1,294	1,438	2,136	2,087	1,944
		Hwy	-42	-344	-205	-526	-205	-468	-129
		Total	1,336	1,333	1,089	913	1,931	1,619	1,815
Costs *	Local Government Funding	PT	7	167	7	167	833	167	832
		Ped bridge	34	0	34	0	0	0	34
		Hwy	0	0	0	0	0	0	0
		Total	42	167	42	167	833	167	867
	Central Government Funding	PT	0	0	0	0	0	0	0
		Ped bridge	0	0	0	0	0	0	0
		Hwy	-2	-10	-5	-13	-5	-13	-1
		Total	-2	-10	-5	-13	-5	-13	-1
	Revenue	PT	1	-17	-14	4	-53	49	-151
		Hwy	0	0	0	0	0	0	0
		Total	1	-17	-14	4	-53	49	-151
	Developer Contribution	PT	0	0	0	0	0	0	0
		Ped bridge	0	0	0	0	0	0	0
		Hwy	0	0	0	0	0	0	0
		Total	0	0	0	0	0	0	0
	Private Sector Provider Costs	PT	416	424	416	424	662	424	662
		Ped bridge	0	0	0	0	0	0	0
		Hwy	0	0	0	0	0	0	0
		Total	416	424	416	424	662	424	663
	Present Value of Costs (PVC) **	PT	423	574	409	594	1,442	640	1,343
		Ped bridge	34	0	34	0	0	0	35
		Hwy	-2	-10	-5	-13	-5	-13	-1
		Total	455	564	439	582	1,437	627	1,377
Net Present Value (NPV)			880	769	650	331	493	993	438
Benefit to Cost Ratio (BCR)			2.9	2.4	2.5	1.6	1.3	2.6	1.3

* Excludes mitigation costs / impacts on Vauxhall LUL station and highway mitigation costs to accommodate LRT

** PVC assumes capital costs completely funded through the public purse

9.2 OA Scenario 3

Full appraisal results for OA Scenario 3 are given in Table 29 (Central Government objectives) and Table 30 (TfL objectives). Reference is also made to Table 25 (Study-Specific objectives) in Chapter 8, and to the economic appraisal in Table 28.

Table 29 Appraisal Against Central Government Objectives, OA Scenario 3

Central Government Objectives		*Development scenario*	Scenario 3		
		Transport package	Base	L2	M
		Description	Without transport packages	Full bus package + ped/cycle bridge	Full bus package + LRT
Objective	Sub-objective	Indicator			
Environment – to protect the built and natural environment	Reduce noise	km of road with traffic increases > 25%	Base for appraisal	3km	4km
		km of road with traffic decreases > 25%	Base for appraisal	1km	3km
	Improve local air quality	km of road with traffic increases > 10%	Base for appraisal	7km	12km
		km of road with traffic decreases > 10%	Base for appraisal	4km	10km
	Reduce greenhouse gases	Change in greenhouse gas emissions - tonnes of CO2e/yr	Base for appraisal	80 tonnes/yr	510 tonnes/yr
	Protect and enhance the landscape	Not assessed	Not assessed	Not assessed	Not assessed
	Protect and enhance the townscape	Impact on townscape	Base for appraisal	Slight change on key bus routes	Slight change on key bus routes Substantial change on LRT route
	Protect the heritage of historic resources	Impact on historic sites and resources	Base for appraisal	No change from Base	Potential significant impact (LRT infrastructure)
	Support biodiversity	Impact on natural resources	Base for appraisal	Little or no expected impact	Little or no expected impact
	Protect the water environment	Impact on water features and resources	Base for appraisal	Little or no expected impact	Little or no expected impact
	Encourage physical fitness	Change in number of people making walking and cycling journeys of more than 30 mins/day	Base for appraisal	Little or no expected impact	Little or no expected impact
	Improve journey ambience	Change in traveller care, travellers' views and traveller stress	Base for appraisal	New bus routes will provide slightly improved experience for users	New bus routes will provide slightly improved experience for users
Safety – to improve safety	Reduce accidents	Change in road accidents per year	Base for appraisal	0.2 pias/year	0.4 pias/year
	Improve security	Change in traveller security	Base for appraisal	New bus routes will provide slightly improved security for users	New bus/LRT routes will provide significantly improved security for users
Economy – to support sustainable economic activity and get good value for money	Get good value for money in relation to impacts on public accounts	Present value of benefits (£m)	Base for appraisal	£1,336m	£1,333m
		Present value of costs (£m)	Base for appraisal	£455m	£564m
		Net present value (£m)	Base for appraisal	£880m	£769m
		Benefit-cost ratio	Base for appraisal	2.9	2.4
	Improve transport economic efficiency for business users and transport providers	Present value of benefits to business users and providers (£m)	Base for appraisal	£530m	£475m
	Improve transport economic efficiency for consumer users	Present value of benefits to consumer users (£m)	Base for appraisal	£805m	£859m
	Improve reliability	Change in PT crowded hours	Base for appraisal	-2,775 passenger hrs	-2,552 passenger hrs
	Provide beneficial wider economic impacts	Change in accessibility to employment opportunities in the OA and for OA residents	Base for appraisal	Slight to significant improvement in access to employment	Significant improvement in access to employment
Accessibility – to improve access to facilities for those without a car and to reduce severance	Increase option values	Change in option values	Base for appraisal	Slight beneficial	Moderate beneficial
	Reduce severance	Change in urban severance	Base for appraisal	No change from Base	No change from Base
	Improve access to the transport system	Change in average PT Accessibility Index - for the OA as a whole	Base for appraisal	4.8 increase	7.6 increase
		- for the Lambeth part of the OA	Base for appraisal	5.4 increase	7.7 increase
		- for the Wandsworth part of the OA	Base for appraisal	4.5 increase	7.6 increase
Integration – to ensure that all decisions are taken in the context of the Government's integrated transport policy	Improve transport interchange	Change in between-platform passenger hours	Base for appraisal	-908 passenger hrs	-890 passenger hrs
		Change in between-station passenger hours	Base for appraisal	-2,128 passenger hrs	-2,039 passenger hrs
		Change in freight interchange facilities (including relocation)	Base for appraisal	No change from Base	Land take for LRT depot may displace freight-related land uses
	Integrate transport policy with land-use policy	Compatibility of transport initiatives with London planning & policy (as advised by TfL)	Base for appraisal	Compatible with emerging London plan/ policy directions	No explicit support exists for the LRT scheme in current London Plan or Mayor's 'Way to Go' document
	Integrate transport policy with other Government policies	Compatibility of transport initiatives with government policies	Base for appraisal	No change from Base	No change from Base

Table 30 Appraisal Against TfL Objectives, OA Scenario 3

TfL Objectives		*Development scenario*	Scenario 3		
		Transport package	Base	L2	M
		Description	Without transport packages	Full bus package + ped/cycle bridge	Full bus package + LRT
Objective	Indicator				
Improve door-to-door journey times and reliability across our transport system	Change in 2026 AM peak PT passenger-hours		Base for appraisal	-5,823 passenger hrs	-5,449 passenger hrs
	Reliability - change in PT crowded hours		Base for appraisal	-2,775 passenger hrs	-2,552 passenger hrs
Engage people in the effective use of our system, with high standards of customer care and information	Not assessed		Not assessed	Not assessed	Not assessed
Reduce CO2 emissions from ground transport and improve the energy efficiency of operations	Change in greenhouse gas emissions - tonnes of CO2e		Base for appraisal	80 tonnes/yr	510 tonnes/yr
Operate a safe and secure transport system	Change in road accidents per year		Base for appraisal	0.2 pias/year	0.4 pias/year
Deliver value for money	Present value of benefits (£m) - Public transport		Base for appraisal	£1,378m	£1,677m
	Present value of benefits (£m) - Highway		Base for appraisal	-£42m	-£344m
	Present value of benefits (£m) - Total		Base for appraisal	£1,336m	£1,333m
	Present value of costs (£m)		Base for appraisal	£455m	£564m
	Net present value (£m)		Base for appraisal	£880m	£769m
	Benefit-cost ratio		Base for appraisal	2.9	2.4
	PV of capital costs (£m)		Base for appraisal	£42m	£167m
	PV of operating costs (£m)		Base for appraisal	£416m	£424m
	PV of revenues (£m)		Base for appraisal	-£1m	£17m
Influence a shift towards more sustainable modes of transport	Public transport, car and slow mode shares		Base for appraisal	Little or no change	Little or no change
Support sustainable growth and regeneration	Change in average PT Accessibility Index - for the OA as a whole		Base for appraisal	4.8 increase	7.6 increase
Provide accessible, affordable and inclusive links between communities and the employment, education and other opportunities London offers	- for the Lambeth part of the OA		Base for appraisal	5.4 increase	7.7 increase
	- for the Wandsworth part of the OA		Base for appraisal	4.5 increase	7.6 increase
Improve the local environment in and around our transport system and enhance the urban realm	Change in local environment and urban realm		Base for appraisal	Slight change on key bus routes	Slight change on key bus routes Substantial change on LRT route
Ensure that the movement of freight and services within London is efficient and reliable	Changes in freight vehicle-hours		Base for appraisal	-7,000 veh hrs/yr	14,000 veh hrs/yr
	Change in average freight vehicle speeds		Base for appraisal	No appreciable change	No appreciable change
	Change in traffic delays at key locations		Base for appraisal	No appreciable change	Significant changes on LRT route

9.2.1 Comparison of Bus and LRT Packages in OA Scenario 3

Compared with the Bus-only package, the LRT package:

- would result in greater traffic noise, air quality and emissions due to the road space taken along Albert Embankment, Nine Elms Lane and the Vauxhall gyratory;
- would incur greater townscape and other physical impacts along its route, especially associated with the required LRT depot facilities;
- would generate virtually identical user benefits, because the greater public transport user benefits would be offset by road user disbenefits due to the road space taken for the LRT (user benefits for both packages have present values of £1,300m);
- would incur greater costs to government and private sector operators (present value of £560m compared to £460m);
- would provide a somewhat lower Benefit/Cost Ratio (2.4 compared to 2.9);
- would result in significantly greater improvement in public transport accessibility;
- would give very similar performance in terms of transport interchange;
- would generate greater adverse traffic impacts to general road users and freight traffic; and
- is not supported in current local government policies and plans.

On balance, the somewhat inferior economic performance of the LRT package compared to the Bus-only package would be compounded by greater negative traffic and land take impacts, including those of LRT depot facilities. Given this, the Bus-only package is considered preferable to LRT in OA Scenario 3.

It may be possible to develop a bus rapid transit (BRT) scheme on the same alignment as the LRT scheme to provide further enhancements to bus services in the corridor, with significantly lower capital costs and greater inherent flexibility of operation than the LRT scheme assessed herein. This could be considered as an enhancement to the Bus-only package in further studies, but would incur at least some, if not all, of the adverse traffic impacts associated with the LRT package. Both packages must also be considered in relation to their impact upon Vauxhall interchange.

9.3 OA Scenario 4

Full appraisal results for OA Scenario 4 are given in Table 31 (Central Government objectives) and Table 32 (TfL objectives). Reference is also made to Table 25 (study-specific objectives) in Chapter 8, and to the economic appraisal in Table 28.

Table 31 Appraisal Against Central Government Objectives, OA Scenario 4

Central Government Objectives			*Development scenario*	Scenario 4			
			Transport package	Base	L	M	H3
			Description	Without transport packages	Full bus package + ped/cycle bridge	Full bus package + LRT	Full bus package + NLE (NE & BPS)
Objective	Sub-objective	Indicator					
Environment – to protect the built and natural environment	Reduce noise	km of road with traffic increases > 25%		Base for appraisal	2km	4km	2km
		km of road with traffic decreases > 25%		Base for appraisal	1km	3km	1km
	Improve local air quality	km of road with traffic increases > 10%		Base for appraisal	7km	9km	7km
		km of road with traffic decreases > 10%		Base for appraisal	4km	8km	4km
	Reduce greenhouse gases	Change in greenhouse gas emissions - tonnes of CO2e/yr		Base for appraisal	150 tonnes/yr	350 tonnes/yr	150 tonnes/yr
	Protect and enhance the landscape	Not assessed		Not assessed	Not assessed	Not assessed	Not assessed
	Protect and enhance the townscape	Impact on townscape		Base for appraisal	Slight change on key bus routes	Slight change on key bus routes Substantial change on LRT route	Slight change on key bus routes Significant change at LUL stations
	Protect the heritage of historic resources	Impact on historic sites and resources		Base for appraisal	No change from Base	Potential significant impact (LRT infrastructure)	Potential slight impact (NLE stations & infrastructure)
	Support biodiversity	Impact on natural resources		Base for appraisal	Little or no expected impact	Little or no expected impact	Little or no expected impact
	Protect the water environment	Impact on water features and resources		Base for appraisal	Little or no expected impact	Little or no expected impact	Little or no expected impact
	Encourage physical fitness	Change in number of people making walking and cycling journeys of more than 30 mins/day		Base for appraisal	Little or no expected impact	Little or no expected impact	Little or no expected impact
	Improve journey ambience	Change in traveller care, travellers' views and traveller stress		Base for appraisal	New bus routes will provide slightly improved experience for users	New bus routes will provide slightly improved experience for users	New bus routes will provide slightly improved experience for users
Safety – to improve safety	Reduce accidents	Change in road accidents per year		Base for appraisal	0.4 pias/year	0.6 pias/year	0.4 pias/year
	Improve security	Change in traveller security		Base for appraisal	New bus routes will provide slightly improved security for users	New bus/LRT routes will provide significantly improved security for users	NLE will provide substantially improved security for users
Economy – to support sustainable economic activity and get good value for money	Get good value for money in relation to impacts on public accounts	Present value of benefits (£m)		Base for appraisal	£1,089m	£913m	£1,931m
		Present value of costs (£m)		Base for appraisal	£439m	£582m	£1,437m
		Net present value (£m)		Base for appraisal	£650m	£331m	£493m
		Benefit-cost ratio		Base for appraisal	2.5	1.6	1.3
	Improve transport economic efficiency for business users and transport providers	Present value of benefits to business users and providers (£m)		Base for appraisal	£389m	£240m	£726m
	Improve transport economic efficiency for consumer users	Present value of benefits to consumer users (£m)		Base for appraisal	£701m	£674m	£1,206m
	Improve reliability	Change in PT crowded hours		Base for appraisal	-2,904 passenger hrs	-3,789 passenger hrs	-4,686 passenger hrs
	Provide beneficial wider economic impacts	Change in accessibility to employment opportunities in the OA and for OA residents		Base for appraisal	Slight to significant improvement in access to employment	Significant improvement in access to employment	Substantial improvement in access to employment
Accessibility – to improve access to facilities for those without a car and to reduce severance	Increase option values	Change in option values		Base for appraisal	Slight beneficial	Moderate beneficial	Strong beneficial
	Reduce severance	Change in urban severance		Base for appraisal	No change from Base	No change from Base	No change from Base
	Improve access to the transport system	Change in average PT Accessibility Index					
		- for the OA as a whole		Base for appraisal	4.8 increase	7.6 increase	7.2 increase
		- for the Lambeth part of the OA		Base for appraisal	5.4 increase	7.7 increase	6.1 increase
		- for the Wandsworth part of the OA		Base for appraisal	4.5 increase	7.6 increase	7.6 increase
Integration – to ensure that all decisions are taken in the context of the Government's integrated transport policy	Improve transport interchange	Change in between-platform passenger hours		Base for appraisal	-949 passenger hrs	-1,028 passenger hrs	-1,211 passenger hrs
		Change in between-station passenger hours		Base for appraisal	-2,407 passenger hrs	-1,955 passenger hrs	-2,465 passenger hrs
		Change in freight interchange facilities (including relocation)		Base for appraisal	No change from Base	Land take for LRT depot may displace freight-related land uses	Land take for LUL extension stations may displace freight-related land uses
	Integrate transport policy with land-use policy	Compatibility of transport initiatives with London planning & policy (as advised by TfL)		Base for appraisal	Compatible with emerging London plan/ policy directions	No explicit support exists for the LRT scheme in current London Plan or Mayor's 'Way to Go' document	London Plan and Mayor's Way to Go document support improvements to the Underground Network
	Integrate transport policy with other Government policies	Compatibility of transport initiatives with government policies		Base for appraisal	No change from Base	No change from Base	No change from Base

Table 32 Appraisal Against TfL Objectives, OA Scenario 4

TfL Objectives		*Development scenario*	Scenario 4			
		Transport package	Base	L	M	H3
		Description	Without transport packages	Full bus package + ped/cycle bridge	Full bus package + LRT	Full bus package + NLE (NE & BPS)
Objective	Indicator					
Improve door-to-door journey times and reliability across our transport system	Change in 2026 AM peak PT passenger-hours		Base for appraisal	-5,272 passenger hrs	-6,632 passenger hrs	-9,686 passenger hrs
	Reliability - change in PT crowded hours		Base for appraisal	-2,904 passenger hrs	-3,789 passenger hrs	-4,686 passenger hrs
Engage people in the effective use of our system, with high standards of customer care and information	Not assessed		Not assessed	Not assessed	Not assessed	Not assessed
Reduce CO2 emissions from ground transport and improve the energy efficiency of operations	Change in greenhouse gas emissions - tonnes of CO2e		Base for appraisal	150 tonnes/yr	350 tonnes/yr	150 tonnes/yr
Operate a safe and secure transport system	Change in road accidents per year		Base for appraisal	0.4 pias/year	0.6 pias/year	0.4 pias/year
Deliver value for money	Present value of benefits (£m) - Public transport		Base for appraisal	£1,294m	£1,438m	£2,136m
	Present value of benefits (£m) - Highway		Base for appraisal	-£205m	-£526m	-£205m
	Present value of benefits (£m) - Total		Base for appraisal	£1,089m	£913m	£1,931m
	Present value of costs (£m)		Base for appraisal	£439m	£582m	£1,437m
	Net present value (£m)		Base for appraisal	£650m	£331m	£493m
	Benefit-cost ratio		Base for appraisal	2.5	1.6	1.3
	PV of capital costs (£m)		Base for appraisal	£42m	£167m	£833m
	PV of operating costs (£m)		Base for appraisal	£416m	£424m	£662m
	PV of revenues (£m)		Base for appraisal	£14m	-£4m	£53m
Influence a shift towards more sustainable modes of transport	Public transport, car and slow mode shares		Base for appraisal	Little or no change	Little or no change	Little or no change
Support sustainable growth and regeneration	Change in average PT Accessibility Index - for the OA as a whole		Base for appraisal	4.8 increase	7.6 increase	7.2 increase
Provide accessible, affordable and inclusive links between communities and the employment, education and other opportunities London offers	- for the Lambeth part of the OA		Base for appraisal	5.4 increase	7.7 increase	6.1 increase
	- for the Wandsworth part of the OA		Base for appraisal	4.5 increase	7.6 increase	7.6 increase
Improve the local environment in and around our transport system and enhance the urban realm	Change in local environment and urban realm		Base for appraisal	Slight change on key bus routes	Slight change on key bus routes Substantial change on LRT route	Slight change on key bus routes Significant change at LUL stations
Ensure that the movement of freight and services within London is efficient and reliable	Changes in freight vehicle-hours		Base for appraisal	-3,000 veh hrs/yr	7,000 veh hrs/yr	-3,000 veh hrs/yr
	Change in average freight vehicle speeds		Base for appraisal	No appreciable change	No appreciable change	No appreciable change
	Change in traffic delays at key locations		Base for appraisal	No appreciable change	Significant changes on LRT route	No appreciable change

9.3.1 Comparison of Bus and LRT Packages in OA Scenario 4

Compared with the Bus-only package, the LRT package:

- would result in greater traffic noise, air quality and emissions due to the road space taken along Albert Embankment, Nine Elms Lane and the Vauxhall gyratory;
- would incur greater townscape and other physical impacts along its route, especially associated with the required LRT depot facilities;
- would generate slightly more public transport user benefits, but also more road user disbenefits (due to the road space taken for the LRT), resulting in fewer overall net user benefits (present value of £900m compared to £1,100m);
- would incur greater costs to government and private sector operators (present value of £580m compared to £440m);
- would provide a significantly lower Benefit-Cost Ratio (1.6 compared to 2.5);
- would result in significantly greater improvement in public transport accessibility;
- would give marginally better performance in terms of transport interchange;
- would generate greater adverse traffic impacts to general road users and freight traffic; and
- is not supported in current local government policies and plans.

On balance (and as in Scenario 3), the inferior economic performance of the LRT package compared to the bus package would be compounded by greater negative traffic and land take impacts, including

those of LRT depot facilities. Given this, the bus package is considered preferable to LRT in OA Scenario 4.

As discussed for Scenario 3 (Section 9.2.1), it may be possible to develop a bus rapid transit (BRT) scheme on the same alignment as the LRT scheme to provide further enhancements to bus services in the corridor.

9.3.2 Comparison of Bus and NLE Packages in Scenario 4

Compared with the Bus-only package, the NLE package:

- would generate substantially more public transport user benefits (road user disbenefits are the same as the Bus-only package) resulting in greater overall net user benefits (present value of £1,900m compared to £1,100m);
- would incur substantially greater costs to government and private sector operators (present value of £1,400m compared to £400m);
- would provide a much lower Benefit-Cost Ratio (1.3 compared to 2.5), due to the higher cost;
- would result in significantly greater improvement in public transport accessibility, especially for the part of the OA in the Borough of Wandsworth;
- would give appreciably better performance in terms of transport interchange (especially in passenger travel time between platforms);
- would result in less crowded and hence more reliable public transport services (greater savings in crowded passenger-hours); and
- is supported by London policy and some key OA stakeholders.

On balance, based on the appraisal, the NLE package would provide substantially greater overall transport user benefits, although not sufficient to compensate for the substantial additional costs. As previously stated, there is no consideration of any additional works that may be required at Vauxhall Underground, NR or bus stations as a result of either package.

For Scenario 4 development, TfL and the GLA would expect the NLE to proceed on the basis that the capital costs of the NLE are 100% privately funded. If fully-funded, the present value of costs would reduce from £1,400m to £600m and the Benefit-Cost Ratio would increase from 1.3 to 3.2, significantly better than that for the Bus-only package without private sector funding (2.5).

9.4 OA Scenario 5

Appraisal results for OA Scenario 5 are given in Table 33 (Central Government objectives) and Table 34 (TfL objectives). Reference is also made to Table 25 (study-specific objectives) in Chapter 8, and to the economic appraisal in Table 28.

Table 33 Appraisal Against Central Government Objectives, OA Scenario 5

Central Government Objectives		*Development scenario*	Scenario 5		
		Transport package	Base	M	H2T
		Description	Without transport packages	Full bus package + LRT	Full bus package + NLE (NE & BPS) + ped/cycle bridge
Objective	Sub-objective	Indicator			
Environment – to protect the built and natural environment	Reduce noise	km of road with traffic increases > 25%	Base for appraisal	2km	1km
		km of road with traffic decreases > 25%	Base for appraisal	4km	2km
	Improve local air quality	km of road with traffic increases > 10%	Base for appraisal	11km	6km
		km of road with traffic decreases > 10%	Base for appraisal	11km	6km
	Reduce greenhouse gases	Change in greenhouse gas emissions - tonnes of CO2e/yr	Base for appraisal	710 tonnes/yr	230 tonnes/yr
	Protect and enhance the landscape	Not assessed	Not assessed	Not assessed	Not assessed
	Protect and enhance the townscape	Impact on townscape	Base for appraisal	Slight change on key bus routes Substantial change on LRT route	Slight change on key bus routes Significant change at LUL stations
	Protect the heritage of historic resources	Impact on historic sites and resources	Base for appraisal	Potential significant impact (LRT infrastructure)	Potential slight impact (NLE stations & infrastructure)
	Support biodiversity	Impact on natural resources	Base for appraisal	Little or no expected impact	Little or no expected impact
	Protect the water environment	Impact on water features and resources	Base for appraisal	Little or no expected impact	Little or no expected impact
	Encourage physical fitness	Change in number of people making walking and cycling journeys of more than 30 mins/day	Base for appraisal	Little or no expected impact	Little or no expected impact
	Improve journey ambience	Change in traveller care, travellers' views and traveller stress	Base for appraisal	New bus routes will provide slightly improved experience for users	New bus routes will provide slightly improved experience for users
Safety – to improve safety	Reduce accidents	Change in road accidents per year	Base for appraisal	0.8 pias/year	0.4 pias/year
	Improve security	Change in traveller security	Base for appraisal	New bus/LRT routes will provide significantly improved security for users	NLE will provide substantially improved security for users
Economy – to support sustainable economic activity and get good value for money	Get good value for money in relation to impacts on public accounts	Present value of benefits (£m)	Base for appraisal	£1,619m	£1,815m
		Present value of costs (£m)	Base for appraisal	£627m	£1,377m
		Net present value (£m)	Base for appraisal	£993m	£438m
		Benefit-cost ratio	Base for appraisal	2.6	1.3
	Improve transport economic efficiency for business users and transport providers	Present value of benefits to business users and providers (£m)	Base for appraisal	£573m	£720m
	Improve transport economic efficiency for consumer users	Present value of benefits to consumer users (£m)	Base for appraisal	£1,048m	£1,095m
	Improve reliability	Change in PT crowded hours	Base for appraisal	-3,981 passenger hrs	-1,516 passenger hrs
	Provide beneficial wider economic impacts	Change in accessibility to employment opportunities in the OA and for OA residents	Base for appraisal	Significant improvement in access to employment	Substantial improvement in access to employment
Accessibility – to improve access to facilities for those without a car and to reduce severance	Increase option values	Change in option values	Base for appraisal	Moderate beneficial	Strong beneficial
	Reduce severance	Change in urban severance	Base for appraisal	No change from Base	No change from Base
	Improve access to the transport system	Change in average PT Accessibility Index - for the OA as a whole	Base for appraisal	7.6 increase	7.2 increase
		- for the Lambeth part of the OA	Base for appraisal	7.7 increase	6.1 increase
		- for the Wandsworth part of the OA	Base for appraisal	7.6 increase	7.6 increase
Integration – to ensure that all decisions are taken in the context of the Government's integrated transport policy	Improve transport interchange	Change in between-platform passenger hours	Base for appraisal	-997 passenger hrs	-944 passenger hrs
		Change in between-station passenger hours	Base for appraisal	-1,750 passenger hrs	-1,729 passenger hrs
		Change in freight interchange facilities (including relocation)	Base for appraisal	Land take for LRT depot may displace freight-related land uses	Land take for LUL extension stations may displace freight-related land uses
	Integrate transport policy with land-use policy	Compatibility of transport initiatives with London planning & policy (as advised by TfL)	Base for appraisal	No explicit support exists for the LRT scheme in current London Plan or Mayor's 'Way to Go' document	London Plan and Mayor's Way to Go document support improvements to the Underground Network
	Integrate transport policy with other Government policies	Compatibility of transport initiatives with government policies	Base for appraisal	No change from Base	No change from Base

Table 34 Appraisal Against TfL Objectives, OA Scenario 5

TfL Objectives		*Development scenario*	Scenario 5		
		Transport package	Base	M	H2T
		Description	Without transport packages	Full bus package + LRT	Full bus package + NLE (NE & BPS) + ped/cycle bridge
Objective	Indicator				
Improve door-to-door journey times and reliability across our transport system	Change in 2026 AM peak PT passenger-hours		Base for appraisal	-7,745 passenger hrs	-725 passenger hrs
	Reliability - change in PT crowded hours		Base for appraisal	-3,981 passenger hrs	-1,516 passenger hrs
Engage people in the effective use of our system, with high standards of customer care and information	Not assessed		Not assessed	Not assessed	Not assessed
Reduce CO2 emissions from ground transport and improve the energy efficiency of operations	Change in greenhouse gas emissions - tonnes of CO2e		Base for appraisal	710 tonnes/yr	230 tonnes/yr
Operate a safe and secure transport system	Change in road accidents per year		Base for appraisal	0.8 pias/year	0.4 pias/year
Deliver value for money	Present value of benefits (£m) - Public transport		Base for appraisal	£2,087m	£1,944m
	Present value of benefits (£m) - Highway		Base for appraisal	-£468m	-£129m
	Present value of benefits (£m) - Total		Base for appraisal	£1,619m	£1,815m
	Present value of costs (£m)		Base for appraisal	£627m	£1,377m
	Net present value (£m)		Base for appraisal	£993m	£438m
	Benefit-cost ratio		Base for appraisal	2.6	1.3
	PV of capital costs (£m)		Base for appraisal	£167m	£867m
	PV of operating costs (£m)		Base for appraisal	£424m	£663m
	PV of revenues (£m)		Base for appraisal	-£49m	£151m
Influence a shift towards more sustainable modes of transport	Public transport, car and slow mode shares		Base for appraisal	Little or no change	Little or no change
Support sustainable growth and regeneration	Change in average PT Accessibility Index - for the OA as a whole		Base for appraisal	7.6 increase	7.2 increase
Provide accessible, affordable and inclusive links between communities and the employment, education and other opportunities London offers	- for the Lambeth part of the OA		Base for appraisal	7.7 increase	6.1 increase
	- for the Wandsworth part of the OA		Base for appraisal	7.6 increase	7.6 increase
Improve the local environment in and around our transport system and enhance the urban realm	Change in local environment and urban realm		Base for appraisal	Slight change on key bus routes Substantial change on LRT route	Slight change on key bus routes Significant change at LUL stations
Ensure that the movement of freight and services within London is efficient and reliable	Changes in freight vehicle-hours		Base for appraisal	27,000 veh hrs/yr	-1,000 veh hrs/yr
	Change in average freight vehicle speeds		Base for appraisal	No appreciable change	No appreciable change
	Change in traffic delays at key locations		Base for appraisal	Significant changes on LRT route	No appreciable change

9.4.1 Comparison of LRT and NLE Packages in OA Scenario 5

Compared with the LRT package, the NLE package:

- would result in less traffic noise, air quality and emissions impact due to road space along Albert Embankment, Nine Elms Lane and at the Vauxhall gyratory not being required;
- would incur lesser townscape and other physical impacts, both along its route and because a new depot is not required;
- would generate slightly less public transport user benefits, but fewer road user disbenefits resulting in slightly greater transport user benefits overall (present value of £1,800m compared to £1,600m);
- would incur substantially greater costs to government (present value of £1,400m compared to £600m);
- would provide a significantly lower Benefit-Cost Ratio (1.3 compared to 2.6), due to the much higher cost;
- would result in marginally less improvement in public transport accessibility, but offers the same level of improvement in the part of the OA that is in the Borough of Wandsworth;

- would give very similar performance in terms of transport interchange (although as discussed in Appendix D the LRT options impose significantly greater passenger throughputs on Vauxhall Underground and NR station facilities, which are relieved by the NLE); and
- would generate fewer adverse traffic impacts to general road users and freight traffic.

On balance the NLE package would provide slightly more overall transport user benefits without incurring the LRT scheme's adverse effects associated with removing road space along its route, the land take for its depot and, possibly, greater improvements to interchange facilities at Vauxhall station. However the substantial additional cost of the NLE package means that its overall economic performance is less than the LRT package.

The GLA and TfL expect 100% private funding for the capital cost of the NLE. If the NLE was fully-funded, the Present Value of Costs of the package would reduce from £1,400m to £600m and the Benefit/Cost Ratio would increase from 1.3 to 3.3, greater than that for the LRT package without private sector funding (2.6).

If the LRT scheme was fully funded by the private sector, the Benefit/Cost Ratio of the LRT package would increase from 2.6 to 3.5, which is only marginally greater than the fully-funded NLE scheme (3.3). In this case the greater traffic and land use impacts of the LRT scheme, together with its lack of key stakeholder support are considered enough to make the NLE scheme preferable overall.

9.5 Full Appraisal Conclusions

The appraisal suggests that the best performing transport package for each OA development scenario is as follows:

- OA Scenarios 1 and 2 – Bus-only packages would probably be sufficient for the levels of development envisaged, although probably not without some improvements to interchange facilities at Vauxhall Underground and NR stations;
- OA Scenario 3 – Bus-only package, possibly enhanced by a bus rapid transit facility along the route of the LRT scheme;
- OA Scenario 4 – Bus-only package as in Scenario 3, alongside the NLE ; and
- OA Scenario 5 – NLE package.

The appraisal demonstrates the inevitable trade-offs that must be made in selecting an optimum transport package for each OA development scenario.

Firstly, there are choices to be made between the costs and additional traffic and land use impacts of LRT schemes over the lower-cost, Bus-only solution. The LRT scheme otherwise appears to perform well in terms of providing capacity to support the development in Scenarios 4 and 5. However the impact of the LRT scheme on road traffic is considerable, reducing capacity on key strategic routes

and reallocating road users along other key routes. The impact is considered to be too great to make this a feasible option.

Secondly, although the NLE package provides much greater overall transport user benefit than the LRT package, its substantially higher cost means that it has a less favourable overall economic result. However, funding from the private sector could alter the economic case for the NLE substantially. If a funding package is identified that allows for the NLE to be delivered at no cost to public sector bodies (as is the expectation of GLA and TfL), the Benefit/Cost Ratio would change from just over 1 to over 3 (with OA Scenarios 4 and 5). This would make the scheme much more attractive to Government. In addition, of the options considered, the NLE offers the most significant relief to the Victoria line, and provides significant relief to Battersea park station through a reduction in boarding passengers in the morning peak. The NLE is the only scheme tested that can provide the required capacity on the network through the OA without overloading Vauxhall Underground station or causing significant congestion on the road network.

If private sector funding were used to cover the first few years of increased bus operations serving OA development, this would offer savings to the private sector compared with funding the capital costs of the NLE. However increased bus operations alone would not provide sufficient capacity to support OA development at Scenario 3, 4 and 5 levels. The transport study has also demonstrated that the NLE package has net overall benefits which are strengthened if the capital costs of the scheme are privately financed, to the point that it becomes the best-performing transport package for the higher-density development scenarios.

Finally, as shown in Table 35, the incremental economic performance of the LRT package over the bus-only package is inferior to that of the NLE package in OA Scenario 4 (the only scenario in which all three packages were evaluated). This shows that, with bus improvements common to all packages, the NLE provides a better incremental economic outcome than the LRT, mainly due to the highway user disbenefits associated with the LRT. The addition of private sector financing would strengthen the advantage of the NLE further in this respect.

Table 35 Economic Performance of LRT and NLE Packages over Bus-only Package

Incremental performance over Bus-only package in OA Scenario 4		Bus + LRT	Bus + NLE
Incremental Present Value of Benefits (£M)	Public Transport Users	144	842
	Highway Users	-321	0
	Total	-176	842
Incremental Present Value of Costs (£M)		143	999
Incremental Net Present Value (£M)		-319	-157
Incremental Benefit Cost Ratio		-1.2	0.8

NOTE This table should only be regarded as comparator between the LRT and NLE schemes in Scenario 4 and is not an accurate measure of the likely BCR for either scheme alone.

9.6 Supporting Analyses

Supporting analyses in line with WebTAG guidance are summarised in the following paragraphs.

9.6.1 Distribution and Equity

Environment and Safety

The full appraisal has included estimation of the length of roads affected by traffic changes more than 25% (as a proxy for significant noise impacts) or 10% (for significant air quality impacts). It has also estimated the change in road accidents associated with traffic changes. However, whilst these are useful as general indicators of the relative performance between transport packages in this regard, the VNEB-H model is not sufficiently accurate to be used to attribute these changes to specific roads or locations.

It is therefore beyond the accuracy of this study to comment on the distribution of these effects.

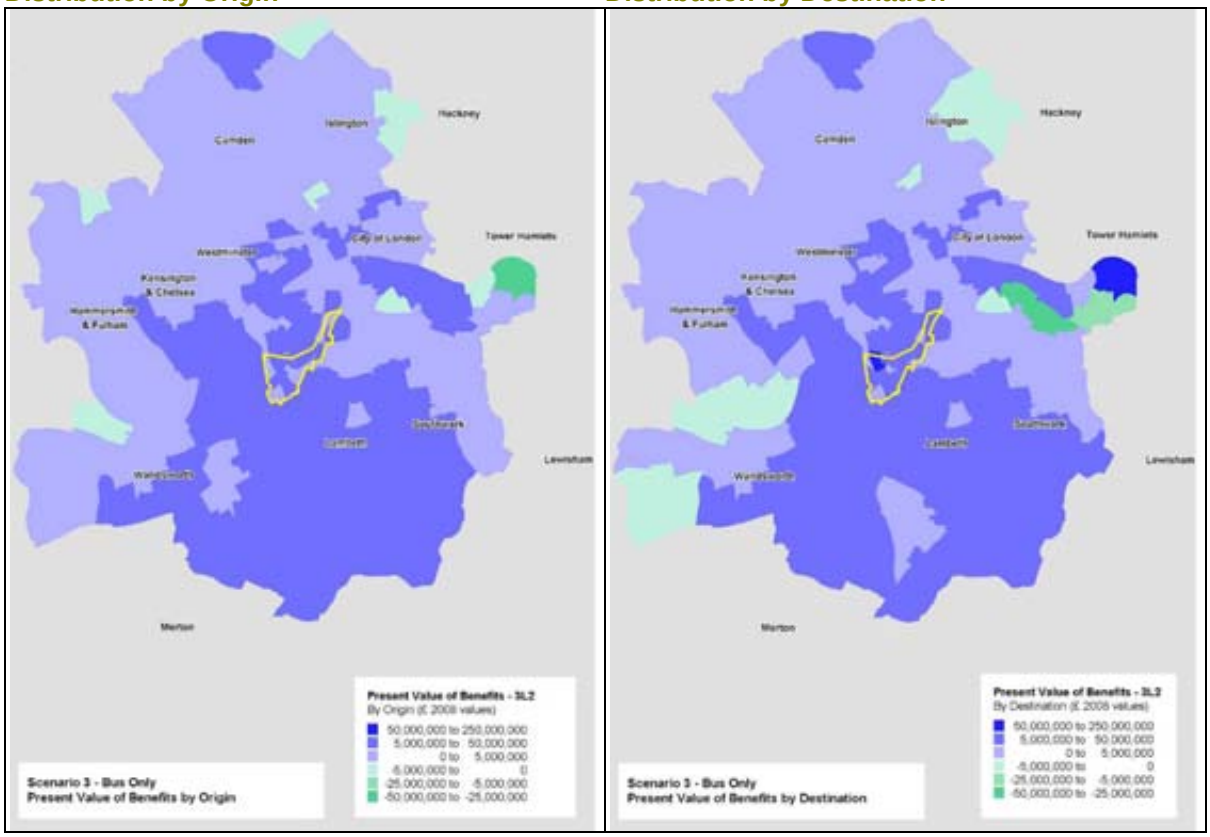
Economy

Figure 63 to Figure 65 illustrate the distribution of public transport user benefits by origin and destination area of public transport journeys respectively, for the Bus-only package in OA Scenario 3 and the NLE in Scenarios 4 and 5. The diagrams are presented for the nine inner London Boroughs in which public transport user benefits arising from VNEB schemes are concentrated.

The public transport user benefits have been plotted at an individual zone level within the OA however outside the OA, as part of a sectoring process in TUBA to produce the plots, adjacent zones have been aggregated (typically into 3 zones). This will result in some of the benefits or disbenefits being small values spread over a larger area outside the OA. The plots show the total present value of benefits calculated by TUBA over the 60-year evaluation period. These are calculated from annual figures that are in turn estimated from the modelled VNEB-P morning and inter-peak time periods. As previously reported the benefits in transport packages which include the NLE exclude the effects of the Partial Separation of the Northern Line.

Figure 63 Public Transport User Benefits – Scenario 3 Bus-only package

Distribution by Origin **Distribution by Destination**

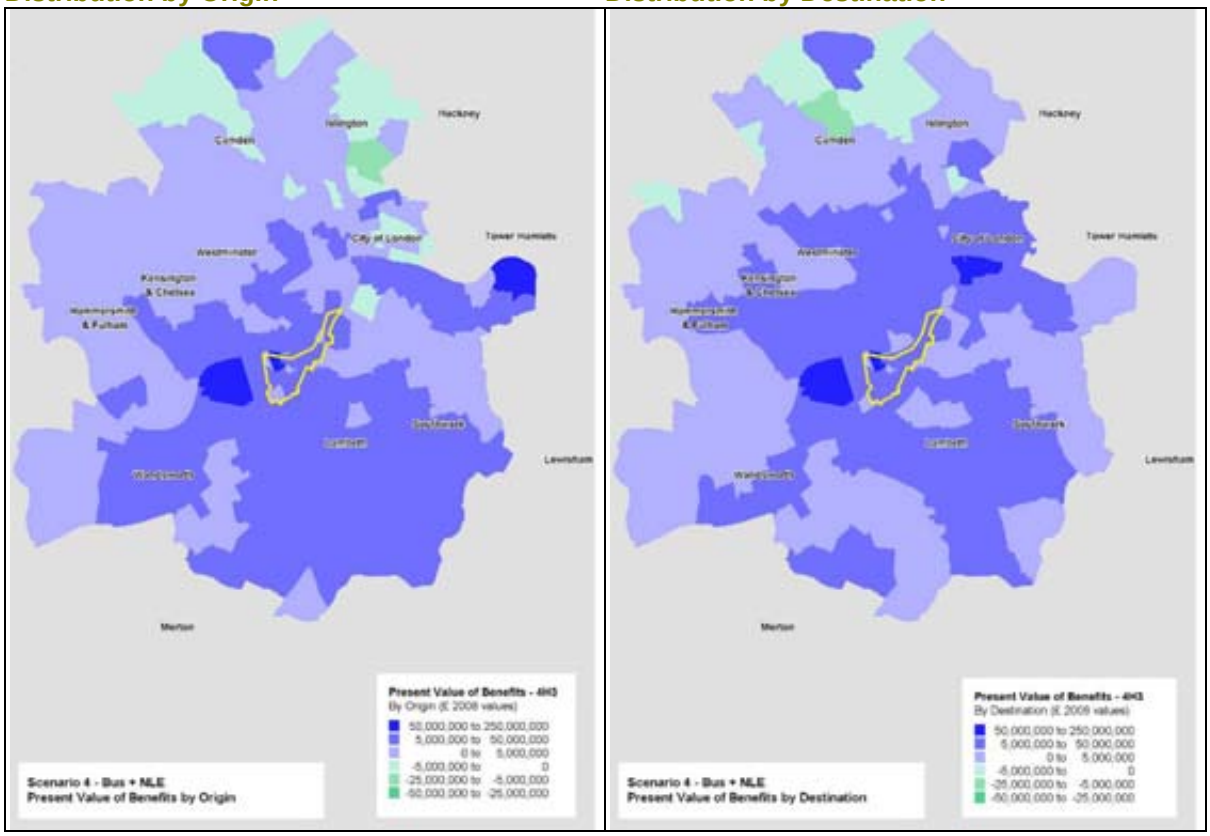


Source: VNEB TUBA results

Figure 63 shows that the indicative bus improvement package benefits users with origins and destinations throughout the area, especially to the south and south west of the OA. The diagram by origin shows a concentration of benefits in the OA and South/South East London, predominantly residential areas. The diagram by destination shows that the benefits are concentrated around the OA and the City of London and Westminster, areas of high employment. As future bus provision is refined through further work, the concentration of benefits is likely to change somewhat in all transport packages.

Figure 64 Public Transport User Benefits – Scenario 4 Bus + NLE Package

Distribution by Origin **Distribution by Destination**

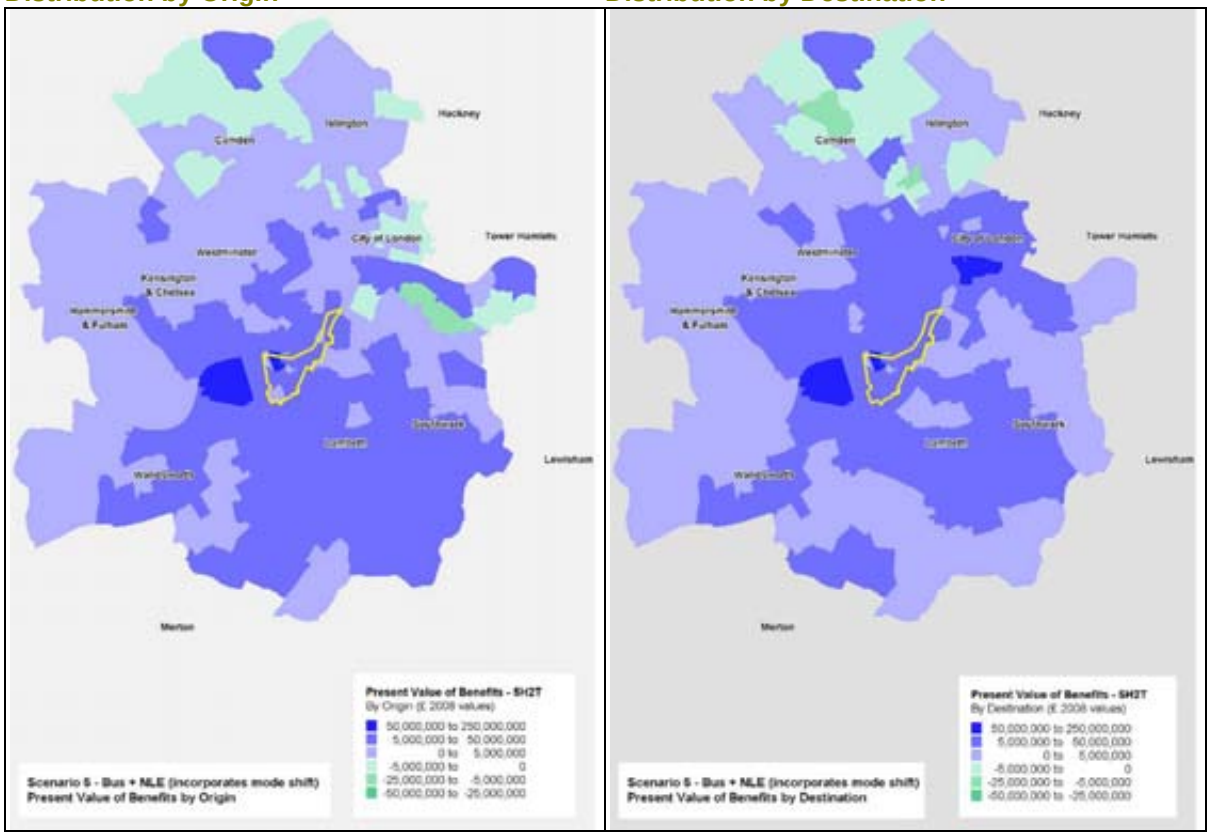


Source: VNEB TUBA results

Figure 64 shows that the NLE in OA Scenario 4 gives rise to benefits for users with journey origins in the OA and areas to the west in particular. Journey destinations show a greater concentration of benefits in central London. The disbenefits shown for Camden, Islington and Tower Hamlets are likely to be attributed to additional crowding on the Northern and Jubilee Lines arising from the extra patronage generated by the NLE.

Figure 65 Public Transport User Benefits – Scenario 4 NLE package

Distribution by Origin **Distribution by Destination**



Source: VNEB TUBA results

Figure 65 shows that the NLE in OA Scenario 5 gives rise to similar benefit distributions as it does in Scenario 4 (Figure 64). Journey origins show greatest concentration of benefits in the OA and areas to the west in particular. Journey destinations show a greater concentration of benefits in central London. The disbenefits shown for Camden, Islington and Tower Hamlets are likely to be attributed to additional crowding on the Northern and Jubilee Lines arising from the extra patronage generated by the NLE.

Accessibility

The PTAL assessment (see Section 6.2) has illustrated the change in accessibility to public transport in the OA, and the results are incorporated in the full appraisal.

9.6.2 Affordability and Financial Sustainability

A full analysis of affordability and financial sustainability is beyond the scope of this strategic study, as it requires analysis of the financial impact (in cash terms), requiring greater knowledge of timing, the level of private sector funding and other financial factors yet to be understood in detail.

Having said this there are two key considerations that the appraisal results have highlighted:

- As shown in Table 28 and Appendix E, all the transport packages assessed would have additional public transport operating costs that exceed expected additional fare revenues.
- The LRT and NLE schemes would both involve significant capital costs (present values of £170m and £830m, respectively) that would require private sector funding to cover them. It remains to be seen if the developed value of the land in the OA under the yet-to-be adopted planning framework makes such contributions financially sustainable for the landowners. The Bus-only packages, on the other hand, would have very small capital costs (present value of £7m), making them much more affordable.

9.6.3 Practicality and Public Acceptability

Practicality

Comments on the practicality of the transport packages are summarised in Table 36.

Table 36 Practicality of Transport Packages

Item	Bus only	Bus + LRT	Bus + NLE
Feasibility	No feasibility problems have been identified	Potential feasibility problems surrounding land required for a depot, and integration at Waterloo Station subject to further study	Feasibility problems for the NLE have been examined in some detail by LUL and Treasury Holdings and many have been resolved through more detailed study
Area of Interest	All transport initiatives have effects extending throughout inner London, especially with the higher-density OA development scenarios.		
Complexity	Generally not complex	Significant complexity in integrating the LRT into the surrounding streetscape	Significant complexity, especially in relation to tunnelling works and station construction
Time Scales and Phasing	Short lead time means that bus initiatives can be implemented quickly in response to development, and staged accordingly	LRT scheme is a stand-alone project and may require significant development planning. Unlikely to be suited to staged development.	NLE is a substantial project and may require significant development planning. Unlikely to be suited to staged development.
Partitioning	Given that the appraisal is being conducted separately for varying degrees of development, partitioning is inherent in the analysis approach		
Complementarity	Bus initiatives can be integrated with existing and other proposed changes relatively easily	LRT scheme is less complementary to other public transport modes as it requires interchange and a separate operating regime	NLE is complementary to existing Underground services which are well-established as one of London's main modes of public transport.

9.6.4 Public Acceptability

The community at large has yet to be consulted on the OAPF and associated transport initiatives. However, during the study extensive consultation was carried out by GLA and TfL with key stakeholders, whose views are summarised in Table 37.

Table 37 Key Stakeholder Views on Transport Packages

Stakeholder interest	Bus only	Bus + LRT	Bus + NLE
London planning and policymakers	Compatible with emerging London plan/ policy directions	No explicit support exists for an LRT scheme to directly serve the OA in current London Plan, Mayor of London 'Way to Go' or TfL Business Plan 2009/10 – 2016/17. London Plan and Mayor's 'Way to Go' document also support reducing congestion and general traffic as well as improving the flow of traffic.	London Plan and Mayor's 'Way to Go' document support improvements to the Underground network, and encourage reduced congestion and improved traffic flows.
Lambeth and Wandsworth policies	Compatible with Borough plans depending on the impact on traffic movement and demand management policies/ plans	No explicit support for a LRT scheme to directly serve the OA exists in any borough level planning policy.	Borough policies support and encourage greater mode shift from car to public transport and has minimal impact on road space
OAPF stakeholders	Appropriate for lower-density development scenarios and as a supporting sub-mode for other initiatives	LRT component is not being actively promoted by any OAPF key stakeholders	NLE component is being actively promoted by some OAPF key stakeholders

10 Study conclusions

10 Study Conclusions

As stated in Chapter 2 the study objective is to provide the context for, and inform the direction of, the transport elements of the OAPF. This chapter sets out the study conclusions on the most appropriate transport solutions to enable growth and to encourage long-term investment in the OA.

10.1 Suggested Transport Initiatives

Following appraisal of the range of solutions described and consideration of all the impacts associated with the development scenario and transport packages, the public transport initiatives required, beyond currently-committed schemes, to meet the future development needs of the OA are considered to be as follows:

- OA Scenarios 1 and 2 (low-medium density housing) would be sufficiently served by enhancements to existing bus services and new bus routes through the OA, with some improvements to interchange and passenger throughput facilities at Vauxhall Underground and NR stations.
- OA Scenario 3 (high density housing) would require additional capacity over and above enhancements to existing bus services and new bus routes through the OA. In addition, the impact on Vauxhall Underground station would be considerable and would require significant improvements to be made to the interchange and passenger throughput facilities at Vauxhall Underground, NR and bus stations, beyond the gate line capacity improvements that are committed, but unfunded in the TfL Business Plan.
- OA Scenario 4 (high density housing and major retail development) would require the addition of a high capacity transport intervention in conjunction with the bus service enhancements as described in Scenario 3. An extension of the Northern Line from Kennington to Battersea Power Station is considered to be the optimum solution at this time, assuming that the capital costs are privately funded. This would also relieve the additional pressure on Vauxhall Underground station sufficiently to reduce the need for investment in improvements beyond those in the current TfL business plan.
- OA Scenario 5 (high density housing, major retail and office development) would also require bus service enhancements and the NLE from Kennington to Battersea Power Station, based on the assumption that the capital costs of the NLE are privately funded.

The study has demonstrated that an LRT option from Waterloo to Battersea Power Station, whilst an attractive proposition for public transport users, would create significant traffic disruption along its route which would incur significant extra costs (not included in the concept examined herein) to mitigate. It would also require a dedicated depot facility with attendant adverse impacts on its surroundings that may be incompatible with the redevelopment concepts for the OA.

It was suggested during consultations that a bus rapid transit facility could be developed as an alternative along the route of the LRT option between Waterloo and Battersea Power Station. This would avoid some of the costs and impacts of the LRT option, such as depot facilities, tracks and the overhead power system. Despite this, however, it is still likely to cause substantial highway and traffic disruption and it may not provide sufficient capacity for OA Scenarios 3, 4 and 5 levels of development.

Whilst it was not possible to model the full effects of the cross river pedestrian/cycle bridge (the model only accounts for pedestrians moving to and from public transport), it is clear that the bridge could attract significant numbers of pedestrians and cyclists. Demand would increase in proportion with population changes in the OA, and overall the bridge would bring significant wider benefits in terms of public realm improvement and encouraging more walking and cycling in the area.

The appraisal results indicate the following key points:

- development levels equivalent to OA Scenarios 3 4 and 5 would require more than the 'bus-only' public transport interventions studied herein;
- all development scenario/transport package combinations, except those including the NLE, would result in increased public transport passenger congestion at Vauxhall, in particular at Vauxhall Underground station;
- the NLE, however, would provide significant relief to this congestion; and
- traffic increases arising from all levels of OA development would put increased pressure on the Vauxhall gyratory and other local and strategic roads within the OA, but the remedial measures required would be subject to further study.

Complementary initiatives will need to be considered in all development scenarios as part of an integrated approach to transport enhancement in the OA. These have not been studied, costed or explicitly modelled in detail, but analysis of general trends from the transport modelling, station capacity analysis and the urban realm studies undertaken by the GLA for the OAPF suggests these measures would be appropriate (subject to more detailed study):

- pedestrian and cycling routes within the OA and to/from surrounding areas;
- a cross-river pedestrian/cycle bridge (Nine Elms-Pimlico);
- further passenger throughput (gate line and escalator) capacity at Vauxhall Underground station[13];

[13] Gate line enhancements at Vauxhall Underground station (as contained within the TfL business plan to 2017/18) are required (and assumed to be in place) for all development scenarios. This will need to be examined further in light of the proposed OA development, as will further additional passenger throughput capacity at Vauxhall Underground station in conjunction with a scheme to increase escalator capacity if deemed technically viable.

- crowd management/segregation for interchange between NR and Underground services at Vauxhall[14];
- increased station concourse capacity at Vauxhall NR station in line with the plans currently being put forward by Network Rail;
- platform and station throughput capacity enhancement at Battersea Park and Queenstown Road stations in line with the plans currently being put forward by Network Rail;
- improved crowd management for access and egress at Victoria Underground station; and
- wider traffic management measures, including restraints on car parking levels, to minimise traffic impacts.

10.2 Funding Sources

This report identifies the level of transport capacity and types of transport intervention required to support growth in the OA in response to the various development scenarios presented. Initial indications of the funding sources which may be available to deliver the appropriate levels of transport intervention are shown in Table 38.

Table 38 Potential Funding Sources

Transport Intervention	Indicative Costs		Potential Funding Sources
	Capital (£M)	Operating & Maintenance (£M/yr)	
Bus service enhancements and new routes (cost ranges per item)	0.2-3.0	2-5	Pooled Development Contributions (Section 106) Area Wide Development Levy/Tariff Private Sector Funding TfL Future Investment Plans
Underground – NLE	670-1060	8-10	Central Government Private Sector Financing/ Area wide Development Levy/Tariff Incremental revenue payment TfL Future Investment Plans
Cross-river pedestrian/cyclist bridge	30	0.01	Pooled development contributions (Section 106) Area Wide Development Levy/Tariff Private Sector Funding
Highway improvements	To be scoped and costed		Section 278 Agreements Area Wide Development Levy/Tariff Pooled development contributions (S106)
Other transport improvements (e.g. station access and interchange improvements	To be scoped and costed		Pooled development contributions (S106) Area Wide Development Levy/Tariff Central Government funding TfL Future Investment Plans Network Rail (NSIP)

[14] The need for improvement work at Vauxhall NR and Underground stations would be significantly reduced by the relieving effect of the NLE on patronage of Vauxhall Underground station and the Victoria Line in general.

10.3 Implementation Programme

Committed schemes that are most relevant to the OA, and their expected completion dates, include:

- Victoria Line PPP upgrade – 2012
- South West and Southern Trains HLOS upgrades – 2014 (including platform lengthening at Battersea Park, Queenstown Road and Vauxhall stations)
- East London Line extension to Clapham Junction (Phase 2b) – 2012
- Northern Line PPP upgrade (Phase 1) – 2012

If required (depending on the transport package adopted for the OA), improvements to Vauxhall and Battersea Park stations should be timed to occur in line with development progress; they are expected to be needed before development is completed. With regard to enhancements to Vauxhall Underground station, expansion of gate line capacity in line with escalator capacity would need to be implemented prior to 2026 regardless of which development scenario is brought forward. Any further increase in escalator capacity would need to be considered in light of the transport package adopted (noting that the NLE in particular would result in significant relief of passenger congestion at Vauxhall) and would also need to be complementary to LUL priorities for the Victoria Line as well as the needs of the OA.

The transport network will only be able to cope with certain levels of development if particular transport interventions are implemented prior to the completed development. For instance, the proposed NLE would be required to support the higher levels of development outlined for the OA. Therefore transport improvements and interventions to serve OA development will have to come forward in line with the phasing of development, depending firstly on which development scenario is progressed, and secondly on the rate and location of development. Bus service upgrades and new routes can be implemented relatively quickly, but the NLE would require much longer lead-in time for design and implementation to enable it to proceed in parallel with development.

10.4 Next Steps and Future Studies

This study has assessed a wide range of transport packages to support significant development and regeneration potential in the OA. Significant resources (public and private sector) have been put into the Transport Study by GLA, TfL and key stakeholders in order to bring forward a co-ordinated approach to delivery of strategic transport initiatives for the area. Further work is required as the redevelopment plans are developed in more detail, to enable more detailed understanding of the transport requirements in the OA. Table 39 describes further studies that would be required.

Table 39 Next Steps and Future Studies

Task/Mode	Future Study
Land Use	Further sensitivity tests assessing the value and effects of: • borough balancing of future OA development; and • addition of OA development without applying borough balancing. Investigation into the effects of interaction of OA development with adjacent development areas such as the development nodes at Waterloo and Elephant & Castle.
Revised Scenario 5	Further modelling to assess the impact of the 'Revised Scenario 5' which, subsequent to this study was taken forward in the final OAPF document, Model outputs would be used for further Public Transport and Highway studies.
Preferred Transport Package	Development of a business case following selection of a preferred transport package.
Further Model Enhancement	Further enhancement to the VNEB-H model to enable its use at a more detailed 'link' level and/or the use of micro simulation modelling to assess the overall impacts of all development (and certain specific planning applications) on key junctions, particularly the Vauxhall gyratory and along Nine Elms lane.
Walking	A PERS audit of the current conditions for pedestrians. Pedestrian modelling at key OA stations (Vauxhall, Battersea Park Road, Victoria and Waterloo); including pedestrian flows in and on the approaches to stations. Further detailed assessment of pedestrian impacts, both in terms of capacity of footways and crossings and also impacts on traffic flow. Consideration of pedestrian requirements on key connecting routes such as Albert Embankment, Nine Elms Lane and Wandsworth Road. Further investigation of a pedestrian / cycle bridge between Nine Elms and St Georges Square.
Cycling	Investigation into future cycling demand in the OA and suitable cycling initiatives, including the pedestrian / cycle bridge and alignment with the Mayor's emerging cycle highways schemes.
Freight	Investigation of the effects of displacement of freight activities following reallocation of existing land use to new developments; this will be further addressed in the final OAPF document.
River Transport	Investigation into the provision of river transport to the OA.
Coach	Investigation into the future requirements for coach parking with particular attention to the displacement of this activity following OA development.
Bus	Further assessment of the bus priority measures and infrastructure (such as bus stands) required to deliver the bus services modelled in this Transport Study. This will allow the costs of delivering these options to be understood more clearly. Detailed investigation into the provision of bus initiatives for the OA (which will firm up the indicative options used in this study) and may include further additional or alternative routes including penetrating individual development sites and/or different levels of bus capacity.
Road	A comprehensive review of the Vauxhall gyratory and other key TLRN routes within the OA, with particular consideration for proposals to improve the urban realm and cycling provision. This should be a joint review by TfL and the relevant planning and highway authorities. Consideration of the impacts and revised traffic projections relating to the removal of the Western Extension of the Congestion Charge Zone, on the OA and the chosen development scenario once the impacts are known. Micro simulation modelling of the road network to investigate details such as: • potential improvements to main junctions in the OA such as the Vauxhall gyratory and Queens Circus, including potential mitigation such as opening the 'market link' to all traffic if necessary; • the impact of the junctions with proposed new links such as the Market link on Thessaly Road; and • the effects on traffic if road space is utilised for bus priority or bus rapid transit.

Task/Mode	Future Study
Underground	Confirmation of the Nine Elms-Battersea option as the preferred option for the NLE. Development of a scheme specific business case for the preferred option Further sensitivity testing to confirm the effects of the Partial Separation of the Northern Line (PSNL) on the proposed NLE. Detailed investigation into the impact of OA development at Vauxhall LUL station, including micro-simulation modelling and studying additional capacity measures. Further investigation into patronage relief on the Victoria Line and the effects on future operation. Further investigation into the feasibility and effects of extending the NLE from Battersea Power Station to Clapham Junction.
NR	Further data collection to identify the capacity and pinch points for each of Vauxhall, Battersea Park and Queenstown Road stations as well as any change in that capacity that would be brought about by the proposed station capacity enhancement proposals. These figures should then be compared with the number of people estimated to be passing though the pinch points under the various scenarios including the Reference Case 2026, and Reference Case 2026 with OA Scenarios 3, 4 and 5. Investigation of station design and provision of capacity at Vauxhall, Battersea Park Road, Queenstown Road and Wandsworth Road NR stations. Investigation of the effects to the OA of extending the ELL Phase 2b to Clapham Junction. This study should include what impacts this service change would have on travel between Wandsworth Road and Battersea Park and Victoria, and travel between Clapham Junction Battersea Park and Victoria.
Interchange	A more detailed analysis of the interchange requirements of the preferred development scenario identified in the OAPF, including detailed capacity modelling will need to be undertaken for individual interchanges and associated stations. This is of particular importance at Vauxhall interchange, but would also be needed at Battersea Park, Queenstown Road, Victoria and potentially Waterloo. Modelling of the wider interchange zone will also be required in order to understand the impacts and requirements in a holistic approach for the entire interchange. This would be required for Vauxhall and the Battersea Park / Queenstown Road interchanges.

Appendix A

List of Reports and Technical Notes

Appendix A List of Reports and Technical Notes

Reports

Inception Report

Highways Model Validation Report

Public Transport Model Validation Report

Technical Notes

TN01 VNEB OA Surveys Specification

TN02 Public Transport Model Specification

TN03 Public Transport Position Paper

TN04 Reference Case Transport Supply and Travel Cost Assumptions

TN05 LTS Planning Data Summary

TN07 Transport Policies and Plans

TN08 Opportunities and Constraints

TN09 Current Travel Demands and LoS

TN10 Current Transport Issues

TN11 & 12 DCP Specification for LTS Reference Case and OA Scenario Forecasts

TN14 JMP Report on Investigating Alternative Forecasting Methods

TN15 Define Preferred OA Forecasting Methodology

TN16 Future Travel Demands and LoS

TN17 Future Transport Issues

TN18 Review of Developer Ideas

TN19 Transport Packages for Each OA Scenario

TN20 Specification of Appraisal Methodology for Preferred Strategies

TN21 VK Report on the Execution of Traffic Surveys

TN22 Specify SATURN Model Development

SKM

Appendix B

Transport Study Programme

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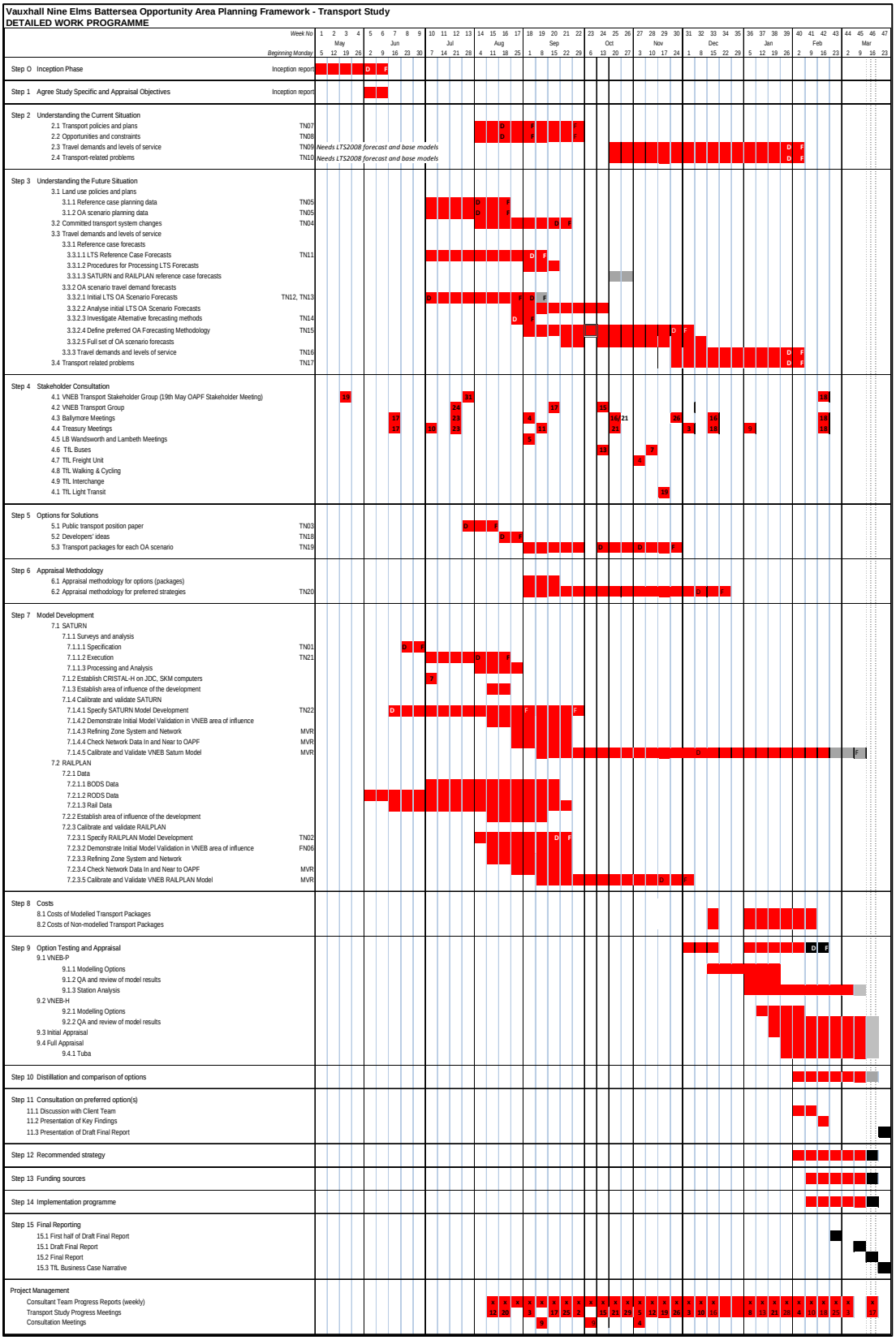


Appendix C

Consultation Strategy

Appendix C Consultation Strategy

Introduction

This Appendix summarises the Consultation Strategy adopted for the VNEB OA Transport Study.

Stakeholders

There were four sets of identified stakeholders:

1) Wider Stakeholder Group (Chair: Chris Porter, TfL): This wider stakeholder group was formed for the transport study and includes OAPF steering group members such as English Heritage, Design for London, LDA and key identified landowners.
2) VNEB Transport Group (Chair: Lee Campbell, TfL): This group was set up to replace the OAPF Steering Group which first met on 31 July 2008. The Transport Group includes representatives from the Lambeth and Wandsworth Boroughs and a number of TfL businesses. This forum was convened at least every 2 months, timed in line with suitable project milestones.
3) Borough Meetings (Chair: Lee Campbell, TfL): This group comprised representatives of Lambeth and Wandsworth Boroughs. Meetings were held more regularly than the Transport Group meetings to ensure the Boroughs were fully consulted throughout the project.
4) Developer Meetings (Chair: Chris Porter, TfL): The two main developers in the Opportunity Area are Treasury Holdings and Ballymore. Separate meetings were held with each of these stakeholders to cover technical issues and provide a forum for each developer to inform the project team of activities being undertaken in the OA. These meetings were separate from the TfL Planning process and were for information sharing purposes only.

Consultation Process

The stakeholder groups were asked to comment on a number of Technical Notes. The project programme was constrained and required a strict adherence to consultation timeframes. A minimum of a week (with two weeks or more where the programme allowed) was provided to the stakeholders.

A pre-formatted response form was provided however written comments (email or letter) were still accepted. There were two different levels of response to comments received on the Technical Notes. If no responses were received from a stakeholder by the designated date it was assumed that they had no comments to be considered.

A document delivery schedule was developed and uploaded to the SharePoint site so all parties were cognisant of the deadlines. Updates to this schedule were distributed as and when required by changes to the project work programme.

There were two levels of consultation:

- VNEB Transport Group
- VNEB Transport Stakeholder Group

VNEB Transport Group/Boroughs

The Borough meetings were a subset of the VNEB Transport Group. This group was provided with all Technical Notes for comment, once agreed with TfL/GLA.

The stakeholders of the VNEB Transport Group were asked to complete the Technical Note list and register for documents they were interested in. There were 3 categories:

- Copy for Comment (CC) – for stakeholders who wanted to receive a report and were likely to provide comment;
- Copy for Information (CI) – for stakeholders who wanted to receive a report but were not provide formal comments; and
- No Copy (NC) – for stakeholders who did not want to review or comment on a report and would not be sent an alert.

The review process was as follows:

- SKM/ TfL LUP undertook to review, collate and identify potential conflicts from the responses received from the Transport Group;
- a response form was be provided by TfL; however any written response was accepted;
- comments were distributed to Lee Campbell (TfL LUP) and Megan Tibby (SKM) to ensure the project team was aware of all the issues;
- a TfL LUP representative summarised the comments and they were be uploaded to the SharePoint site so all participants could read the stakeholder reviews; and
- TfL LUP led any internal conflict resolution.

VNEB Transport Stakeholder Group

Technical notes were released to these Stakeholders (including Treasury Holdings and Ballymore) once they had been agreed with TfL/GLA and where possible the VNEB Transport Group. The exception to this was TN14-TN20 which was issued concurrently to both groups to ensure that comments which fed back into the modelling methodology were incorporated in good time.

The project team reserved the right not to incorporate comments from this group within the Technical Notes. Comments were instead distributed for consideration to the appropriate members of the project team and the TfL representative. The comments could be appended to the technical notes where appropriate.

Dissemination of Information

The VNEB project used the existing TfL SharePoint site which was managed by Lee Campbell.

The information was managed as follows:

- SKM delivered draft documents to the TfL/GLA client team for comment and review;
- following approval SKM emailed the documents to LUP to be uploaded to the SharePoint site. The emails were sent per SharePoint folder and marked "VNEB UPLOAD REQUIRED" in the subject box. SKM was responsible for document control;
- SKM prepared "alert" emails detailing the new documents available and timeframes for consultation. For consistency of contact it was considered appropriate that the nominated Chairperson for each Stakeholder group (see 2 above) would then email these details to the appropriate stakeholder group;
- LC issued the documents and emails to the Lambeth and Wandsworth Boroughs and Network Rail separately as these organisations did not have access to the SharePoint site; and
- CP issued the relevant documents to Ballymore and Treasury Holdings separately as these organisations also did not have access to the SharePoint site.

Meetings

A meeting schedule was developed in line with key milestones of the project. This ensured that meetings were meaningful and allowed the appropriate time for preparation and discussion. Meeting responsibilities were as follows:

- SKM developed a suggested consultation meeting schedule for review by the TfL/GLA project team;
- the Consultation Group Chairperson was responsible for booking a room and sending out email invites;
- SKM provided an agenda to the nominated consultation group chairperson for review;
- SKM provided either a SharePoint "alert" email or the relevant documents to be attached to the meeting invite; and
- SKM recorded meeting minutes and once approved by the client team these were uploaded to SharePoint.

Appendix D

Station Capacity Analysis

Appendix D Station Capacity Analysis

Introduction

Five key stations within and influenced by the OA have been considered for this station capacity analysis:

- Vauxhall;
- Victoria;
- Battersea Park;
- Queenstown Road; and
- Waterloo.

The high level analysis compares the forecast demand at these key OA stations with existing and future station capacities to assess the wider effects of both additional development and transport packages on the key stations within the OA. TfL have provided estimates of current and proposed future station capacity in the form of gate line and escalator capacity. The comparison of forecast demand with station capacity has been undertaken between:

- 2008 Reference Case and 2026 Reference Case;
- 2026 Reference Case and the 2026 OA Scenarios without transport packages; and
- 2026 OA Scenarios with and without transport packages.

The analysis presented in this appendix is the forecast effect of development scenarios with and without transport packages on stations and are subject to tolerances. Therefore the results provide a broad assessment of capacity requirements but caution needs to be used when interpreting results near capacity thresholds.

Development of Station Interchange Matrices

2008 Station Interchange Matrices (matrices of movements between lines and modes at each station) have been extracted from VNEB-P. VNEB-P is a strategic model and as such the use of the station interchange matrices directly from the model is not considered appropriate for this analysis. Therefore an alternative method has been used.

Data for Underground stations have been extracted from the TfL 2008 RODS data, and data for NR stations from bespoke 2008 station entry and exit surveys. These ‘counts’ have been totalled as appropriate to correspond to the rows and column totals of the modelled station interchange output. The 2008 modelled station interchange matrix has then been furnessed to the 2008 observed data. An adjustment station interchange matrix has been calculated by subtracting the 2008 model output from the furnessed 2008 station interchange matrix. The resulting absolute matrix adjustments have then been applied to all subsequent 2026 station interchange forecasts.

The following data are taken from the VNEB-P AM peak model. This is a three-hour model, and for all the figures and analysis in this appendix a factor of 0.54 has been applied to estimate the busiest morning peak hour. 0.54 represents the standard factor used by TfL in strategic multimodal public transport modelling and serves as a consistent basis for estimating peak hour demand for TfL projects and for planning future facilities.

Current observed data, especially at central London underground stations indicate that 45% of movements in the AM peak period take place in the peak hour, suggesting a factor of 0.45 may be appropriate, particularly at Vauxhall. However, London Underground has advised that 0.54 is the appropriate factor to use for forecasting future demand, because that is what has been observed in the past whereas current flows reflect a constrained situation. As such, London Underground considers that future planning should not reflect constrained demand.

Vauxhall

Station Configuration

Vauxhall NR station has a total of eight platforms, as shown in Table D 1.

Table D 1 Vauxhall NR Station Platform Configuration

Platform	Pairing	Line	Comments
1	Island with 2	Windsor reversible	Not in regular use by trains calling at Vauxhall
2	Island with 1	Up Windsor	
3	Island with 4	Down Windsor fast	
4	Island with 3	Down Windsor slow	
5	Island with 6	Up main fast	Not in regular use by trains calling at Vauxhall
6	Island with 5	Down main fast	Not in regular use by trains calling at Vauxhall
7	Island with 8	Up main slow	
8	Island with 7	Down main slow	

As a consequence of this arrangement:

- passengers to and from the Windsor lines use separate islands for up and down trains; and
- passengers to and from the SW main line use the same island for up and down trains.

There is an east-west subway running beneath the platforms. Three of the four island platforms have a single staircase connecting with the subway, but platforms 7/8 now have two staircases. There are gated entrances to the subway at both ends, with the main access at the western end adjacent to the bus station and Underground station.

The Underground station has a sub-surface ticket hall accessed from a public subway with multiple entrances. There are two platforms, which, although in separate tunnels, share a central circulating area and access between the circulation area and the ticket hall is via a group of three escalators.

Interchange between the NR and Underground stations occurs outside the barrier lines. There is a staircase providing access to the public subway immediately outside the western entrance to the NR station, and this subway converges at a junction with the other subways immediately outside the Underground ticket hall. The predominant flow in the AM peak is from the NR station to the Underground station.

It is therefore considered that key constraints to passenger flow at Vauxhall are:

- access to and from the Underground platforms via the escalators;
- access to and from platforms 7/8 of the NR station; and
- capacity in the public subway linking the NR and Underground stations.

Changes in Underground Station Use

Key constraints at Vauxhall Underground station are as follows.

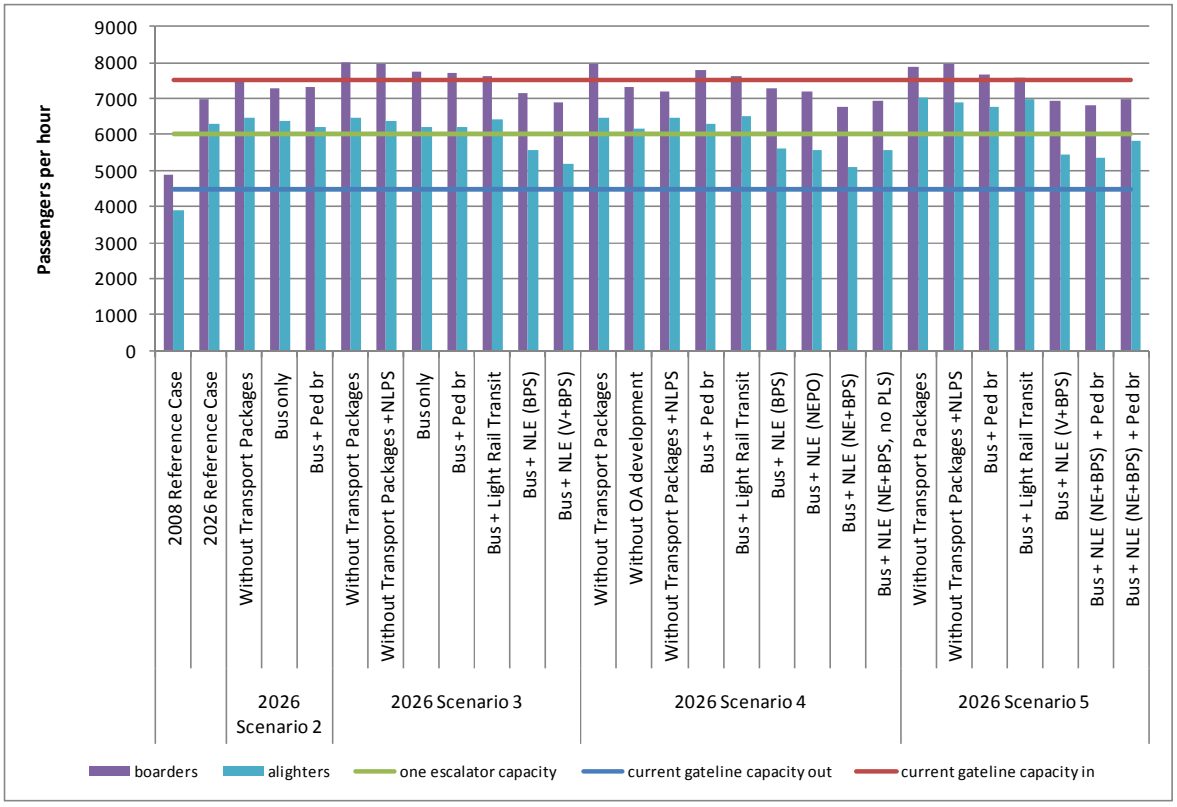
- Escalators to and from the Victoria Line platforms:
  - three escalators each with capacity of 6,000 pax/hr;
  - normal morning peak configuration is two down and one up; and
  - overall capacity of 18,000 pax/hr can only be configured as 12,000 pax/hr in one direction and 6,000 pax/hr in the reverse direction.
- Gate lines:
  - currently seven gates; and
  - maximum morning peak configuration of 7,500 pax/hr in and 4,500 pax/hr out.

There are proposals to increase gate line capacity at Vauxhall Underground station. This would increase the number of ticket gates from seven to twelve and would also install step free access between the ticket halls and platforms. This would bring the gate line capacity in line with escalator capacity. It is estimated to cost in the region of £50 million and is currently unfunded.

There are no plans to increase the capacity of the station beyond the current escalator capacity. Initial estimates indicate the costs of doing so would be over £100 million. There are also doubts that such a scheme would be feasible, either for engineering reasons, given the location of the current station and platforms or for strategic reasons because of the potential impact on other parts of the Victoria Line.

Figure D 1 shows the forecast number of Victoria Line boarders and alighters passing through the ticket hall for each proposed development and transport scenario. It should be noted, that where transport packages include NLE platforms at Vauxhall, these numbers include passengers interchanging between the Northern Line and the Victoria Line. These interchange passengers would use the Victoria Line escalator; however, due to the indicative station configuration they would not pass through the gate line. Thus comparisons with gate line capacity are not appropriate for these packages.

Figure D 1 Vauxhall Underground Station: Victoria Line Boarders and Alighters[15]
(morning peak busiest hour)



The impact on escalator capacity is as follows.

- Boarders:
  - the 2008 Reference Case forecast indicates that boarders are within the capacity of a single down escalator, though two are operated;
  - the 2026 Reference Case forecast indicates that boarders would exceed the capacity of one escalator;
  - the capacity of one escalator would also be exceeded with the addition of further development in OA Scenarios 2, 3, 4 and 5 without transport packages;
  - none of the proposed transport packages are forecast to reduce the number of boarders below the capacity of one escalator; and
  - all 2026 Reference Cases and 2026 scenarios with or without the transport packages would therefore require the continued use of two escalators.

[15] This analysis was carried out using a factor of 0.45 to present current year flow and a factor of 0.54 to represent 2026 demand.

- Alighters:
  - the 2026 Reference Case and all 2026 scenarios without transport packages are forecast to have an increase in alighters above the capacity of a single escalator; and
  - NLE transport packages are forecast to reduce alighters to within the capacity of one escalator.
- Combined effect of boarders and alighters:
  - the 2026 Reference Case and all scenarios without transport packages are forecast to increase the numbers both of boarding and alighting passenger beyond the capacity of a single escalator;
  - there is therefore no scope to consider reversal of the second escalator to accommodate growth in the number of alighting passengers;
  - only the NLE transport packages would be effective in maintaining alighting passenger flows within the capacity of a single up escalator through diversion of demand to new escalators within Vauxhall Underground station or new stations; and
  - the individual effect of Partial Separation of the Northern Line is forecast to be minimal and would not give sufficient relief of escalator demand.

Thus the 2026 Reference Case, all 2026 scenarios without transport packages, and all transport packages in 2026, except those which include the NLE, would yield demands which would exceed escalator capacity at Vauxhall.

The impact on gate line capacity is as follows.

- Boarders:
  - the 2026 Reference Case demands would remain within the existing gate line capacity but, with OA Scenarios 2, 3, 4 and5 without transport packages, demands would reach or exceed gate line capacity;
  - with the addition of transport packages, some but not all packages are forecast to reduce boarders back below current gate line capacity;
  - the options which are forecast to provide greatest relief are those which include the NLE serving stations other than Vauxhall; and
  - the individual effect of Partial Separation of the Northern Line is forecast to reduce boarders in OA Scenario 4 but increase boarders in Scenario 5.
- Alighters:
  - The demands in the 2026 Reference Case and all scenarios with and without transport packages are forecast to exceed the current gate line capacity.

Vauxhall Underground station is currently operating close to the capacity of the exit gate line. The increase in gate line capacity currently under consideration would be required before the passenger numbers forecast for the 2026 Reference Case are reached.

The future operation of Vauxhall LUL station is a key issue for the redevelopment of the Opportunity Area. As such, it is recommended that more detailed station modelling (such as Pedroute and/or Legion) should be undertaken at Vauxhall to support the preferred transport package.

Changes in Network Rail Station Use

As noted above, the island platform 7/8 at Vauxhall is the busiest, with the stairs to the subway most likely to suffer from congestion.

Figure D 2 shows the impact forecast for each scenario and transport package on the overall number of passengers using platforms 7 and 8 at Vauxhall NR station (including boarding, alighting and interchange with the Underground).

Figure D 2 Passengers Using Platforms 7/8 at Vauxhall NR station (morning peak busiest hour)

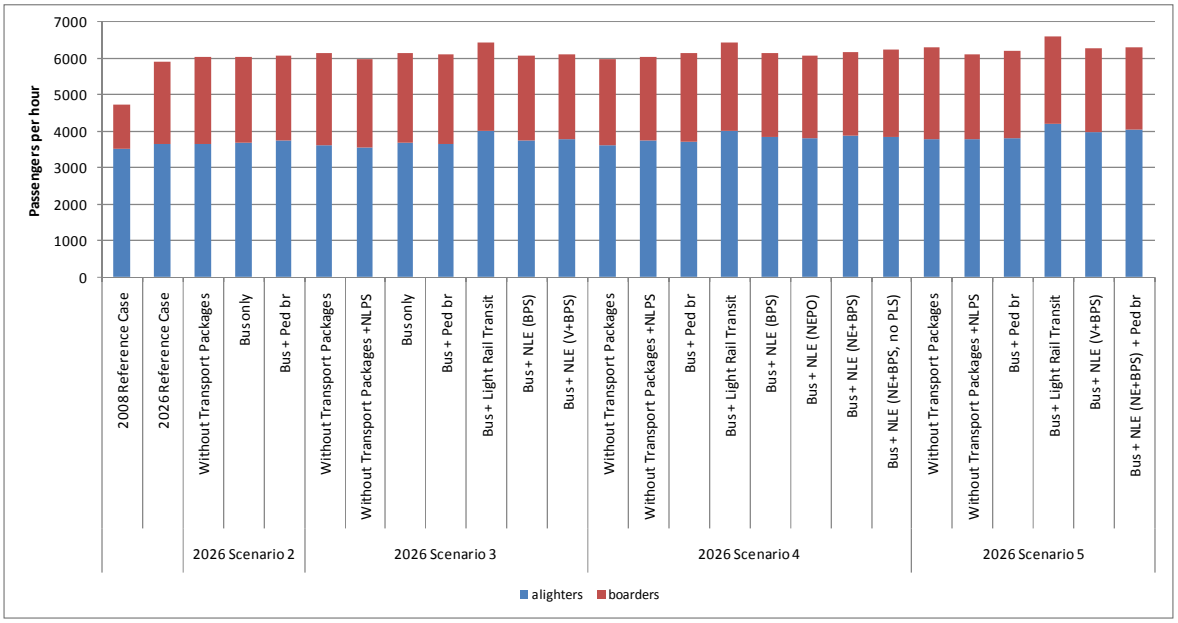


Figure D 2 shows that the 2026 Reference Case forecast indicates a doubling in the number of boarders, with a small increase in the number of alighters. The additional effect of the development scenarios without transport packages relative to the 2026 Reference Case is forecast to be small and the individual effect of Partial Separation of the Northern Line is forecast to offer some relief in OA Scenarios 3 and 5.

The general effect of the transport packages is forecast to be a slight increase in the overall number of NR passengers using platforms 7 and 8 compared with the development scenarios. The transport

packages which include LRT have increased alighters, possibly taking advantage of the enhanced interchange possibilities.

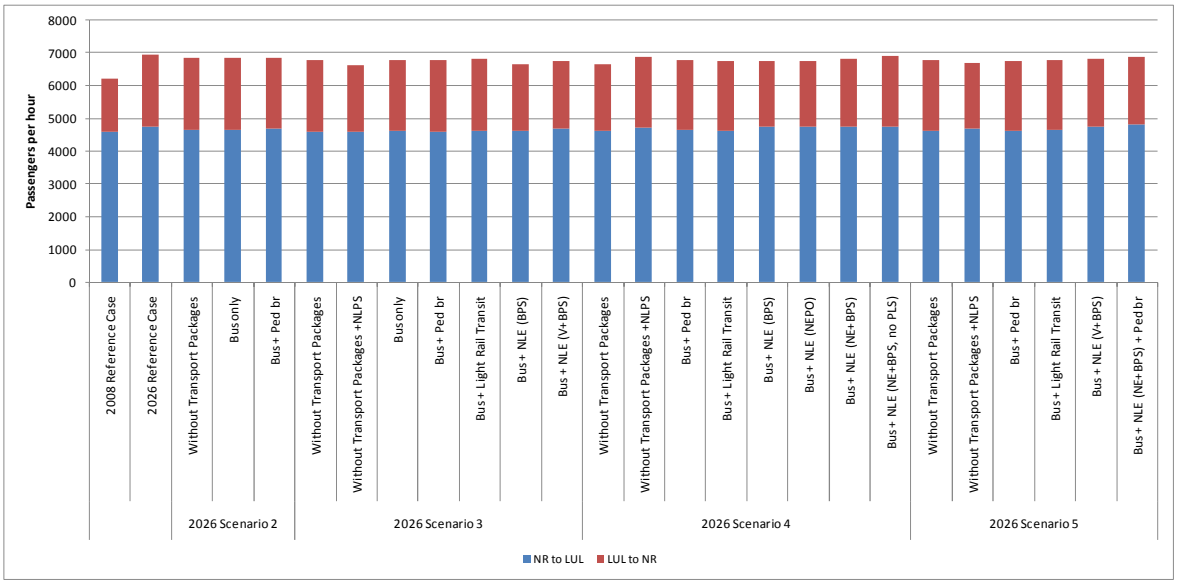
A particular problem, however, is that most of the forecast increase between 2008 and all 2026 scenarios is for boarding passengers; some of which are passengers interchanging from the Underground. This could potentially result in more conflict with alighting passengers using the staircases. The station operator already manages passenger flows across the two staircases and the forecasts indicate further adjustment to allow for more boarding passengers may be required.

Network Rail is progressing a scheme to increase train ticket hall capacity and improve interchange and passenger flow between the NR, Underground and bus stations through the utilisation of the vacant archway immediately south of the existing station to increase station and gate line capacity. This scheme is part of the National Station Improvement Programme (NSIP programme). Network Rail is able to commit up to 50% of the cost of this project (currently estimated at £3 million), however require match funding from third party sources to enable the work to progress.

Interchange Passengers

Figure D 3 shows the forecast impact of each scenario and transport package on the overall number of passengers interchanging between NR and Underground at Vauxhall. Note that, where transport packages include NLE platforms at Vauxhall, these numbers do not include passengers interchanging between NR services and the Northern Line.

Figure D 3 Vauxhall: Interchange Passengers between NR and Underground
(morning peak busiest hour)



In general, the development scenarios with or without the transport packages are forecast to have little impact on the number of interchange passengers from NR to Underground compared with the 2026

Reference Case. Growth is forecast to be in mainly passengers interchanging from Underground to NR.

Summary

- The key issue at Vauxhall is capacity at the Underground station.
- Escalator capacity is a serious issue. Because escalator capacity can only be configured with 12,000 pax/hr in one direction and 6,000 pax/hr in the other; there would be congestion if both boarders and alighters were close to or in excess of 6,000. This is forecast to occur with the 2026 Reference Case, all development scenarios, and all transport packages except those which include NLE.
- The gate line capacity is also insufficient for the 2026 Reference Case and all scenarios. However, it is understood that there are already plans to increase gate line capacity to match current escalator capacity.
- The most important benefit of the transport packages in terms of station operation at Vauxhall would be the reduction in the number of alighting passengers. The transport packages which include LRT options are forecast to offer little benefit, and in OA Scenario 4 slightly worsen the situation. NLE options perform best; and would in some cases reduce numbers to levels close to the 2008 Reference Case.
- The main increase in passenger numbers forecast, in both the pedestrian subway linking the NR and Underground stations and those using platforms 7/8 at the NR station, is in passengers boarding train services, many of whom would be interchanging from the Underground. Because these passengers would be moving against the predominant flow, additional measures may be required to ensure segregation.
- The proposed NSIP improvements to the NR station would provide considerable benefits to both interchange and NR passengers.
- More detailed station modelling is required at Vauxhall LUL station to understand the extent of the problem.

Victoria

Station Configuration

The Victoria interchange includes both the NR and Underground stations. Both are gated (with the exception of the Gatwick Express platforms) and interchange between NR and Underground occurs outside the gated area.

The main impact of the VNEB options and packages is expected to be on passenger circulation at the Underground station, and particularly to and from the platforms. The station has two ticket halls, with the main Victoria Line ticket hall predominantly used by passengers interchanging with the NR station. The District Line ticket hall is also used by passengers passing to and from the street. A sub-

surface passageway links the two ticket halls, thus passengers interchanging between NR and the District Line pass through both ticket halls but use the gates in the District Line hall.

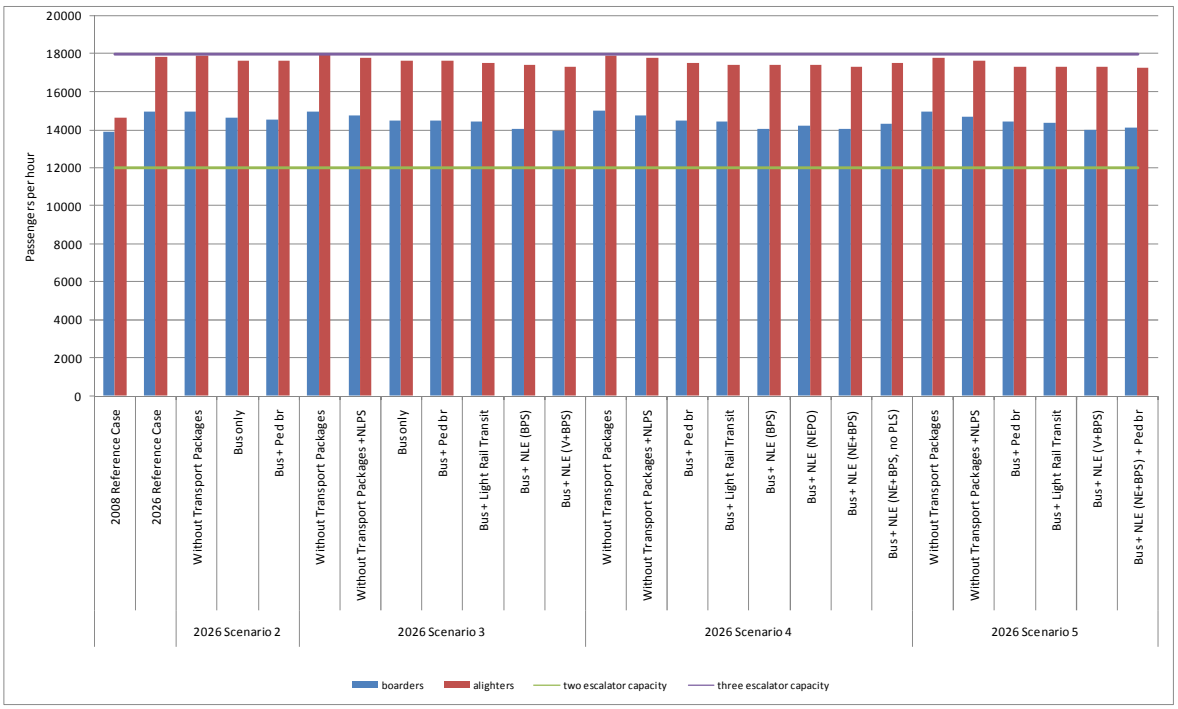
There are three escalators between the Victoria Line ticket hall and the Victoria Line platforms. Normal morning peak configuration is two escalators down and one up. There are also three escalators for interchange between the Victoria Line and District Line platforms. In the morning peak these operate two up and one down. Each of the escalators has a capacity of 6,000 pax/ hr. This gives a total capacity of six escalators giving access to the Victoria line which can be reversed to suit demand.

TfL is currently progressing a significant redevelopment of Victoria Underground station to reduce overcrowding and delays and improve access for the increasing number of passengers using the station. This includes an additional ticket hall as well as increased gate line and escalator capacity and additional interchange facilities. This project is intended to reduce congestion and delay that is already forecast and will most likely mitigate many of the additional impacts on the station from the OA development. As this project is currently awaiting Secretary of State approval only the current station layout has been considered.

Changes in Underground Use and Interchange

Figure D 4 shows the forecast impact of each development scenario and transport package on the total number of boarders and alighters from the Victoria Line platforms. All access to the Victoria Line platforms is via the escalators either to the ticket hall or the District Line.

Figure D 4 Boarders and Alighters from Victoria Line (morning peak busiest hour)

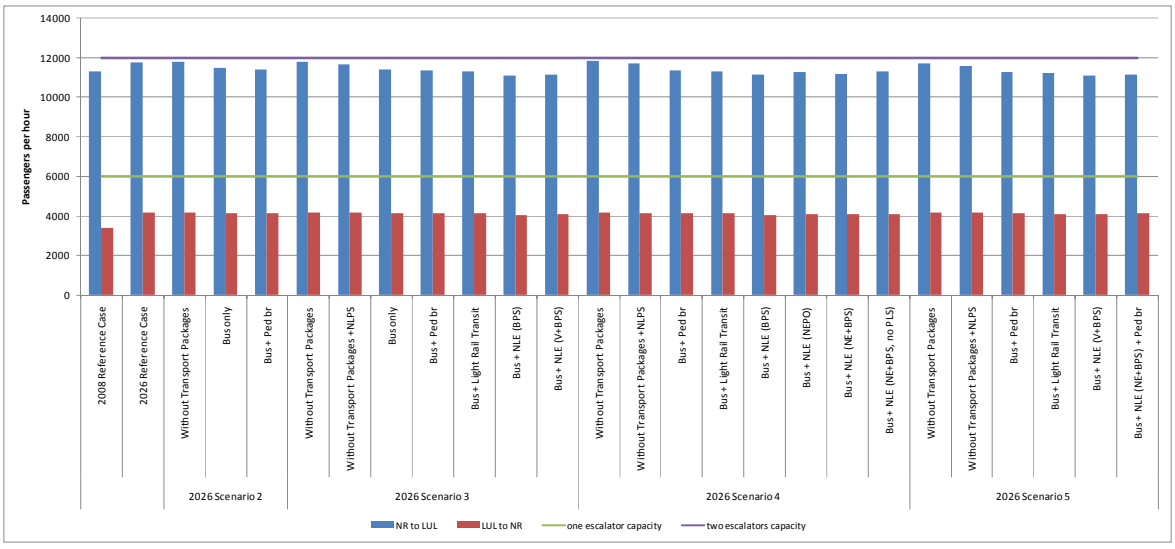


Key points from Figure D 4 are:

- in the 2008 Reference Case, the overall numbers of boarders and alighters are in excess of the capacity of two escalators each;
- however, for the 2026 Reference Case and all options and transport packages, neither the boarders nor alighters are forecast to exceed 18,000 pax/ hr; which is within the maximum capacity of three escalators;
- the main difference between 2008 and 2026 Reference Case is forecast to be a significant increase in the number of alighters, increasing the number of alighting passengers very close to the capacity of three escalators;
- the effect of the VNEB development scenarios and transport packages is forecast to be less marked on the number of alighters than on the number of boarders;
- the transport packages offer some margin of slack below theoretical maximum capacity, which may be useful in regulating passenger flows; and
- in this context, the individual impact of Partial Separation of the Northern Line is forecast to be minimal.

On the assumption that the main use of the escalators between the Victoria line platforms and the Victoria line ticket hall is for passengers interchanging to and from NR, Figure D 5 illustrates the impact of each development scenario and transport package on the total number of interchange passengers.

Figure D 5 Victoria: Interchange Passengers between Victoria Line and NR
(morning peak busiest hour)



Key points from Figure D 5 are that, excluding passengers to and from the street:

- all forecasts for the 2026 Reference Case, development options and transport packages remain just within the existing maximum capacity of two down escalators and one up;
- in OA Scenarios 3, 4 and 5, the effect of partial line separation is a small reduction in the number of interchange passengers from NR to Underground; and
- the effect of the transport packages is a further small reduction in the number of interchange passengers from NR to Underground.

Figure D 6 shows the forecast impact for passengers interchanging between the Victoria Line and the District Line.

Figure D 6 Victoria: Interchange Passengers between Victoria and District Lines
(morning peak busiest hour)

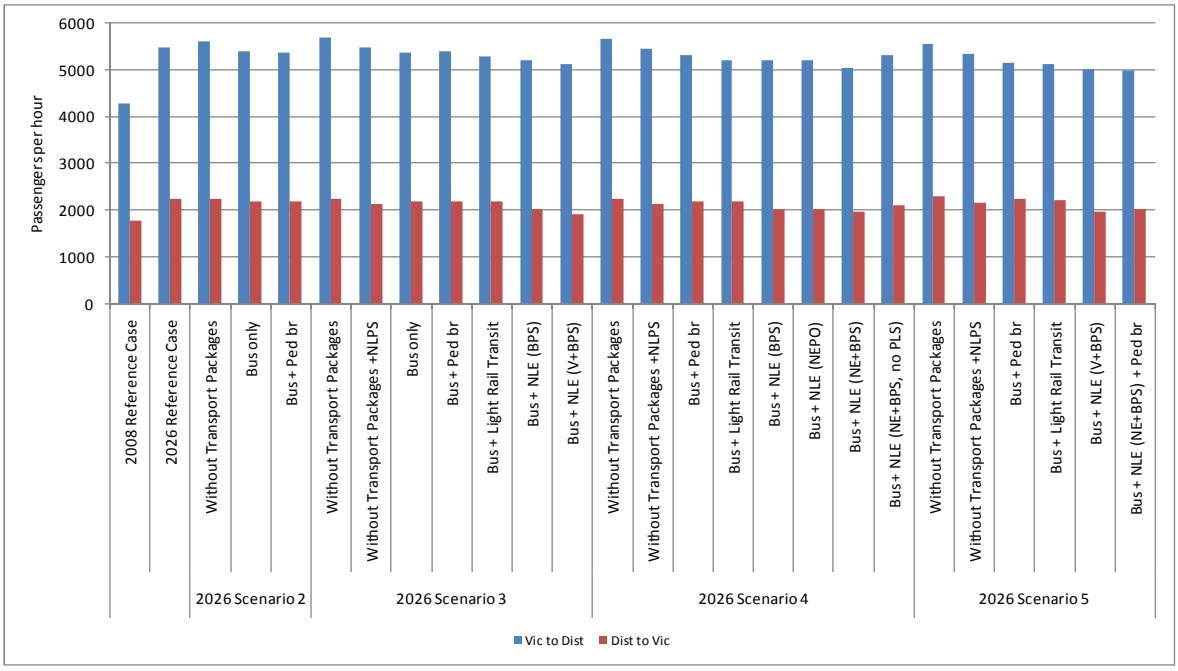


Figure D 6 highlights the following forecast results:

- the overall impact of future forecasts is similar to the pattern of interchange between the Victoria and District Lines;
- despite the forecast increase in the number of alighting passengers, these flows can be accommodated within the capacity of a single escalator in each direction; and
- the effect of the VNEB transport packages is estimated to be a small reduction in the number of interchange passengers in both directions.

The remaining issue is therefore the requirement for access between the Victoria Line platforms and the street or the bus station. Figure D 7 illustrates the forecast impact of each development scenario and transport package on the number of Victoria Line passengers passing to and from the street.

Figure D 7 Victoria: Non-rail-interchange Passengers To and From the Victoria Line (morning peak busiest hour)

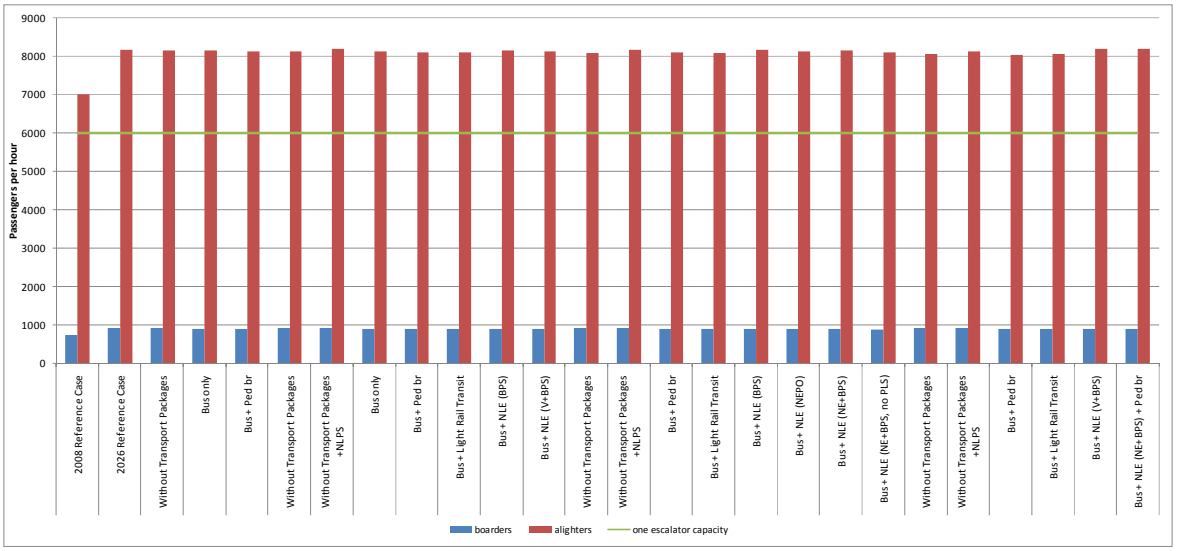


Figure D 7 shows that:

- the 2026 Reference Case forecasts an increase of some 1,000 alighters, compared with the 2008 Reference Case;
- the forecast effect of the development scenarios and transport packages would be small when compared to the 2026 Reference Case;
- it is likely that non-rail interchange boarders would enter via the District Line ticket gates and use available capacity on the interchange escalators from the District Line rather than through the Victoria Line gates. This would provide useful relief to the escalators from the Victoria Line ticket hall as the numbers of passengers interchanging from rail is already close to the capacity of the two down escalators; and
- the number of alighting passengers already exceeds the capacity of a single escalator; however there is currently scope to accommodate them together with the interchange passengers to the District Line via the interchange escalators with exit through the District Line ticket hall. There is also some spare capacity on the escalator to the Victoria Line ticket hall.

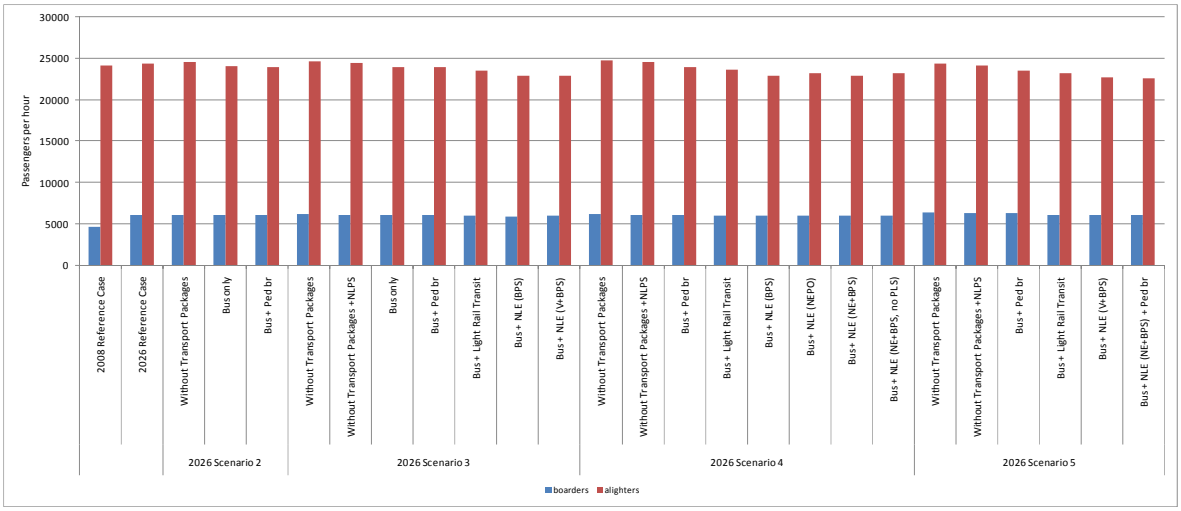
In future scenarios, with the total number of alighting passengers forecast to be very close to the capacity of three escalators it would be necessary to manage passenger flows to ensure that there is a balance between passengers exiting via the District and Victoria Line ticket halls. Provided this is handled effectively, the overall capacity of the current escalators is forecast to be sufficient, however there may be problems clearing the platforms into the circulation areas at the foot of the staircases.

Changes in Network Rail Station Use

Victoria NR station is split into two main sections, served by South Eastern and South Central services. South Central trains serve Battersea Park and Wandsworth Road. South Eastern trains do not serve any stations within the Opportunity Area.

Figure D 8 shows the forecast number of South Central boarders and alighters at Victoria, including interchange passengers with the Underground.

Figure D 8 Victoria Network Rail Station: South Central Boarders and Alighters (morning peak busiest hour)



The following summarises the key points illustrated in Figure D 8:

- the main difference between the 2008 and 2026 Reference Cases is an increase of around 2,700 boarding passengers;
- OA Scenarios 2, 3 and 4 without transport packages add around 200-300 alighting passengers with little change in boarders, however OA Scenario 5 has alighter volumes similar to the 2026 Reference Case, but an additional 250 boarders;
- Partial Separation of the Northern Line generally reduces alighters by about 200 for each development scenario;
- the transport packages further reduce alighters compared with the development scenarios, with the greatest reductions of some 1,500 – 2,000 passengers for the NLE packages; and
- Partial Separation of the Northern Line and the NLE has a smaller effect on the number of boarders.

Summary

- Victoria Underground station is already operating close to capacity;

- the effect of the forecast increase to the 2026 Reference Case is such that effective crowd management would be even more important, with little excess capacity unless there is further expansion of station capacity;
- the addition of the VNEB development options is forecast to add further passengers. This provides additional justification for the station upgrade works already planned at Victoria Underground Station; and
- the effect of the transport packages is useful in diverting some of the pressure away from Victoria. This is particularly marked with the NLE options.

The complex passenger movements through Victoria Station cannot be completely accounted for in the strategic analysis carried out in this study. However the key consideration at Victoria (relative to development of the OA) is the total number of passengers on the Victoria Line and the Victoria Line platforms, rather than the impact of movement through Victoria itself, so this is not considered to be a critical issue.

Battersea Park

Station Configuration

Battersea Park station currently has five platforms, of which four are in regular use, as shown in Table D 2.

Table D 2 Battersea Park Station Platform Configuration

Platform	Pairing	Line	Comments
1	Side platform	Down Atlantic	South London Line trains to London Bridge
2	Island with 3	Up Atlantic	South London Line trains to Victoria
3	Island with 2	Down Brighton slow	South Central suburban services towards Clapham Junction
4	Island with 5	Up Brighton slow	South Central suburban services towards Victoria
5	Island with 4	Down Brighton fast	Not in regular use by trains calling at Battersea Park

The majority of suburban services call at platforms 3 and 4, with only the South London Line services using platforms 1 and 2.

The station is situated on a viaduct and access from the street is via a single staircase to a mid-level subway serving three staircases to platform 1, platforms 2/3 and platforms 4/5. All staircases are towards the country (south) end of the platforms. The island platform 2/3 has a reasonable amount of circulating space at the head of the staircase. However the staircase to platforms 4/5 opens directly onto the end of the island platform, which at this point is the same width as the staircase, and is narrow throughout its length. Signs on the stairs warn passengers that they are steep and narrow, and that fast trains pass on platform 5. These stairs therefore act as a significant bottleneck, particularly as there is no further circulating space on the platform at the stair head.

Platforms 3-5 currently have capacity for 8 cars. In order to extend platforms 3 and 4 for 10-car suburban services, it is proposed to lengthen them at the north end. This would sever the connection to the Atlantic Lines. South London Line services would no longer serve Battersea Park and platforms 1 and 2 would be taken out of use. This would mean that all regular boarding and alighting would take place on platforms 3 and 4. However, unless additional access is provided, the stairs at the southern end of the platforms remain a constraint on capacity. The overall width of the viaduct means that it would be difficult to widen platform 4/5.

Network Rail is currently developing proposals for Battersea Park Station as part of the Southern route utilisation strategy (RUS) to ensure the station can accommodate 10 car trains. Proposals include a possible new station entrance (2nd) on Queens Circus, which would help alleviate capacity constraints elsewhere in the station. The cost of these improvements is currently estimated at £7.5 million and would require a significant funding contribution from third party sources to proceed.

The majority of passengers use the station for boarding and alighting, as there is limited scope for interchange.

Changes in Station Use

Figure D 9 shows the forecast impact of each scenario and transport package on the overall number of passengers using Battersea Park station.

Figure D 9 Battersea Park: All Boarders and Alighters (morning peak busiest hour)

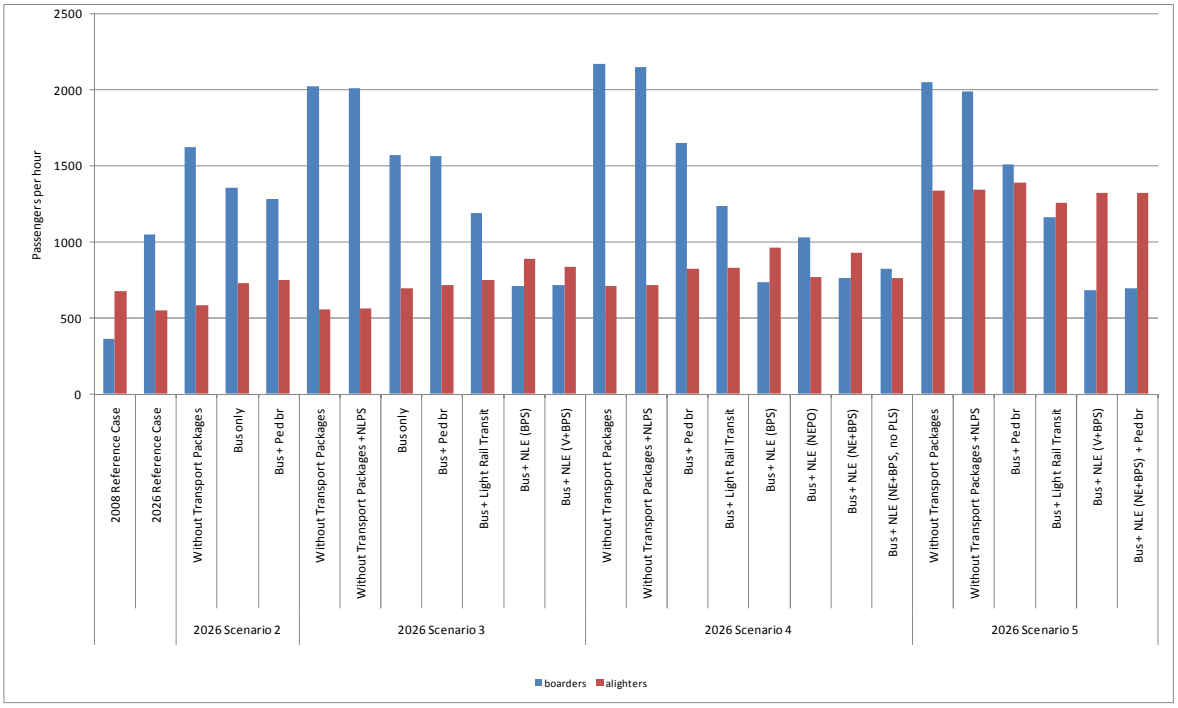


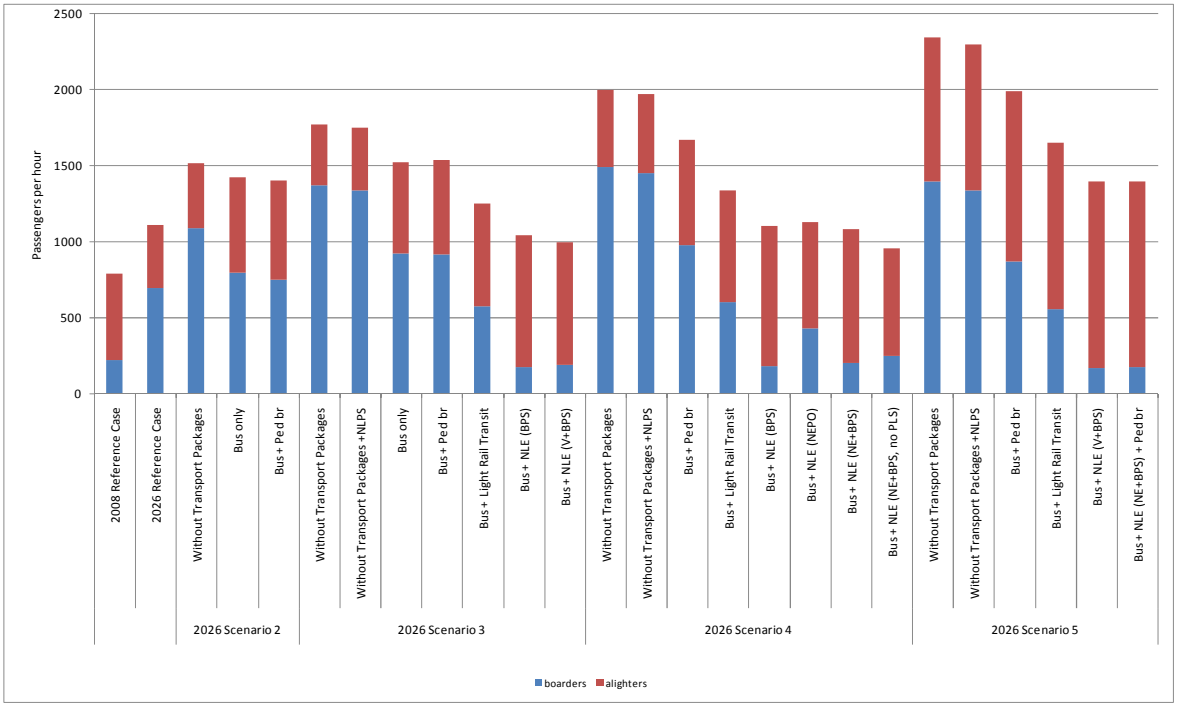
Figure D 9 illustrates that:

- Between the 2008 and 2026 Reference Case a significant increase in the total number of boarders and a drop in the number of alighters is forecast. This is commensurate with current patterns of development, with a significant residential and commercial complex on the former Battersea Wharf to the west of the rail line.
- Each of the development scenarios is forecast to add significantly to the number of boarders, with OA Scenario 5 also adding significantly to the number of alighters. In comparison with 2008, the scenarios are forecast to increase the overall use of the station with a doubling in OA Scenario 2 and tripling of OA Scenario 5. Even compared with the 2026 Reference Case, OA Scenario 5 represents a doubling of overall station usage.
- Partial Separation of the Northern Line is forecast to have little effect.
- The transport packages give a significant reduction in the number of boarding passengers, especially the NLE. However they have less impact on the number of alighters, in most cases resulting in a slight increase, as Battersea Park becomes a more attractive interchange point.

As a result of the configuration of platforms, it is valuable to consider separately the changes in passenger numbers for up and down services.

Figure D 10 shows the forecast change in the number of passengers using up services.

Figure D 10 Battersea Park: Up Boarders and Alighters (morning peak busiest hour)



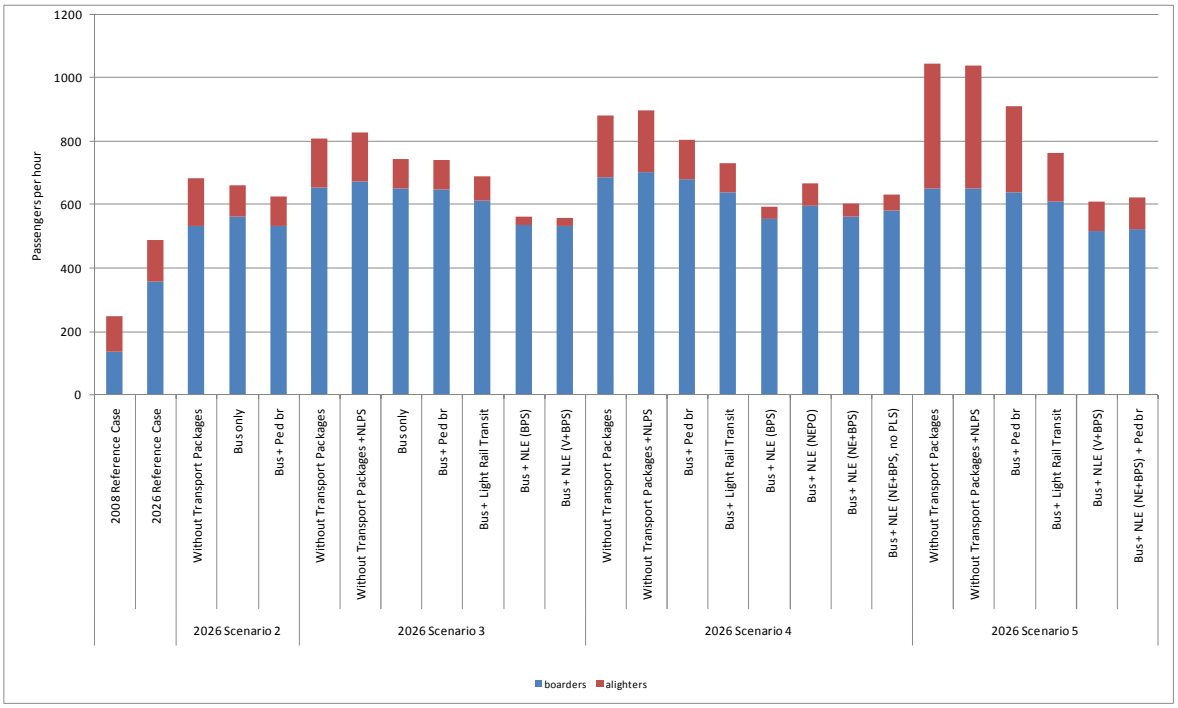
The following summarises the changes in passenger numbers on up services:

- it is forecast that all up services calling at Battersea Park would serve platform 4 by 2026;
- at present there is a predominance of alighting passengers, but the 2026 Reference Case and development scenarios without transport packages all have a higher proportion of boarders;
- the combination of more passengers and an increase in conflicting movement on the existing narrow platform and staircase could result in congestion and may become dangerous, especially as full length 10-car trains would by then be serving a platform which only has access at one end;
- the transport packages including the NLE (and to a lesser extent the LRT) are forecast to reduce the overall passenger numbers. A useful feature of some of the NLE transport packages is that they reduce the numbers of boarding passengers close to 2008 levels, with all the increase being in alighting passengers. This would reduce conflict between passengers on the stairs (though it is likely that it would be difficult for boarding passengers to ascend immediately after the arrival of a train). More importantly it would mean that passengers waiting to use the stairs would predominantly be spread along the platform and can observe progress towards the stairs, rather than being congested in the booking hall or intermediate subway as passengers ascending the stairs attempt to enter a crowded platform; and
- Partial Separation of the Northern Line is forecast to have a minimal effect on passenger numbers.

On the assumption that the evening peak is the reverse of the morning peak, it is of benefit that the greater circulating space on platforms 2/3 would provide somewhere for boarding passengers to spread out after they have ascended from the booking hall.

Figure D 11 shows the forecast change in the number of passengers using down services.

Figure D 11 Battersea Park: Down Boarders and Alighters (morning peak busiest hour)



By 2026 it is anticipated that all down services would serve platform 3. Analysis of the change in number of boarders and alighters on down services shows that:

- the 2008 Reference Case has a fairly even mix of boarders and alighters, but the 2026 Reference Case shows both an overall increase of over 200 passengers and a significantly higher proportion of boarders;
- the development scenarios and transport packages forecast a significant increase in the number of boarders, with only OA Scenario 5 giving a significant increase in the number of alighters; and
- as with up services, the transport packages are estimated to provide useful reductions in overall passenger numbers, with the NLE options performing best. This is particularly evident in OA Scenario 5 where NLE options are forecast to have a more significant effect on the number of alighters.

Summary

- even without the VNEB development scenarios and transport packages, Battersea Park station is forecast to be significantly busier in 2026 that in 2008, with a reversal in the balance between boarders and alighters;
- Network Rail aspirations for a potential second entrance to the station would be likely to alleviate some of the current capacity constraints;
- the development scenarios are forecast to add significant numbers of boarders;

- the transport packages are forecast to subsequently reduce these boarders, with packages including the NLE having the largest impact; and
- restriction of access to platforms is likely to become a major issue, especially platform 4 for up services. In this context the NLE options, are forecast to deliver worthwhile reductions in passenger numbers and reduce the extent of conflict between boarding and alighting passengers.

Queenstown Road

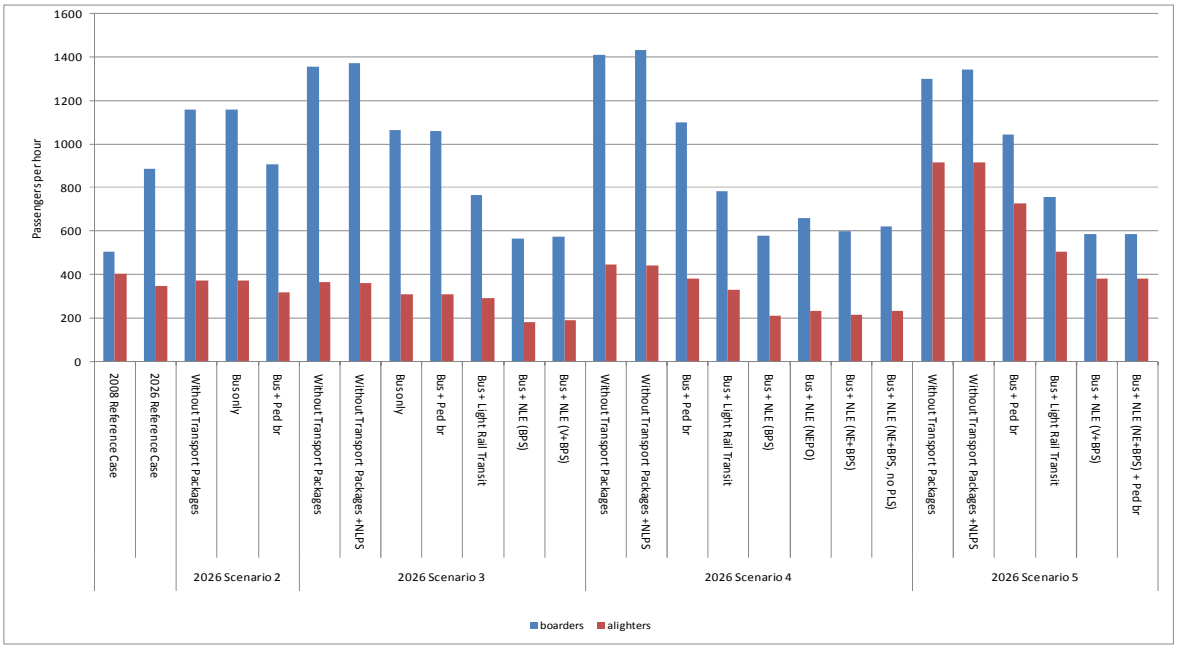
Station Configuration

Queenstown Road station has three platforms of which two (platforms 2 and 3) are currently in use. These are the two faces of an island platform serving the up and down Windsor Lines. Access to the street is via a staircase which opens onto the platform towards the London end. Half way down, this staircase a side stair gives access to the ticket hall. When the ticket hall is closed, passengers continue on the main staircase to and from street level. Current platform capacity is 8 cars and there is space at the country end for planned extension to 10 or 12 cars.

Changes in Station Use

Figure D 12 shows the forecast impact of each development scenario and transport package on the overall number of passengers using Queenstown Road station.

Figure D 12 Queenstown Road: All Boarders and Alighters (morning peak busiest hour)



Analysis of the forecast impact of each development scenario and transport package on the total passenger numbers at Queenstown Road station suggests that:

- between the 2008 Reference Case and 2026 Reference Case there is a significant increase in boarders and a smaller drop in the number of alighters;
- with the exception of OA Scenario 5, all the development scenarios build on the above mentioned trend, with OA Scenario 4 adding the most boarders. OA Scenario 5 is forecast to have a slight reduction in boarders but a significant increase of alighters compared with Scenario 4 which is due to increased employment within the OA;
- the station is therefore busier overall in OA Scenario 5 than in other scenarios;
- the transport packages are forecast to have the greatest effect on the number of boarders, though in OA Scenario 5 there is also a significant reduction in alighters. The NLE options are most effective in diverting demand;
- the individual effect of Partial Separation of the Northern Line is forecast to have slight increase in the number of boarders at Queenstown Road; and
- because the station has an island platform, all passengers use the same staircase, thus the critical factor is total passenger numbers at the station.

Summary

Although the effect of the VNEB development scenarios and transport packages is forecast to be significant compared with the 2008 and 2026 forecasts, current passenger numbers at Queenstown Road are relatively low and the additional passengers are not expected to cause significant problems.

Waterloo

Station Configuration

The Waterloo interchange includes both the NR and Underground stations. Both are gated and interchange between NR and Underground is outside the gated area.

The NR station has a common concourse and gate line, but is split operationally into three main sections, serving the South Western Main Line (SWML) (suburban and longer-distance platforms), the Windsor Lines, and Eurostar (currently not in use).

The Underground station currently has three ticket halls, as outlined in Table D 3.

Table D 3 Waterloo Underground Station Ticket Hall Configuration

Location	Access to
Below main Waterloo station concourse near the Windsor Line platforms	Direct access to Bakerloo and Northern Line, then via interchange passage to Jubilee Line.
Within the Shell centre on the northwest side of York Road	Direct access to Bakerloo and Northern Line, then via interchange passage to Jubilee Line.
Within the Colonnade on the southwest side of Waterloo Road	Direct access to Jubilee Line, then via interchange passage to Bakerloo and Northern Line

Access to the Waterloo and City Line is outside the main Underground gated area via a subway underneath the NR station platforms. Regular interchange passengers between NR and Underground can be expected to use the station entrance which gives easier access to their selected Underground line.

It has been assumed that the LRT station included in some transport packages would be located in the vicinity of Belvedere Road.

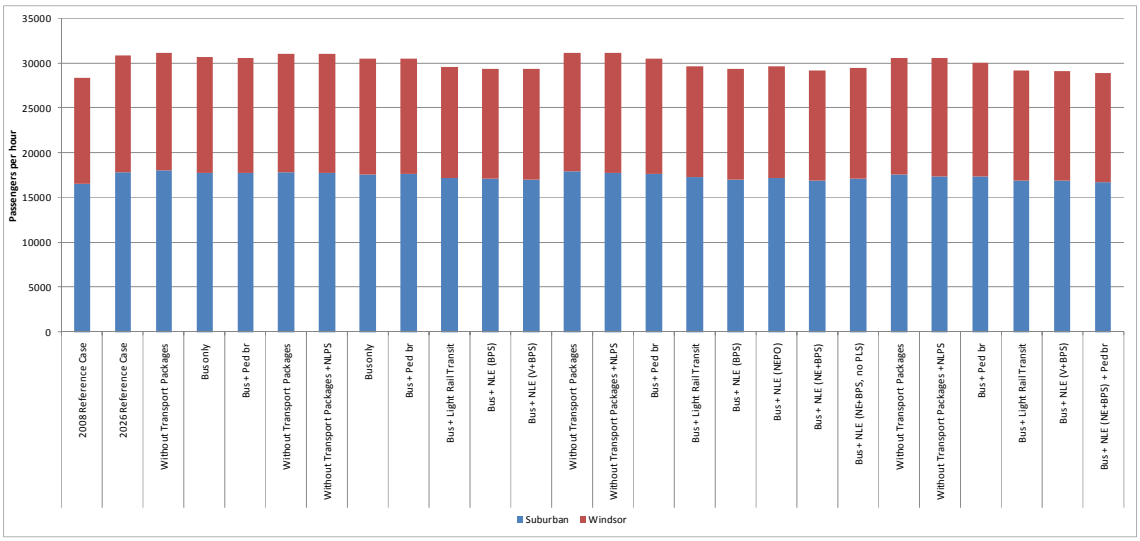
It should be noted that Waterloo East station is not included in this analysis. Any passengers interchanging between Waterloo East and Underground are counted as to/from the street.

Changes in Network Rail Station Use

It is anticipated that the main changes between 2008 and 2026 would be in the numbers of passengers using the SWML suburban and Windsor Line platforms.

Figure D 13 shows the number of arriving passengers on the suburban and Windsor Lines – these are the NR services that call at Vauxhall and Queenstown Road.

Figure D 13 Waterloo: Alighters from Suburban and Windsor Line Platforms
(morning peak busiest hour)



The change in numbers of rail alighters at Waterloo NR station shows that:

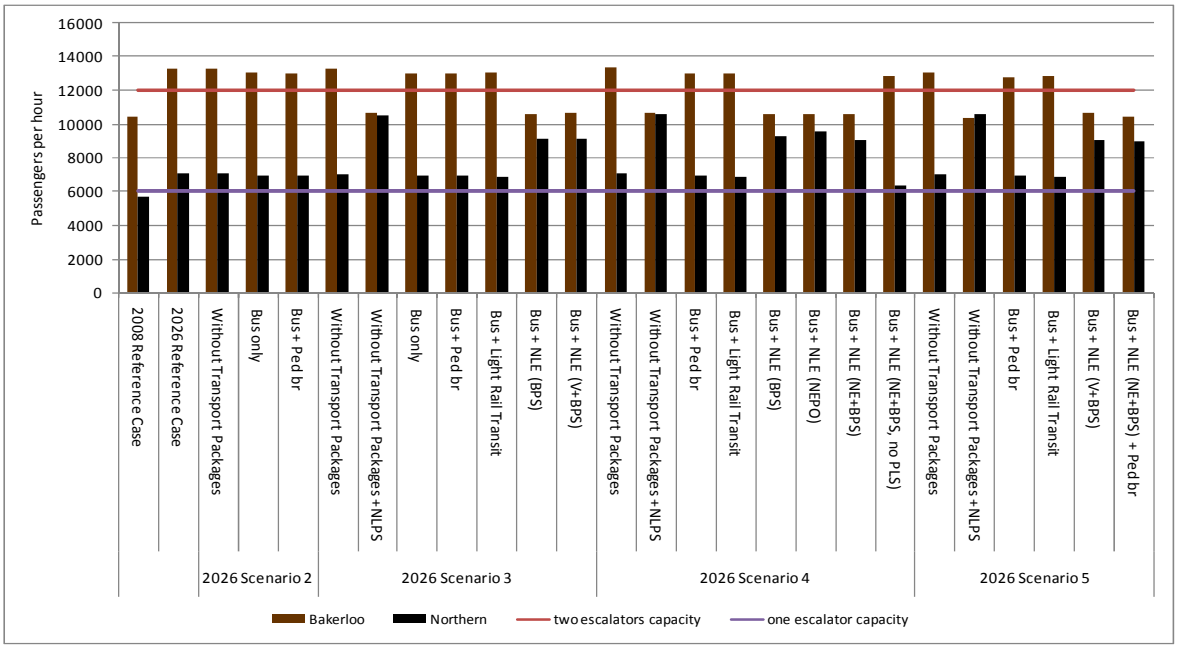
- the 2026 Reference Case forecast is some 2,500 passengers more than the 2008 Reference Case;
- the difference between the development scenarios without transport packages and the 2026 Reference Case is small. All except OA Scenario 5 are forecast to add some 200-300 passengers, while Scenario 5 is estimated to remove around 300 passengers; and
- the effect of the transport packages is forecast to be a small reduction in the overall number of rail alighters. In this case there is less difference in impact between the LRT and NLE options, with both offering greater relief than bus.

Changes in Underground Station Use and Interchange With Rail

There are significant changes in the pattern of interchange between the Northern Line and Underground, and in particular with the Bakerloo and Northern Lines.

Figure D 14 shows the number of passengers interchanging between NR services and the Northern and Bakerloo Lines.

Figure D 14 Waterloo: Rail to Bakerloo and Northern Line Northbound Interchange Passengers (morning peak busiest hour)



The implications for interchange between NR and the Northern and Bakerloo Lines at Waterloo are summarised below:

- the 2026 Reference Case forecasts an increase of almost 3,000 Bakerloo Line boarders and around 1,400 Northern Line northbound boarders over the 2008 Reference Case;

- the forecasts for the development scenarios show only small changes from the 2026 Reference Case;
- the transport packages containing LRT also have only a small effect compared with the 2026 Reference Case;
- however, a key effect of the Partial Separation of the Northern Line is a net transfer of around 3,000 forecast passengers from the Bakerloo Line to the Northern Line, reducing the number of Bakerloo Line passenger close to the 2008 Reference Case; and
- the reduction as a result of Partial Separation of the Northern Line is greater than the net effect of the extension of services to Battersea Power Station, where the reduction in Bakerloo boarders is broadly the same, but there is a smaller increase in Northern Line boarders.
- the majority of boarding passengers are forecast to interchange from NR; therefore the transfer of passengers between the Bakerloo and Northern Lines would be reflected in a revision of passenger flows. The majority of these passengers use the peak hour subway under the NR platforms to access the main ticket hall adjacent to the two peak hour escalators. These are configured to give direct access to the Bakerloo Line, with limited access to the Northern Line circulation area;
- in the 2008 Reference Case, the Bakerloo Line passengers are within the capacity of the two rush hour escalators, and Northern Line passengers within the capacity of one of the three main escalators from the ticket hall to the Bakerloo/Northern Line circulation area (one of which is required for alighting passengers);
- the passenger numbers forecast in the 2026 Reference Case require the use of a second main escalator to accommodate the additional Bakerloo and Northern Line Passengers. This also applies for the development scenarios without transport packages and the transport packages including LRT; and
- the effect of Partial Separation of the Northern Line and the NLE transport packages is to give a better balance between passenger flows on the two escalators serving the Bakerloo Line and those serving the Bakerloo/Northern Line circulation area.

Interchange with Light Rail Transit

Although the numbers are forecast to be much smaller than those interchanging from rail, a specific impact of the LRT options is an increase in the number of passengers entering Waterloo station from the street. Figure D 15 shows the total number of passengers entering Waterloo station (NR and Underground) from the street.

Figure D 15 Waterloo: Passengers Entering the Station from the Street (morning peak busiest hour)

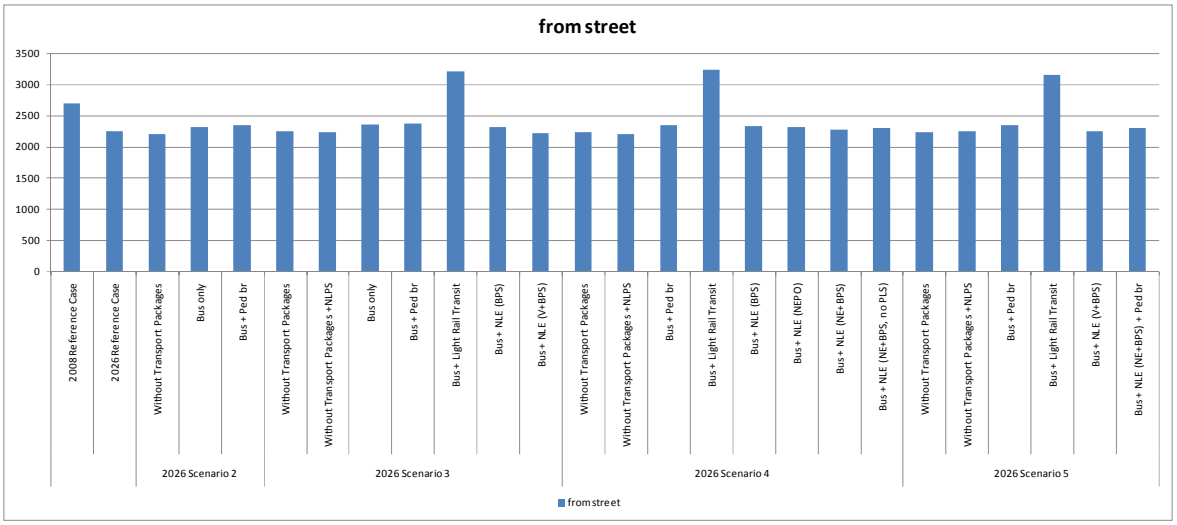


Figure D 15 shows that:

- A significant proportion of the additional passengers entering the station are those forecast as alighting from the LRT; however
- the majority of these are Underground passengers, and access to the Underground station is less of an issue as it is anticipated many would use the Shell Centre entrance which is closer to the proposed LRT stop and less heavily used than other entrances.

Summary

- overall, the biggest impact on passenger movement at Waterloo is forecast to be as a result of Partial Separation of the Northern Line with a transfer of flows from the Bakerloo line to the Northern Line;
- the VNEB transport packages are also forecast to deliver some relief to the numbers of rail passengers and NR to Underground interchange passengers at Waterloo; and
- as might be expected, the LRT options result in an increase in the number of passengers entering Waterloo station from the street.

Appendix E

WebTAG economic results tables

Appendix E WebTAG Economic Results Tables

Table E 1 Economic Efficiency of the Transport System (TEE) - Scenario 3 - Bus Only

Scenario 3 - Bus Only	£000's			
Consumer user benefits	All modes	Road		PT
Travel Time	808,238	- 17,960		826,198
Vehicle operating costs	- 3,206	- 3,206		-
User charges	354	-		354
Construction maintenance delays	-	-		-
NET CONSUMER BENEFITS	805,386	- 21,166		826,552
Business user benefits	All modes	Road Personal	Road Freight	PT Personal
Travel Time	531,482	8,325	- 27,642	550,799
Vehicle operating costs	- 1,220	865	- 2,085	-
User charges	236	-	-	236
Construction maintenance delays	-	-	-	-
Subtotal	530,498	9,190	- 29,727	551,035
Private Sector Provider Impacts	All modes	Road		PT
Revenue	-	-		-
Operating costs	-	-		-
Investment costs	-	-		-
Grant/subsidy	-	-		-
Subtotal	-	-		-
Other business Impacts	All modes	Road		PT
Developer contributions	-	-		-
NET BUSINESS IMPACT	530,498	9,190	- 29,727	551,035
TOTAL				
Present Value of Transport Economic Efficiency Benefits (PVB)	1,335,884			

Table E 2 Economic Efficiency of the Transport System (TEE) - Scenario 3 - Bus + LRT

Scenario 3 - Bus + LRT	£000's			
Consumer user benefits	All modes	Road		PT
Travel Time	878,750	- 137,610		1,016,360
Vehicle operating costs	- 9,855	- 9,855		-
User charges	- 10,068	-		- 10,068
Construction maintenance delays	-	-		-
NET CONSUMER BENEFITS	858,828	- 147,465		1,006,293
Business user benefits	All modes	Road Personal	Road Freight	PT Personal
Travel Time	494,892	- 172,478	- 10,204	677,574
Vehicle operating costs	- 12,752	- 5,458	- 7,294	-
User charges	- 6,712	-	-	- 6,712
Construction maintenance delays	-	-	-	-
Subtotal	475,428	- 177,936	- 17,498	670,862
Private Sector Provider Impacts	All modes	Road		PT
Revenue	-	-		-
Operating costs	-	-		-
Investment costs	-	-		-
Grant/subsidy	-	-		-
Subtotal	-	-		-
Other business Impacts	All modes	Road		PT
Developer contributions	-	-		-
NET BUSINESS IMPACT	475,428	- 177,936	- 17,498	670,862
TOTAL				
Present Value of Transport Economic Efficiency Benefits (PVB)	1,334,256			

Table E 3 Economic Efficiency of the Transport System (TEE) - Scenario 4 - Bus Only

Scenario 4 - Bus Only	£000's			
Consumer user benefits	All modes	Road		PT
Travel Time	714,218	- 70,400		784,618
Vehicle operating costs	- 5,074	- 5,074		-
User charges	- 8,178	-		- 8,178
Construction maintenance delays	-	-		-
NET CONSUMER BENEFITS	700,965	- 75,474		776,439
Business user benefits	All modes	Road Personal	Road Freight	PT Personal
Travel Time	403,084	- 100,303	- 19,691	523,078
Vehicle operating costs	- 8,698	- 3,215	- 5,483	-
User charges	- 5,452	-	-	- 5,452
Construction maintenance delays	-	-	-	-
Subtotal	388,934	- 103,518	- 25,174	517,626
Private Sector Provider Impacts	All modes	Road		PT
Revenue	-	-		-
Operating costs	-	-		-
Investment costs	-	-		-
Grant/subsidy	-	-		-
Subtotal	-	-		-
Other business Impacts	All modes	Road		PT
Developer contributions	-	-		-
NET BUSINESS IMPACT	388,934	- 103,518	- 25,174	517,626
TOTAL				
Present Value of Transport Economic Efficiency Benefits (PVB)	1,089,900			

Table E 4 Economic Efficiency of the Transport System (TEE) - Scenario 4 - Bus + LRT

Scenario 4 - Bus + LRT	£000's			
Consumer user benefits	All modes	Road		PT
Travel Time	683,890	- 176,760		860,650
Vehicle operating costs	- 11,826	- 11,826		-
User charges	2,415	-		2,415
Construction maintenance delays	-	-		-
NET CONSUMER BENEFITS	674,479	- 188,586		863,065
Business user benefits	All modes	Road Personal	Road Freight	PT Personal
Travel Time	263,044	- 245,898	- 64,825	573,767
Vehicle operating costs	- 24,243	- 7,499	- 16,744	-
User charges	1,610	-	-	1,610
Construction maintenance delays	-	-	-	-
Subtotal	240,411	- 253,397	- 81,569	575,377
Private Sector Provider Impacts	All modes	Road		PT
Revenue	-	-		-
Operating costs	-	-		-
Investment costs	-	-		-
Grant/subsidy	-	-		-
Subtotal	-	-		-
Other business Impacts	All modes	Road		PT
Developer contributions	-	-		-
NET BUSINESS IMPACT	240,411	- 253,397	- 81,569	575,377
TOTAL				
Present Value of Transport Economic Efficiency Benefits (PVB)	914,890			

Table E 5 Economic Efficiency of the Transport System (TEE) - Scenario 4 - Bus + NLE

Scenario 4 - Bus + NLE	£000's			
Consumer user benefits	All modes	Road		PT
Travel Time	1,242,621	- 70,400		1,313,021
Vehicle operating costs	- 5,074	- 5,074		-
User charges	- 31,573	-		- 31,573
Construction maintenance delays	-	-		-
NET CONSUMER BENEFITS	1,205,975	- 75,474		1,281,449
Business user benefits	All modes	Road Personal	Road Freight	PT Personal
Travel Time	755,354	- 100,303	- 19,691	875,348
Vehicle operating costs	- 8,698	- 3,215	- 5,483	-
User charges	- 21,048	-	-	- 21,048
Construction maintenance delays	-	-	-	-
Subtotal	725,607	- 103,518	- 25,174	854,299
Private Sector Provider Impacts	All modes	Road		PT
Revenue	-	-		-
Operating costs	-	-		-
Investment costs	-	-		-
Grant/subsidy	-	-		-
Subtotal	-	-		-
Other business Impacts	All modes	Road		PT
Developer contributions	-	-		-
NET BUSINESS IMPACT	725,607	- 103,518	- 25,174	854,299
TOTAL				
Present Value of Transport Economic Efficiency Benefits (PVB)	1,931,582			

Table E 6 Economic Efficiency of the Transport System (TEE) - Scenario 5 - Bus + LRT

Scenario 5 - Bus + LRT	£000's			
Consumer user benefits	All modes	Road		PT
Travel Time	1,032,432	- 190,507		1,222,939
Vehicle operating costs	- 13,793	- 13,793		-
User charges	29,535	-		29,535
Construction maintenance delays	-	-		-
NET CONSUMER BENEFITS	1,048,174	- 204,300		1,252,474
Business user benefits	All modes	Road Personal	Road Freight	PT Personal
Travel Time	570,804	- 228,844	- 15,645	815,293
Vehicle operating costs	- 17,172	- 7,355	- 9,817	-
User charges	19,690	-	-	19,690
Construction maintenance delays	-	-	-	-
Subtotal	573,322	- 236,199	- 25,462	834,983
Private Sector Provider Impacts	All modes	Road		PT
Revenue	-	-		-
Operating costs	-	-		-
Investment costs	-	-		-
Grant/subsidy	-	-		-
Subtotal	-	-		-
Other business Impacts	All modes	Road		PT
Developer contributions	-	-		-
NET BUSINESS IMPACT	573,322	- 236,199	- 25,462	834,983
TOTAL				
Present Value of Transport Economic Efficiency Benefits (PVB)	1,621,496			

Table E 7 Economic Efficiency of the Transport System (TEE) - Scenario 5 - Bus + NLE (incorporates mode shift)

Scenario 5 - Bus + NLE (incorporates mode shift)	£000's			
Consumer user benefits	All modes	Road		PT
Travel Time	1,149,171	- 67,989		1,217,160
Vehicle operating costs	- 3,338	- 3,338		-
User charges	- 50,883	-		- 50,883
Construction maintenance delays	-	-		-
NET CONSUMER BENEFITS	1,094,950	- 71,327		1,166,277
Business user benefits	All modes	Road Personal	Road Freight	PT Personal
Travel Time	758,734	- 65,827	13,121	811,440
Vehicle operating costs	- 5,011	- 2,511	- 2,500	-
User charges	- 33,922	-	-	- 33,922
Construction maintenance delays	-	-	-	-
Subtotal	719,801	- 68,338	10,621	777,518
Private Sector Provider Impacts	All modes	Road		PT
Revenue	-	-		-
Operating costs	-	-		-
Investment costs	-	-		-
Grant/subsidy	-	-		-
Subtotal	-	-		-
Other business Impacts	All modes	Road		PT
Developer contributions	-	-		-
NET BUSINESS IMPACT	719,801	- 68,338	10,621	777,518
TOTAL				
Present Value of Transport Economic Efficiency Benefits (PVB)	1,814,751			

Table E 8 Public Accounts - Scenario 3 - Bus Only

Scenario 3 - Bus Only	£000's		
Local Government Funding	All modes	Road	Rail
Revenue	590	-	590
Operating costs	415,818	-	415,818
Investment costs	41,508	-	41,508
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
NET IMPACT	457,916	-	457,916
Central Government Funding	All modes	Road	Rail
Revenue	-	-	-
Operating costs	-	-	-
Investment costs	-	-	-
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
Indirect tax revenues	- 2,360	- 2,360	-
NET IMPACT	- 2,360	- 2,360	-
Total			
TOTAL Present Value of Costs (PVC)	455,556		

Table E 9 Public Accounts - Scenario 3 - Bus + LRT

Scenario 3 - Bus + LRT	£000's		
Local Government Funding	All modes	Road	Rail
Revenue	- 16,779	-	- 16,779
Operating costs	423,625	-	423,625
Investment costs	166,787	-	166,787
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
NET IMPACT	573,633	-	573,633
Central Government Funding	All modes	Road	Rail
Revenue	-	-	-
Operating costs	-	-	-
Investment costs	-	-	-
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
Indirect tax revenues	- 9,978	- 9,978	-
NET IMPACT	- 9,978	- 9,978	-
Total			
TOTAL Present Value of Costs (PVC)	563,655		

Table E 10 Public Accounts - Scenario 4 - Bus Only

Scenario 4 - Bus Only	£000's		
Local Government Funding	All modes	Road	Rail
Revenue	- 13,630	-	- 13,630
Operating costs	415,818	-	415,818
Investment costs	41,508	-	41,508
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
NET IMPACT	443,696	-	443,696
Central Government Funding	All modes	Road	Rail
Revenue	-	-	-
Operating costs	-	-	-
Investment costs	-	-	-
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
Indirect tax revenues	- 4,925	- 4,925	-
NET IMPACT	- 4,925	- 4,925	-
Total			
TOTAL Present Value of Costs (PVC)	438,771		

Table E 11 Public Accounts – Scenario 4 - Bus + LRT

Scenario 4 - Bus + LRT	£000's		
Local Government Funding	All modes	Road	Rail
Revenue	4,025	-	4,025
Operating costs	423,625	-	423,625
Investment costs	166,787	-	166,787
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
NET IMPACT	594,437	-	594,437
Central Government Funding	All modes	Road	Rail
Revenue	-	-	-
Operating costs	-	-	-
Investment costs	-	-	-
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
Indirect tax revenues	- 12,876	- 12,876	-
NET IMPACT	- 12,876	- 12,876	-
Total			
TOTAL Present Value of Costs (PVC)	581,561		

Table E 12 Public Accounts - Scenario 4 - Bus + NLE

Scenario 4 - Bus + NLE	£000's		
Local Government Funding	All modes	Road	Rail
Revenue	- 52,621	-	- 52,621
Operating costs	662,386	-	662,386
Investment costs	832,555	-	832,555
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
NET IMPACT	1,442,320	-	1,442,320
Central Government Funding	All modes	Road	Rail
Revenue	-	-	-
Operating costs	-	-	-
Investment costs	-	-	-
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
Indirect tax revenues	- 4,925	- 4,925	-
NET IMPACT	- 4,925	- 4,925	-
Total			
TOTAL Present Value of Costs (PVC)	1,437,395		

Table E 13 Public Accounts - Scenario 5 - Bus + LRT

Scenario 5 - Bus + LRT	£000's		
Local Government Funding	All modes	Road	Rail
Revenue	49,225	-	49,225
Operating costs	423,625	-	423,625
Investment costs	166,787	-	166,787
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
NET IMPACT	639,637	-	639,637
Central Government Funding	All modes	Road	Rail
Revenue	-	-	-
Operating costs	-	-	-
Investment costs	-	-	-
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
Indirect tax revenues	- 13,071	- 13,071	-
NET IMPACT	- 13,071	- 13,071	-
Total			
TOTAL Present Value of Costs (PVC)	626,566		

Table E 14 Public Accounts - Scenario 5 - Bus + NLE (incorporates mode shift)

Scenario 5 - Bus + NLE (incorporates mode shift)	£000's		
Local Government Funding	All modes	Road	Rail
Revenue	- 151,354	-	- 151,354
Operating costs	662,638	-	662,638
Investment costs	866,761	-	866,761
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
NET IMPACT	1,378,045	-	1,378,045
Central Government Funding	All modes	Road	Rail
Revenue	-	-	-
Operating costs	-	-	-
Investment costs	-	-	-
Developer contributions	-	-	-
Grant/Subsidy	-	-	-
Indirect tax revenues	- 816	- 816	-
NET IMPACT	- 816	- 816	-
Total			
TOTAL Present Value of Costs (PVC)	1,377,229		

Table E 15 Analysis of Monetised Costs and Benefits - Scenario 3 - Bus Only

Scenario 3 - Bus Only	£000's		
	Total	Road	Rail
Noise	-		
Local air quality	-		
Greenhouse gases	- 361	- 361	
Journey ambience (incl. rolling stock quality, and in vehicle crowding)	-		
Accidents (incl. safety)	-		
Consumer users (sub-total 1, Table 1)	805,386	- 21,166	826,552
Business users and providers (sub-total 5, Table 1)	530,498	- 20,537	551,035
Reliability (incl. performance & reliability)	-		
Option values	-		
Interchange (station quality and crowding)	-		
PVB (a = sum of all benefits)	1,335,523		
PVC (b = sub-total 9, Table 2)	455,556		
Overall impact, total			
- NPV (a-b)	879,967		
- BCR (a/b)	2.9		

Table E 16 Analysis of Monetised Costs and Benefits - Scenario 3 - Bus + LRT

Scenario 3 - Bus + LRT	£000's		
	Total	Road	Rail
Noise	-		
Local air quality	-		
Greenhouse gases	- 1,585	- 1,585	
Journey ambience (incl. rolling stock quality, and in vehicle crowding)	-		
Accidents (incl. safety)	-		
Consumer users (sub-total 1, Table 1)	858,828	- 147,465	1,006,293
Business users and providers (sub-total 5, Table 1)	475,428	- 195,434	670,862
Reliability (incl. performance & reliability)	-		
Option values	-		
Interchange (station quality and crowding)	-		
PVB (a = sum of all benefits)	1,332,671		
PVC (b = sub-total 9, Table 2)	563,655		
Overall impact, total			
- NPV (a-b)	769,016		
- BCR (a/b)	2.4		

Table E 17 Analysis of Monetised Costs and Benefits - Scenario 4 - Bus Only

Scenario 4 - Bus Only	£000's		
	Total	Road	Rail
Noise	-		
Local air quality	-		
Greenhouse gases	- 749	- 749	
Journey ambience (incl. rolling stock quality, and in vehicle crowding)	-		
Accidents (incl. safety)	-		
Consumer users (sub-total 1, Table 1)	700,965	- 75,474	776,439
Business users and providers (sub-total 5, Table 1)	388,934	- 128,692	517,626
Reliability (incl. performance & reliability)	-		
Option values	-		
Interchange (station quality and crowding)	-		
PVB (a = sum of all benefits)	1,089,151		
PVC (b = sub-total 9, Table 2)	438,771		
Overall impact, total			
- NPV (a-b)	650,380		
- BCR (a/b)	2.5		

Table E 18 Analysis of Monetised Costs and Benefits - Scenario 4 - Bus + LRT

Scenario 4 - Bus + LRT	£000's		
	Total	Road	Rail
Noise	-		
Local air quality	-		
Greenhouse gases	- 2,013	- 2013	
Journey ambience (incl. rolling stock quality, and in vehicle crowding)	-		
Accidents (incl. safety)	-		
Consumer users (sub-total 1, Table 1)	674,479	- 188,586	863,065
Business users and providers (sub-total 5, Table 1)	240,411	- 334,966	575,377
Reliability (incl. performance & reliability)	-		
Option values	-		
Interchange (station quality and crowding)	-		
PVB (a = sum of all benefits)	912,877		
PVC (b = sub-total 9, Table 2)	581,561		
Overall impact, total			
- NPV (a-b)	331,316		
- BCR (a/b)	1.6		

Table E 19 Analysis of Monetised Costs and Benefits - Scenario 4 - Bus + NLE

Scenario 4 - Bus + NLE	£000's		
	Total	Road	Rail
Noise	-		
Local air quality	-		
Greenhouse gases	- 749	- 749	
Journey ambience (incl. rolling stock quality, and in vehicle crowding)	-		
Accidents (incl. safety)	-		
Consumer users (sub-total 1, Table 1)	1,205,975	- 75,474	1,281,449
Business users and providers (sub-total 5, Table 1)	725,607	-128,692	854,299
Reliability (incl. performance & reliability)	-		
Option values	-		
Interchange (station quality and crowding)	-		
PVB (a = sum of all benefits)	1,930,833		
PVC (b = sub-total 9, Table 2)	1,437,395		
Overall impact, total			
- NPV (a-b)	493,438		
- BCR (a/b)	1.3		

Table E 20 Analysis of Monetised Costs and Benefits - Scenario 5 - Bus + LRT

Scenario 5 - Bus + LRT	£000's		
	Total	Road	Rail
Noise	-		
Local air quality	-		
Greenhouse gases	- 2,061	- 2,061	
Journey ambience (incl. rolling stock quality, and in vehicle crowding)	-		
Accidents (incl. safety)	-		
Consumer users (sub-total 1, Table 1)	1,048,174	- 204,300	1,252,474
Business users and providers (sub-total 5, Table 1)	573,322	- 261,661	834,983
Reliability (incl. performance & reliability)	-		
Option values	-		
Interchange (station quality and crowding)	-		
PVB (a = sum of all benefits)	1,619,435		
PVC (b = sub-total 9, Table 2)	626,566		
Overall impact, total			
- NPV (a-b)	992,869		
- BCR (a/b)	2.6		

Table E 21 Analysis of Monetised Costs and Benefits - Scenario 5 - Bus + NLE (incorporates mode shift)

Scenario 5 - Bus + NLE (incorporates mode shift)	£000's		
	Total	Road	Rail
Noise	-		
Local air quality	-		
Greenhouse gases	- 103	- 103	
Journey ambience (incl. rolling stock quality, and in vehicle crowding)	-		
Accidents (incl. safety)	-		
Consumer users (sub-total 1, Table 1)	1,094,950	- 71,327	1,166,277
Business users and providers (sub-total 5, Table 1)	719,801	- 57,717	777,518
Reliability (incl. performance & reliability)	-		
Option values	-		
Interchange (station quality and crowding)	-		
PVB (a = sum of all benefits)	1,814,648		
PVC (b = sub-total 9, Table 2)	1,377,229		
Overall impact, total			
- NPV (a-b)	437,420		
- BCR (a/b)	1.3		