

# L: Climate Change Calculations and Assumptions

**Environmental Statement**

Volume II



## NLE Climate Change Mitigation: Projected footprint of the NLE

<b>Construction</b>				
Construction emissions are those arising during the construction of the NLE. These include emissions from embodied carbon in the extraction and processing of raw materials, as well as emissions from energy use in construction processes such as vehicles delivering building materials to the site. Two construction design options presented in Chapter 4: Description of the NLE; have been modelled to compare emissions. Construction Option A and B are mostly the same, with alternative tunnelling methods being applied for Option B.				
	Description	Rational for calculation and assumptions	tCO2 - Option A	tCO2 - Option B
Embodied carbon in construction materials	Embodied carbon from the extraction and processing of raw materials	Embodied carbon emissions are based multiplying the quantities of materials by published emissions factors from The Inventory of Carbon and Energy (ICE) (January 2011).	161,835.35	161,969.88
Transportation of extracted materials	Vehicles removing extracted materials from the site	Assumed distances are used for the vehicle movements based on average distances for delivery vehicles.	2,576.79	2,730.32
Transportation of materials to site	Vehicles delivering building materials to the site	Assumed distances are used for the vehicle movements based on average distances for delivery vehicles.	270.41	284.49
Construction site energy	The operation of vehicles and plant equipment in the construction of the site. On-site accommodation, lighting and any other use of fossil fuels for the construction of the project.	Emissions from construction vehicles and plant are based on the fuel requirements of typical construction vehicles over the length of the project.	25,978.99	25,978.99
<b>TOTAL CONSTRUCTION</b>			<b>190,661.54</b>	<b>190,963.69</b>

<b>Baseline</b>			
The purpose of the baseline is to act as a reference to compare the impact of any new project against. The baseline accounts for emissions from indirect sources assuming no NLE is built, based on 2031 projected development. Operation of existing stations has been excluded from the baseline, as it is assumed that the energy use at existing stations will not change significantly as a result of the NLE.			
	Description	Rational for calculation and assumptions	tCO2
Transport - indirect	Indirect transport by people in the NLE area, including public transport and private vehicle use.	Based on the scenario for 'without NLE' as detailed in Chapter 2	12,882,949.66
<b>TOTAL BASELINE</b>			<b>12,882,949.66</b>

<b>Operational emissions</b>			
Operational emissions are those arising during the running of a fully operational NLE. They include direct emissions from trackside and non-trackside energy use as well as vehicles associated with the maintenance and operation of the line. Indirect emissions are also included from transport in the NLE area, and from third party activities associated with the NLE operation. The operational emissions calculation is based on emissions during 2031.			
	Description	Rational for calculation and assumptions	tCO2
<b>Scope 1</b>			
Transport - direct	Company leased vehicles emissions (from London Underground 2008 carbon footprint data)	Total company leased vehicle emissions, for support road fleet - assumed proportional to 2008 LU carbon footprint.	4
<b>Scope 2</b>			
Operation - Non Trackside	Non-trackside emissions (from Energy Strategy calculations)	Heating & Domestic hot water (DHW)	NB. Not included here as this would be double-counting tube travel emissions which are built into the transport emissions.
		Cooling	
		Lighting	
		Auxiliary	
Operation - Trackside	Trackside emissions (from London Underground 2008 carbon footprint data)	Small Power & Escalators & Lifts	
		Traction - assumed proportional to 2008 LU carbon footprint.	
		Groundwater Pumps - assumed proportional to 2008 LU carbon footprint.	
<b>Scope 3</b>			
Operation - indirect	Indirect operational emissions (from London Underground 2008 carbon footprint)	Total indirect operational emissions - assumed proportional to 2008 LU carbon footprint.	935
Transport - indirect	Indirect transport by people in the NLE area, including public transport and private vehicle use.	Based on the scenario for 'with NLE' as detailed in Chapter 2	12,893,376.98
<b>TOTAL OPERATION</b>			<b>12,894,315.79</b>

Construction Footprint									
Two construction design options have been modelled to compare emissions. Construction Option A and B are mostly the same, with alternative tunnelling methods being applied for Option B.									
Embodied Energy of Construction Materials									
Design Option A									
Source: Table 1-3 Clean Excavated Material Generated by the NLE (from Appendix B1 - Material Management Strategy - Draft 3)									
Source: The Inventory of Carbon and Energy (ICE) (January 2011)									
Location	Material	Components	Total Quantity	Unit	Density (kg/m3)	Material weight (kg)	Emissions Factor Description	Emissions Factor (kg CO2e/kg	tco2e
Running Tunnels and Cross Passages (including Battersea work	Concrete		99,625.00	m3	2,400.00	239,100,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	41,603.40
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings (sprayed concrete)		2,365.00	m3	2,400.00	5,676,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	987.62
Running Tunnels and Cross Passages (including Battersea work	230mm thick precast platform deck units		1,695.00	m3	2,400.00	4,068,000.00	Precast RC 40/50 MPa	0.18	732.24
Running Tunnels and Cross Passages (including Battersea work	Reinforcement		21,740.00	tonnes		21,740,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	30,436.00
Running Tunnels and Cross Passages (including Battersea work	Grout		14,690.00	m3	2,162.00	31,759,780.00	Cement mortar (Grout)	0.22	7,018.91
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings	PCC Segments	84,962.50	tonnes		84,962,500.00	Precast RC 40/50 MPa	0.18	15,293.25
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings	SGI lining rings (Spheroidal	310.00	tonnes		310,000.00	Iron	2.03	629.30
Nine Elms Station	Concrete		74,172.00	m3	2,400.00	178,012,800.00	RC 40/50 Mpa (suitable for high strength a	0.17	30,974.23
Nine Elms Station	Reinforcement		16,445.00	tonnes		16,445,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	23,023.00
Kennington Green Ventilation Shaft	Concrete		2,595.00	m3	2,400.00	6,228,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	1,083.67
Kennington Green Ventilation Shaft	Grout		370.00	m3	2,162.00	799,940.00	Cement mortar (Grout)	0.22	176.79
Kennington Green Ventilation Shaft	Reinforcement		455.00	tonnes		455,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	637.00
Kennington Green Ventilation Shaft	Tunnel Linings	PCC lining rings	1,037.50	tonnes		1,037,500.00	Precast RC 40/50 MPa	0.18	186.75
Kennington Park Ventilation Shaft	Concrete		4,838.00	m3	2,400.00	11,611,200.00	RC 40/50 Mpa (suitable for high strength a	0.17	2,020.35
Kennington Park Ventilation Shaft	Grout		370.00	m3	2,162.00	799,940.00	Cement mortar (Grout)	0.22	176.79
Kennington Park Ventilation Shaft	Reinforcement		1,025.00	tonnes		1,025,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	1,435.00
Kennington Park Ventilation Shaft	Tunnel Linings	PCC lining rings	1,037.50	tonnes		1,037,500.00	Precast RC 40/50 MPa	0.18	186.75
Radcot Street and Harmsworth Street Temporary Shafts	Concrete		221.00	m3	2,400.00	530,400.00	RC 40/50 Mpa (suitable for high strength a	0.17	92.29
Radcot Street and Harmsworth Street Temporary Shafts	Grout		484.00	m3	2,162.00	1,046,408.00	Cement mortar (Grout)	0.22	231.26
Radcot Street and Harmsworth Street Temporary Shafts	Reinforcement		28.00	tonnes		28,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	39.20
Radcot Street and Harmsworth Street Temporary Shafts	Tunnel Linings	PCC lining rings	142.50	tonnes		142,500.00	Precast RC 40/50 MPa	0.18	25.65
Radcot Street and Harmsworth Street Temporary Shafts	Tunnel Linings	SGI lining rings (Spheroidal	102.40	tonnes		102,400.00	Iron	2.03	207.87
Step Plate junctions	Concrete		2,140.00	m3	2,400.00	5,136,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	893.66
Step Plate junctions	Grout		1,534.00	m3	2,162.00	3,316,508.00	Cement mortar (Grout)	0.22	732.95
Step Plate junctions	Reinforcement		169.00	tonnes		169,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	236.60
Step Plate junctions	Tunnel Linings	PCC lining rings	1,535.00	tonnes		1,535,000.00	Precast RC 40/50 MPa	0.18	276.30
Step Plate junctions	Tunnel Linings	SGI lining rings (Spheroidal	1,230.80	tonnes		1,230,800.00	Iron	2.03	2,498.52
<b>TOTAL</b>						<b>618,305,176.00</b>			<b>161,835.35</b>
Design Option B									
Source: Table 1-3 Clean Excavated Material Generated by the NLE (from Appendix B1 - Material Management Strategy - Draft 3)									
Source: Email from Simon Lewis (ch2m) 27.03.13									
Source: The Inventory of Carbon and Energy (ICE) (January 2011)									
NB. There is no materials data for Option B and so have assumed same as Option A, except removed Radcot Street and Harmsworth Street Temporary Shafts data, as these not expected to be in Design Option 2. Have also included gallery tunnels.									
Location	Material	Components	Total Quantity	Unit	Density (kg/m3)	Material weight (kg)	Emissions Factor Description	Emissions Factor (kg CO2e/kg	tco2e
Running Tunnels and Cross Passages (including Battersea work	Concrete		99,625.00	m3	2,400.00	239,100,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	41,603.40
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings (sprayed concrete)		2,365.00	m3	2,400.00	5,676,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	987.62
Running Tunnels and Cross Passages (including Battersea work	230mm thick precast platform deck units		1,695.00	m3	2,400.00	4,068,000.00	Precast RC 40/50 MPa	0.18	732.24
Running Tunnels and Cross Passages (including Battersea work	Reinforcement		21,740.00	tonnes		21,740,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	30,436.00
Running Tunnels and Cross Passages (including Battersea work	Grout		14,690.00	m3	2,162.00	31,759,780.00	Cement mortar (Grout)	0.22	7,018.91
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings	PCC Segments	84,962.50	tonnes		84,962,500.00	Precast RC 40/50 MPa	0.18	15,293.25
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings	SGI lining rings (Spheroidal	310.00	tonnes		310,000.00	Iron	2.03	629.30
Nine Elms Station	Concrete		74,172.00	m3	2,400.00	178,012,800.00	RC 40/50 Mpa (suitable for high strength a	0.17	30,974.23
Nine Elms Station	Reinforcement		16,445.00	tonnes		16,445,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	23,023.00
Kennington Green Ventilation Shaft	Concrete		2,595.00	m3	2,400.00	6,228,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	1,083.67
Kennington Green Ventilation Shaft	Grout		370.00	m3	2,162.00	799,940.00	Cement mortar (Grout)	0.22	176.79
Kennington Green Ventilation Shaft	Reinforcement		455.00	tonnes		455,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	637.00
Kennington Green Ventilation Shaft	Tunnel Linings	PCC lining rings	1,037.50	tonnes		1,037,500.00	Precast RC 40/50 MPa	0.18	186.75
Kennington Green Gallery Tunnel	Tunnel Linings		1,045.00	m3	2,400.00	2,508,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	436.39
Kennington Park Ventilation Shaft	Concrete		4,838.00	m3	2,400.00	11,611,200.00	RC 40/50 Mpa (suitable for high strength a	0.17	2,020.35
Kennington Park Ventilation Shaft	Grout		370.00	m3	2,162.00	799,940.00	Cement mortar (Grout)	0.22	176.79
Kennington Park Ventilation Shaft	Reinforcement		1,025.00	tonnes		1,025,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	1,435.00
Kennington Park Ventilation Shaft	Tunnel Linings	PCC lining rings	1,037.50	tonnes		1,037,500.00	Precast RC 40/50 MPa	0.18	186.75
Kennington Park Gallery Tunnel	Tunnel Linings		705.00	m3	2,400.00	1,692,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	294.41
Step Plate junctions	Concrete		2,140.00	m3	2,400.00	5,136,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	893.66
Step Plate junctions	Grout		1,534.00	m3	2,162.00	3,316,508.00	Cement mortar (Grout)	0.22	732.95
Step Plate junctions	Reinforcement		169.00	tonnes		169,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	236.60
Step Plate junctions	Tunnel Linings	PCC lining rings	1,535.00	tonnes		1,535,000.00	Precast RC 40/50 MPa	0.18	276.30
Step Plate junctions	Tunnel Linings	SGI lining rings (Spheroidal	1,230.80	tonnes		1,230,800.00	Iron	2.03	2,498.52
<b>TOTAL</b>						<b>620,655,468.00</b>			<b>161,969.88</b>

Transport of Excavated Materials (Clean)									
Source: Material Volumes: Table 1-4 Clean Excavated Material Generated by the NLE (from Appendix B1 - Material Management Strategy - Draft 3)									
Source: Transport Data: Battersea to Northfleet by road from Google maps direction search. Barge from Battersea Jetty to Wallasea Island see "Construction Vehicle movements for excavated materials" table below									
Source: Emission Factors: Defra 2012: "Defra-ghg-conversionfactors2012" J:\Wimbledon-Jobs\Transport for London (TfL)\46368016 Northern Line Ext Climate & Ad\Technical\Carbon Footprint\Data Sources									
Source: Distances travelled: GRNLEB-HGL-00-XX-TNT-MDR-00018-01 - REV_01 - Activity_7 - Technical_Note_for_removal_of_Excavated_Material_at_Battersea									
NB. Assumed sea-going boat has same capacity as barge for transport from Northfleet to Wallasea Island									
NB. Journey distances account for return journey. Emissions factors assume boats are 60% loaded for entire trip and HGVs are 44% loaded both ways.									
Design Option A							Emission Factors		
Works	Volume of Excavated Materials (m3)	Density Factor from m3 to Tonnes	Road (km travelled)	Barge (km travelled)	Sea-going boat (km travelled)	Conversion Factor to km	Road Artic Truck, 3.5-33t (kgCO2e/tonne.km)	Barge General Cargo, 0-4999 dwt (kgCO2e/tonne.km)	Sea-going boat General Cargo, 0-4999 dwt (kgCO2e/tonne.km)
Nine Elms Station Box	110,310.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Battersea Station Box	76,340.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Overrun Tunnels at Battersea	12,170.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Crossover at Battersea	71,200.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Running Tunnels	141,730.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Step Plate Junctions	9,030.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Kennington Park (Permanent Shaft) and Substation	12,500.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Kennington Gardens (Permanent Shaft)	6,730.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Cross Passages	2,160.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Temporary Shafts	1,300.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Gallery Tunnels	-	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
<b>TOTAL Excavated Material</b>	<b>443,470.00</b>	<b>2.00</b>	<b>77.25</b>	<b>77.25</b>	<b>21.60</b>	<b>1.61</b>	<b>0.20</b>	<b>0.02</b>	<b>0.02</b>
Design Option B							Emission Factors		
Works	Volume of Excavated Materials (m3)	Density Factor from m3 to Tonnes	Road (km travelled)	Barge (km travelled)	Sea-going boat (km travelled)	Conversion Factor to km	Road Artic Truck, 3.5-33t (kgCO2e/tonne.km)	Barge General Cargo, 0-4999 dwt (kgCO2e/tonne.km)	Sea-going boat General Cargo, 0-4999 dwt (kgCO2e/tonne.km)
Nine Elms Station Box	110,310.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Battersea Station Box	76,340.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Overrun Tunnels at Battersea	12,170.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Crossover at Battersea	71,200.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Running Tunnels	141,730.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Step Plate Junctions	9,030.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Kennington Park (Permanent Shaft) and Substation	12,500.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Kennington Gardens (Permanent Shaft)	6,730.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Cross Passages	2,160.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Temporary Shafts	-	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Gallery Tunnels	6,290.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
<b>TOTAL</b>	<b>448,460.00</b>	<b>2.00</b>	<b>77.25</b>	<b>77.25</b>	<b>21.60</b>	<b>1.61</b>	<b>0.20</b>	<b>0.02</b>	<b>0.02</b>
Transport of Excavated Materials (Contaminated)									
Source: "Draft Strategy for Excavated Material 2 TW" Extracted from source document on 15/02/2013 + Email 28.02.13 (Howard Waples)									
Design Option A									
Works	Volume of Excavated Materials (m3)	Volume of Disposal Truck (m3)	Road (km travelled)	Emission Factors: Artic Truck, 3.5-33t (kgCO2e/vehicle km)	Number of Journeys	Total distance	Carbon Emissions (tCO2e)		
Contaminated Materials	4,650.00	10.00	20.00	1.11	465.00	9,300.00	10.31		
Contaminated Dredged Materials	4,500.00	10.00	20.00	1.11	450.00	9,000.00	9.98		
Design Option B									
Works	Volume of Excavated Materials (m3)	Density Factor from m3 to Tonnes	Road (km travelled)	Emission Factors: Artic Truck, 3.5-33t (kgCO2e/vehicle km)	Number of Journeys	Total distance	Carbon Emissions (tCO2e)		
Contaminated Materials	4,650.00	10.00	20.00	1.11	465.00	9,300.00	10.31		
Contaminated Dredged Materials	4,500.00	10.00	20.00	1.11	450.00	9,000.00	9.98		



Design Option B								
Source: GRNLEB-HGL-00-XX-SCH-MDR-00006 - REV 02-01 - VEHICLE MOVEMENT SCHEDULE ACL - ALT PRG								
Backfill Materials - location	Number of lorries	Road (km travelled) - assumed 5km	Emissions factor description	Emission Factors (kgCO2e/km)	Total km travelled	Carbon Emissions (tCO2e)		
Temporary Shafts at Radcot Street (shaft 1) and Harmsworth S	77.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	385.00	0.51		
Radcot Street Shaft 1: connection to chamber	5.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	25.00	0.03		
Radcot Street Shaft 1: Access tunnel	26.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	130.00	0.17		
Harmsworth Street Shaft 2: connection chamber	5.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	25.00	0.03		
Ventilation shafts at Kennington Green (Shaft 3) and Kenningt	20.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	100.00	0.13		
Sub-surface tunnel	51.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	255.00	0.34		
Shaft 4	31.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	155.00	0.21		
Sub-surface Traction power Substation and Head house	108.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	540.00	0.72		
SCL Gallery Tunnels: Kennington Green SCL Tunnel	440.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	2.33	2,200.00	5.12		
SCL Gallery Tunnels: Kennington Park SCL Tunnel	297.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	3.33	1,485.00	4.94		
<b>TOTAL</b>						<b>12.21</b>		
Construction Materials - location								
Materials	Number of lorries	Road (km travelled) - assumed 5km	Emissions factor description	Emission Factors (kgCO2e/km)	Total km travelled	Carbon Emissions (tCO2e)		
Ventilation shafts at Kennington Green (Shaft 3) and Kenningt	Concrete	1250	5.00	Concrete wagon (6m3	1.33	6,250.00	8.30	
Ventilation shafts at Kennington Green (Shaft 3) and Kenningt	PCC segment, SGI segm	87	5.00	Artic wagon (40t): Arti	1.42	435.00	0.62	
Ventilation shafts at Kennington Green (Shaft 3) and Kenningt	Grout	124	5.00	Grout wagon (6m3): A	1.33	620.00	0.82	
Step-plate junction 1 Northbound	Concrete	181	5.00	Concrete wagon (6m3	1.33	905.00	1.20	
Step-plate junction 1 Northbound	PCC segment, SGI segm	79	5.00	Artic wagon (40t): Arti	1.42	395.00	0.56	
Step-plate junction 1 Northbound	Grout	133	5.00	Grout wagon (6m3): A	1.33	665.00	0.88	
Step-plate junction 2 Southbound	Concrete	181	5.00	Concrete wagon (6m3	1.33	905.00	1.20	
Step-plate junction 2 Southbound	PCC segment, SGI segm	76	5.00	Artic wagon (40t): Arti	1.42	380.00	0.54	
Step-plate junction 2 Southbound	Grout	130	5.00	Grout wagon (6m3): A	1.33	650.00	0.86	
From Kennington shaft to Kennington Loop - Running tunnel tr	Concrete	112	5.00	Concrete wagon (6m3	1.33	560.00	0.74	
From Kennington shaft to Kennington Loop - Running tunnel tr	PCC segment, SGI segm	2	5.00	Artic wagon (40t): Arti	1.42	10.00	0.01	
From Kennington shaft to Kennington Loop - Running tunnel tr	Grout	0	5.00	Grout wagon (6m3): A	1.33	-	-	
From Battersea to Kennington shafts Both tunnels - Running tu	Concrete	3263	5.00	Concrete wagon (6m3	1.33	16,315.00	21.66	
From Battersea to Kennington shafts Both tunnels - Running tu	PCC segment, SGI segm	49	5.00	Artic wagon (40t): Arti	1.42	245.00	0.35	
From Battersea to Kennington shafts Both tunnels - Running tu	Grout	0	5.00	Grout wagon (6m3): A	1.33	-	-	
Crossover tunnels - Running tunnel track bed	Concrete	210	5.00	Concrete wagon (6m3	1.33	1,050.00	1.39	
Crossover tunnels - Running tunnel track bed	PCC segment, SGI segm	4	5.00	Artic wagon (40t): Arti	1.42	20.00	0.03	
Crossover tunnels - Running tunnel track bed	Grout	0	5.00	Grout wagon (6m3): A	1.33	-	-	
Nine Elms Station	Concrete	11999	5.00	Concrete wagon (6m3	1.33	59,995.00	79.67	
Nine Elms Station	PCC segment, SGI segm	410	5.00	Artic wagon (40t): Arti	1.42	2,050.00	2.92	
Nine Elms Station	Grout	0	5.00	Grout wagon (6m3): A	1.33	-	-	
Battersea Station	Concrete	16565	5.00	Concrete wagon (6m3	1.33	82,825.00	109.98	
Battersea Station	PCC segment, SGI segm	3407	5.00	Artic wagon (40t): Arti	1.42	17,035.00	24.27	
Battersea Station	Grout	2447	5.00	Concrete wagon (6m3	1.33	12,235.00	16.25	
<b>TOTAL</b>							<b>272.28</b>	
Construction site energy								
Source: Power requirements for construction activities -MDR-00050 - REV 01-01. Assumed 75% of peak load is used for whole construction period & powered by grid electricity. Hours of operation from CoCP (13-02-01_NLE_document_CoCP_edited draft_3).								
NB. Assumed Design Option A and Option B are the same for construction power use								
NB. No information on specific plant use such as TBMs etc. so assumed all equipment used for standard construction period for full years of construction. Excludes power requirements for any conveyor to the river and ship loaders								
Specific Equipment & max power use	Average kW rating of equipment	Hours of construction per year	Years of construction	Total construction hours	Fuel use (kWh)	Emissions factor description	Emissions Factor (kg CO2e per kWh)	Carbon Emissions (tCO2e)
Conveyors - 1820kW	1,365.00	2,780.00	6.50	18,070.00	24,665,550.00	UK Grid Electricity for 2010	0.59	14,548.23
Lighting - 140kW	105.00	2,780.00	6.50	18,070.00	1,897,350.00	UK Grid Electricity for 2010	0.59	1,119.09
General Power - 300kW	225.00	2,780.00	6.50	18,070.00	4,065,750.00	UK Grid Electricity for 2010	0.59	2,398.06
Pumps - 20kW	15.00	2,780.00	6.50	18,070.00	271,050.00	UK Grid Electricity for 2010	0.59	159.87
Compressors - 10kW	7.50	2,780.00	6.50	18,070.00	135,525.00	UK Grid Electricity for 2010	0.59	79.94
Ventilation - 560kW	420.00	2,780.00	6.50	18,070.00	7,589,400.00	UK Grid Electricity for 2010	0.59	4,476.38
Accommodation (offices, canteens, toilet/shower blocks) - 400	300.00	2,780.00	6.50	18,070.00	5,421,000.00	UK Grid Electricity for 2010	0.59	3,197.41
<b>TOTAL</b>								<b>25,978.99</b>

Transport Capacity			Number of Journeys			Total tonne km per Journey			Carbon Emissions (tCO2e)			
Road	Barge	Sea-going boat	Road	Barge	Sea-going boat	Road	Barge	Sea-going boat	Construction Option 1			TOTAL (both methods transport) to Northfleet
Lorry Capacity per journey (tonnes)	Barge Capacity per Journey (tonnes)	Boat capacity per journey (tonnes)	Number of Journeys - assumed 30% road	Number of Journeys - assumed 70% barge	Number of Journeys - assumed 100% of trips use boat	tonne km	tonne km	tonne km	Road	Barge	Sea-going boat	
20	1000	1000	1654.65	77.22	110.31	1,544.97	77,248.51	21,602.90	502.05	99.26	39.65	640.96
20	1000	1000	1145.10	53.44	76.34	1,544.97	77,248.51	21,602.90	347.44	68.69	27.44	443.57
20	1000	1000	182.55	8.52	12.17	1,544.97	77,248.51	21,602.90	55.39	10.95	4.37	70.71
20	1000	1000	1068.00	49.84	71.20	1,544.97	77,248.51	21,602.90	324.05	64.07	25.59	413.71
20	1000	1000	2125.95	99.21	141.73	1,544.97	77,248.51	21,602.90	645.05	127.53	50.95	823.52
20	1000	1000	135.45	6.32	9.03	1,544.97	77,248.51	21,602.90	41.10	8.13	3.25	52.47
20	1000	1000	187.50	8.75	12.50	1,544.97	77,248.51	21,602.90	56.89	11.25	4.49	72.63
20	1000	1000	100.95	4.71	6.73	1,544.97	77,248.51	21,602.90	30.63	6.06	2.42	39.10
20	1000	1000	32.40	1.51	2.16	1,544.97	77,248.51	21,602.90	9.83	1.94	0.78	12.55
20	1000	1000	19.50	0.91	1.30	1,544.97	77,248.51	21,602.90	5.92	1.17	0.47	7.55
20	1000	1000	0.00	0.00	0.00	1,544.97	77,248.51	21,602.90	-	-	-	-
20	1000	1000	6,652.05	310.43	443.47	1,544.97	77,248.51	21,602.90	2,018.34	399.03	159.42	2,576.79
Transport Capacity			Number of journeys			Total tonne km per Journey			Carbon Emissions (tCO2e)			
Road	Barge	Sea-going boat	Road	Barge	Sea-going boat	Road	Barge	Sea-going boat	Construction Option 2			TOTAL (both methods transport) to Northfleet
Lorry Capacity per journey (tonnes)	Barge Capacity per Journey (tonnes)	Boat capacity per journey (tonnes)	Number of Journeys - assumed 32% road	Number of Journeys - assumed 68% barge	Number of Journeys - assumed 100% of trips use boat	tonne km	tonne km	tonne km	Road	Barge	Sea-going boat	
20	1000	1000	1764.96	75.01	110.31	1,544.97	77,248.51	21,602.90	535.52	96.42	39.65	671.59
20	1000	1000	1221.44	51.91	76.34	1,544.97	77,248.51	21,602.90	370.61	66.73	27.44	464.77
20	1000	1000	194.72	8.28	12.17	1,544.97	77,248.51	21,602.90	59.08	10.64	4.37	74.09
20	1000	1000	1139.20	48.42	71.20	1,544.97	77,248.51	21,602.90	345.65	62.23	25.59	433.48
20	1000	1000	2267.68	96.38	141.73	1,544.97	77,248.51	21,602.90	688.05	123.88	50.95	862.88
20	1000	1000	144.48	6.14	9.03	1,544.97	77,248.51	21,602.90	43.84	7.89	3.25	54.98
20	1000	1000	200.00	8.50	12.50	1,544.97	77,248.51	21,602.90	60.68	10.93	4.49	76.10
20	1000	1000	107.68	4.58	6.73	1,544.97	77,248.51	21,602.90	32.67	5.88	2.42	40.97
20	1000	1000	34.56	1.47	2.16	1,544.97	77,248.51	21,602.90	10.49	1.89	0.78	13.15
20	1000	1000	0.00	0.00	0.00	1,544.97	77,248.51	21,602.90	-	-	-	-
20	1000	1000	100.64	4.28	6.29	1,544.97	77,248.51	21,602.90	30.54	5.50	2.26	38.29
20	1000	1000	7,175.36	304.95	448.46	1,544.97	77,248.51	21,602.90	2,177.12	391.99	161.21	2,730.32



## Baseline Footprint

### Scope 1

No scope 1 emissions associated with the baseline

### Scope 2

No scope 2 emissions associated with the baseline

### Scope 3

#### Transport - indirect

no NLE is built, includes central London area

without NLE scenario	Source	Unit	Car	Taxi	LGV	OGV	Bus	Tube	Rail	TOTAL tonnes CO2e
Total distance	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	km/yr	20,827,716,826.00	796,345,379.00	4,200,214,701.00	3,556,160,934.00	9,012,982,688.00	16,938,681,891.00	26,263,908,011.00	
Total person trips	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	people trips/yr	n/a	n/a	n/a	n/a	2,569,623,481.00	2,476,403,025.00	1,187,577,250.00	
Total vehicle trips	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	vehicle trips/yr	2,757,241,223.00	47,655,885.00	380,043,837.00	284,331,018.00	n/a	n/a	n/a	
Average trip length	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	km/trip	7.55	16.71	11.05	12.51	3.50	6.80	22.10	
Emissions factor description	<i>Defra, all scopes grand total GHG</i>	kg CO2e per km	Average car unknown fuel	Taxi (black cab)	Van/Light Commercial Veh	Diesel HGV Road Freight	Local London bus	London Underground	National rail	
Emissions factor value	<i>Defra</i>	kg CO2e per km	0.23394	0.188446667	0.29968	0.718520392	0.10005	0.08154	0.06715	
<b>Total tonnes CO2e</b>			<b>4,872,436.07</b>	<b>150,068.63</b>	<b>1,258,720.34</b>	<b>2,555,174.15</b>	<b>901,748.92</b>	<b>1,381,180.12</b>	<b>1,763,621.42</b>	<b>12,882,949.66</b>

#### Operation - indirect

Currently assuming that the energy use at existing stations will not change significantly as a result of the NLE

## Operation Footprint

### Scope 1

#### Transport - direct

LU company leased vehicles (support road fleet)

	Source	Unit	Vehicles
Total CO2e from LU footprint	<i>London Underground 2008 leased vehicles footprintf</i>	tco2e	461
Total km LU	<a href="http://www.tfl.gov.uk/corporate/modesoftransport/londonunderground/1608.aspx">http://www.tfl.gov.uk/corporate/modesoftransport/londonunderground/1608.aspx</a>	km	402
Total km NLE		km	3
<b>Total CO2e</b>		<b>tco2e</b>	<b>4</b>

### Scope 2

Do not include in Operation totals as this will double count the impacts of tube emissions accounted for in Scope 3.

#### Operation - Non Trackside

Space	Source	Location	CO2 emissions (tonnes CO2/year)						
			Space Heating	DHW	Cooling	Lighting	Auxiliary	Small Power & Escalators & Lifts	Total
Baseline Scheme	Energy Strategy provided by URS 'compliance with building regulations' scenario	Battersea Station	108	5	73	656	391	464	1,697
		Nine Elms Station	108	5	73	786	472	441	1,884
		Kennington Park	1	-	16	67	627	18	729
		Kennington Green	-	-	16	49	606	13	683
<b>TOTAL</b>		<b>NLE</b>	<b>217</b>	<b>10</b>	<b>178</b>	<b>1,558</b>	<b>2,096</b>	<b>936</b>	<b>4,993</b>

#### Operation - Trackside

	Source	Unit	Traction	Groundwater Pumps	Ventilation fans	Total
Total CO2e from LU footprint	<i>London Underground 2008 footprint</i>	tco2e	473,491	36,339	9,027	
Total km LU	<a href="http://www.tfl.gov.uk/corporate/modesoftransport/londonunderground/1608.aspx">http://www.tfl.gov.uk/corporate/modesoftransport/londonunderground/1608.aspx</a>	km	402	402	402	
Total km NLE		km	3	3	3	
<b>Total CO2e</b>		<b>tco2e</b>	<b>3,651</b>	<b>280.23</b>	<b>70</b>	<b>4,001</b>

Scope 3

Operation - indirect

	Source	Unit	Water consumption	Wastewater discharge	Waste produced	Employee commuting	Business travel	Rail replacement buses	Contracted maintenance vehicles	Purchased materials	Contracted activities	End Use products
Total CO2e from LU footprint	London Underground 2008 footprint	tco2e	216	38	34,872	497	718	1,521	2,567	1,775	76,670	2,407
Total km LU	<a href="http://www.tfl.gov.uk/corporate/modesoftransport/londonunderground/1608.aspx">http://www.tfl.gov.uk/corporate/modesoftransport/londonunderground/1608.aspx</a>	km	402	402	402	402	402	402	402	402	402	402
Total km NLE		km	3	3	3	3	3	3	3	3	3	3
<b>Total CO2e</b>		<b>tco2e</b>	<b>2</b>	<b>0</b>	<b>269</b>	<b>4</b>	<b>6</b>	<b>12</b>	<b>20</b>	<b>14</b>	<b>591</b>	<b>19</b>

Transport - indirect

Public transport in the NLE area  
(assuming NLE is built)

with NLE scenario	Source	Unit	Car	Taxi	LGV	OGV	Bus	Tube	Rail	TOTAL tonnes CO2e
Total distance	tfl (motorcycle = estimation, walk/cycle from LTS)	km/yr	20,849,261,934.00	796,642,730.00	4,204,720,793.00	3,559,435,307.00	8,988,952,748.00	17,007,456,749.00	26,240,441,590.00	
Total person trips	tfl (walk/cycle from LTS)	people trips/yr	n/a	n/a	n/a	n/a	2,565,028,000.00	2,488,049,737.00	1,184,721,550.00	
Total vehicle trips	tfl (motorcycle = estimation, walk/cycle from LTS)	vehicle trips/yr	2,757,377,535.00	47,655,885.00	380,043,837.00	284,331,018.00	n/a	n/a	n/a	
Average trip length	tfl (motorcycle = estimation, walk/cycle from LTS)	km/trip	7.56	16.72	11.06	12.52	3.50	6.80	22.10	
Defra, all scopes grand total GHG	kg CO2e per km	Average petrol mot	Average car unknown fuel	Taxi (black cab)	Van/Light Commercial Ve	Diesel HGV Road Freight	Local London bus	London Underground	National rail	
Defra	kg CO2e per km	0.14238	0.23394	0.188446667	0.29968	0.718520392	0.10005	0.08154	0.06715	
<b>Total tonnes CO2e</b>			<b>4,877,476.34</b>	<b>150,124.67</b>	<b>1,260,070.73</b>	<b>2,557,526.85</b>	<b>899,344.72</b>	<b>1,386,788.02</b>	<b>1,762,045.65</b>	<b>12,893,376.98</b>

nb/ emissions for travel on the NLE are accounted for in 0.81 trackside energy use

**Baseline Vs Operation**

without NLE	Source	Unit	Car	Taxi	LGV	OGV	Bus	Tube	Rail	TOTAL tonnes CO2e
Total distance	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	km/yr	20,827,716,826.00	796,345,379.00	4,200,214,701.00	3,556,160,934.00	9,012,982,688.00	16,938,681,891.00	26,263,908,011.00	
Total person trips	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	people trips/yr	n/a	n/a	n/a	n/a	2,569,623,481.00	2,476,403,025.00	1,187,577,250.00	
Total vehicle trips	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	vehicle trips/yr	2,757,241,223.00	47,655,885.00	380,043,837.00	284,331,018.00	n/a	n/a	n/a	
Average trip length	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	km/trip	7.55	16.71	11.05	12.51	3.50	6.80	22.10	
Emissions factor description	<i>Defra, all scopes grand total GHG</i>	kg CO2e per km	Average car unknown fuel	Taxi (black cab)	Van/Light Commerc	Diesel HGV Road Fre	Local London bus	London Underground	National rail	
Emissions factor value	<i>Defra</i>	kg CO2e per km	0.23394	0.188446667	0.29968	0.718520392	0.10005	0.08154	0.06715	
<b>Total kg CO2e</b>			<b>4,872,436,074.27</b>	<b>150,068,632.19</b>	<b>1,258,720,341.60</b>	<b>2,555,174,149.17</b>	<b>901,748,917.93</b>	<b>1,381,180,121.39</b>	<b>1,763,621,422.94</b>	<b>12,882,949.66</b>

with NLE	Source	Unit	Car	Taxi	LGV	OGV	Bus	Tube	Rail	TOTAL tonnes CO2e
Total distance	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	km/yr	20,849,261,934.00	796,642,730.00	4,204,720,793.00	3,559,435,307.00	8,988,952,748.00	17,007,456,749.00	26,240,441,590.00	
Total person trips	<i>tfl (walk/cycle from LTS)</i>	people trips/yr	n/a	n/a	n/a	n/a	2,565,028,000.00	2,488,049,737.00	1,184,721,550.00	
Total vehicle trips	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	vehicle trips/yr	2,757,377,535.00	47,655,885.00	380,043,837.00	284,331,018.00	n/a	n/a	n/a	
Average trip length	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	km/trip	7.56	16.72	11.06	12.52	3.50	6.80	22.10	
<i>Defra, all scopes grand total GHG</i>	kg CO2e per km	Average petrol mot	Average car unknown fuel	Taxi (black cab)	Van/Light Commerc	Diesel HGV Road Fre	Local London bus	London Underground	National rail	
<i>Defra</i>	kg CO2e per km	0.14238	0.23394	0.188446667	0.29968	0.718520392	0.10005	0.08154	0.06715	
<b>Total CO2e</b>			<b>4,877,476,336.84</b>	<b>150,124,666.99</b>	<b>1,260,070,727.25</b>	<b>2,557,526,852.94</b>	<b>899,344,722.44</b>	<b>1,386,788,023.31</b>	<b>1,762,045,652.77</b>	<b>12,893,376.98</b>

## Difference

Operation vs Baseline	Source	Unit	Car	Taxi	LGV	OGV	Bus	Tube	Rail	TOTAL tonnes CO2e
Total distance	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	km/yr	21,545,108.00	297,351.00	4,506,092.00	3,274,373.00	- 24,029,940.00	68,774,858.00	- 23,466,421.00	
Total person trips	<i>tfl (walk/cycle from LTS)</i>	people trips/yr	n/a	n/a	n/a	n/a	- 4,595,481.00	11,646,712.00	- 2,855,700.00	
Total vehicle trips	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	vehicle trips/yr	136,312.00	-	-	-	n/a	n/a	n/a	
Average trip length	<i>tfl (motorcycle = estimation, walk/cycle from LTS)</i>	km/trip	0.01	0.01	0.01	0.01	-	-	-	
<i>Defra, all scopes grand total GHG</i>	kg CO2e per km	Average petrol mot	Average car unknown fuel	Taxi (black cab)	Van/Light Commerc	Diesel HGV Road Fre	Local London bus	London Underground	National rail	
<i>Defra</i>	kg CO2e per km	0.14238	0.23394	0.188446667	0.29968	0.718520392	0.10005	0.08154	0.06715	
<b>Total tonnes CO2e</b>			<b>5,040.26</b>	<b>56.03</b>	<b>1,350.39</b>	<b>2,352.70</b>	<b>- 2,404.20</b>	<b>5,607.90</b>	<b>- 1,575.77</b>	<b>10,427.32</b>

N: Code of Construction Practice and  
Construction Noise Mitigation

**Environmental Statement**

Volume II



N1: Code of Construction Practice (CoCP)

**Environmental Statement**

Volume II





# Northern Line Extension (NLE)

## Code of Construction Practice - Part A

April 2013

**DRAFT**

Editor: Nick Street Consents Manager	
Approved by:	
Project Manager	Date:
Authorised by:	
Project Director	Date:

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## 0 Abbreviations

BS	British Standard
BPM	Best Practical Means ( <i>this means that every practical mitigation has been applied to reduce noise and vibration produced by the works to as low a level as possible</i> ).
CDM	Construction (Design and Management) Regulations
CoPA	Control of Pollution Act 1974
CoCP	Code of Construction Practice
EA	Environment Agency
EHO	Environmental Health Officer
EMP	Environmental Management Plan
ES	Environmental Statement
GLA	Greater London Authority
LBL/LBS/LBW	London Borough of Lambeth / Southwark / Wandsworth (otherwise referred to as the boroughs or relevant local authority)
LFEP	London Fire and Emergency Planning Authority
NL/E	Northern Line / Extension
OA	Opportunity Area
OAPF	Opportunity Area Planning Framework
S61	Prior consent from a council under the Section 61 of the Control of Pollution Act 1974 - for construction works where BPM has been demonstrated to be applied.
SEMP	Site Environment Management Plan
SI	Site Investigation
SWMP	Site Waste Management Plan
TCPA	Town & Country Planning Act(s)
TfL	Transport for London**
TMP	Traffic Management Plan
TWA/O	Transport & Works Act / Order
VNEB	Vauxhall, Nine Elms, Battersea

**\*\* Where appropriate to the context 'TfL' should be taken as including its subsidiaries London Underground and Tube Lines and also those acting on behalf of TfL including consultants and contractors appointed by TfL**

## 1. Introduction

### 1.1 Document Status / Origin / Future Development

- 1.1.1 The status of this document is DRAFT and it will remain so until agreed with LBL, LBS and LBW. It is a working document for discussion during the period leading up to the submission of a Transport and Works Act Order application in spring 2013. It is envisaged that the Code and compliance with it will be the subject of a proposed condition to be attached to the NLE TWA/O and deemed planning permission. The Code will remain subject to review in order to reflect changes in construction industry practice, etc.; however, any changes made will be agreed between TfL and the boroughs.
- 1.1.2 The provisions of the Code are based on current good practice for major rail projects involving tunnelling in and around London.
- 1.1.3 It is acknowledged that the works will take place at a time when a number of other major construction projects are underway in the VNEB area. TfL would be willing to participate in any Forum that might be established by one or more of the boroughs to manage the cumulative impact of construction issues. Similarly, it is acknowledged that construction will affect the local community and TfL is willing to participate in any forum established for the purpose of community liaison.

### 1.2 Purpose, application and enforcement of the Code

- 1.2.1 It is intended that this CoCP will apply so as to control possible impacts arising from the construction of NLE. During construction, TfL, through design and mitigation, will control the effects of noise and vibration from within the construction sites using BPM. These controls will be agreed with relevant councils in the form of a Section 61 consent for all surface construction sites under the Control of Pollution Act 1974. The CoCP will be applied to all construction works. Accordingly, TfL will ensure that all parties involved in the construction work (including Contractors, sub-Contractors and their suppliers) will observe the relevant provisions of the CoCP.
- 1.2.2 This CoCP sets out standards and procedures for managing the environmental impact of constructing the NLE. It covers environmental, public health and safety aspects of the project that may affect the interests of local residents, businesses, the general public and the surroundings in the vicinity of the proposed construction sites.
- 1.2.3 The CoCP is split into two parts. This document is Part A, which sets out:
- the context and underlying principles of the NLE CoCP.

- the principal obligations of Contractors and developers when undertaking work.
  - the general measures to be used during construction, how they will be applied by the contract and enforced by TfL, and the relevant local authority.
  - the details of the measures for each relevant environmental topic
- 1.2.4 Part B of the CoCP will be developed by TfL and its main Contractor when appointed to supplement Part A. Part B shall be subject to the approval of the relevant local planning authority in accordance with the planning conditions to which the NLE works are subject. It will identify detailed site-specific measures and take into account the environmental issues in the NLE area and each of the NLE constituent work sites (such as site set ups and servicing arrangements). Part B may include, but is not limited to:
- conditions imposed on planning permissions;
  - assurances given in relation to planning and other consents;
  - Site Environment Management Plans and other Environment Management Plans to be produced /co-ordinated by the main Contractor, examples of which are listed in 2.4.2 below;
  - consents obtained /co-ordinated by the main Contractor under Section 61 of the Control of Pollution Act (herein referred to as “Section 61”); and
  - Traffic Management Plans
- 1.2.5 The purpose of the CoCP is to ensure that best practice is used so that adverse effects of construction on the environment are kept to a reasonable minimum. Overall, it aims to mitigate nuisance to the public and to safeguard the environment.
- 1.2.6 The Code may be revised from time to time in light of relevant legislation, discussions with the local planning authority and/or other affected parties. “Construction” in the Code includes site preparation (including remediation and / or ground treatment, where appropriate), demolition, scaffolding, material delivery, excavated material disposal, waste removal and all related engineering and construction activities. Testing and commissioning are NOT “Construction” activities. Site investigations carried out under the terms of permitted development or planning permission granted before the making of the TWA Order may be subject to different provisions where appropriate. Other advance works will be subject to the provisions of the CoCP except where carried out by an undertaker whose works are already covered by an established and accepted CoCP.
- 1.2.7 TfL and/or other parties exercising its functions will hold discussions with the local authorities and other statutory agencies as appropriate in advance of submissions for approval.

- 1.2.8 The TfL NLE Project Manager (PM) is responsible for compliance with the Code. TfL will apply its Environmental Management System approach. The PM will ensure that:
- the Contractor(s) submit reports regarding performance and other relevant matters sufficient to inform the PM regarding compliance with the CoCP;
  - arrangements for auditing are in place and are implemented; and
  - accountabilities and responsibilities, throughout the Client and Contractor organisations, are clearly allocated and identified.
- 1.2.9 Following the agreed planning conditions (if imposed by the Secretary of State), the Code will be enforced by the relevant local authority, as the local planning authority. This will be done in consultation with their Environmental Health departments.

### 1.3 The works – objectives and scope

- 1.3.1 The primary aim of the NLE is to encourage economic growth in London and the wider UK economy by facilitating the sustainable regeneration and development of the Vauxhall Nine Elms Battersea (VNEB) Opportunity Area. This includes the creation of a major new sustainable residential, business and leisure district in London’s Central Activities Zone.
- 1.3.2 The scheme will help to meet a number of the goals for transport set out in the Mayor’s Transport Strategy (MTS, 2010) ). The MTS sets six goals; while the sixth is specific to the 2012 Games, the others are relevant as secondary aims of the NLE. Those goals are enumerated below and each is followed by information on how the NLE will achieve them:
1. *Support economic development and population growth*  
By enabling the sustainable regeneration and development of the VNEB OA, the NLE will catalyse the creation of 16,000 new homes and 20-25,000 new jobs. In addition, it will enhance access to employment for local people in the surrounding area and integrate the VNEB OA with the remainder of central London.
  2. *Enhance the quality of life for all Londoners*  
As part of a wider package of transport and urban realm improvements, the NLE will bring economic and accessibility benefits to a wide area, including the existing and new communities around Nine Elms station.
  3. *Improve the safety and security of all Londoners*  
The Underground is a safe and secure transport mode whilst stations provide safe and attractive meeting points: the new stations at Battersea and Nine Elms will be modern, well-designed landmarks which will be integrated with high quality urban realm, benefiting new and existing communities in the area.

4. *Improve transport opportunities for all Londoners*

The NLE will transform accessibility across the VNEB OA and deliver standards available elsewhere in central London, assisting and complementing London's transport network. Both new stations will be step-free from street to train and will significantly enhance transport accessibility to all by creating new high quality access points to the Underground network.

5. *Reduce transport's contribution to climate change and improve its resilience*

The Underground is a sustainable transport mode and the NLE will be constructed to the most up-to-date design and environmental standards. The NLE will contribute to making the area more typical of central London in terms of providing alternatives to car travel.

1.3.3 THE NLE works comprise the construction of an underground railway to form an extension of the Northern line (Charing Cross branch) from Kennington to Battersea. It will diverge from the existing railway south of Kennington station from a section of track used by terminating trains (known as the Kennington loop) and will comprise the following:

- a railway approximately 3,150 metres long northbound and approximately 3,250 metres long southbound including overrun / stabling tunnels west of the terminus at Battersea, a crossover east of the terminus and junctions serving each of the tunnels to link with the existing railway at the Kennington Loop;
- a terminus at Battersea between Battersea Park Road and Battersea Power Station and an intermediate station at Nine Elms west of Wandsworth Road and north of Pascal Street, both providing step-free access from trains to street level;
- intervention and ventilation shafts with head houses at Kennington Green and Kennington Park to provide emergency access, tunnel ventilation and smoke control; and
- ancillary and mitigation works within the limits of deviation including (but not limited to) providing power supply, additional cross passages at platform level at Kennington station and works related to highways, footways and utilities.
- The NLE works also include:
- accommodation works for affected landowners / occupiers including (but not limited to):
  - temporary facilities for Battersea Dogs and Cats Home and Covent Garden Market Authority;
  - temporary and permanent facilities for occupiers of the park lodge at Kennington Park; and
  - the installation of a water tank for the benefit of the Beefeater Gin Distillery.
- temporary works including worksites at the locations of the proposed stations and shafts / head-houses, temporary shafts at Radcot Street and Harmsworth Street and a temporary conveyor and associated alterations to the jetty at Battersea Power station to facilitate the transfer of material onto barges.

## 2 General Principles

### 2.1 Construction Strategy

2.1.1 A construction strategy has been developed with the following objectives:

- (a) to meet the requirements of all relevant legislation, codes of practice and latest standards;
- (b) having regard to latest standards to limit adverse impacts on the local community and the environment so far as reasonably practicable;
- (c) to implement a community liaison plan;
- (d) to minimise disruption to the highway network and bus services so far as is reasonably practicable;
- (e) to limit impacts on the operations of Network Rail, London Underground and other rail companies so far as is reasonably practicable;
- (f) to carry out the planning and delivery of the project in a cost effective manner; and
- (g) to co-ordinate with other relevant projects as far as reasonably practicable to reduce the combined impacts

### 2.2 Environmental Principles

2.2.1 TfL is committed to ensuring that NLE is built, where reasonably practicable, in accordance with all relevant and current environmental legislation and best practice for minimising the environmental effects of construction.

2.2.2 TfL's arrangements for managing Contractors will include the selection of competent Contractors who must plan and implement appropriate Health, Safety, Quality and Environmental systems. This will require tenderers for the main construction contracts to have as a minimum an Environmental Management System (EMS) which is consistent with current legislation and best practice and which will deliver the works in accordance with the provisions of this Code.

### 2.3 Health and Safety Principles

2.3.1 TfL is committed to ensuring the health, safety and welfare of its employees and people who may be affected by the conduct of its undertaking. TfL will apply appropriate industry standards for health and safety and will seek continuous improvement in safety performance.

2.3.2 TfL and those acting on its behalf will ensure that adequate arrangements are in place for the discharge of all duties as named parties under the current Construction (Design & Management) Regulations (CDM). TfL will assess the competence and resources for health and safety of organisations appointed as other duty-holders

under CDM, and will monitor compliance with discharge of its own and others' CDM duties throughout the project.

- 2.3.3 TfL will ensure the development of a health and safety management system. This system will include documentation defining TfL's internal arrangements for managing health and safety on the project and the specific requirements for health and safety applying to all designers and Contractors appointed to work on the project.
- 2.3.4 TfL will ensure that all Contractors appointed to carry out work on the TfL project produce a Health and Safety Plan defining how their work and associated risks to health and safety will be managed.
- 2.3.5 TfL's arrangements for health and safety will include a system for management of risks. At the time of contract appointment the Contractor will be presented with a Project Risk Register as part of the Client's Health & Safety File submission. Subsequently, the Contractor's responsibilities will include that all hazards are identified, on an ongoing basis throughout the life of the project, suitable and sufficient assessments are made of the associated risk, followed by adoption and execution of appropriate measures to eliminate the risk or to control the risk, so far as is reasonably practicable. Where risks to the public are involved, these will be reduced to as low as reasonably practicable, and will be managed in accordance with current guidance. Tunnelling works will be required to comply with the requirements of the Association of British Insurers Construction Code for risk management in tunnelling works.
- 2.3.6 TfL will continuously monitor the work of Contractors and will conduct a programme of audits and inspections to ensure compliance with the requirements of this Code and other project health and safety requirements.

## 2.4 Site Management

### General

- 2.4.1 Contractual arrangements will require all NLE Contractors to provide suitably qualified staff to manage and execute works for which they are responsible. TfL will require that all Contractors demonstrate an appropriate awareness of local sensitivities, expected codes of conduct, working knowledge of the legislation, codes of practice, and guidance relevant to the various construction activities in which they are engaged.

### Environmental Management Plans

- 2.4.2 This Code requires the production of a number of environmental management plans (EMPs) throughout the lifetime of this project. The

plans do not need to be separate documents and will include, but are not limited to:

- Site environmental management plan(s)
- Noise and vibration management plan
- Traffic management plan(s)
- Site waste management plans
- Air quality and dust management plan
- Water conservation plan
- Green travel plan
- Energy management plan
- Ecology management plan
- Ecology reinstatement plan
- Lighting management plan(s) for any construction sites where potentially significant impacts are identified

These plans will set out the environmental objectives/targets of the project, how the project will deliver the environmental requirements, and how environmental issues that arise are to be handled to ensure compliance with relevant legislation, regulations, best practice and this Code. The requirement for EMPs will be subject to ongoing review with the relevant local authority and other statutory agencies. The plans will define the approach to address all relevant environmental issues and will set out how TfL intends to operate the construction and work sites and will set out the specific control measures necessary to deliver the requirements of the Code. The Contractor may not commence work until TfL is satisfied that all appropriate procedures and processes are in place.

### Training and Competence

- 2.4.3 TfL will require Contractors to employ an appropriately qualified workforce, which may include holding a card from an appropriate recognised competence scheme, such as the Construction Skills Certification Scheme or the appropriate TfL safety induction scheme for working on or close to the railway. TfL will require Contractors to operate induction schemes for all personnel to ensure that they are aware of their individual responsibility to comply with the Code. The Contractor will be responsible for identifying the training needs of its personnel and will ensure that appropriate training is provided. The training will include information on local considerations and the Client's expectations on site behaviours, "toolbox talks" for site operatives to maintain an appropriate level of awareness on health, safety and environmental topics and to advise employees of changing circumstances as work progresses. Records will be kept of attendance.

## 2.5 Community Consultation & Liaison / Helpline

- 2.5.1 TfL and/or Contractors will be committed to providing community relations personnel who will be focussed on engaging with the community to provide appropriate information and to be the first line of

response to resolve issues of concern. TfL will take reasonable steps to engage with all residents including those who may be differentially affected by construction impacts. TfL will ensure that occupiers of nearby properties will be informed in advance of works taking place, including the duration. In the case of work required in response to an emergency, the local authority and local residents shall be advised as soon as reasonably practicable that emergency work is taking place.

- 2.5.2 TfL and its Contractors will implement a community liaison plan following further consultation with the boroughs and representatives of local residents and local businesses. TfL is seeking to address the concerns of residents and local business and especially to effective monitoring and mitigation of predicted and actual effects of the construction programme. TfL will, in consultation with the boroughs, establish and maintain a Community Liaison Group (or Groups) and this (or these) will meet regularly before and during the construction period.
- 2.5.3 TfL will maintain a telephone helpline service which includes a complaints option staffed 24 hours per day during the construction period to handle enquiries and complaints from the general public. It will also act as a first point of contact and information in case of an emergency. All calls will be logged, together with a record of the responses and action taken. Appropriate contacts and response times will be the subject of a detailed procedure to be agreed prior to the commencement of construction. Potentially affected occupiers will be notified of the helpline number and it will be widely advertised and displayed on site signboards.
- 2.5.4 A Complaints Register recording the nature of the complaint and action taken will be maintained. This register will record all complaints received (e.g. written, via the telephone helpline or direct to site personnel) and an updated copy will be provided to the relevant local authority each month (or such other interval as agreed with the relevant local authority). A summary of the Complaints Register (with all personal details removed) will be provided to others on request.
- 2.5.5 A Commitment Register, which includes relevant documents, will be provided as a component of, or accompaniment to, the CoCP Part B.

## 2.6 Approvals Process

- 2.6.1 It is proposed to obtain approval for the NLE primarily by means of an Order under the Transport and Works Act 1992 (TWA) for the main part of the works together with planning permission for these works.
- 2.6.2 TfL will implement a project approval process to ensure that all other appropriate approvals and clearances are obtained before a specific element of the works is started.

## 3 General Site Operations

### 3.1 Construction Process

- 3.1.1 The NLE is a major construction project and will involve many different types of construction activities. These activities will include: demolition; site clearance; site investigation; remediation (as necessary); tunnelling; piling; excavation; services diversion and new installations; highway works; and below ground and surface building works. It will also involve changes/modifications to existing TfL infrastructure.

### 3.2 Working Hours

- 3.2.1 Details of working hours will, with the exception of tunnelling works, be the subject of submissions under Section 61 CoPA 1974 which shall be made to the relevant local authority. Unless otherwise agreed with the relevant local authority, no construction works will be undertaken outside normal working hours unless formal consent under Section 61 has been obtained. Only general principles relating to the types of activity for which it is likely to be necessary to seek Section 61 consent for working outside normal working hours are set out here.
- 3.2.2 Normal working hours are planned to be from 0800 to 1800 on weekdays (Mon-Fri excluding Bank Holidays) and 0800 to 1300 on Saturdays. Where feasible, operations likely to cause disturbance and/or disruption will be limited to these hours.
- 3.2.3 In addition start up and shut down activities will take place for up to one hour before and after these times. Start up and shut down activities can include but are not limited to:
- maintenance
  - site briefings, meetings and training
- 3.2.4 Start up and shut down activities will NOT include operation of plant or machinery giving rise to noise likely to exceed threshold levels for normal working hours. The start up and shut down periods shall not be regarded as extensions to normal working hours and particular care will be taken to limit and control disturbance to local residents during such periods.
- 3.2.5 Non-disruptive preparatory work, repairs and maintenance may be carried out on Saturday afternoons or Sundays between 1000 and 1600.
- 3.2.6 TfL will generally adhere to normal working hours as far as reasonably practicable but in some circumstances it may be that some works would cause less disturbance and/or disruption if carried out wholly or partly outside normal working hours. Therefore, it may be proposed that some works be rescheduled outside normal working hours in which case permission will be sought. However, any such rescheduling of works will

not be proposed/ permitted if it would have a material adverse effect on local residents or other local occupiers.

- 3.2.7 Proposals for working outside normal working hours will be discussed with the relevant local authority in the context of the full information available in Section 61 applications.
- 3.2.8 Tunnelling works together with directly associated activities will normally be carried out on a 24 hours per day, 7 days per week basis. Once tunnelling has commenced it may need to continue uninterrupted for reasons of engineering practicability and safety. The Section 61 process is not appropriate in the case of tunnelling operations; however proposals for tunnelling will be discussed with the relevant local authorities.
- 3.2.9 There are some types of work that necessarily have to take place outside normal working hours or, being non-disruptive, can reasonably be done. These include:
- The conveyor at Battersea will normally be operational on a 24 hours per day, 7 days per week basis as it will be necessary to load material including tunnel arisings on to barges every high tide (with some 'downtime' between each high tide).
  - Internal fit out works within the tunnels, stations and shafts including electrical, communications, ventilation and signalling works. This work involves complex and time consuming work but is non-disruptive. Also, because the works involve linking with the existing Northern line, some of it will have to take place at night (or at weekends) when the Underground is closed or during possessions (which are most likely to occur at night, at weekends and/or on Bank Holidays) or at other such times as are necessary for safety critical works.
  - In order to safeguard the works it may be necessary for certain items of construction plant and equipment particularly associated with the tunnelling operations to be kept running 24 hours per day, 7 days per week. This shall include pumps, ventilation fans, cranes, compressors, batching plants and possibly generators. Any such equipment will be shielded in order to provide appropriate noise attenuation.
  - Works which require temporary possession of roads and railways, or which need to take place during non-rail traffic hours or when volumes of road traffic are low, for reasons of safety, engineering practicability or operational requirements. Limiting disruption to the travelling public may also be a factor with regard to such works.
  - Works in connection with utilities which have to be undertaken when demand is low.
  - Operations which for reasons of engineering practicability must be completed once commenced and which cannot be completed within a working day (e.g. a major concrete pour and certain piling operations).

- 3.2.10 Times at which such works could need to take place may include Saturday afternoons, night-times, Sundays and/or Bank Holidays from time to time.
- 3.2.11 If TfL intend undertaking works as specified in paragraph 3.2.8, all such surface works will be the subject of a Section 61 Application to the relevant local authority. The noise levels in Section 61s will be determined by the application of BPM (best practical means).
- 3.2.12 In the case of work required in response to an emergency or which, if not completed, would be unsafe or harmful to the permanent works, the local authority will be informed as soon as reasonably practicable of the reasons for, and likely duration of, the works. The local authority will provide a telephone number and nominate an officer to receive such notification; this will be reviewed regularly. Examples of the type of work envisaged might include where pouring concrete takes longer than planned due to equipment failure or where unexpected poor ground conditions encountered whilst excavating require immediate stabilisation.
- 3.2.13 Where work has to be rescheduled for reasons not envisaged and is expected to extend beyond the agreed or normal working hours or exceed the agreed limits and dispensation to the Section 61 consent, the Contractor will apply for a variation to the section 61 consent to the relevant local authority at least 14 days in advance of the start of those works (or within an appropriate timescale to be agreed with the local authority).
- 3.2.14 Where rescheduling relates to work of a critical nature (such as key activities likely to delay other key activities) applications will be made where practicable 48 hours in advance and no fewer than 7 days in advance if the work is expected to last for a period of 5 days or more. The variation will be sought by means of an application setting out the revised construction programme or method and the relevant noise calculations.
- 3.2.15 Where such working outside normal hours has been discussed and accepted, nearby occupiers who are likely to be affected by the works will be informed by letter to their postal address as soon as reasonably practicable by TfL about the nature and likely duration of the works.
- 3.2.16 Deliveries will be arranged to minimise impacts on the road system as far as reasonably practicable, although loading and unloading will normally take place during normal working hours. However, there are good reasons why it may sometimes be necessary for this activity to take place at other times (e.g. large loads or to minimise disruption). Each case will be considered on its merits and will be the subject of prior agreement with the relevant local authority. A procedure for obtaining prior agreement will be established.



### 3.3 Site Layout and Facilities

- 3.3.1 TfL will ensure, as far as reasonably practicable and appropriate, that site layouts and appearance will be designed using the following principles:
- (a) the sites will be screened and fully secured;
  - (b) storage sites, fixed plant, machinery, equipment and temporary offices will be located to limit environmental effects, as far as reasonably practicable, and having due regard to neighbouring accommodation, as far as allowed by the constraints of the site(s);
  - (c) site lighting will be located and directed so as not to intrude into occupied residential properties or disturb wildlife on sensitive areas or constitute a road hazard; and
  - (d) fixed site plant and facilities will be powered from mains electrical sources
- 3.3.2 TfL will ensure, as far as reasonably practicable, that the visual intrusion of construction sites on nearby residents and users of local facilities and amenities is contained and limited. TfL will display the helpline number and a contact name and address at appropriate locations on the boundaries of the sites.
- 3.3.3 The type of hoarding or fencing used and vehicle access and egress points will be agreed with the relevant local authority. Signage, decoration or enhancement, for information or aesthetic purposes, on the hoarding will be in accordance with TfL's corporate requirements.
- 3.3.4 TfL will promote and enforce a "good housekeeping" policy on the construction sites to ensure that they are clean, tidy and safe. Arrangements will be implemented to provide effective preventative pest control and prompt treatment of any pest infestation.
- 3.3.5 TfL will ensure that appropriate welfare facilities are provided for construction personnel including toilets, showers, locker rooms and first aid posts. The facilities will be connected to mains services and drainage, where reasonably practicable.

### 3.4 Site Security

- 3.4.1 TfL will ensure that the construction site(s) are secure and staffed for security on a 24 hour basis. Access to the sites will be limited to specified entry points only and all personnel entries/exits will be recorded and monitored for both security and health and safety purposes.
- 3.4.2 The site boundaries will be secured and constructed such that it minimises opportunities for unauthorised entry. The boundary will be monitored both directly and remotely (by CCTV) by the Contractor/Contractor's security team. Should the site boundary suffer

damage then it will be immediately rectified by the Contractor to the satisfaction of TfL and in accordance with the reasonable requirements of the relevant Borough.

### 3.5 Site Lighting

- 3.5.1 Site lighting and signage will be provided to ensure the safety and security of the construction sites and will be at the minimum luminosity necessary. Where appropriate, lighting to site boundaries will be provided and illumination will be sufficient to provide a safe route for the passing public and the lux levels on footways shall be at least equal to those provided by the existing street lighting. In particular, precautions will be taken to avoid shadows cast by the site hoarding on surrounding footpaths, roads and amenity areas.
- 3.5.2 Appropriate industry standard procedures will be implemented at all construction sites for site lighting. Lighting will also be designed, positioned and directed so as not to unnecessarily intrude on adjacent buildings, wildlife sites and land uses and so as to prevent unnecessary interference with local residents, railway operations, passing motorists, or the navigation lights for air or water traffic and wildlife breeding seasons. The contractor shall consult the ecologist appointed to carry out the bat survey in accordance with paragraph 11.2.1(b) to ensure the design for the site lighting will not disturb or adversely affect bats in the area. This provision will apply particularly to sites where night working will be required. In addition, at construction sites where potentially significant impacts are identified, a lighting management plan will be prepared, implemented and reviewed by relevant authorities, including the Environment Agency.
- 3.5.3 The lighting will be designed to comply with the provisions of current guidance and good practice. The lighting will be designed to comply with the provisions of BS5489, Code of Practice for the Design of Road Lighting, where applicable. Further guidance is contained within Guidance Notes for the Reduction of Obtrusive Light GN01:2011 by the Institution of Lighting Professionals and Bats and Lighting in the UK, Bat Conservation Trust, May 2009.

### 3.6 Emergency Planning and Response

#### Emergency Procedures

- 3.6.1 TfL will ensure that emergency procedures for each work site are developed. The procedures will be standardised as far as possible across the work sites and will be appropriate to the anticipated hazards and the specific layout. The emergency plan will include Emergency Services, Police, etc., and will include notification procedures so that the Services can act accordingly in the event of an incident. The emergency plan will include emergency pollution control measures that will take into

account EA guidelines. The emergency plan will contain emergency phone numbers and the method of notifying local authorities and statutory authorities. Contact numbers for the key TfL and Contractor's staff will also be included.

### **Emergency Access**

- 3.6.2 TfL will ensure that the requirements of the London Fire and Emergency Planning Authority (LFEPA) will be followed for the provision of site access points. Where appropriate, the accesses will be designed to the requirements of current LFEPA guidance. . In accordance with procedures and processes agreed prior to start of construction, the emergency services will be notified of any variations of the accesses. In all cases the arrangements put in place will also be suitable for and agreed with the London Ambulance Service (LAS).

### **3.7 Fire Prevention and Control**

- 3.7.1 All construction sites and associated accommodation and welfare facilities will have in place appropriate plans and management controls to prevent fires. The site fire plans will be prepared, regularly reviewed, and updated as necessary, and will have due regard to relevant current guidance.
- 3.7.2 During detailed construction planning and design development stages, TfL will look to reduce fire risk and potential fire load applicable to the works and the operating station. The specification of non-combustible materials, products and packaging will be pursued wherever reasonably practicable. The project will also have to comply with any third party requirements as may be appropriate at specific sites.

### **3.8 Cranes**

- 3.8.1 Crane arcs will be confined within the site boundary unless agreed otherwise with the local authority and property owners/occupiers whose air space is affected. TfL will obtain the relevant permissions from the highway authority (TfL or the relevant local authority as appropriate) for cranes located adjacent to roads. Cranes will be operated in accordance with the requirements the current Code of Practice for Safe Use of Cranes.

### **3.9 Unexploded Ordnance**

- 3.9.1 A risk assessment will be completed for the possibility of unexploded ordnance being found on the sites and a response process will be included in the emergency procedures. An emergency response procedure will be prepared and implemented to respond to unexploded ordnance.

### **3.10 Electromagnetic Interference**

- 3.10.1 TfL will consider the effects of electromagnetic interference on wireless telecommunication systems during the design and construction of NLE, which will include site specific effects from the installation of tower cranes.

### **3.11 Green Travel Plan**

- 3.11.1 TfL will produce a green travel plan for the project. The plan will be developed to encourage the use of public transport by those working on the project.

### **3.12 Construction Camps**

- 3.12.1 None are proposed

## 4 Public Access and Highway

### 4.1 General Requirements

4.1.1 TfL will ensure that legal requirements for works affecting highways are implemented and shall undertake the works in such a way as to maintain, as far as reasonably practicable, existing public access routes and rights of way during construction. TfL will limit undue inconvenience to the public as far as reasonably practicable whilst carrying out the works. Detailed proposals will be set out in a Traffic Management Plan (TMP). The NLE TWAO will include any necessary provisions for stopping up and diversion of highways, together with protective provisions for highway authorities.

### 4.2 Traffic Management Plan

4.2.1 A TMP (or TMPs) will be produced, co-ordinated and then implemented by the main Contractor. The plan(s) will address pedestrian issues and diversion routes as appropriate and will be prepared in consultation with highway and traffic authorities and the emergency services. The TMP(s) will include:

- site boundaries and the main access/egress points for the worksites;
- temporary and (if any) permanent closures and diversions of highways;
- the strategy for traffic management including parking; and
- local routes to be used by lorries generated by construction activity, including: lorry holding areas, lorry route signing strategy, means of monitoring lorry use and any routes prohibited from use by Contractors' vehicles.

### 4.3 Works Affecting Highways and Public Rights Of Way

4.3.1 TfL and its Contractor will comply with any relevant requirements that may be detailed in the NLE TWAO before commencing works that will involve interference with the highway. All necessary consents and licences will be obtained in advance. [NOTE: 'Highway' includes all land vested in the relevant local authority or TfL for highway purposes including footways]. All temporary closures of highways and public rights of way will be for as short a time as reasonably practicable. Pedestrian access to premises will be maintained. As far as reasonably practicable, diversion routes will be provided prior to the commencement of the relevant parts of the works and will be maintained to a comparable standard of those that they replace. Suitable signage and barriers will be provided. Local residents and businesses will be informed in advance of the dates and durations of closures and, with the exception of emergency works as referred to above, will be provided with details of

diversion routes a minimum of two weeks in advance (or when final details are available).

### 4.4 Highway Reinstatement

4.4.1 Where temporary alterations to the highway are required, the highway will be restored to the reasonable satisfaction of the relevant highway authority. Surveys will be used to establish the condition of the highway prior to the commencement and after the completion of the NLE works. The locations where surveys will be undertaken will be identified in the TMP.

### 4.5 Road Cleanliness

4.5.1 All reasonably practicable measures will be put in place to avoid/limit and mitigate the deposition of mud and other debris on the highway. These measures will have regard to the nature and the use of the site and could include:

- hardstandings at the access and egress points which will be cleaned at appropriate intervals;
- vehicle wash down points to clean vehicle wheels at each exit point on to the highway;
- the correct loading of vehicles and sheeting of loads where necessary to avoid spillage during their journeys; and
- the use of mechanical road sweepers combined with water sprays for the suppression of dust to clean site hardstandings and roads and footpaths in the vicinity of the site.

4.5.2 After completion of any works affecting a highway, all surplus materials arising from the works will be cleared from the highway, leaving it in a clean and tidy condition in accordance with the reasonable requirements of the highway authority.

### 4.6 Lorry Controls

4.6.1 Details of local routes to be used by construction lorries will be set out in the TMP. As far as reasonably practicable, there will be no parking of lorries on the highway in the vicinity of any worksite except in specified holding areas for delivery or removal of materials from the site. An appropriate control system will be implemented for the dispatch of all vehicles containing excavated material, demolition materials or other waste material. Waste will be controlled and deposited in accordance with relevant legislation. Signs identifying the NLE project and Contractor contact numbers will be displayed in a prominent position on vehicles carrying project waste on public roads.

### 4.7 Access for Persons with Restricted Mobility during Construction

4.7.1 TfL will, where reasonably practicable, ensure that persons with restricted mobility (PRM) and those with other forms of disability, as

specified in the Disability Discrimination Act 2005, continue to have access to services and buildings where existing access and services are temporarily disrupted during the NLE construction works. Where the normal means of access has to be diverted or blocked off, alternative safe routes for persons with restricted mobility will be identified, taking into account existing hazards and obstructions such as pavement kerbs and street lighting standards (poles). Where particular difficulties are identified, arrangements will be made on a site by site basis.

## **5 Noise and Vibration**

### **5.1 General**

- 5.1.1 TfL will, as far as reasonably practicable, seek to control and limit noise and vibration levels so that affected properties and other sensitive receptors are protected from excessive or prolonged noise and vibration associated with construction activities. TfL will apply Best Practicable Means (BPM), as defined under Section 72 of the Control of Pollution Act 1974 to all activities.
- 5.1.2 TfL will obtain consents from the relevant local authority under Section 61 (which will include noise and vibration limits where relevant) for the proposed surface construction works. Site specific management and mitigation requirements for noise and vibration, both on and off-site, will be further defined in the Section 61 consents. By exception, TfL may agree with the local authority that, for certain activities not anticipated to be noise sensitive, such as normal site investigation and site set up (subject to these being in accordance with this Code), that a Section 61 will not be necessary.

### **5.2 Procedures Monitoring**

- 5.2.1 TfL will undertake appropriate noise and vibration monitoring as agreed in advance with the relevant local authority, including agreeing appropriate threshold levels before works start, having regard to the TfL NLE Construction Noise and Vibration Mitigation Scheme.
- 5.2.2 The results of any noise and vibration monitoring will be made available, as required, to the relevant local authority. Access to the sites will be facilitated at all reasonable times for inspection and/or noise measurements by the local authority environmental health personnel, following appropriate site specific induction and/or health and safety training.

### **5.3 Specific Provisions**

#### **Selection and Use of Equipment**

- 5.3.1 Each item of plant used on the project will comply with the noise limits quoted in the relevant European Commission Directive 2000/14/EC/United Kingdom Statutory Instrument (SI) 2001/1701 The Noise Emission in the Environment by Equipment for Use Outdoors Regulations (as amended).
- 5.3.2 TfL will adopt the recommendations for the control of noise, as set out in BS 5228-1:2009 section 8, and for the control of vibration, as set out in BS 5228-2:2009 section 8. Where alternative authoritative guidance and procedures are thought to be more reasonable and have been agreed in

advance with the relevant local authority, these may be adopted in place of the aforementioned.

- 5.3.3 Plant and equipment liable to create noise and/or vibration whilst in operation will, as far as reasonably practicable, be located away from sensitive receptors. The use of barriers to absorb and/or deflect noise away from noise sensitive areas will be employed where required and reasonably practicable.
- 5.3.4 All plant, equipment, and noise control measures applied, shall be maintained in good and efficient working order and operated such that noise emissions are minimised as far as reasonably practicable. Any plant, equipment, or items fitted with noise control equipment found to be defective will not be operated until repaired.
- 5.3.5 Where reasonably practicable, fixed items of construction plant shall be electrically powered in preference to being diesel or petrol driven.
- 5.3.6 Vehicles and mechanical plant utilised on site for any activity associated with the construction works will be fitted with effective exhaust silencers and shall be maintained in good working order and operated in a manner such that noise emissions are controlled and limited as far as reasonably practicable.
- 5.3.7 Machines in intermittent use will be shut down or throttled down to a minimum during periods when not in use. Static noise-emitting equipment operating continuously will be housed within suitable acoustic enclosure, where appropriate.
- 5.3.8 For underground activities, and also for conveyors above surface level, the following measures will be adopted, where reasonably practicable and appropriate:

#### **Conveyors**

- (a) The mounting for any conveyors used to remove excavated material from the works (underground, sub-surface or surface) will be designed and installed so as to mitigate the transmission of noise and vibration;
- (b) A maintenance programme will be implemented to ensure that the noise generation of any conveyor does not deteriorate over time.
- (c) The surface conveyor systems will be of similar standard to underground conveyors and will be acoustically enclosed where they run through, or adjacent to, noise sensitive areas. They too will be subject of a maintenance programme. (Note: the conveyer will be covered throughout its length to prevent material spillage.)

#### **Temporary Construction Railway**

- (a) The alignment, jointing and mounting of the temporary construction railway will be installed, maintained and operated in a manner so as to minimise the transmission of vibration and ground borne noise from the passage of rail vehicles.
- (b) Any diesel locomotives used will be fitted with efficient exhaust silencers.

#### **Temporary Tunnel Ventilation**

All tunnel ventilation plant with connections to the atmosphere in any noise-sensitive location will be subject to mitigation measures appropriate to its local environment.

#### **Notifications**

- 5.3.9 Occupiers of nearby properties shall be informed in advance of the works taking place, including the duration and likely noise and vibration effects. In the case of work required in response to an emergency, the relevant local authority and local residents shall be advised as soon as reasonably practicable that emergency work is taking place. Potentially affected residents will also be notified of the helpline number.

#### **Provision of Noise Insulation and Further Mitigations**

- 5.3.10 Noise insulation (or a grant therefore) or further mitigation may be offered where the predicted or actual noise levels exceed the prescribed levels defined in the TfL NLE Construction Noise and Vibration Mitigation Scheme.

#### **5.4 Reversing Alarms**

- 5.4.1 TfL will, as far as reasonably practicable, ensure that the noise from reversing alarms is controlled and limited. This will be managed through the following hierarchy of techniques:
  - (a) the site layout will be designed to limit, and where reasonably practicable, avoid the need for the reversing of vehicles. TfL will seek to ensure that drivers are familiar with the worksite layout;
  - (b) banksmen will be utilised to avoid, as far as reasonably practicable, the use of reversing alarms;
  - (c) reversing alarms incorporating one or more of the features listed below or any other comparable system will be used where reasonably practicable;
    - i. highly directional sounders;
    - ii. use of broadband signals;
    - iii. self adjusting output sounders; and
    - iv. flashing warning lights.

- (d) reversing alarms will be set to the minimum output noise level required for health and safety compliance.

#### 5.5 References – Noise and Vibration

- (a) Control of Pollution Act 1974
- (b) TfL NLE Construction Noise and Vibration Mitigation Scheme
- (c) European Commission Directive 2000/14/EC/United Kingdom Statutory Instrument (SI) 2001/1701 The Noise Emission in the Environment by Equipment for use Outdoors Regulations 2001 (as amended)
- (d) BS5228: Code of practice for noise and vibration control on construction and open sites:
  - o Part 1 (2009) Noise
  - o Part 2( 2009) Vibration

## 6 Air Quality

### 6.1 General

- 6.1.1 TfL will, as far as reasonably practicable, seek to control and limit emissions to the atmosphere in terms of gaseous and particulate pollutants from vehicles and plant used on the site, and dust from construction, demolition, vehicles and plant activities. TfL will identify potential sources and apply appropriate control techniques, and these will be documented in an Air Quality and Dust Management Plan.

### 6.2 Vehicle and Plant Emissions

- 6.2.1 TfL will ensure that the adverse effects of vehicle and plant emissions are controlled. Measures to be considered for limiting emissions and avoiding nuisance will include the following as appropriate and as far as reasonably practicable:

- (a) ensuring that the engines of all vehicles and plant on site are not left running unnecessarily;
- (b) using low emission vehicles and plant fitted with catalysts, diesel particulate filters or similar devices;
- (c) using ultra low sulphur fuels in plant and vehicles;
- (d) requiring that plant will be well maintained, with routine servicing of plant and vehicles to be completed in accordance with the manufacturers recommendations and records maintained for the work undertaken;
- (e) requiring that all project vehicle, including off-road vehicles, will hold current MOT certificates, where required due to the age of the vehicle, (or to be tested to an equivalent standard) and that they will comply with exhaust emission regulations for their class (a procedure for checking this to be set out in the Air Quality and Dust Management Plan);
- (f) siting plant away from potential sensitive receptors;
- (g) avoiding the use of diesel or petrol powered generators and using mains electricity or battery powered equipment (NB an emergency diesel generator will be required during tunnelling works);
- (h) maximising energy efficiency [this may include maximising vehicle utilisation by ensuring full loading and efficient routing];
- (i) In compliance with the London Low Emissions Zone, all vehicles, cars and vans shall meet or exceed the following CO<sub>2</sub> limits and European emission standards (Euro standards):
  1. Cars - maximum certified CO<sub>2</sub> emissions of 95 g/km and a minimum of Euro 5 emission standards
  2. Vans equal to or less than 1,205 kg kerb weight – maximum certified CO<sub>2</sub> emissions of 105 g/km CO<sub>2</sub> and a minimum of Euro V emission standards

3. Vans between 1,205 and 1,660 kg kerb weight – maximum certified CO<sub>2</sub> emissions of 145 g/km CO<sub>2</sub> and a minimum of Euro V emission standards
  4. Vans greater than 1,660 kg kerb weight – maximum certified CO<sub>2</sub> emissions of 205 g/km CO<sub>2</sub> and a minimum of Euro V emission standards
- (j) In compliance with the London Low Emission Zone, all heavy duty road vehicles and non-road diesel engines shall meet or exceed the following emission standards:
1. Heavy duty road vehicles >3500 kg kerb weight – Euro VI European emission standards
  2. Non road diesel engines between 19 and 36 kW – Stage 3A European emission standards
  3. Non road diesel engines between 37 and 55 kW – Stage 3B European emission standards
  4. Non road diesel engines between 56 and 560 kW – Stage 3B European emission standards
- (k) If any road vehicles or non road diesel engines are due for replacement during the period of the works, TfL shall ensure that the replacement vehicle/engine meets or exceeds the European emission standards and CO<sub>2</sub> limits (if applicable) for that year in which it is introduced into the fleet. Standards and the years in which they apply are shown in the tables 1-3 below. If vehicles that meet the requirements are not available by the specified deadline, then TfL will consider an alternative standard until such time as those vehicles become available. The contractual requirement to meet these standards applies to all Contractors and sub-Contractors' vehicles.
- (l) In line with Mayoral environmental strategies and commitments to reduce carbon dioxide emissions, Contractors are also encouraged to include zero or ultra low carbon vehicles in their fleet such as electric, plug-in hybrid or biomethane vehicles where possible.
- (m) All members of the Contractor's staff who drive vehicles under this Contract shall undertake a fuel-efficient driver training course within three months of the commencement of the contract. The training course shall consist of theoretical training and practical implementation skills and shall be a minimum duration of one hour. Throughout the duration of the Contract, any new staff employed by the Contractor who drives for work shall also be required to undertake fuel-efficient driver training. The Contractor shall encourage its sub-Contractors to undertake similar fuel efficient driver training. The Employer will request evidence of the training from time to time.

**Table 1:**

	European Emission Standards for Road Vehicles					
	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Cars	Euro 5	Euro 6	Euro 6	Euro 6	Euro 6	Euro 6
Vans ≤ 1205kg kerb weight	Euro 5	Euro 6	Euro 6	Euro 6	Euro 6	Euro 6

Vans 1205-1660kg kerb weight	Euro V	Euro V	Euro VI	Euro VI	Euro VI	Euro VI
Vans >1660kg kerb weight	Euro V	Euro V	Euro VI	Euro VI	Euro VI	Euro VI
Heavy Duty Vehicles >3500kg	Euro VI	Euro VI	Euro VI	Euro VI	Euro VI	Euro VI

**Table 2:**

	European Emission Standards for Non Road Diesel Engines					
	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Non road diesel engines 19-37kW	Stage 3A	Stage 3A	Stage 3A	Stage 3A	Stage 3A	Stage 3A
Non road diesel engines 37-56kW	Stage 3B	Stage 3B	Stage 3B	Stage 3B	Stage 3B	Stage 3B
Non road diesel engines 56-560kW	Stage 3B	Stage 4	Stage 4	Stage 4	Stage 4	Stage 4

**Table 3:**

	Certified CO <sub>2</sub> Limits (g/km)					
	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Cars	95	90	85	80	75	70
Vans ≤ 1205kg kerb weight	105	100	95	90	85	80
Vans 1205-1660kg kerb weight	145	140	135	130	125	120
Vans >1660kg kerb weight	205	200	195	190	185	180

### 6.3 Dust

#### General

- 6.3.1 TfL will ensure that all Contractors comply with the provisions of all legislation relevant to the control of dust and emissions.
- 6.3.2 TfL will recognise that the duration of operations and the proximity of receptors cannot be significantly altered since the location and other site criteria will be dictated by issues such as availability of land, spatial

requirements of the project and techniques available for specific construction activities. TfL will require that measures to reduce the impact of dust are designed and implemented in an appropriate and timely manner. The Supplementary Planning Guidance 'The Control of Dust and Emissions from Construction and Demolition' will form the basis of the site specific plans for the control of dust.

### **Dust Control**

6.3.3 TfL will ensure that an Air Quality and Dust Management Plan is prepared and implemented for the worksite(s), which details controls to limit dust emissions, including the consideration of using green walls, screen and other green infrastructure to minimise the impact of dust and pollution and also to improve the local ambience during construction. Three levels of control for dust impacts are planned, with the standard level, Tier 1, as the minimum that will be implemented on any site. A risk-based approach will be used to identify construction sites with potential to generate significant quantities of dust near sensitive receptors and which require additional levels of control (Tiers 2 and 3). This will be addressed in the Air Quality and Dust Management Plan.

6.3.4 In the event of a pollution incident arising from dust, the Contractor will be required to agree remedial mitigation measures for implementation with the relevant local authority.

### **Dust monitoring**

6.3.5 TfL will ensure that, unless agreed with the relevant local authority as inappropriate, dust monitoring is carried out during construction at all medium and high-risk sites. A risk-based approach will be used to identify the type of dust monitoring to be used at each worksite by looking at the details of the specific packages of work within the site boundaries, the dust raising potential of those construction activities, proximity to potential receptors and the duration of construction activities at each location.

6.3.6 Where sites have a risk score that assigns them to the low risk category, no dust monitoring will be carried out. Where sites have a risk score that is in the medium risk category, passive deposition monitoring techniques (glass slides/Frisbee gauges/sticky pads) will be adopted at appropriate locations (site boundaries/local receptors) according to specific site conditions as outlined further below. Where sites have a risk score that is in the high risk category, additional monitoring techniques will be adopted according to specific site conditions as outlined subsequently.

### **Standard Dust Control Procedures (Tier 1)**

6.3.7 The standard dust control procedures, Tier 1, will include, as appropriate, site controls to:

- (a) ensure no burning of waste materials takes place on site;
- (b) ensure an adequate water supply on the site;
- (c) ensure water suppression is used during demolition operations;
- (d) ensure appropriate disposal of run-off water from dust suppression activities, in accordance with legal requirements;
- (e) maintain all dust control equipment in good condition and record maintenance activities;
- (f) keep site fencing, barriers and scaffolding clean;
- (g) provide easily cleaned hardstanding for vehicles;
- (h) ensure regular cleaning of hardstandings;
- (i) not allow dry sweeping of large areas;
- (j) provide and ensure the use of wheel cleaning facilities near the site exit wherever there is a potential for carrying dust or mud off the site;
- (k) clean the public highway using wet sweeping methods when necessary;
- (l) ensure vehicles working on site have exhausts positioned such that the risk of re-suspension of ground dust is minimised (exhausts should preferably point upwards), where reasonably practicable;
- (m) ensure all vehicles carrying loose or potentially dusty material to or from the site are fully sheeted;
- (n) ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery;
- (o) mix large quantities of cement, bentonite, grouts and other similar materials in designated areas which will be enclosed or shielded;
- (p) store materials with the potential to produce dust away from site boundaries where reasonably practicable;
- (q) ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out;
- (r) minimise the amount of excavated material held on site;
- (s) sheet, seal or damp down unavoidable stockpiles of excavated material held on site, where required;
- (t) avoid double handling of material wherever reasonably practicable;
- (u) ensure that any crushing or grinding plant used on the site has an appropriate permit or exemption issued by the EA, and is maintained according to the permit or exemption;
- (v) ensure that any plant identified above is operated in accordance with the conditions set out in the permit and a copy of the permit is held on site;
- (w) use enclosed rubble chutes and conveyors where reasonably practicable or use water to suppress dust emissions from such equipment;
- (x) sheet or otherwise enclose loaded bins and skips;



- (y) minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate;
- (z) use design/prefabrication to reduce the need for grinding, sawing and cutting on site wherever reasonably practicable;
- (aa) only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction;
- (bb) carry out site inspections regularly to monitor compliance with dust control procedures set out above and record the results of the inspections, including nil returns, in a site log book;
- (cc) increase the frequency of site inspections when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions; and
- (dd) record any exceptional incidents causing dust episodes on or off the site and the action taken to resolve the situation in the site log book referred to in (bb) above.

**Enhanced Dust Control Procedures for Sites/ Operations with an Risk of Dust Emissions (Tier 2)**

6.3.8 These procedures are relevant where there is a medium risk of emissions of dust due to the proximity of receptors, the type of activity on site or the duration of operations. In such cases a higher standard of dust control will be adopted, which will incorporate all relevant Tier 1 techniques as set out above, as well as additional relevant measures as outlined below. Alternatives may be proposed to suit specific circumstance providing the resulting control is at least as effective as that arrived at using the specified measures.

- 6.3.9 In the event that enhanced dust control procedures are required, these will include, as appropriate, site controls to:
- (a) strip insides of buildings, as far as reasonably practicable, before demolition;
  - (b) bag and remove biological debris (such as birds nests and droppings) or damp down such material prior to demolition;
  - (c) wherever reasonably practicable, retain walls and windows while the rest of the building is demolished to provide a screen against dust;
  - (d) screen buildings, where dust producing activities are taking place, with debris screens or sheeting;
  - (e) avoid carrying out earthworks during dry weather if reasonably practicable having regard to programme and contracting arrangements for the relevant works or provide and ensure appropriate use of water sprays to control dust;
  - (f) seed or seal medium or long term excavated materials and soil stockpiles;
  - (g) ensure slopes on stockpiles are no steeper than the natural angle of repose of the material and maintain smooth profile;

- (h) ensure appropriate equipment is readily available on site and clean up any spillages as soon as reasonably practicable after the event using wet cleaning methods;
- (i) ensure mixing of cement, bentonite, grout and other similar materials takes place in enclosed areas remote from site boundaries and potential receptors;
- (j) where appropriate use increased hoarding height to protect receptors; and
- (k) consider full enclosure of sites or specific operations where there is a high potential for dust production and the site is active for an extensive period.

6.3.10 For such Tier 2 sites, and in addition to the monitoring outlined above, a comprehensive site survey will be undertaken to determine the prevailing wind direction (using available meteorological data) and a minimum of two permanent PM<sub>10</sub> monitoring stations will be installed along the transect of the average wind direction and to make data readily available to the local authority.

6.3.11 Dust monitoring will be continued until the site has a risk score that assigns it to the lower risk category. Any cessation of monitoring will be subject to consultation with, and the agreement of, the relevant local authority that the Tier 2 risk level no longer applies, provided that such agreement is not unreasonably withheld.

**Advanced Dust Control Procedures for Sites /Operations with a High Risk of Dust Emissions (Tier 3)**

6.3.12 These procedures are relevant where there is a high risk of significant adverse impact from dust emissions due to the proximity of receptors, the type of activity on site or the duration of operations. In such cases the highest standard of dust control reasonably achievable will be adopted, which will incorporate all relevant Tier 1 and Tier 2 techniques as set out above, as well as additional relevant measures as outlined below. Measures to be used will be site specific and will be proportionate to the level of risk arising, such as having personnel on site to monitor and manage dust emissions. Techniques such as total enclosure of certain operations to protect vulnerable receptors would be implemented where appropriate.

6.3.13 For such Tier 3 sites, and in addition to the monitoring outlined above, existing baseline dust levels will be established prior to the commencement of any potentially significant dust-creating activities. Where practicable, such baselines will make reference to data sourced from local background PM<sub>10</sub> concentrations (such as measured by the Automatic Urban and Rural Network (AURN) monitoring sites and appropriate local authority automatic monitoring sites and those

established by dust monitoring in the neighbourhood) and will ideally refer to data from the preceding 12 month period.

6.3.14 As part of this baseline work, the Contractor will be required, as far as is reasonably practicable, to ensure that:

- (a) Monitoring data is available for a suitable duration prior to construction.
- (b) Data is collected as  $PM_{10} \mu g.m^{-3}$ , the same units as suggested for the site action level in the SPG.
- (c) Any unusual activity in the vicinity of monitoring sites that may affect monitoring results and/or create a false baseline (eg local construction activity) are avoided or noted by local monitoring site operators.
- (d) Dust monitoring commences as soon as reasonably practicable to provide localised data to augment the data obtained from the AURN/local authority sites.

6.3.15 During the “high risk” construction events themselves, particulate monitoring will be undertaken using appropriate survey instruments such as Osiris, Topaz, DustScan or similar devices sited at appropriate locations such as site boundaries, potential receptors or in a transect orientated to the prevailing wind, as required by specific site characteristics.

6.3.16 The survey instruments used will operate an alarm (PC based or mobile phone) should a predetermined site action level be reached. This level will be established in consultation with the relevant local authority and by reference to both local authority and AURN PM10 monitoring data. Subject to such consultation, a preliminary site action level of  $250 \mu g.m^{-3}$  (15 minute average) is proposed for both Total Suspended Particulates (TSP) - a leading indicator of PM10 - and PM10.

6.3.17 If the alarm is triggered the following actions will be taken:

- (a) The nominated person or someone delegated by the nominated person will as quickly as reasonably practicable investigate activities on the site to ascertain if any visible dust is emanating from the site or activities are occurring that are not in line with dust control procedures.
- (b) Any identified causes will be rectified where practicable. Actions will be recorded in the site logbook and the relevant local authority notified of the incident and actions by telephone or e-mail as soon as practicable after or during the incident.
- (c) If no source of the incident is identified the local authority and/or AURN monitoring sites will be contacted to establish if there is a wider area increase in particulate concentrations.
- (d) If the cause of the alarm is not related to site operations the outcome of any investigation will be recorded in the site logbook and reported to the relevant local authority at an appropriate time.

6.3.18 Dust monitoring will be continued until the site has a risk score that assigns it to the lower risk category. Any cessation of monitoring will be subject to consultation with, and the agreement of, the relevant local authority that the Tier 3 risk no longer applies, provided that such agreement is not unreasonably withheld.

6.3.19 In the event that all monitoring indicates that the above measures have not prevented a material increase in dust leaving the site, and this gives rise to a problem that is reported via the Helpline or the Community Liaison Group, TfL will take reasonable steps to ensure the parties affected are compensated.

6.3.20 To ensure plans are co-ordinated and dust and particulate matter emissions are minimised, regular liaison meetings with site managers and /or environmental managers of other high risk construction sites within 500m of the site boundary will occur.

#### 6.4 Odour

6.4.1 It is not anticipated that the TfL works will give rise to any odour nuisance, but if necessary TfL will adopt appropriate measures so as to avoid the creation of statutory nuisance from odours.

#### 6.5 References - Air Quality / Dust Control

- Department for the Environment Food and Rural Affairs: Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007.
- Supplementary Planning Guidance “The Control of Dust and Emissions from Construction and Demolition”
- Mayor’s Air Quality Strategy
- Borough Air Quality Actions plans
- Institute of Air Quality Management - Air Quality Monitoring in the Vicinity of Demolition and Construction Sites 2012

## 7 Water Resources

### 7.1 General

- 7.1.1 TfL will undertake the works and implement working methods which will be developed to protect surface and groundwater from pollution and other adverse impacts including change to flow volume, water levels and quality. This will be completed in accordance with relevant legislative requirements and appropriate industry guidance.
- 7.1.2 TfL will ensure that the design of the site layout and facilities referred to in Section 3.3 above and management of construction operations will take account of the guidance contained within the relevant EA Pollution Prevention Guides and Construction Industry Research and Information Association (CIRIA) documents and will be based on accepted industry practice. This will be detailed in the SEMP.
- 7.1.3 Contingency plans to deal with major pollution incidents at the work sites will be included within the overall emergency planning. EA guidance on pollution incident response planning will be reflected in the emergency plans.

### 7.2 Water Conservation

- 7.2.1 TfL will implement working methods that reduces water consumption and continually improves water-use efficiency on site. TfL will ensure a water conservation plan based on the water hierarchy, is prepared and implemented for the worksite(s). The plan will include but not limited to:
- (a) Water audits that identify all water-using processes, activities and equipment on site (aligned with significant changes in site(s) activities through the project life cycle)
  - (b) Action plan, including staff engagement and training, to reduce water consumption by all water-using processes, activities and equipment on site
  - (c) Monitoring regime that assess the effectiveness of water conservation measures in the plan
  - (d) Reporting effectiveness of plan annually
- 7.2.2 The water hierarchy is as follows and sets out the options in order of preference; the highest option(s) that is/are reasonably practicable will be adopted but usually a combination of (a) plus one or more of the others will be appropriate:

- (a) **Eliminate** - Eliminate water use by identifying if the water-using process or activity really necessary and/or if there is a cost effective alternative to using water.
- (b) **Substitute** – Identify and use alternative ‘non-potable’ sources and eliminate inappropriate use of drinking (potable) water. Asses whether rainwater or grey water can be used for the activity/process.
- (c) **Reduce** - Explore options to improve efficiency, e.g. by regular maintenance of water using equipment (to ensure they are working to maximum efficiency), metering and monitoring supplies, updating fittings and/or processes.
- (d) **Reuse** – Identify whether water can be treated/filtered for reuse in a process or activity, e.g. wheel washing.
- (e) **Recycle** – Identify if water can be recycled for use offsite
- (f) **Disposal** - Dispose of excess water legally and responsibly to ensure there is no flooding, pollution or inconvenience to stakeholders.

### 7.3 Site Drainage

- 7.3.1 Site drainage, including surface runoff and dewatering effluents, will be discharged to sewers where appropriate and relevant permissions will be obtained from the sewerage undertaker. Surface water run off will be controlled to achieve run off rates of 50% of those of the site as previously developed.
- 7.3.2 TfL will ensure that the site drainage meets the effluent standards required by the sewerage undertaker, or EA, as appropriate, and will provide holding or settling tanks, separators, and other measures as may be required. TfL will ensure that access is provided to the undertaker so that samples of discharge can be obtained and analysed and the flows verified as required. The relevant sections of BS 6031:2009 Code of Practice for Earthworks for the general control of site drainage will be followed.

### 7.4 Protection of watercourses

- 7.4.1 TfL will seek to control flood risk to appropriate levels set by the Environment Agency, using mitigation, compensation and/or monitoring where required. Approval will be obtained in advance for all crossings of, diversions to, and work affecting watercourses from the EA as set out in the protective provisions.
- 7.4.2 Watercourses, including land and/or road drainage, within the construction sites will be maintained to provide effective working conditions at all times.
- 7.4.3 All reasonably practicable measures will be taken to prevent the deposition of silt or other material in, and the pollution by sediment of,

any existing watercourse, borehole, aquifer or catchment area, arising from work operations. The measures will accord with the principles set out in industry guidelines, including the EA's note 'PPG05: Works in near or liable to affect water courses' and CIRIA's report 'C532: Control of water pollution from construction sites'. Measures may include use and maintenance of temporary lagoons, tanks, bunds and silt fences or silt screens as well as consideration of the type of plant used and the time of the year for working in watercourses.

## 7.5 Control of Pollution of Surface Water

7.5.1 TfL will ensure that protection measures to control the risk of pollution to surface water will be adopted and will include, where appropriate and reasonably practicable:

- (a) any containers of contaminating substances on site will be leak-proof and kept in a safe and secure building or compound from which they cannot leak, spill or be open to vandalism. The containers will be protected by temporary impermeable bunds with a capacity of 110% of the maximum stored volume. Areas for transfer of contaminating substances, or delivery of materials, will be similarly protected;
- (b) all refuelling, oiling and greasing will take place above drip trays or on an impermeable surface which provides protection to underground strata and watercourses and away from drains as far as reasonably practicable. Vehicles will not be left unattended during refuelling;
- (c) only construction equipment and vehicles free of all oil/fuel leaks will be permitted on site. Drip trays will be placed below static mechanical plant;
- (d) all wash down of vehicles and equipment will take place in designated areas and will comply with EA's PPG13 'Vehicle Washing and Cleaning';
- (e) as far as reasonably practicable, only biodegradable hydraulic oils will be used in equipment working in, on or over watercourses; and
- (f) appropriate measures to be taken to protect erodible earthwork surfaces.

## 7.6 Control of Pollution of Groundwater

- 7.6.1 TfL will ensure that protection measures to control the risk of pollution to groundwater will be included within the overall strategy and in compliance with relevant legislation.
- 7.6.2 Where reasonably practicable, TfL will avoid using materials in the permanent or temporary works that could pollute groundwater. This will include special consideration for the use of substances listed in relevant legislation.

## 7.7 Control of Water Ingress

7.7.1 It is not anticipated that dewatering will be necessary as part of the works. Some measures may be necessary to control the ingress of water into the works. All such measures will be implemented in accordance with the provisions of section 7.1 above.

## 7.8 Dredging

- 7.8.1 TfL will follow Port of London Authority guidance for dredging in the tidal Thames and its tributaries. As far as is practicable, during the critical period of June to August planned, non-emergency dredging will be avoided (and it is to be noted that this is a locally significant spawning area for Smelt, between April and May). This will be achieved through programming capital dredging outside this period, and implementing a monitoring program to identify future maintenance dredging. Where practicable, TfL will undertake a single maintenance dredge prior to the critical period.
- 7.8.2 TfL reserves the right to undertake emergency dredging within the critical period of June to August should there be a requirement to do so. Dredging in response to an unforeseen event or occurrence outside of the control of TfL or its contractors and which could not be reasonably expected or planned and which jeopardises the operation of the barge loading facilities constitutes an emergency.
- 7.8.3 So far as is practicable, to assist with minimising water quality and aquatic ecology impacts, the TfL will undertake capital and maintenance dredging using techniques that limit the dispersal of inter-tidal sediments.

## 7.9 References - Water Resources

- BS 6031: Code of Practice for Earthworks
- EA Pollution Prevention Guidance Notes (PPG 2, PPG5, PPG6, PPG 7 PPG13 etc.)
- CIRIA C532, Control of water pollution from construction sites: Guidance for consultants and contractors
- CIRIA Report 169 Inland Dredging – guidance on good practice
- CIRIA's C547 'Scoping the assessment of sediment plumes from dredging'
- CIRIA C697 The SUDS Manual
- CIRIA/Environment Agency Joint Guidelines:
- Concrete Bunds for Oil Storage Tanks
- Masonry Bunds for Oil Storage Tanks
- EA Guidance Note: Piling into Contaminated Sites
- Strategic Forum for Construction – Water Guidance

## 8 Contaminated Land

### 8.1 Introduction

8.1.1 TfL will apply all relevant statutory and industry best practice guidance in relation to contaminated land and will develop remediation measures in accordance with relevant legislation and guidance. If contaminated land is identified, the statutory guidance and industry best practice will be applied to ensure that where it is reasonable to do so, remediation is carried out so that the land no longer presents a significant risk of harm being caused.

### 8.2 Site Assessment and Remedial Practice

8.2.1 TfL will carry out site assessments, investigations and/or risk assessments wherever construction work is planned in order to assess the potential for contamination in both the land and groundwater. The necessary measures will be agreed with the Environment Agency and the Local Authority as part of the construction planning process, in accordance with industry best practice.

8.2.2 A set of criteria for site investigation will be developed prior to the commencement of any intrusive works. Where site investigation reveals the presence of contaminated land, and groundwater, an appropriate remedial strategy will be developed to identify the most appropriate option for dealing with the presence of the contamination. This strategy would include the following:

- (a) TfL will liaise with the relevant local authority, the EA and other relevant statutory bodies, with a view to addressing their requirements and will agree control or protection measures necessary to provide appropriate mitigation. This may involve the sealing, excavation and disposal of contaminated materials or on-site remedial works;
- (b) TfL will also give consideration to alternatives to landfill disposal as the solution to treating contaminated soil. This may include the use of remedial technologies (in-situ and ex-situ) to reduce the quantity of materials requiring disposal, and/or treatment of materials to a standard, such as the CL:AIRE –‘The Definition of Waste: Development Industry Code of Practice’, such that they can be re-used at a site or be disposed of as non-hazardous waste. On-site remedial works will be carried out in accordance with relevant regulations;
- (c) Monitoring of excavation works will be undertaken by TfL to check for unexpected or unusual materials with a contaminative potential. This material could consist of buried drums, tanks or containers, soil, groundwater or liquids with an unusual colour or odour, or other evidence of contamination. If this type of material is encountered, then work at that particular site, and directly

affected by the contaminating agent, will be stopped until the material has been properly identified and suitable precautions taken. This approach will be included in the Health and Safety Plan;

- (d) TfL will ensure that there are designated areas on site where contaminated materials can be separated from clean ones and stored in an appropriate environment. Storage of contaminated materials may require specific facilities to prevent contaminants from leaching into the ground, nearby sewers or neighbouring properties;
- (e) TfL will follow guidance provided in, but not limited to, the Environment Agency’s Pollution Prevention Guidance Notes (PPG’s) in respect of water pollution (in particular PPG01, PPG02, PPG05, PPG06, PPG07 and PPG21 will be followed as far as reasonably practicable) and further guidance is provided in Defra/Environment Agency’s Model Procedures for the Management of Contamination (CLR11) and the CL:AIRE –‘The Definition of Waste: Development Industry Code of Practice’ for all excavated materials; and
- (f) On completion of any remedial works, a record will be kept by TfL of the works undertaken to comply with the remedial strategy.

### 8.3 References – Contaminated Land

#### 8.3.1 Contaminated Land

- CIRIA (1996) A guide to safe working on Contaminated Sites Report 132
- BSI (2001) *Investigation of Potentially Contaminated Sites. Code of Practice.* 10175.
- Defra/Environment Agency’s Model Procedures for the Management of Contamination (CLR11).
- CL:AIRE –‘The Definition of Waste: Development Industry Code of Practice’

#### 8.3.2 Asbestos

- Asbestos: Exposure Limits and Measurement of Airborne Dust Concentrations (EH10 and MDHS 39/4).
- HSE guidance MDHS100: Surveying, sampling and assessment of asbestos containing materials.

#### 8.3.3 Environment Agency Pollution Prevention Guidance Notes (PPG’s)

- PPG01 General guide to the prevention of water pollution.
- PPG02 Above ground oil storage tanks.
- PPG05 Works near or liable to affect watercourses.
- PPG07 Refuelling Activities
- PPG06 Working at construction or demolition sites.
- PPG21 Pollution incident response planning.
- PPG23 Maintenance of structures over water.
- EA Guidance Note: Piling into Contaminated Sites.

## 9 Materials and Waste Management

### 9.1 Materials and Wastes - General

- 9.1.1 Within the SEMP, TfL will demonstrate how it will undertake material resource management and minimise waste creation. Where the method of procurement may involve design, the role of design in ensuring reduction in material and waste will be demonstrated. This will also be reflected in the construction strategy.
- 9.1.2 TfL will manage demolition / construction / fit out and excavation wastes generated at worksites in accordance with the waste hierarchy (see below) and within the relevant regulatory controls. Further details will be set out in the SEMP and will include the requirements of the site waste management plan regulations which will be delivered through the Site Waste Management Plan(s) (SWMP).
- 9.1.3 TfL will follow, if reasonably practicable to do so, the:
- CL:AIRE The Definition of Waste: Development Industry Code of Practice for all excavated materials produced onsite during the works.
  - WRAP and/or Environment Agency Quality Protocols for materials, e.g. the WRAP Quality Protocol for the Production of Aggregates from Inert Waste.
  - Institution of Civil Engineers (ICE) Demolition Protocol for all demolition works required during the works.
- 9.1.4 The waste hierarchy is as follows and sets out the options in order of preference; the highest option(s) that is/are reasonably practicable will be adopted but usually a combination of (a) plus one or more of the others will be appropriate:
- (a) **prevent** the generation of excavated materials and other wastes through efficient design;
  - (b) **reduce** generation of excavated materials and other wastes through efficient materials resource management;
  - (c) **re-use** excavated materials and other waste within the TfL project;
  - (d) **re-use** excavated materials and other waste through environmentally beneficial use at sites out-with the TfL project;
  - (e) **recycle** excavated materials and other wastes
  - (f) **recover** value, e.g. energy generation or beneficial land use, from waste materials
  - (g) **dispose** of surplus excavated materials and other waste at permitted landfill sites.
- 9.1.5 TfL will ensure that the requirements of the waste hierarchy are enforced and the duty of care placed on all parties to take responsibility

for protecting the interests and safety of others from the potential effects of handling, storing, transporting and depositing of excavated materials and wastes. TfL will ensure that waste is managed in accordance with Policy 5.3 Sustainable Design and Construction of the London Plan 2011, the Mayor's Business Waste Strategy as well as all relevant legislation and best practice guidance.

### 9.2 Materials and Wastes - Procedures

#### Site Waste Management Plan (SWMP)

- 9.2.1 TfL will be responsible for the development and maintenance of a Site Waste Management Plan (SWMP). The plan will be developed following best practice and, as a minimum, meet all the requirements of the legislation and Waste Resource Action Programme (WRAP) SWMP template.
- 9.2.2 The **Principal Contractor** is responsible for:
- ensuring all decisions taken during design that minimise waste are obtained from the designer and recorded in the SWMP
  - ensuring the SWMP meets the requirements of the WRAP template
  - complying with the SWMP
  - obtaining relevant information from sub-Contractors
  - updating the SWMP at least every three months as the project progresses
  - keeping the SWMP on site during the project
  - ensuring that other Contractors know where the SWMP is kept
  - allowing other Contractors and the Client access to the SWMP during the project
  - handing the completed SWMP, including the lessons learnt review, back to the Client at the end of the project
  - keeping a copy of the SWMP for three years
- 9.2.3 The plan will include an audit programme to be undertaken to demonstrate compliance with statutory requirements.
- 9.2.4 Waste treatment sites will be identified in consultation where appropriate with the relevant LPAs, Defra and the EA. With the dynamic nature of disposal sites it is imperative to maintain a regular dialogue with the waste management treatment/disposal operators, or other relevant party, to explore options for beneficial re-use of the excavated materials

and uphold validity of the robust case for disposal of the excavated material.

### **Duty of Care**

- 9.2.5 TfL will comply with the 'duty of care' to protect the interests and safety of others from the potential effects of handling, storing, transporting and depositing of excavated materials and demolition/construction waste arising from the project. Such compliance will include the implementation and monitoring of accepted industry practices for the control of dust, mud and other debris on site.
- 9.2.6 TfL will also comply with its waste 'duty of care' responsibilities to ensure that waste is produced, stored, transported and treated or disposed of in a responsible manner and in compliance with all relevant legislation. Where it passes responsibility for waste management onto Contractors, the duty of care will be transferred as appropriate.
- 9.2.7 The SWMP will include detailed procedures for compliance with the requirements for waste transfer and consignment notes, in accordance with relevant legislation, and arrangements for auditing the actions of other parties in the waste handling chain. A sample waste transfer and consignment note documents, together with details of the administrative arrangements for record keeping, will be included in the SWMP.

### **Specific Provisions**

- 9.2.8 Littering on site by any individual under the control of TfL will be dealt with under a disciplinary procedure to be set out in the SWMP. TfL and its Contractor will:
- Develop storage, segregation, transportation and other management procedures for contaminated or hazardous materials;
  - Obtain any necessary permits and/or exemptions for the storage treatment and disposal of waste (including dewatering discharge);
  - Use registered waste carriers/brokers or seek registration as a waste carrier for the handling of all waste, including contaminated materials; and
  - Ensure that removal and disposal of hazardous waste complies with duty of care procedures and that delivery is to appropriately permitted facilities.

9.2.9 Provision will be made for a suitable environmental specialist to identify any Hazardous Waste, so that it can be suitably managed and disposed of during the works.

9.2.10 Other specific provisions/measures available for the handling of excavated materials and demolition/construction waste will be reflected in the SEMP and in the contractual requirements imposed by TfL to meet the procedures outlined above.

### **9.3 Asbestos**

9.3.1 A management system will be established, which will adopt measures complying with the Legislation and Codes of Practice, to manage the risk from release of asbestos during alteration and demolition works and excavation work.

9.3.2 Measures for managing asbestos in alteration, demolition and excavation works will include:

- (a) employing competent Contractors to carry out alteration and demolition works;
- (b) Contractors implementing a procedure for dealing with potentially suspect materials exposed requiring sampling and analysis by an independent specialist consultant;
- (c) formal exchange of information before start of work, including relevant information from the Asbestos Register to clearly identify location of asbestos-containing materials; and
- (d) method statements for any works in the vicinity of asbestos-containing materials to avoid any disturbance to such materials.

9.3.3 Measures for managing work involving asbestos-containing materials encountered in construction will include:

- (a) consideration of the appointment of a specialist consultant independent of the asbestos treatment Contractor;
- (b) ensuring any work with asbestos-containing materials is notified to the Health & Safety Executive;
- (c) ensuring any work with asbestos-containing materials is carried out by licensed specialist asbestos treatment Contractors;
- (d) method statements defining detailed control measures to be produced by the specialist asbestos treatment Contractor and approved by the Client/independent specialist consultant;
- (e) air sample monitoring of work to ensure required air quality standards are achieved; and
- (f) disposal of asbestos-containing materials to permitted waste sites.

### **9.4 References – Materials and waste management**

- The London Plan, 2011, published by the Mayor of London.

- CL:AIRE –‘The Definition of Waste: Development Industry Code of Practice’
- ICE Demolition Protocol
- The Mayor of London’s Business Waste Strategy

#### 9.5 References – Asbestos

- Asbestos: Exposure Limits and Measurement of Airborne Dust Concentrations (EH10 and MDHS 39/4).
- HSE guidance MDHS100: Surveying, sampling and assessment of asbestos containing materials.

## 10 Energy Management

### 10.1 General

10.1.1 TfL will implement working methods that reduces energy consumption and continually improves energy efficiency on site. This will include but not be limited to:

- (a) Avoiding unnecessary day and night time site, accommodation and office lighting
- (b) Installing energy efficient security and task lighting, e.g. LED
- (c) Providing well insulated site accommodation
- (d) Metering, data collection, communication and reporting

10.1.2 TfL will ensure that energy management considerations are integral to the design of the works and to the construction strategy and consequent energy impacts.

### 10.2 Energy Management Plan, Construction

10.2.1 TfL will develop an energy management plan to demonstrate how energy consumption during construction will be minimised. This plan will complement the Green Travel Plan (see 3.11 above) and will include but not limited to:

- (a) Energy audits that identify all energy-using processes, activities and equipment on site (aligned with significant changes in site(s) activities through the project life cycle)
- (b) Action plan, including staff engagement and training, to reduce energy consumption by all energy consuming processes, activities and equipment on site and in the site offices
- (c) Monitoring regime that assess the effectiveness of energy efficiency measures in the plan
- (d) Reporting effectiveness of the plan annually

### 10.3 References - Energy Management

- Strategic Forum for Construction – Carbon Guidance (produced in conjunction with the Carbon Trust).



## 11 Ecology and Nature Conservation

### 11.1 General

11.1.1 TfL will ensure that procedures are implemented to control and limit disturbance to areas of nature conservation interest and protected species and habitats in accordance with relevant legislative requirements and accepted industry practice, including allowing sufficient time to obtain the required licenses or consents.

11.1.2 TfL will produce site specific ecological management plan as required, for consultation with relevant local authorities, Natural England and the Environment Agency, as appropriate. The plans will include a programme for any outstanding ecology surveys, methods for watching briefs, measures to be adopted in the event of the discovery of protected species and measures for the relocation of certain species.

11.1.3 TfL will produce site specific ecology reinstatement plan, as required, for consultation with relevant local authorities, the Environment Agency, wildlife bodies, as appropriate. The plans will implement the TfL Biodiversity Action Plan, as well as relevant borough Biodiversity Action Plans.

### 11.2 Specific Provisions

11.2.1 Mitigation measures to protect species and habitats will be considered on a site by site basis and will include the following general principles which will be applied where applicable:

- (a) wildlife habitats which will be disturbed by construction work will be surveyed by an ecologist approved by TfL prior to commencement of works to inform restoration work, if required and where appropriate;
- (b) prior to work commencing, sites will be checked (including bat surveys) for protected species by an ecologist approved by TfL. Where protected species are identified, either prior to the works (through surveys), or during the works, Natural England will be contacted to agree appropriate measures for implementation;
- (c) appropriate control measures will be adopted in the event that legally controlled and alien invasive species are found on site to ensure that they will not be, are not knowingly introduced or caused to grow in the wild;
- (d) temporary work areas including site access will be situated, as far as reasonably practicable, on previously used sites or amenity grassland of low conservation value;
- (e) where practicable habitat removal (particularly woodland and other trees) will take place outside the breeding bird season (approximately 1st March to the 31st July) to avoid impacts on

nesting birds. Where this is not practicable, all woodland and scrub will be checked by a specialist for nesting birds before removal. If any are identified, appropriate mitigation measures will be agreed with Natural England and implemented;

- (f) after construction, habitats or ecological features that have been affected by construction activities will be reinstated or allowed to recolonise so that (so far as is reasonably practicable), habitat will be of better quality than its pre-construction condition;
- (g) where appropriate, landscape planting (other than ornamental and specimen tree planting) will be undertaken using native species typical of the area, as far as reasonably practicable obtained from local sources;
- (h) impacts on adjacent wetland habitats and watercourses will be avoided by appropriate design of site drainage and by use of construction techniques to maintain existing drainage patterns along appropriate sections of the route;
- (i) where required, topsoil and subsoil will be stripped and stored separately and reinstated appropriately as soon as reasonably practicable to minimise adverse impacts to the soil structure;
- (j) topsoil and the seed bank which it contains will be replaced along the works as close as reasonably practicable to the location from which it was taken. This is particularly important for areas of nature conservation interest;
- (k) appropriate construction management practices will be adopted on site to minimise the risk of indirect impacts to adjacent habitat (for example pollution);
- (l) where appropriate, construction activities will be screened to protect nature conservation sites; and
- (m) where open spaces, sport and recreation facilities have been used as worksites during construction, as far as reasonably practicable, those sites will be reinstated to their former use in consultation with the local authority or other responsible statutory agency.

### 11.3 Protection of Trees

11.3.1 TfL will use reasonably practicable measures to minimise the loss of trees. Any essential remedial or protective work to trees adjacent to construction activity will be carried out by suitably trained or qualified personnel using recognised methods in accordance with BS 5837 "Guide for trees in relation to construction".

11.3.2 The site specific Ecology Reinstatement Plans will include suitable mitigation measures for specific worksites where mature tree loss is possible. The plan will be discussed with the local planning authority and in preparing the plans the TfL will take into account their observations. The plan will cover such issues as tree protection

measures, monitoring during construction, replanting and post-construction monitoring.

#### 11.4 References - Ecology and Nature Conservation

- BS 3837:1991 Guide for Trees in Relation to Construction
- London Underground Biodiversity Action Plan
- Lambeth Biodiversity Action Plan
- Wandsworth Biodiversity Action Plan
- Southwark Biodiversity Action Plan

## 12 Archaeology and Built Heritage

### 12.1 General

12.1.1 An initial study indicates that there is limited potential for finds of archaeological interest as a result of TfL works. At Battersea Power Station (BPS) some temporary works will take place within an Archaeological Priority Area (APA) and some permanent and temporary works will be undertaken at Nine Elms and Kennington close to but outside of APAs. TfL will carry out the works in such a way as to ensure that disturbance to potential archaeological sites and deposits and listed buildings will be managed in accordance with accepted industry practice and, where disturbance is unavoidable, is controlled and limited as far as reasonably practicable.

12.1.2 The works will require works to be carried out within the curtilage of BPS, a building of historical and architectural interest (a Grade II\* "listed building"). Also works will be undertaken at platform level at Kennington station (Grade II listed). No other listed buildings are predicted to be materially affected although there are a number of listed buildings close to some of the Kennington worksites. The NLE construction sites at Kennington Green, Kennington Park and Radcott Street are all in Conservation Areas. At both the Park and the Green it will be necessary to demolish an existing building or structure and to remove or lop trees. Kennington Park is a designated Grade II Registered Park whilst Kennington Green is designated under the London Squares Preservation Act 1931. TfL acknowledges and will have regard to the special qualities of the Conservation Areas.

### 12.2 Procedures

12.2.1 A watching brief will be undertaken and appropriate steps will be taken if anything of archaeological interest is found. Proposals for works directly affecting listed buildings or comprising the demolition of a building in a conservation area will be subject of applications for listed building or conservation area consent.

### 12.3 Specific Provisions

12.3.1 Specific provisions will be addressed in the scope for the watching brief and applications for listed building or conservation area consent. The provisions will include the following as necessary and/or appropriate:

- (a) Suitable precautions will be taken to avoid any unplanned impacts on identified cultural heritage resources.
- (b) Alterations to listed buildings will be undertaken in line with the listed building consents.

- (c) Where necessary, suitable screening and other protective measures will be erected around archaeological mitigation works and around listed buildings within and adjacent to works areas.
- (d) Where archaeological remains are encountered unexpectedly during works, an appropriate programme of mitigation will be agreed with stakeholders and implemented.
- (e) Procedures will be established and agreed for the emergency repair of damage to listed buildings.
- (f) Security procedures will be established and agreed to prevent unauthorised access to any excavation found to be of archaeological interest and the damage or theft of cultural heritage resources, including the use of metal detectors.
- (g) Procedures will be established and agreed to be followed in the event of the discovery of human remains.
- (h) Procedures will be established and followed in the event of the discovery of artefacts that fall within the criteria identified in the Treasure Act 1996. These procedures will be in line with the Treasure Act Code of Conduct 1997.
- (i) If necessary, an appropriate level of analysis and publication of the results of archaeological investigations will be agreed and implemented in a format suitable for public dissemination.
- (j) A clear policy will be agreed and implemented regarding the deposition at appropriate public archives of artefacts, records, and data recovered from archaeological investigations.
- (k) Condition surveys will be undertaken to define appropriate vibration limits for cultural heritage resources that may be potentially affected by vibration from construction works.
- (l) Where cultural heritage resources are very close to worksites, or attached to buildings or structures that form parts of worksites, detailed assessment will be undertaken prior to commencement of works to inform the selection of specific items of plant and working methods.
- (m) For listed buildings that are attached or contiguous to buildings that are proposed for demolition, the attached buildings will be unattached, where practicable, using non-vibratory techniques, such as diamond sawing, before demolition commences.
- (n) Where necessary, appropriate vibration monitoring regimes will be adopted during demolition or other major activities. This would, to provide full safeguarding, in the worst case, allow cessation of works should vibration levels exceed relevant limits.

## 13 Settlement

### 13.1 General

13.1.1 TfL will design and undertake construction of the scheme in a manner that will minimise the damage to land and property as a result of ground movement. Techniques for the assessment and control of settlement of buildings and protecting buildings from irreparable damage due to tunnel construction are well developed and set out in TfL document "London Underground Guidelines on Ground Movement due to Tunnelling and Deep Excavations and Non Technical Summary (July 2008)". Appropriate techniques will be implemented in order to control and limit, as far as is reasonably practicable, the effects of settlement based on other tunnelling projects within London such as Crossrail, the Jubilee Line Extension and Channel Tunnel Rail Link.

### 13.2 Specific Provisions

13.2.1 These will be developed as an ongoing part of the design process in accordance with the guidelines above.



## N2: Construction Noise and Vibration Mitigation Scheme

**Environmental Statement**

Volume II





# London Underground Northern Line Extension Construction Noise and Vibration Mitigation Scheme

Issue No.: 1

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MAYOR OF LONDON



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## 1 Introduction

- 1.1 The construction of Northern Line Extension (NLE) will cause noise and vibration impacts in some locations.
- 1.2 During construction, London Underground (LU), through design and mitigation, will control the effects of noise and vibration from within the construction sites using Best Practical Means (BPM). These controls will be agreed with relevant councils in the form of a Section 61 agreement under the Control of Pollution Act 1974. Nevertheless, there will be circumstances in which noise impacts will arise that will need to be mitigated still further. In certain circumstances, explained below, LU will offer to either provide and install free of charge, or provide grant aid for, noise insulation. In certain cases where the level of noise created by construction activity is predicted to be acute, LU will contact you to offer to arrange temporary rehousing, or help residents to arrange it for themselves and recoup the costs from LU.
- 1.3 LU has adopted a set of noise and vibration thresholds in relation to the provision of grant aid for noise insulation and, if appropriate, temporary rehousing. These thresholds follow the precedents established by recent and similar major schemes.
- 1.4 The purpose of this document is to explain both how the noise insulation and temporary rehousing schemes work, and what you should do next if you think that you may be eligible for either scheme.

## 2 Am I eligible for the scheme?

- 2.1 Construction noise insulation and temporary rehousing arrangements apply to dwellings and other buildings lawfully used for residential purposes.
- 2.2 To be eligible you must own or occupy a private dwelling and the dwelling must be one in which the predicted or actual construction noise exceeds the relevant 'noise trigger level' (as shown in Appendix A) for:
- a period of 10 or more days of working in any 15 consecutive days
  - a period of 3 or more nights of working in any 7 consecutive nights;  
or
  - for a total of 40 days or more in any 6 consecutive months

The rooms to which this scheme applies, eligible rooms, are defined as living rooms or bedrooms having a qualifying door or a qualifying window in any eligible building. On your behalf LU will prepare the predictions and monitor the actual noise levels in consultation with the relevant local authority.

- 2.3 Initially eligibility for the scheme depends on the predicted noise level following the assessment that will be carried out for that purpose once detailed construction plans are in place. If those noise predictions indicate that a property is eligible, the offer of noise insulation will be made and, if accepted and all necessary approvals obtained, the insulation installed before the works commence. However, the actual noise may turn out to be more or less than the prediction and therefore the noise levels will be monitored as work progresses. If it is found that noise levels are not as high as expected, the insulation package will not be removed. If it is found that the noise levels are higher than expected and meet the thresholds set out in this document, you will be informed and the provisions set out in paragraphs 9.5 to 9.10 will apply. Full details of the noise trigger levels, for both noise insulation and temporary rehousing are set out in Appendix A.



- 2.4 Some buildings and/or their occupants will be treated as special cases:
- Mobile homes and houseboats will be treated on a case by case basis. Given that noise insulation does not represent a viable option for mobile homes, where eligibility is confirmed, appropriate alternative mitigation measures will be adopted. The sorts of measures that will be considered include works management methods (eg adopting quiet times, rescheduling works, and imposing noise limits), or where this is not effective or appropriate, temporary rehousing will be offered even if the Temporary Rehousing thresholds are not exceeded.
  - Night workers, those needing a particularly quiet home environment to work in, or those that have a medical condition which will be seriously aggravated by construction noise, will also be considered on a case by case basis. Whilst these discretionary arrangements only apply to residential properties, buildings which may be particularly sensitive to noise (including, commercial, educational and community) will be subject to individual consideration by LU on the application of any body or person responsible for, or holding a legal interest or estate in, any such building.

## 3 What is the Noise Insulation Package?

- 3.1. The package will consist of:
- Secondary glazing or thermal double glazing (see also sections 5.1, 5.2 and 5.5) for living room and bedroom windows on eligible facades, plus additional ventilation if required under the relevant specifications.
  - Blinds, for south facing windows.
  - Insulation treatment for external doors on eligible facades.
- 3.2 Depending on the type of window you already have, secondary glazing will usually comprise another pane of glass in its own frame (wood, metal or plastic) 100-200 mm inside the existing window. This can be opened for cleaning or ventilation.
- 3.3 Secondary glazing works best when closed – so additional ventilation is usually required. The package includes an electric ventilator fan in a slim metal cover, fitted inside the room in question, to an outside wall (a 75-100 mm hole is drilled through the wall, through which the fan draws in air from the outside).
- 3.4 On a south facing window secondary glazing may make the room too hot. As set out under the relevant specifications, subject to the agreement of the claimant, blinds will be fitted between the main window and the secondary glazing to minimise this effect. If the claimant chooses not to accept blinds as part of the noise insulation package the possible impacts of this will be explained to them, blinds will not be retrofitted post installation of the noise insulation package should the claimant change their mind at a later date.
- 3.5 LU may be able to install a "secondary" door to improve noise insulation. If the design of your house prevents this, other methods can be used, such as sealing strip between the existing door and its frame.
- 3.6 There may be circumstances in which it is not possible to fit secondary glazing. Such cases will be considered on a case by case basis. Where eligibility is confirmed, appropriate mitigation measures will be adopted. The sorts of measures that will be considered include works management methods (eg adopting quiet times, rescheduling works, and imposing noise limits), or temporary rehousing even if the Temporary Rehousing thresholds are not exceeded.





## 4 Who does the insulation work and on what terms?

- 4.1. Once LU has conducted an initial survey and the details of the insulation for your house are agreed with you, LU will either offer to do the work at its expense, or offer grant aid for you to carry out the works.
- 4.2. LU will ask you to ensure that you provide adequate access for the survey and installation; and if you should incur expense in arranging access, LU will reimburse you provided it has agreed the amount before the cost is incurred.
- 4.3. In the cases where LU offer you a grant so that you can have the work done yourself, the grant would be made on the following conditions:
  - i. You must first obtain 3 independent written quotations.
  - ii. The work must comply with the relevant specifications.
  - iii. You must select the quote that represents the best price for complying with point ii, above.
  - iv. The amount of the grant will be for whichever is the lesser amount of either your selected quote, or the actual cost of the installation.
  - v. LU may pay 10% of the estimated cost in advance, and the balance when the work is satisfactorily completed.
  - vi. The work must be completed within 12 months of any advance payment, or before completion of the NLE construction works for which insulation is needed, whichever is the earlier. If this condition is not complied with, no further grant will be paid, and any payments already made will have to be repaid to LU or its agent.
  - vii. You must obtain the consent of any other person or body that may be required to permit the carrying out of insulation work (e.g. your landlord if you are a tenant, or any consents required from your local authority).
- 4.4. Please note that the Scheme can not be used for work needed to remedy existing building defects.
- 4.5. The scheme also covers the making good of the existing fabric and decoration (not including curtains) after the installation of secondary glazing, ventilation equipment, and second doors, including the adaptation of any existing pelmet and curtain rack.

## 5 Frequently asked questions relating noise insulation

### 5.1 Is secondary glazing the same as double glazing?

- 5.1.1 No. Secondary glazing is a separate pane of glass installed 100 – 200 mm inside the existing window, and the existing window remains in place. Double glazing consists of two panes of glass in the same casing, typically around 20mm apart which replace the existing windows.

### 5.2 What if I already have double glazing?

- 5.2.1 The noise assessments are based on the expected noise immediately outside the building so the type of glazing you currently have installed would not affect your eligibility under the scheme (subject to 5.4 below). You are not obliged to accept the



offer of insulation if you do not think you need it. LU will provide advice as to the effectiveness of any currently installed double glazing in terms of attenuation of external noise compared to the offer of secondary glazing. You may, at your own discretion, and accepting the reduced level of noise attenuation, choose only to have ventilation units and blinds installed.

### 5.3 What if I choose not to accept the offer of noise insulation but subsequently wish to adopt it?

- 5.3.1 A decision to accept an offer of noise insulation must be made within a certain timeframe. Specifically an offer must be accepted no later than 6 months after the date it is made in writing to you or one month before LU intends to install the other noise insulation at eligible properties affected by the same NLE construction works, whichever is the sooner. In the latter case, you will receive notice of the cut-off date for acceptance at the time the offer is made or shortly thereafter. If you do not respond within the time-frame due to circumstances beyond your control, LU will give due consideration to your case but the construction works will continue as programmed. If you choose not to accept the offer of noise insulation there is no scope to change your mind later. However, if the noise levels change during the course of the works such that you would be eligible for temporary rehousing, then the process set out in paragraphs 9.5 to 9.10 will apply.

### 5.4 What if I already have secondary glazing installed as the result of a grant from another public works scheme?

- 5.4.1 If your home has already had insulation work carried out or a grant for such work in respect of another public works scheme (such as a road or earlier railway works) you will not be eligible for further work or grant from NLE. However, the existing noise insulation will be inspected to ensure that it is in a state adequate to attenuate the construction noise to the extent that it should. If it is not, the works will be carried out or a grant made to have them carried out to bring the installed noise insulation package up to the appropriate standard.

### 5.5 What if I have already had secondary glazing or thermal double glazing installed privately, i.e. not as the result of a grant from another public works scheme?

- 5.5.1 If you have had a noise insulation package (i.e. secondary glazing or thermal double glazing, plus ventilation units and blinds) installed privately, it will be inspected to check whether it is in a state adequate to attenuate the construction noise to the extent that it should.
- 5.5.2 If LU identifies that you are eligible for noise insulation following the procedure set out in section 8 of this document, and the package meets the specification of the works set out in this document, the person who incurred the cost of those works can receive a grant in respect of the work already done. The amount of that grant will be for the full amount (as qualified by section 4.3 (iv) and, in the case of thermal double glazing, section 5.6), and excluding any element of cost attributable to work in excess of the specification for the works in this document, if you have followed the procedure for seeking and selecting a quotation set down in sections 4.3 (i) and (iii) of this document for private installation. If you have not followed that procedure, LU will make a grant to the amount that it would have offered if the procedure set out in section 8.1 for his carrying out the works had been followed. If the noise insulation package does not meet the specification set out in this document, the works will be carried out, or a grant made to you to have them carried out, to bring the installed noise insulation package up to the appropriate standard. In addition, LU will make a



grant to the person who incurred the cost of the work previously carried out to the amount of the difference between:

- The amount it would have offered if the procedure set out in section 8.1 for his carrying out the works meeting the specification had been followed; and
- The cost of the remedial works to bring the installed package up to the appropriate standard.

If the cost of the remedial works is greater than the amount of grant that would have been paid under the procedure set out in section 8.1 then no such further grant will be paid.

## 5.6 Can I just have thermal double glazing installed instead of secondary glazing?

- 5.6.1 Once an offer of noise insulation has been made pursuant to section 4.1, thermal double glazing can be provided instead of secondary glazing only if it is specifically requested by the claimant. The claimant will be made aware of the potential shortfall in sound insulation performance of the thermal double glazing compared to the secondary glazing.
- 5.6.2 The amount of the grant payable for the installation of thermal double glazing will be no more than the cost of installing the secondary glazing package specified in this document. If you arrange for the work to be carried out yourself, the amount paid to you in reimbursement will be for no more than the cost that would have been incurred if the secondary glazing package specified in this document had been installed. LU will calculate the cost that would have been incurred for installing the secondary glazing package using the experience gained from installing it in the nearest similar properties.
- 5.6.3 Neither secondary nor thermal double glazing can be provided without additional ventilation and or blinds where required to comply with the Noise Insulation (Railways and other Guided Transport Systems) Regulations 1996, Schedule I, Specifications.

## 5.7 If I choose to just have thermal double glazing installed instead of secondary glazing, and find later that due to the noise impact I would like secondary glazing due to the construction noise, can I claim again?

- 5.7.1 No. As noted in 5.6, the claimant will be made aware of any potential shortfall in sound insulation performance of the thermal double glazing compared to the secondary glazing. If the claimant elects to take a grant for the installation of thermal double glazing no further grant will be made or works undertaken to later install secondary glazing on top of the thermal double glazing.

## 5.8 Can I take the grant and not do the works?

- 5.8.1 No. If a grant is offered and you accept it, you must have the works carried out to the specification in the offer. Otherwise you must repay the grant. You are not obliged to accept the offer if you do not think you need it. See also para 4.3 (vi).



## 5.9 What if my landlord / tenant does not want the work carried out but I do?

- 5.9.1 LU will try to reach agreement between all parties where possible. In any event, the party wishing to have the work carried out is requested to do all that they reasonably can to reach agreement with all other interested parties that can influence whether or not the work can be carried out.

## 5.10 Will there be a maintenance grant for the noise insulation package?

- 5.10.1 No. There will be no obligation to repair, maintain or make any payments in respect of repairing or maintaining any equipment or apparatus installed under the application of this document or to pay for the running costs, which will be minimal for mechanical ventilation units. Notwithstanding this, should equipment such as the ventilation units fail after installation of the noise insulation package through no fault of the resident, and this occurs during NLE construction works, the failed apparatus will be repaired or replaced as necessary.

## 6 What is the Temporary Rehousing Package?

- 6.1. If, following the assessment that will be carried out for that purpose once detailed construction plans are in place, the predicted or actual (see section 9) construction noise level exceeds the trigger level for temporary rehousing, LU will notify you that you are eligible for alternative temporary accommodation. There are two options:
- Option A:** to arrange temporary alternative accommodation to meet your agreed needs.
- Option B:** to provide information and guidance to help you arrange your temporary alternative accommodation
- 6.2 If you choose Option A, the services provided by LU will include arranging for:
- Temporary alternative accommodation (which, where appropriate, could be a local hotel or guest house).
  - Removals.
  - Storage and insurance of your personal effects.
  - Insurance for the house you vacate.
  - Where appropriate your pets to go into kennels, catteries etc.
  - Where appropriate the disconnection and later reconnection of gas, water, electricity etc.
- 6.3 If you choose Option B then, instead of actually identifying the alternative accommodation and making the arrangements for you, LU will supply you with information and guidance on all the matters listed above, to enable you to make the arrangements yourself; and LU will also help you ensure that the costs you incur can be agreed and paid to you as soon as practicable.
- 6.4 Whether you choose Option A or Option B, LU will bear (or reimburse you with) the reasonable costs associated with your temporary rehousing together with the continuing, unavoidable costs of maintaining your own house whilst you are away.



However, these will be paid less the costs that you would have paid if you had stayed in your own house over the same period.

## 7 Frequently asked question relating to temporary rehousing

### 7.1 Do I have to move?

7.1.1 No. The acceptance of any offer of temporary rehousing is discretionary. You do not have to move if you do not want to. If you do decide to stay, you cannot claim compensation for disruption due to the noise of the works.

### 7.2 What happens in relation to my existing tenancy

7.2.1 The offer of temporary accommodation will be in addition to your current home. You will still be responsible for the rent, bills and other outgoings at your current home and you will still be a tenant there. The offer will include the additional cost of the relocation accommodation. You are free to visit and use your current home as you wish during the relocation, subject to the terms of your existing tenancy. If your tenancy agreement expires during the relocation you should (if you want to) renew it with your landlord in the normal way. If you choose not to renew your tenancy, the grant to meet the cost of the alternative accommodation will cease when your tenancy expires.

### 7.3 What about insurance, mail and redirection etc?

7.3.1 Most temporary relocations will be short term. In some areas, the relocation may be longer term and you will be reimbursed reasonable additional costs which you incur due to long term absence from your property.

### 7.4 Will the temporary accommodation offered be of the same quality a my current home?

7.4.1 The type of rehousing offered will depend on the duration of the relocation. For short durations hotel accommodation may be appropriate. For longer periods, alternative rented accommodation would be more suitable. In all cases account will be taken of your existing accommodation as far as possible.

### 7.5 How far away will I be moved?

7.5.1 The accommodation offered will be governed by what is available at the time and your reasonable requirements. Some people may be prepared to move to another area on a temporary basis if they would be nearer friends, family or work. Others may need to stay in the same area.

### 7.6 Can I have noise insulation and temporary relocation?

7.6.1 This will depend on the circumstances. The noise generated by the works will vary over the course of the job. In some areas, the noise may qualify for temporary relocation for one period, and noise insulation only for a different period. In these circumstances you would receive a temporary relocation offer for one period and a noise insulation offer for the other period. In other areas, a home may qualify for temporary relocation for a given period, but outside that period the noise may not trigger a separate noise insulation offer. In such a case, a temporary relocation offer only would be made and noise insulation would not be offered.



7.6.2 If you qualify for temporary relocation but not noise insulation, you do not have to accept the offer of relocation and may request noise insulation instead. You will be made aware of any shortfall in sound insulation performance of the noise insulation in relation to the thresholds presented in Appendix A and that the degree of disturbance could be high even with the noise insulation in place. If you choose to adopt this approach and noise insulation is provided you will not be able to later request temporary relocation under this scheme.

### 7.7 I am a landlord. Will you compensate me for lost rent if you temporarily relocate my tenant?

7.7.1 No. Your tenant will remain your tenant and remain liable to pay rent in the normal way.

## 8 What is the procedure for noise insulation and temporary rehousing?

8.1 The procedure comprises 7 steps.

- i. LU will carry out an assessment in every area likely to be materially affected by NLE construction noise, so as to predict what the noise levels will be and will discuss and agree the findings with the relevant local authority.
- ii. LU will then notify owners or occupiers of buildings which, on the basis of the assessment, LU considers qualify, and accordingly which type of assistance (noise insulation or temporary rehousing) they are eligible for. LU will also send an application form at this stage.
- iii. If you receive such a notice and application form, you should complete and return the form to LU or his agent. LU will then assess your application and if acceptable notify you in writing.
- iv. LU will then arrange to visit you in order to discuss the application with you generally; view your home and in the case of noise insulation take any necessary measurements; and identify any special issues or requirements (such as any other approvals that may be required in the case of noise insulation).
- v. LU will then assess your case in detail and, if it is accepted, notify you of:
  - any further survey likely to be needed at your house, and (in insulation cases) the work LU thinks should be done and its offer to do it; or
  - (in rehousing cases) either its proposals to re-house you temporarily or the information and guidance you need to make your own rehousing arrangements. In either case the proposals will be discussed with you and you will not be under any obligation to accept the offer.
- vi. Assuming you agree, the noise insulation package or temporary rehousing plan (as the case may be) is then put into effect.
- vii. LU reimburses you for any agreed costs, which you have incurred or (in grant cases) pays the balance of the grant. Alternatively, LU pays for noise insulation or removal/rehousing costs where it or its agent has done the work. A noise insulation package will not be offered if the noise trigger level is only exceeded whilst you are in temporary alternative accommodation (however see section 7.6 above).



8.2 Further technical information describing the process for predicting eligibility, particular in relation to cut-off points on long facades such as terraced housing, is presented in Appendix B.

## 9 What if I am not initially considered eligible to received either noise insulation or temporary rehousing but it is found subsequently that I qualify?

9.1 The following section address the procedure that will be followed in the case of people who consider themselves affected by construction noise and eligible for noise insulation or temporary rehousing who have not been offered either form of mitigation. Such claims may arise before or after the start of construction work.

### 9.2 Predictions for eligibility for noise insulation / temporary rehousing

Predictions will be carried out on behalf of LU using the British Standard method of calculating construction noise, based on the contractor's method of working and plant lists

9.3 Noise levels received at dwellings near the construction site will only vary significantly from the predictions already produced if there has been (i) a significant variation in the method of working or plant used from that currently anticipated or (ii) an error in the predictions.

### 9.4 Claims before the start of construction

If a person does not receive notification of eligibility for noise insulation/temporary rehousing according to paragraph 8.1 (ii) above, they may request a copy of the noise predictions on which the determination of the extent of eligibility was based. If they consider there to be any error in the predictions (for example incorrect identification of the claimant's property) they should provide to LU sufficient information concerning the claimed error. LU will then reconsider the matter of eligibility and either make an offer of noise insulation/temporary rehousing or confirm that the claimant remains ineligible.

### 9.5 Claims after the start of construction

The trigger levels for eligibility for noise insulation/temporary rehousing involve both noise levels and durations (temporal criteria). There are two possible cases that may arise:

i. The predictions do not identify that noise insulation/temporary rehousing thresholds will be exceeded, but in practice they are and this is expected to continue for a period of time sufficient to exceed the temporal criteria.

ii. The predictions identify that the noise insulation/temporary rehousing thresholds will be exceeded but will not carry on for a sufficient duration to trigger the temporal criteria. However, in practice the works go on for longer and the temporal criteria are triggered.

In both cases the approach will essentially be the same.

9.6 If a person claims, after the start of construction work, that the noise levels actually experienced are such as to cause eligibility for noise insulation/temporary rehousing where none was predicted, or that received noise levels are sufficient for eligibility for



noise insulation/temporary rehousing where this was predicted, and that the noise has continued, or seems to them likely to continue for longer than the temporal triggers where that had not been predicted, the claim will be considered by LU according to the following process.

9.7 A claim after the start of construction will inevitably take the form of a complaint or formal representation to the nominated undertaker. On receipt of the claim, LU will review the works being undertaken that have generated the claim and assess whether it is likely that the claim is valid. Where LU considers there is a potentially valid claim short-term site monitoring will be undertaken to identify whether the noise insulation/temporary rehousing trigger levels are indeed being exceeded. Whether or not monitoring is undertaken LU will discuss the results of the review with the claimant and explain the findings and any actions that have been taken.

9.8 At the same time, LU will inform the local authority that granted the Section 61 (Control of Pollution Act 1974) consent about the claim and what actions are being taken to address it. If LU considers that works are being carried out in breach of the Section 61 consent, they will ensure that all necessary steps are taken to put it right and inform the local authority of the actions taken. On being informed by LU about the claim and the steps being taken to address it, it is for the local authority to consider whether enforcement action should be taken pursuant to the Section 61 consent.

9.9 If the short-term noise monitoring identifies that the noise insulation/temporary rehousing thresholds are being exceeded, but that operations are being performed in accordance with the terms of the relevant Section 61 consent, LU will identify whether the activities causing those levels will carry on for longer than a period of 10 or more days of working in any 15 consecutive days or for 3 or more nights of working in any 7 consecutive nights or for a total of days exceeding 40 in any six consecutive months. If they are not, then no further action is required. The findings will be made known to the local authority who issued the S61 consent and discussed with them.

9.10 If the works causing noise levels above the noise insulation/temporary rehousing thresholds are projected to go on for longer than a period of 10 or more days of working in any 15 consecutive days or for 3 or more nights of working in any 7 consecutive nights or for a total of days exceeding 40 in any six consecutive months, but the construction works are being carried out in accordance within the terms of the relevant Section 61 consent, then LU will require action to be taken to reduce the level of noise being caused, or offer noise insulation and/or temporary rehousing to the affected property as appropriate. Works will not cease during the organisation and installation of the noise insulation. However, if appropriate, temporary rehousing will be offered to cover the period during which the noise insulation is installed. The temporary rehousing will be withdrawn:

- once the noise insulation is installed; or
- if the claimant unnecessarily delays obtaining any necessary consents in accordance with paragraph 4.3 (vii). If it is not possible to fit secondary glazing appropriate measures will be considered on a case by case basis (see paragraph 3.6).

If the complainant is not satisfied by the response of LU following a claim under section 9.7 above, they may register a complaint in accordance with the project's complaints procedure (to be determined prior to the start of the main construction works).



## 10 How do I start making a request for assistance?

- 10.1 In the majority of cases where residents are eligible, they will receive from LU a notice and application form. Once you receive a notice, you simply complete and return the form.
- 10.2 If you do not receive a notice, but you believe you may be eligible (e.g. because your neighbours have received notices, or you have some particular reason to think you will be affected by construction noise even if you might not strictly speaking be eligible under the Scheme) please contact LU at the address given below, and LU will then consider your position individually. See also section 9.4 above.
- 10.3 Whilst every endeavour will be made to ensure all those who might be eligible under this policy receive notices and application forms, some properties may be inadvertently missed, particularly in relation to special cases where specific circumstances may not be apparent. Clearly, we would hope that such an occurrence does not occur. LU or its agents will liaise with the relevant local authority to minimise the risk of any inadvertent omissions.
- 10.4 This noise and vibration mitigation scheme will be implemented together with any relevant procedures set down in any detailed community relations plan established by LU to ensure that residents understand how any concerns raised will be made known to LU and the lines of communication available through which action will be initiated.

## 11 I have further questions that are not answered here. Where can I get further information?

Email us at: [NLE@tfl.gov.uk](mailto:NLE@tfl.gov.uk)

Write to us at:

Northern Line Extension  
London Underground  
55 Broadway  
London  
SW1H 0PD

## 12 References

### 12.1 Abbreviations

The following abbreviations are created:

Abbreviation	Definition
LU	London Underground
NLE	Northern Line Extension

### 12.2 Definitions

The following terms are used within this document:

Term	Definition
A-weighted	Is the A-weighted level, expressed as "dB(A)", allows for the frequency dependent characteristics of hearing. Corrections are applied for each octave frequency band, and the resultant values summed, to obtain a single overall level.



Term	Definition
Best Practical Means	This means that every practical mitigation has been applied to reduce noise and vibration produced by the works to as low a level as possible.
Claimant	Means an owner or occupier of an eligible building who makes a request, or is made an offer under the NLE Construction Noise and Vibration Mitigation Scheme.
Construction	Includes demolition and excavation
Contiguous façade	Means a façade of a building that is horizontally separated from other facades by a stairwell, corner or some other discontinuity.
decibel (dB)	Is the ratio of sound pressures which we can hear – a ratio of 10 <sup>6</sup> (one million: one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is the 'sound pressure level' (L <sub>p</sub> ) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply,
Eligible building	Has the meaning assigned to it in regulation 7 of Statutory Instrument 1996 No. 428, The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 excluding that part of regulation 7 (1) which refers to distances from running rail or the nearest apparatus corresponding thereto which is not applicable to noise from construction sites, but does not include any building with respect to which a notice to treat has been or is intended to be served for its acquisition, or with respect to which a vesting declaration for its acquisition has been or is intended to be made.
Eligible room	Means a living room or a bedroom having a qualifying door or a qualifying window in an eligible building.
Equivalent continuous sound pressure level (L <sub>eq</sub> )	Another index for assessing overall noise exposure is the equivalent continuous sound level, L <sub>eq</sub> . This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level. The A-weighted L <sub>eq</sub> is denoted as L <sub>Aeq</sub> .
Façade	Means an outer wall of a building.
Insulation work	Means work carried out to insulate an eligible building against noise which will include adequate ventilation and may include blinds.
Pre-existing ambient noise	Means the level of ambient noise, expressed as a level of L <sub>Aeq</sub> determined with respect to the relevant time period and the relevant L <sub>Aeq</sub> averaging time, prevailing one metre in front of relevant windows or doors in a façade of a dwelling, immediately before the placing of a contract for the construction of the relevant part of the NLE works.
Qualifying door	Means an external door opening directly into an eligible room which is in that part of the façade in respect of which the relevant noise level satisfies the requirements of Appendix A of this document or meets the criteria for a contiguous façade as set out in Appendix B.
Qualifying window	Means a window in an eligible room which is in that part of the façade in respect of which the relevant noise level satisfies the requirements of Appendix A of this document or meets the criteria for a contiguous façade as set out in Appendix B.
The Regulations	Means the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996.
The relevant specifications	Means the items in Part I of Schedule 1 to the Regulations except where they are amended by the provisions of this document, such of the items in Part II of Schedule 1 to the Regulations as may be approved by LU and such of the specifications set out in Part III of Schedule 1 to the Regulations as are applicable in the circumstances of the case or items whose performance is equivalent thereto.



Term	Definition
Section 61 agreement	Prior agreement from a council - under Section 61 of the Control of Pollution Act 1974 - for construction works where Best Practical Means has been demonstrated to be applied.
The works	Is the construction works required for NLE which fall within the remit of the NLE Construction Code.

### 12.3 Person accountable for the document

Person accountable for the document
TfLs Consents and Environment Manager

### 12.4 Document history

Issue no	Date	Changes	Author
R1	Sept 2012	New document	Suzie Jackman



## 13 Appendix A

### Criteria for Eligibility for Noise Insulation or Temporary Re-housing

To be read in conjunction with Section 2 above

#### 13.1 Noise Insulation

A dwelling will be eligible where the total noise level due to construction of the railway (pre-existing ambient plus airborne NLE construction noise), measured or predicted at a point one metre in front of the most exposed of any windows and doors in any façade of a building which is an eligible dwelling, exceeds whichever is the higher of either: a) any of the following criteria in Table 1:

**Table 1: Noise Insulation Trigger Level Table**

Time	Relevant Time Period	Averaging Time T	Noise Insulation Trigger Level dB L <sub>Aeq, T</sub>
Monday to Friday	07:00 – 08:00	1 hr	70
	08:00 – 18:00	10 hr	75
	18:00 – 19:00	1 hr	70
	19:00 – 22:00	3 hr	65
	22:00 – 07:00	1 hr	55
Saturday	07:00 – 08:00	1 hr	70
	08:00 – 13:00	5 hr	75
	13:00 – 14:00	1 hr	70
	14:00 – 22:00	3 hr	65
	22:00 – 07:00	1 hr	55
Sunday and Public Holidays	07:00 – 22:00	1 hr	65
	22:00 – 07:00	1 hr	55

Or

(b) 5 dB above the pre-existing airborne noise level for the corresponding times of day (i.e. the Relevant Time Periods presented in column 2 of Table 1);

And

for a period of 10 or more days of working in any 15 consecutive days or for a period of 3 or more nights (22:00-07:00) of working in any 7 consecutive nights or for a total of days exceeding 40 in any six consecutive months.

#### 13.2 Temporary Rehousing



Occupiers of a dwelling will be eligible for re-housing where the total noise level due to construction of the railway (pre-existing ambient plus airborne NLE construction noise), measured or predicted at a point one metre in front of the most exposed of any windows and doors in any façade of an eligible dwelling, exceeds whichever is the higher of either (a) or (b) or if criteria (c) is met:

- (a) 10 dB above any of the noise levels in Table 1 above or
- (b) 10 dB above the pre-existing airborne noise level for the corresponding time of day (i.e. the Relevant Time Periods presented in column 2 of Table 1);

and in the case of both (a) and (b) this occurs for a period of 10 or more days of working in any 15 consecutive days or for a period of 3 or more nights (22:00-07:00) of working in any 7 consecutive nights or for a total number of days exceeding 40 in any six consecutive months.

or

- (c) When night-time maximum noise levels due to construction works are predicted to regularly (at least 15 occurrences) exceed  $75\text{dB}_{L_{AFmax}}$  throughout the night time period (22:00-07:00) for 3 or more nights of working in any 7 consecutive nights.

### 13.3 Interpretation of the trigger levels

In interpreting and applying the trigger levels in Table 1, two conventions will be adopted. The first is that in interpreting the noise insulation/temporary rehousing policy where eligibility arises if noise levels in Table 1 are exceeded, a resolution of 0.1 dB will be applied. For example, a value of  $L_{Aeq,T}$  of 55 dB (with pre-existing ambient at least 5 dB lower) will not trigger eligibility. A value of 55.1 dB will trigger eligibility<sup>1</sup>.

The second convention relates to the choosing of minimum one-hour  $L_{Aeq,T}$  levels at night to define the pre-existing ambient, given that a series of survey results often shows different minima over a series of nights. The approach will be to select a 7-day survey period during which favourable weather conditions existed<sup>2</sup> and select the lowest one hourly value from that data set.

<sup>2</sup> Wind speed not more than 5, /s and no precipitation.



## 14 Appendix B Eligibility Assessment

### 14.1 Introduction

As explained in the main body of this appendix, eligibility for noise mitigation arises under the Scheme when whichever is the higher of the following two requirements is met (i) the total predicted (or actual) noise level due to construction works (pre-existing ambient plus airborne NLE construction noise) exceeds a trigger level or (ii) the margin between the construction noise level plus the pre-existing ambient and the pre-existing ambient is at least 5 dB and also (iii) the temporal requirements (10 out of 15 days of working etc) are met.

If the eligibility requirements were applied strictly this could lead to anomalies whereby some dwellings in a terrace might be included and not others or it might result in dividing the facades of apartment blocks into eligible and ineligible properties.

The procedure to be followed by LU in implementing the Scheme so as to avoid dividing facades in a manner likely to be contentious for residents is set out below.

### 14.2 Procedure for Administering the Policy

While construction noise predictions made using a noise model such as SoundPlan can be presented using contours that will indicate a finite value for any location of interest, the same is not true of eligibility. The principal reason for this is that measured baseline noise levels are of necessity carried out at discrete locations. While interpolation between discrete values is possible in theory, it is in many circumstances impracticable.

The procedure will normally identify a single representative noise measurement location per façade, except for long facades. Sometimes a noise measurement location may serve as a surrogate for other comparable facades as well. Measurement locations should generally be towards the centre of the façade or façade section that they represent. The noise measurements from these locations may well be rounded.

The predicted noise including the contribution from the construction works will then be made for the worst affected window in the façade under consideration.

Whether a property is eligible for noise mitigation or not will then be determined using this predicted level. This determination will be applied to all the dwellings for which the measurement location was taken as representative.

In the case of a very long façade, it may be appropriate to utilise more than one noise measurement location. However, since measured values will vary slightly with quite small movements in position, a protocol needs to be established to avoid anomalous results as described above. The solution is to determine that more than one measurement location will be adopted for the same continuous facade only if the results from different noise measurement locations alongside the same façade differ by at least 3dB. For a façade at right-angles to a noise source such as a road or railway, this broadly means a doubling of distance from the source and would therefore normally only apply to long facades.

### 14.3 Protocol for Determining Eligibility

- 1) Establish baseline  $L_{Aeq}$  for relevant time of day for appropriate monitoring locations.
- 2) Assign monitoring results to facades according to the following rules:



- a. Monitoring results to apply to whole façade where there is only one monitoring location for that façade. The monitoring location is to be as near as possible to the centre of the façade.
- b. Monitoring results to apply to whole façade where another façade is used a surrogate.
- c. Where more than one monitoring location exists for the same façade, only if the  $L_{Aeq}$  levels for any period differ by 3 dB or more shall the façade be divided, in which case façade areas around the location to be apportioned equally (i.e. as far as practicable each monitoring location to be in the centre of the area assigned to it).
- d. The definition of a façade of a building is one that is horizontally separated from other facades by a stairwell, corner or some other discontinuity, as set out in section 2 of this document.

3) The predicted noise levels including construction noise to be utilised for the whole facade are those for the worst affected window/door in any façade.



O: Energy and Sustainability

**Environmental Statement**

Volume II



## O1: Outline Energy Strategy

**Environmental Statement**

Volume II





Northern Line Extension  
**Outline Energy Strategy**

April 2013

Prepared for  
**Transport for London**

## Revision Schedule

**Outline Energy Strategy**  
April 2013

Issue	Date	Details	Prepared by	Reviewed by	Approved by
01	04/04/2013	Final	<b>Kristina Schaferova</b> Senior Sustainability Engineer	<b>Veronica Hamilton</b> Senior Energy Engineer	<b>Oliver Riley</b> Technical Director

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## List of Abbreviations

AAP	Area Action Plan	SHW	Solar Hot Water
ADL	Approved Document L	SPD	Supplementary Planning Documents
AHU	Air Handling Unit	SPG	Supplementary Planning Guidance
AQMA	Air Quality Management Area	TBC	To be confirmed
ASHP	Air Source Heat Pumps	TER	Target Emissions Rate
BER	Building Emissions Rate	TfL	Transport for London
BMS	Building Management System	TWA Order	Transport and Works Act Order
BPS	Battersea Power Station	UDP	Unitary Development Plan
BREDEM12	Building Research Establishment Domestic Energy Model 12	VNEB	Vauxhall, Nine Elms and Battersea
BREEAM	BRE Environmental Assessment Method		
CCHP	Combined Cooling Heat and Power		
CEEQUAL	Civil Engineering Environmental Quality and Assessment Scheme		
CFD	Computational Fluid Dynamic		
CHP	Combined Heat and Power		
CIBSE	Chartered Institution of Building Services Engineers		
CLG	Communities and Local Government		
CO <sub>2</sub>	Carbon Dioxide		
COP	Coefficient of Performance		
CSH	Code for Sustainable Homes		
DEN	District Energy Network		
DHN	District Heating Network		
DHW	Domestic Hot Water		
DMPD	Development Management Policies Document		
DSM	Dynamic Simulation Model		
DTP	Deep Tube Programme		
DTR	Deep Tube Railway		
GLA	Greater London Authority		
GSHP	Ground Source Heat Pump		
H <sub>2</sub>	Hydrogen		
HSE	Health, Safety and Environment		
IES	Integrated Environmental Solutions		
LBL	London Borough of Lambeth		
LBW	London Borough of Wandsworth		
LBS	London Borough of Southwark		
LDF	Local Development Framework		
LED	Light Emitting Diode		
LU	London Underground		
LZC	Low and Zero Carbon		
M&E	Mechanical and Electrical		
NLE	Northern line extension		
NO <sub>x</sub>	Nitrogen Oxide		
OAPF	Opportunity Area Planning Framework		
OAs	Opportunity Areas		
OES	Outline Energy Strategy		
OSD	Over Site Development		
PIR	Passive Infra Red		
PM10	Particulate Matter (of 10 Microns in diameter or smaller)		
PSAR	Project Sustainability Appraisal Report		
PSD	Platform Screen Doors		
PV	Photovoltaic		

## Executive Summary

This Outline Energy Strategy has been prepared in support of a Transport and Works Act (TWA) Order application in developing a scheme to extend the Northern line to Battersea.

The Northern Line Extension (NLE) consists of an extension of the Northern line from Kennington to Battersea, including a development of two new Underground stations; Nine Elms Underground station located in the London Borough of Lambeth (LBL) and Battersea Underground station in the London Borough of Wandsworth (LBW). In addition, two sub-stations will be developed in Kennington Park and Kennington Green in the London Borough of Southwark (LBS).

In compliance with Greater London Authority (GLA) policies, energy consumption reductions in the NLE will be achieved through the implementation of passive design and energy efficiency measures and meet part of the remaining energy demand through the incorporation of low and zero carbon (LZC) technologies.

The Outline Energy Strategy demonstrates how the designers are considering the aspirations set in the London Plan 2011 (Ref. 1) by following the Mayor's energy hierarchy and the detailed guidance provided in the GLA Energy Guidance on Planning Energy Assessments (Ref. 2). These include the following:

- Passive design and energy efficiency (i.e. use less energy – ‘be lean’);
- Energy efficient supply of services (i.e. ‘be clean’); and
- On site renewable energy technologies to provide energy (i.e. use renewable energy – ‘be green’).

### *Baseline Scheme*

For the purposes of this report the baseline scheme is defined as that meeting the emissions requirements of the Building Regulations Approved Document L (ADL) 2010 (Ref. 3). The NLE's energy consumption and CO<sub>2</sub> emissions have been calculated on a ‘whole energy’ basis and include both regulated and non-regulated loads.

The CO<sub>2</sub> emissions of the baseline scheme are estimated to be approximately 5,000 tonnes CO<sub>2</sub>/year.

### *Be Lean*

It is proposed to reduce the energy demand of the NLE by incorporating passive design measures where possible. These measures could include:

- Provision of natural ventilation to reduce the need for mechanical fans;
- Partial humped alignments to minimise the energy needed for braking and acceleration;
- Promotion of daylighting to reduce energy consumption associated with artificial lighting as practicably possible;
- Efficient use of thermal mass to manage the risk of overheating; and
- Energy awareness schemes to promote energy saving behaviour of staff and commuters.

It is proposed to achieve a further reduction in the energy demand of the NLE by providing energy efficiency measures, including:

- Energy efficient internal and external lighting with appropriate control systems;
- High efficiency heating and cooling systems (for staff areas);
- High efficiency heat recovery systems for mechanically ventilated areas (for staff areas);
- Waste heat recovery from tunnels;
- Incorporation of water pipes within the tunnel lining for future proofing against overheating risk associated with expected increases in temperatures due to climate change;
- Efficient fans and pumps;
- Energy efficient equipment and appliances;
- Thermal zoning and controls;
- Building Management Systems (BMS);
- Energy display devices; and
- Efficient lifts and escalators.

The resulting savings in CO<sub>2</sub> emissions due to the incorporation of the above passive design and energy efficiency measures (i.e. via ‘be lean’ scheme) could achieve a 24% reduction over the baseline scheme considering all energy uses.

### *Be Clean*

The potential for connection to any existing neighbouring low carbon heat distribution networks including Combined Heat and Power (CHP) was investigated and is currently being considered. The viability of connection to any of the following

energy networks will be determined at later stages when design has progressed sufficiently to allow detailed feasibility analyses:

- Vauxhall, Nine Elms and Battersea (VNEB) District Energy Network (DEN);
- Over Site Development (OSD) at Battersea; and
- OSD at Nine Elms.

The use of an on-site CHP and Combined Cooling Heat and Power (CCHP) in the NLE has been assessed: based on the current estimates of the stations heat demands it is not considered feasible for the NLE.

#### *Be Green*

To further reduce CO<sub>2</sub> emissions, an analysis of the feasibility of renewable energy technologies for the NLE has been undertaken and Air Source Heat Pumps (ASHP) have been identified as feasible at this stage.

In addition to ASHP, the following technologies are being taken forward for detailed stages of the project:

- Photovoltaic (PV) arrays could be incorporated into the design of the Nine Elms Underground station should the OSD design allow for such installation.
- Passive provision for borehole cooling should be considered at detailed design stages following a thermal modelling exercise, which will identify the need for tunnel cooling in the future.
- GSHP could be installed either to supply joint heating and cooling loads of the stations and OSDs or to extract waste heat from the tunnel lining once a detailed study determines it's potential.
- The incorporation of Fuel Cells should also be considered at detailed design stages in collaboration with the OSDs.
- A kinetic energy harvesting system could be incorporated either to raise the passengers' sustainability awareness or should it become economically viable and technically reliable a large installation could be installed to contribute to the scheme's CO<sub>2</sub> reduction targets.

#### *Outline Energy Strategy*

It is currently estimated that the NLE has the potential to achieve 25% savings in total CO<sub>2</sub> emissions via the incorporation of improved energy efficiency, passive design measures and specification of ASHPs. It should be noted that there is a large potential to incorporate further measures into the scheme, however, their applicability cannot be confirmed as yet due to the early stage of the project and uncertainties associated with the development of OSDs.

When considering only the regulated energy uses of the stations (i.e. heating, domestic hot water (DHW), cooling, ventilation and lighting) the proposed energy strategy could achieve a 34% reduction in CO<sub>2</sub> emissions over the baseline scheme.

The CO<sub>2</sub> emissions and the potential to reduce total CO<sub>2</sub> emissions of each of the energy strategy stages are shown in Executive Summary Table 1.

**Executive Summary Table 1 CO<sub>2</sub> Emissions for the Energy Strategy Stages**

Scheme	CO <sub>2</sub> emissions (tonnes CO <sub>2</sub> /year)				
	Regulated	Improvement Regulated	Non-Regulated	Regulated & Non-regulated	Improvement (Regulated & Non-regulated)
Baseline	2,787	-	2,206	4,993	-
Be Lean	1,888	32%	1,920	3,808	24%
Be Green (ASHP)	1,828	3%	1,920	3,748	2%
Overall (over Baseline)	34%			25%	

## 1 Introduction

This Outline Energy Strategy (OES) has been prepared in support of a Transport and Works Act (TWA) Order application by Transport for London (TfL) in developing a scheme to extend the Northern Underground line to Battersea (herein referred to as the Northern Line Extension (NLE)).

Tackling climate change and enhancing the environment are TfL strategic goals. As a transport provider TfL accepts its responsibility to operate a network that is as low-carbon as possible and resilient to the expected changes in the city's climate.

To limit climate change the Mayor of London has set a target to reduce London's CO<sub>2</sub> emissions by 60% compared to 1990 levels by 2025 (Ref. 4). To achieve this target, TfL is expected to achieve 60% savings for London Underground (LU), buses and rail network by 2050 (Ref. 5).

Whilst there are physical limitations when improving the existing network; there is an excellent opportunity to embed sustainability and energy efficiency within the design of a new extension of an Underground line. This report evaluates the opportunities for reducing the operational CO<sub>2</sub> emissions associated with the NLE and following these evaluations introduces the OES for the project.

In the context of this TWA Order application, the consideration must be given by TfL to the requirements of the following planning documentation:

- *The London Plan, Spatial Development Strategy for Greater London, Greater London Authority (GLA), 2011;*
- *Sustainable Design and Construction – The London Plan Supplementary Planning Guidance (SPG), GLA, 2006 (Ref. 6);*
- *Integrating Renewables into New Developments: Toolkit for Developers, Planners and Consultants, London Energy Partnership, 2004 (Ref. 7);*
- *GLA Guidance on Preparing Energy Assessments, GLA, 2011;*
- *Delivering London's Energy Future: The Mayor's Climate Change Mitigation Energy Strategy, GLA, 2011;*
- *Vauxhall Nine Elms Battersea Opportunity Area Planning Framework, GLA, 2012 (Ref. 8);*
- *London Borough of Lambeth (LBL) Core Strategy, LBL, 2011 (Ref. 9);*
- *London Borough of Wandsworth (LBW) Core Strategy, LBW, 2010 (Ref. 10);*
- *London Borough of Southwark (LBS), Core Strategy, 2011 (Ref. 11);*

In line with the above documents, it is sought to reduce the NLE's CO<sub>2</sub> emissions and to mitigate its impact on climate change following the principles set out in the Mayor's energy hierarchy described in Policy 5.2–Climate Change Mitigation of the London Plan.

The OES will take into account environmental and spatial constraints and will identify how to minimise the NLE's operational energy consumption through the implementation of passive design measures, energy efficiency, and Low and Zero Carbon (LZC) technologies.

This OES has been prepared using information included in a number of documents, which were developed by other team members as part of the design works. Particular attention should be paid to the Project Sustainability Appraisal Report (PSAR) (see Appendix O1 of ES Volume II), which considers energy on a wider sustainability level.

In line with the project requirements the NLE will be assessed under Civil Engineering Environmental Quality and Assessment Scheme (CEEQUAL) with a target rating of Excellent. In addition, the station design will be assessed under BRE Environmental Assessment Method (BREEAM) and will look to achieve a minimum BREEAM 'Very Good' rating.

The remainder of this strategy is structured as follows:

- Section 2 presents an overview of the NLE;
- Section 3 outlines the policy context;
- Section 4 sets out the energy assessment methodology;
- Section 5 describes the Part L compliant assessment;
- Section 6 details the passive design and energy efficient appraisal;
- Section 7 details the Combined Heat and Power (CHP) and district energy networks (DEN) appraisal;
- Section 8 includes the appraisal of renewable energy technologies;
- Section 9 summarises the proposed outline energy strategy;
- Section 10 presents the conclusions; and
- Appendix A includes Electrical Load Schedules for Battersea station, Nine Elms station, Kennington Park sub-station and ventilation shaft and Kennington Green.

## 2 Overview of the Northern Line Extension

The NLE works comprise the construction of an underground railway to form an extension of the Northern line (Charing Cross branch) from Kennington to Battersea. It will diverge from the existing railway south of Kennington station from a section of track used by terminating trains (known as the Kennington Loop) and will comprise the following:

- Railway approximately 3,150 metres long northbound and approximately 3,250 metres long southbound including overrun / stabling tunnels west of the terminus at Battersea, a crossover east of the terminus and junctions serving each of the tunnels to link with the existing railway at the Kennington Loop;
- A terminus at Battersea between Battersea Park Road and Battersea Power Station (BPS) and an intermediate station at Nine Elms west of Wandsworth Road and north of Pascal Street, both providing step-free access from trains to street level;
- Intervention and ventilation shafts with head houses at Kennington Green and Kennington Park to provide emergency access, tunnel ventilation and smoke control; and
- Ancillary and mitigation works within the limits of deviation including (but not limited to) providing power supply, additional cross passages at platform level at Kennington station and works related to highways, footways and utilities.

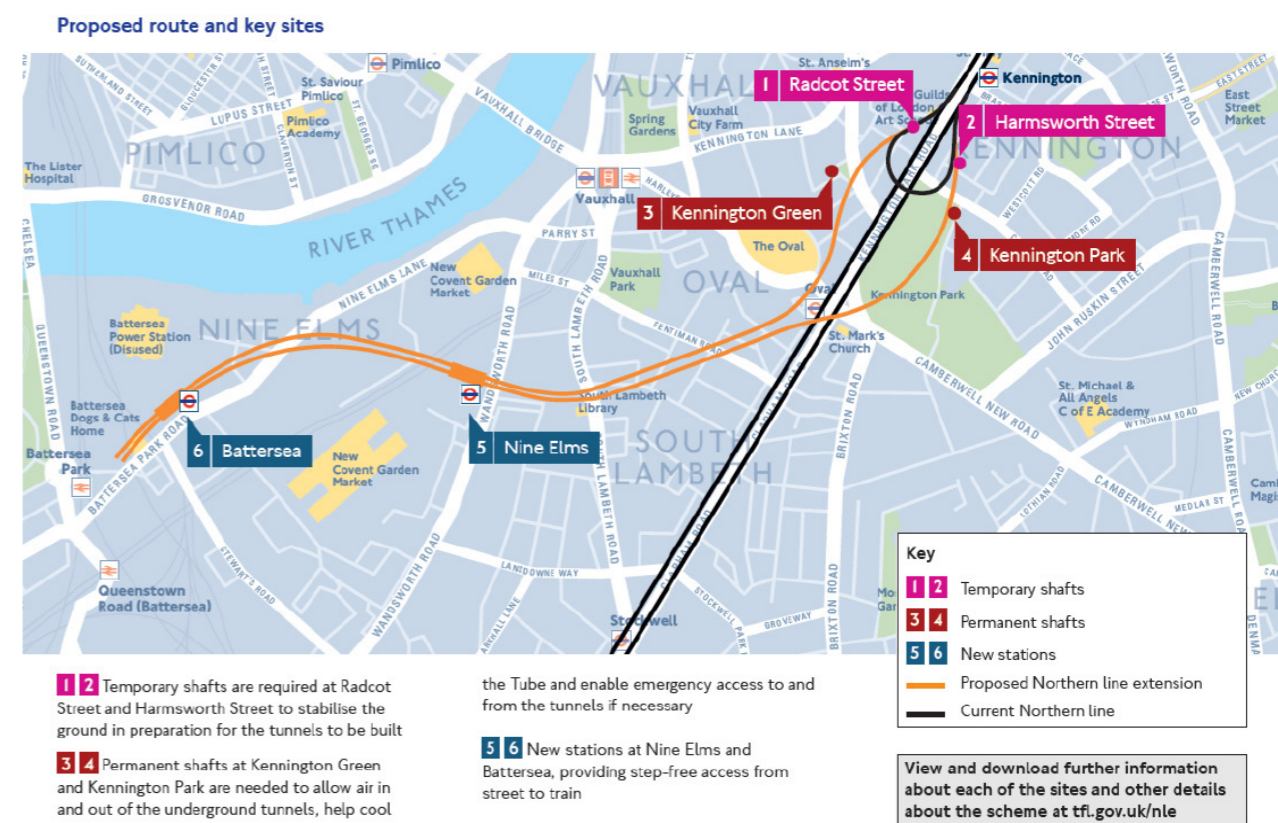
The NLE works also include:

- Accommodation works for affected landowners / occupiers including (but not limited to):
  - Temporary facilities for Battersea Dogs and Cats Home and Covent Garden Market Authority;
  - Temporary and permanent facilities for occupiers of the park lodge at Kennington Park; and
  - The installation of a water tank for the benefit of the Beefeater Gin Distillery.
- Temporary works including worksites at the locations of the proposed stations and shafts / head-houses, temporary shafts at Radcot Street and Harmsworth Street (only for Construction Option A – see Chapter 4: Description of the NLE in ES Volume I) and a temporary conveyor and associated alterations to the jetty at BPS to facilitate the transfer of material onto barges.

The location of the proposed stations and ventilation shafts is indicated on Figure 1.

The proposed Nine Elms and Battersea stations are excavated deep box structures. Ticketing and staff accommodation at Nine Elms will be at surface level, with the majority of the plant located in basement level plant rooms. At Battersea, staff accommodation, ticketing and plant will all be at basement level within the box structure.

The stations have been designed to take account of future OSDs, although these are not sought by this TWA Order application and are outside of TfL's control. At Battersea, this OSD is subject to the adjacent proposals being progressed at BPS. At Nine Elms, the station will allow a comprehensive development to come forward.



**Figure 1 Map Showing the Proposed Route and Key Sites of the NLE – Option A (TfL)**

### 3 Policy Context and Guidance

Rising international and national aspirations have led to the strengthening of national planning policies and building control processes that contribute to the Government's long-term commitment to support sustainable development.

In addition, being aware of the scale of the impact transport has on the environment; TfL prepared a number of standards and guidance documents, which set out TfL's sustainability targets aiming to mitigate this impact and to increase their environmental credentials.

#### 3.1 National Planning Policy

The Government has launched a raft of measures to combat global warming and climate change. The following publications demonstrate a timeline for the measures that have been implemented within the development of national policy:

- The Department of Transport and Industry White Paper entitled Our Energy Future – Creating a Low Carbon Economy, 2003 (Ref. 12) sets a target for 10% of electricity to be produced from renewable sources nationally by 2010 and twice this by 2020, with a 60% reduction in CO<sub>2</sub> emissions by 2050;
- Sustainable and Secure Buildings Act 2004 (Ref. 13) sets out the purposes for which Building Regulations may be made to further the conservation of fuel and power, ensure water use efficiency, protect and enhance the environment, and prevent/detect non-compliance with the Building Regulations;
- Climate Change and Sustainable Energy Act 2006 (Ref. 14), enhances the contribution of the UK to combating climate change, alleviating fuel poverty and securing a diverse and viable long-term energy supply;
- The department for Communities and Local Government's (CLG's) Building a Greener Future: Towards Zero Carbon Development, 2006 (Ref. 15), demonstrates the step change required in the Building Regulations to achieve zero carbon housing in order to ensure energy security, which is a risk of climate change;
- The Department of Transport and Industry White Paper entitled Meeting the Energy Challenge, 2007 (Ref. 16), sets out the UK strategy, which recognises the need to tackle climate change and energy security;
- The Climate Change Act 2008 (Ref. 17) sets up a framework for the UK to achieve its long-term goals of reducing greenhouse gas emissions by 34% over the 1990s baseline by 2020 and by 80% by 2050 and to ensure steps are taken towards adapting to the impact of climate change. The Act introduces a system

of carbon budgeting which constrains the total amount of emissions in a given time period, and sets out a procedure for assessing the risks of the impact of climate change for the UK, and a requirement on the Government to develop an adaptation programme;

- The Planning and Energy Act 2008 (Ref. 18) enables local planning authorities to set requirements for energy use and energy efficiency in local plans;
- The Energy Act 2011 (Ref. 19) provides for a step change in the provision of energy efficiency measures to homes and businesses, and makes improvements to our framework to enable and secure, low carbon energy supplies and fair competition in the energy markets. The Act tackles barriers to investment in energy efficiency by launching the Green Deal and measures to maximise uptake, introducing a new Energy Company Obligation from 2012 to underpin the Green Deal, extending powers to direct the roll out of smart meters, requiring cheapest tariff information on energy bills and making energy performance data from Energy Performance Certificates more widely available;
- The Carbon Plan, 2011 (Ref. 20), sets out the Government's plans for achieving the emissions reductions committed to in the Climate Change Act, on a pathway consistent with meeting the 2050 target. This publication brings together the Government's strategy to curb greenhouse gas emissions and deliver our climate change targets, as well as the updated version of actions and milestones for the next five years;
- The National Planning Policy Framework, 2012 (Ref. 21), sets out the Government's planning policies for England and how these are expected to be applied. It must be taken into account in the preparation of local and neighbourhood plans, and is a material consideration in planning decisions. The document presents a series of policies that constitute the Government's view of what sustainable development in England means in practice for the planning system. At the heart of the National Planning Policy Framework is a presumption in favour of sustainable development. Policies in Local Plans should follow the approach of the presumption in favour of sustainable development so that it is clear that development which is sustainable can be approved without delay.

#### 3.2 Regional Planning Policy

##### 3.2.1 The London Plan 2011

The London Plan, which establishes policy over the next 20 – 25 years, retains the fundamental objective of accommodating London's population and economic

growth through sustainable development. The Mayor’s vision is for London to excel among global cities, expanding opportunities for all its people and enterprises, achieving the highest environmental standards and quality of life and leading the world in its approach to tackling the urban challenges of the 21<sup>st</sup> century, particularly that of climate change.

The London Plan sets out policy and guidance in the London context and identifies six main objectives related to improving the living and working conditions in London, giving more detail about how the vision should be implemented and ensuring London is:

- A city that meets the challenges of economic and population growth;
- An internationally competitive and successful city;
- A city of diverse, strong, secure and accessible neighbourhoods;
- A city that delights the senses;
- A city that becomes a world leader in improving the environment; and
- A city where it is easy, safe and convenient for everyone to access jobs, opportunities and facilities.

In terms of Climate Change Mitigation, the London Plan includes a strategic target to achieve an overall reduction in London’s CO<sub>2</sub> emissions of 60% by 2025 (Policy 5.1). In the planning context, the Mayor expects that all new development will fully contribute towards the reduction of CO<sub>2</sub> emissions and this will be achieved through the application of Policy 5.2: Minimising CO<sub>2</sub> emissions.

Specifically, Policy 5.2 (A) requires developments to make the fullest contribution to minimising emissions of CO<sub>2</sub> in accordance with the energy hierarchy:

- Be lean: using less energy (Policy 5.3);
- Be clean: Supplying energy efficiently, in particular by prioritising decentralised energy generation (Policy 5.5 and 5.6); and
- Be green: Using renewable energy (Policy 5.7).

The following targets for CO<sub>2</sub> emissions reduction, which all major developments are expected to meet (Policy 5.2 (B)):

**Table 1 Targets for CO<sub>2</sub> emissions reduction**

Year	Improvement on 2010 Building Regulations	
	Residential buildings:	Non-domestic buildings:
2010 - 2013	25% (CSH Level 4)	25%
2013 - 2016	40%	40%
2016 - 2019	Zero Carbon	As per Building Regulations requirements
2019 - 2031		Zero Carbon

All major development proposals are expected to include a detailed energy assessment to demonstrate how these targets are to be met within the framework of the energy hierarchy (Policy 5.2 (C)). Guidance is also given on the content of Energy Assessments (Policy 5.2 (D)).

Policy 5.3: Sustainable Design and Construction, seeks to ensure future developments meet the highest standards of sustainable design and construction including construction and operation, and ensure that they are considered at the beginning of the design process. Major development proposals should meet the minimum standards outlined in the Mayor’s supplementary planning guidance and this should be clearly demonstrated within a design and access statement. Sustainable design principles to be achieved include:

- Minimise CO<sub>2</sub> emissions across the site, including the building and services (such as heating and cooling systems);
- Avoid internal overheating and contribution to the urban heat island effect;
- Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings;
- Minimise pollution (including noise, air and urban run-off);
- Minimise the generation of waste and maximise reuse or recycling;
- Avoid impacts from natural hazards (including flooding);
- Ensure developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions;
- Secure sustainable procurement of materials, use local supplies where feasible; and
- Promote and protect biodiversity and green infrastructure.

Policy 5.5 DEN, prioritises the development of decentralised heating and cooling networks at the development and area wide levels, while Policy 5.6: Decentralised

Energy in Development Proposals (A) requires development proposals to evaluate the feasibility of CHP systems, and where a new CHP system is appropriate, also examine opportunities to extend the system beyond the site boundary to adjacent sites.

Developments should select the energy systems in accordance with the following hierarchy (Policy 5.6 (B)):

1. Connection to existing heating or cooling networks;
2. Site wide CHP network; and
3. Communal heating and cooling.

Where future network opportunities are identified, proposals should be designed to connect to these networks (Policy 5.6 (C)).

Policy 5.7: Renewable Energy expects that within the framework of the Energy Hierarchy, major development proposals will provide a reduction in CO<sub>2</sub> emissions through the use of on-site renewable energy generation. The London Plan also includes a presumption that all major development proposals will seek to reduce CO<sub>2</sub> emissions by at least 20% through the use of on-site renewable energy generation.

Policy 5.8 Innovative Energy Technologies supports the use of alternative energy technologies (e.g. the uptake of electric and hydrogen fuel cell vehicles, hydrogen supply and distribution infrastructure and the uptake of advanced conversion technologies such as anaerobic digestion, gasification and pyrolysis).

Policy 5.9: Overheating and Cooling expects major development proposals to reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the recommended cooling hierarchy.

### 3.2.2 The Renewables Toolkit and the Sustainable Design and Construction Supplementary Planning Guidance

New developments are expected to be assessed using procedures set out in Integrating Renewable Energy into New Developments: Toolkit for Planners, Developers and Consultants, September 2004. This document, otherwise known as the 'Renewables Toolkit', provides a review of the planning context, guidance on feasibility studies, case histories and cost models for a wide range of applications. Renewables are defined as solar hot water, PV, biomass heating or CHP, geothermal, ground source heat pumps, borehole cooling, solar air heating, fuel cells using hydrogen from a renewable source, gas from anaerobic digestion, ground cooling and micro hydro-electric schemes.

In May 2006 the Mayor published a SPG on Sustainable Design and Construction to provide guidance to developers. This SPG sets out the Mayor's essential and preferred standards, covering a wide range of sustainability measures that major developments are expected and encouraged to meet.

### 3.2.3 Delivering London's Energy Future: The Mayor's Climate Change Mitigation and Energy Strategy

The Mayor's Climate Change Mitigation and Energy Strategy sets out Mayor's strategic approach to limiting further climate change and securing a low carbon energy supply for London.

To limit further climate change the Mayor has set a target to reduce London's CO<sub>2</sub> emissions by 60% of 1990 levels by 2025. The Mayor's Climate Change Mitigation and Energy Strategy detail the programmes and activities that are ongoing across London to achieve this. These include:

- RE:NEW – retrofitting London's homes with energy efficiency measures, and helping Londoners save money off their energy bills.
- RE:FIT – retrofitting London's public sector buildings, saving millions of pounds every year.
- RE:CONNECT – ten low carbon zones in London aiming to reduce CO<sub>2</sub> emissions by 20% by 2012 across the community.
- Decentralised energy programme – aiming to supply 25% of London's energy from secure, low carbon local sources.

The Mayor's Climate Change Mitigation and Energy Strategy also details policies and activities underway to reduce CO<sub>2</sub> emissions from new development and transport through the London Plan and the Mayor's Transport Strategy (Ref. 22).

### 3.2.4 Energy Planning - GLA Guidance on Preparing Energy Assessment

The GLA Energy Team published a document Energy Planning - GLA Guidance on Preparing Energy Assessments in September 2011. This note provides details on how to address the London Plan's energy hierarchy through the provision of an energy assessment to accompany strategic planning applications.

### 3.2.5 Vauxhall Nine Elms Battersea Opportunity Area Planning Framework

The London Plan identifies Opportunity Areas (OAs) across the capital, identifying them as places in London with the potential to accommodate substantial numbers of new jobs and homes. Vauxhall Nine Elms Battersea (VNEB) is such an area.



The GLA approved in March 2012 an Opportunity Area Planning Framework (OAPF) for VNEB, which identifies the current challenges and opportunities of the area.

The VNEB OAPF supports a transport interventions package focusing on the delivery of a NLE from Kennington to Battersea via Nine Elms. In association with a package of other transport measures throughout the OA, this aims to achieve the step change in public transport accessibility and capacity that is required to fully realise the development potential and support growth within the area.

The framework also sets out an area specific strategy for energy. The key energy principles of the VNEB OAPF include the delivery of the VNEB district heating network (DHN). The scheme will be designed to enable heat to be supplied from a number of different points on the network.

In spatial planning terms the OAPF sets out an energy master plan, which connects key sites within the OA to a DHN and requires developments connect to the VNEB district energy network. Where a development is completed before the VNEB network is completed, the development should be designed to ensure it can connect to the VNEB network with minimum delay and modifications.

### 3.3 Local Planning Policy

Alongside the London Plan the relevant adopted Local Development Frameworks (LDF) for the LBL, LBS and LBW have been considered within this PSAR and are listed in the following sections.

#### 3.3.1 London Borough of Wandsworth (LBW)

The Local Plan for LBW includes amongst other documents the Core Strategy of the LDF and the Development Management Policies Document (DMPD) (Ref. 23).

##### 3.3.1.1 LBW Core Strategy

The LBW Core Strategy was adopted in October 2010 and sets out the Council's spatial vision and strategic objectives on how the borough should develop over the next fifteen years along with core policies and information on monitoring and implementation.

Policy IS 2 promotes low carbon development and renewable energy by requiring developments to:

- Include measures to improve energy conservation and efficiency and contributions to renewable energy generation;

- Demonstrate and justify their approach to energy conservation as part of an energy assessment;
- Assess the feasibility of combined cooling, heat and power and be designed to connect to decentralised energy, heating and cooling networks wherever possible; and
- Achieve a reduction in carbon emissions in line with London Plan targets through on site renewable energy generation unless it can be demonstrated that such provision is not feasible.

##### 3.3.1.2 LBW Development Management Policies Document

The LBW DMPD published in February 2012 is part of the LDF and supports the LBW Core Strategy and London Plan and sets out the Council's detailed policies for managing development in the borough.

With regard to energy, Policy DMS 3 requires applications for major development to be accompanied by an energy assessment stating how Core Strategy Policy IS2 will be addressed. This should include information on how the following energy hierarchy has been applied:

- Calculation of baseline energy demand and CO<sub>2</sub> emissions including regulated and unregulated energy usages;
- Proposals to reduce CO<sub>2</sub> emissions through the use of passive design and energy efficient design measures that aim to reduce the demand for energy;
- Proposals to reduce CO<sub>2</sub> emissions through connection to existing or planned heating and cooling networks and/or through the installation of on-site communal energy systems (prioritising CHP), where feasible;
- Proposals to reduce CO<sub>2</sub> emissions further through the use of on-site renewable energy technologies.

#### 3.3.2 London Borough of Lambeth (LBL)

The adopted Development Plan for LBL includes amongst other documents the Core Strategy of the LDF and the UDP (Ref. 24) (2007) saved policies beyond 5 August 2010. In addition, Supplementary Planning Document (SPD) (Ref. 25) provides detailed guidance to the policies in Lambeth's UDP and site specific guidance for the development of sites.

### 3.3.2.1 LBL Unitary Development Plan

The LBL UDP was adopted 2007 and similarly to the LBW UDP some of its policies have expired whereas others remain part of the Lambeth's Development Plan.

Lambeth is committed to achieving sustainable development, which is reflected in the objectives of the plan such as to promote energy conservation and sustainable design.

Policy 35 of the LBL UDP states, that all development proposals should show, how they incorporate sustainable design and construction principles, including employing built forms, materials, orientation and layout and renewable energy production, natural ventilation and cooling, where practical, that will contribute to reduced energy consumption and associated emissions. Larger schemes should, wherever feasible, include CHP and community heating.

### 3.3.2.2 LBL Core Strategy

The Core Strategy was adopted in January 2011 and is the first and most important document in the LBL LDF as it sets out the Council's spatial strategy, vision and strategic objectives to be achieved. One of the key themes of the LBL Core strategy is tackling and adapting to climate change.

- Policy S7 Sustainable Design and Construction aims to ensure that future development, including construction of the public realm, highways and other physical infrastructure, achieves the highest standards of sustainable design and construction and subsequent operation by requiring all major development to achieve a reduction in CO<sub>2</sub> emissions in line with London Plan targets through energy efficient design, decentralised heat, cooling and power systems, and on-site renewable energy generation. In addition, this policy aims to safeguard existing heat, cooling and power networks and support the development of new networks.
- Policy PN2 Vauxhall appreciates the link between areas of Nine Elms and Battersea and Vauxhall which make up the London Plan OA (refer to Section 3.2.5 VNEB OAPF). This policy recognises that public transport capacity of this area is currently limited and seeks substantial improvements in the quality, access and capacity of public transport in the OA as a whole.

### 3.3.2.3 LBL Sustainable Design and Construction SPD

This SPD explains and provides further guidance to the interpretation and application of LBL UDP policies, the London Plan and relevant Government policies.

The SPD requires that a sustainability assessment is prepared for new developments. This must include an assessment of the energy demand and CO<sub>2</sub> emissions from proposed major developments, which should demonstrate the expected energy and CO<sub>2</sub> emissions savings from energy efficiency and renewable energy measures incorporated in the development and how this will be maintained throughout the lifetime of the development.

## 3.3.3 London Borough of Southwark (LBS)

The adopted Development Plan for LBS includes amongst other documents the Southwark Core Strategy of the LDF and the saved policies within the Southwark Plan (Ref. 26). In addition, LBS Sustainability Assessment SPD (Ref. 27) provides detailed technical guidance for masterplans/ developments.

### 3.3.3.1 Southwark Plan

The Southwark Plan was adopted in 2007. In 2010 some of the more detailed policies mainly for urban design, open space, housing tenure and transport along with some detailed site allocations were 'saved' until July 2013. The relevant Southwark Plan saved policies include:

- Policy SP 14 Sustainable Buildings;
- SP 18 Sustainable Transport;
- Policy 3.4 Energy Efficiency; and
- Policy 3.5 – Renewable Energy.

### 3.3.3.2 LBS Core Strategy

The Core Strategy was adopted in April 2011 sets out the long term vision, spatial strategy and strategic policies with an implementation plan for the next 15 years until 2026. It sets demanding standards and targets as reduction in CO<sub>2</sub> emissions, protection of other natural resources and environment.

- The Policy 13 High Environmental Standards expects proposed developments to meet the energy targets as set in the London Plan.

### 3.3.3.3 LBS Sustainability Assessment SPD

The SPD gives further guidance on the detail of the LBS's development plan. The Sustainability Assessment 2009 requires that sustainability assessments take place to ensure social, environmental and economic factors are considered and balanced to get the most sustainable development possible. The Council requires a sustainability assessment to be submitted with all development applications proposing ten or more dwellings, or 1,000 m<sup>2</sup> or more of floorspace.

## 3.4 TfL and LU Standards and Guidance Documents

This section includes a number of relevant TfL documents within the LU and TfL Management System. It should be noted that LU Management System conforms to the principles of ISO 14001.

### 3.4.1 Health, Safety and Environment (HSE) Policy

The TfL HSE Policy (Ref. 28) requires improvements in HSE management by actively supporting the Mayor in delivering the environmental strategies on air quality, ambient noise, biodiversity, energy and municipal waste.

It also states that TfL will implement and operate effective risk control systems by providing premises, plant and equipment and systems of work that contribute to a safe and healthy work place and minimise harm to the environment.

TfL has set out environmental objectives and targets and has reported annually on its environmental performance since 2004.

### 3.4.2 Health, Safety and Environment Report

In 2012 TfL has produced an integrated HSE report (Ref. 29), which focuses on TfL's strategic objectives and outcomes in relation to HSE.

The report identified one of the major challenges facing TfL, which is how to reduce its total CO<sub>2</sub> emissions while increasing service capacity. It has set environmental objectives and targets relevant to CO<sub>2</sub> emissions as follows:

- Reduce the normalised emissions (measured in grams CO<sub>2</sub> per passenger km) from its main public transport services by 20% in 2017/18, against a 2005/2006 baseline; and
- Achieve a 40% reduction in total NO<sub>x</sub> emissions by 2017/18 against 2005/06 levels;

It is also expected that over next 10 years the capacity of London's public transport system will increase by 30%. Improve the efficiency of TfL's operations is therefore considered to be essential if CO<sub>2</sub> emissions are to be minimised.

The HSE report states, that the Tube carried 42 million more passengers in 2010/11, a rise of 5% compared to the previous year. The combination of increased passenger journeys and investment in energy saving schemes, such as regenerative braking, reduced normalised emissions by 5% to 72 grams CO<sub>2</sub> per passenger km.

### 3.4.3 Business Plan 2011/12 – 2014/15

Delivering a 'cleaner, greener' outlook for London is a central part of TfL's current Business Plan (Ref. 35), 2011. This reflects TfL's strategic goal of 'tackling climate change and enhancing the environment' and need to reflect this in the way TfL delivers its business.

For example, LU is working to establish new ways of sourcing decentralised and renewable energy. New processes are being put into place that can help LU work with energy companies under the Government's current Feed in Tariff rules. It is also exploring possible partnerships with local energy providers in London.

### 3.4.4 TfL Vision (The Plan – Value and Sustainability Workstream)

The Plan (Ref. 31), issued in March 2012, sets out where Rail & Underground is focusing its efforts to drive a step-change in performance.

One of the Plan's business change programmes is Value & Sustainability, which aims to ensure that a sustainable approach is embedded within Rail & Underground's processes and activities to deliver carbon and energy efficiency. In addition, the Plan promotes reliable and sustainable supplies of energy and asks for a whole life asset approach to climate change.

The Plan states that Value & Sustainability programme will ensure that Rail & Underground contributes to meeting long-term Mayoral commitments on CO<sub>2</sub> and decentralised energy and that it will deliver long-term cost efficiencies to Rail & Underground, protection against energy and carbon price uncertainties, and efficient and effective asset interventions to meet the challenges of a changing climate.

### 3.4.5 LU Environment Strategy 2008-13

The LU Environment Strategy (Ref. 30) (revised in 2011) focuses on the impact of LU activities on the environment and sets environmental priorities until 2013.

LU is committed to continuous environmental improvement by embedding good environmental practices into the business. One LU objective is to reduce greenhouse gas emissions and to deliver a low carbon transport service.

Note that the strategy will be revised in 2013 and the updated TfL Environment Strategy will follow the current LU Environment Strategy. The revision will be TfL wide and updated objectives and targets will be implemented to support the Business Plan and the implementation of the TfL Vision (see Section 3.4.4).

#### **3.4.6 Lighting of LU Assets**

This standard (Ref. 32), updated in 2011, includes the required illuminance levels and general lighting requirements of the LU.

#### **3.4.7 Mechanical Building Services, Utility Provision and Energy Management in LU**

The purpose of this standard (Ref. 33), updated in 2011, is to define the requirements for operational property building mechanical services, the provision of utility connections and energy management and it covers hot and cold water systems; gas, oil and solid fuel systems; ventilation, comfort cooling, air conditioning and heating systems; mechanical services; electrical supplies; and energy management.

#### **3.4.8 LU Asset Management Strategy & Policy 2010**

The Asset Management Strategy and Policy (Ref. 34), issued in 2010, sets out the way LU assets are managed throughout their life cycle. The strategy confirms that LU acknowledges the Mayor of London's CO<sub>2</sub> reduction targets for London (refer to Section 3.2.3 The Mayor's Climate Change Mitigation Energy Strategy) and aims to support their delivery.

In addition, LU has a CO<sub>2</sub> reduction target as part of its overall Strategic Management System. This represents a 16% reduction in LU's CO<sub>2</sub> emissions per passenger kilometre by 2025.

LU has been certified against British Standards Institute's PAS 55, the international asset-management standard, which is recognised cross-industry framework of best-practice systems for asset management.

## 4 Assessment Methodology

The overall strategy and measures identified to reduce CO<sub>2</sub> emissions associated with the operation of the NLE reflect the Mayor's energy hierarchy and include the following:

- Passive design and energy efficiency (i.e. use less energy – 'be lean');
- Efficient supply of services (i.e. supply energy efficiently – 'be clean'); and
- On site renewable energy technologies to provide energy (i.e. use renewable energy – 'be green').

This hierarchy is generally applied to a development as follows:

- The energy demand and CO<sub>2</sub> emissions of a scheme, which represents the development designed just to comply with Building Regulations Approved Document L2A (ADL2A) 2010, are calculated ('baseline scheme');
- Appropriate energy efficiency and passive design measures are determined and applied to the energy calculations, representing an enhanced baseline ('be lean') scheme;
- Appropriate clean energy supply technology (CHP/DEN) is determined and applied to the energy calculations, representing a 'be clean' scheme; and
- Appropriate renewable energy technologies are determined and applied to the energy calculations, representing a 'be green' performance.

Therefore, this OES accounts for these four scenarios in detail.

For the purposes of this report the baseline energy consumption and associated CO<sub>2</sub> emissions of the development represent an estimate of the energy usage of the development where:

- Buildings meet the minimum requirements of Building Regulations ADL 2A 2010 in relation to CO<sub>2</sub> emissions (i.e. the Building Emissions Rate (BER) is equal to the Target Emissions Rate (TER), which is the maximum emission rate permitted by Building Regulations); and
- 'Non-building' infrastructure is constructed to a typical industry standard complying with all other relevant regulations.

At this stage the NLE has not been modelled for ADL 2A compliance, but where appropriate this should be undertaken at detailed design. Energy consumption and associated CO<sub>2</sub> emissions of the NLE are estimated using:

- Technical documentation and schedule of services developed for the NLE (Appendix A);
- Industrial benchmarks such as CIBSE Guide F (Ref.36), CIBSE Guide D (Ref. 37), Guide TM46 (Ref.38), and Energy Consumption Guide 19 (Ref. 39); and
- Previous experience on similar developments modelled with approved software used for Dynamic Simulation Modelling (DSM).

Whole energy use of the NLE is considered in these OES calculations. This includes Building Regulations ADL 2A regulated energy uses (i.e. hot water, space heating, and space cooling, lighting and auxiliary energy) and extra energy uses such as appliances, computers, lifts, escalators, ticket gates etc. (i.e. non-regulated energy uses).

The assessment methodology of renewable energy sources is based on the publication Integrating Renewable Energy into New Developments: Toolkit for Planners, Developers and Consultants, known as the Renewables Toolkit.

An outline strategy has been developed at this stage describing measures, which would be feasible for the NLE to reduce CO<sub>2</sub> emissions associated with the operation of the LU line. The energy saving measures presented within this report will be refined and tested at the detailed design stages of the project.

## 5 Baseline Scheme

This OES considers as the starting point an estimate of the energy usage of the development in operation where buildings meet the minimum requirements of Building Regulations ADL 2A 2010 in relation to CO<sub>2</sub> emissions (i.e. the BER is equal to the TER, which is the maximum emission rate permitted by Building Regulations) and 'non-building' infrastructure is constructed to a typical industry standard complying with all other relevant regulations. Please see the notes in Section 4 for details of the assessment methodology.

It can be noted that the auxiliary loads stated in the table account for fan power, which is a significant consumer of energy, particularly in the ventilation shafts.

The development's estimated energy consumption and CO<sub>2</sub> emissions breakdowns are shown in Table 2 and Table 3, respectively. Figure 2 shows the energy breakdown by uses for the proposed stations.

Stations Energy Breakdown - Baseline

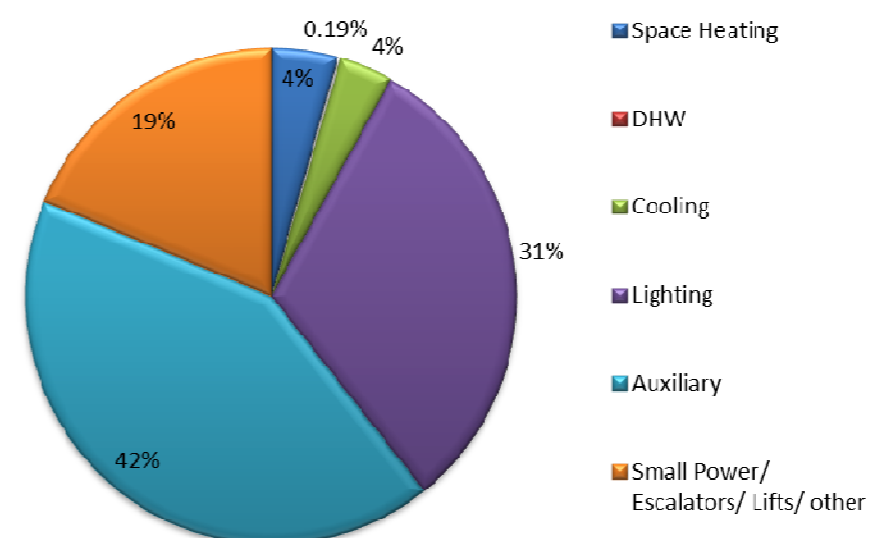


Figure 2 Stations Overall Energy Breakdown (Baseline)

Table 2 Baseline Energy Consumption (estimated)

Scheme	Location	Energy Consumption (MWh/year)						Total
		Space Heating	DHW	Cooling	Lighting	Auxiliary	Small Power/ Escalators/ Lifts/ other	
Baseline Scheme	Battersea station	210	9	141	1269	756	898	3,283
	Nine Elms station	210	9	141	1520	912	853	3,645
	Kennington Park	1	0	30	131	1212	35	1,409
	Kennington Green	0	0	30	94	1172	25	1,321
TOTAL	NLE	420	18	343	3,014	4,052	1,811	9,659

Table 3 Baseline CO<sub>2</sub> Emissions (estimated)

Scheme	Location	CO <sub>2</sub> emissions (tonnes CO <sub>2</sub> /year)						Total
		Space Heating	DHW	Cooling	Lighting	Auxiliary	Small Power/ Escalators/ Lifts/ other	
Baseline Scheme	Battersea station	108	5	73	656	391	464	1,698
	Nine Elms station	108	5	73	786	472	441	1,884
	Kennington Park	1	0	16	67	627	18	729
	Kennington Green	0	0	16	49	606	13	683
TOTAL	NLE	217	9	177	1,558	2,095	936	4,993

## 6 Passive Design and Energy Efficiency Appraisal

The design of the NLE is fully integrated with a sustainability strategy to bring about savings in CO<sub>2</sub> emissions.

The following sections list passive design and energy efficiency measures that can be incorporated into the design of the NLE to reduce energy consumption and therefore enhance its environmental performance.

In addition to the measures, which are considered to be implemented as part of works under this TWA Order application, a number of features and opportunities have been identified, which are not part of the proposed works and fall outside of the remit of the NLE design team. These measures, however, will have an impact on the operational emissions of the NLE and are therefore listed in this report.

### 6.1 Passive Design

Based on the initial calculations and the project's character, a number of passive design measures have been considered for the NLE. These are listed in the following sub-sections.

#### 6.1.1 Potential for natural ventilation

The energy consumption associated with mechanical ventilation has been identified as one of the highest amongst the regulated energy uses and although the nature of the scheme does not allow sole dependence on natural ventilation, its potential will be maximised through the design.

Ventilation shafts will be designed to operate without fan assisted ventilation under normal operating conditions. The size of these shafts will be of sufficient diameter to allow for passive ventilation with a bypass allowing fans to be used when needed. Fan assisted tunnel/platform ventilation will be required under the following circumstances only:

- Testing of fans – once per week for 15 minutes;
- Emergencies (e.g. event of fire, stalled train event, etc.) – exceptional event;
- When temperature in the tunnels raises above the comfort levels - partial load only in summer months.

Ticket halls and other passenger circulation areas will be naturally ventilated as well as underground platforms. Complex natural ventilation modelling will be carried out at detailed design stages of the project to ensure that sufficient ventilation levels are achieved in all relevant areas.

In addition, the opportunity for utilising heat stacks at Kennington Park to provide means of natural ventilation and also as an energy source for heating of the staff areas is being explored. Its feasibility will be further investigated at later stages.

#### 6.1.2 Platform screen doors

Platform screen doors (PSDs) were considered for both proposed stations. PSDs could improve climate control within the stations by physically insulating them from the tunnels. Hence the heat associated with the trains braking would be prevented from entering the station. Draught and air pressure caused by trains would be reduced providing more comfort to the passengers at the stations. PSDs could also improve station safety and allow trains to enter the stations at higher speed.

However, the current design is to provide ventilation of the tunnels via air exchange with the stations. The heat would be obstructed from venting through the platforms due to PSDs, making thermal conditions in the tunnels and in the trains (which are currently not air-conditioned) unacceptable for passengers. Additional ventilation would be needed to counterbalance this effect including either increased auxiliary power of fans or added draught relief.

Partial height PSDs, which do not significantly affect the air exchange, could be incorporated in the design. However, the inclusion at this stage would restrict door configuration of any future trains. Therefore, partial height PSDs are not proposed at this stage, but the design will make passive provision to incorporate them in future.

#### 6.1.3 Promotion of daylighting

Daylighting will be promoted wherever feasible in order to reduce energy consumption associated with artificial lighting. Additionally, a naturally lighted environment enhances the standard of indoor comfort for the end users.

As the vast majority of the NLE will be situated underneath buildings or below ground the potential of utilising daylighting is limited.

Daylighting will be utilised where a façade exists along the building envelope by maximising transparent areas.

The potential of utilising light tubes for transport of light to locations below ground is also being investigated. Based on the design proposals, this option will not be viable for the proposed Battersea station. The design of the Nine Elms station is not yet fully developed, therefore the cost efficiency and practical deliverability of the light tubes cannot be currently evaluated in full. This will be completed at the detailed design stage.

#### 6.1.4 Building orientation

Most of the building structure, including staff offices and ticket halls, will be located below ground and therefore favourable building orientation will have only a minimal impact on the energy performance of the building.

#### 6.1.5 Shading systems

As stated above, the majority of the development will be formed by an underground structure. Over ground exposed areas will be minimal and will not be adjacent to any permanently occupied spaces. It is not currently expected that the buildings will suffer from extensive solar gains and hence the provision of solar shading systems is not pursued at this stage.

The design of the station buildings is however not yet fully developed. Therefore, the potential of incorporation of shading systems will be revisited in the design process.

#### 6.1.6 Thermal mass

Thermal mass is a design concept utilising the abilities of the mass of the building to store heat and minimise temperature fluctuations. Thermal mass will be used wherever feasible to efficiently manage the risk of overheating and the need for mechanical cooling in summer and the need for heating in winter.

#### 6.1.7 Efficient envelope and reduced air permeability

The main benefit of airtight and well insulated building envelopes is the minimisation of heat losses in winter.

Based on the preliminary estimations the heat demand of the development will be minimal compared to the other energy uses such as ventilation or electrical consumption associated with lighting and small power (refer to Section 5, Table 1 and Table 2).

In addition, the nature of the underground stations does not allow for airtight construction as a consequence of the natural ventilation strategy and the movement of passengers in and out of the building.

Therefore, it is considered that the NLE will not benefit from improved thermal insulation and airtight construction. The Building Regulations ADL2A 2010 limiting U-values will be applied to the NLE where appropriate.

#### 6.1.8 Trombe walls & wind catchers

The below ground structure of the NLE with a minimum of available external areas and the likelihood of OSDs being developed on top of the stations do not offer adequate space to incorporate wind catchers and/or Trombe walls.

#### 6.1.9 Active landscaping (tree cover for natural shading, passive cooling, etc.)

The proposed stations are located in dense urban areas and will be adjacent to the OSDs. Hence the provision of active landscaping to be provided as part of works under this TWA Order will be limited. However, landscaping proposals are set out in AppendixM: Design and Access Statement of ES Volume II. TfL will encourage the developers of the OSDs to maximise the landscape areas as part of their detailed proposals.

In addition, living roofs will be promoted wherever feasible, specifically at Kennington Park, where greater design opportunities have been identified compared to Battersea.

#### 6.1.10 Energy awareness scheme for staff and public

As best practice, TfL is running an Energy Savings Challenge to encourage staff and public to reduce energy usage. This provides an opportunity for TfL staff to get involved and do their bit to save energy in their workplace.

The following initiatives are covered under Energy Saving Challenge:

- Destination Green;
- Station Energy Dashboard;
- Energy Champion; and
- Energy News.

Both stations and their staff will take part in the above schemes.

#### 6.1.11 Humped alignment

Humped alignment means that the station is raised above the inter-station alignment. Trains entering the station roll up the 'hump' and require less energy for braking; they also use less energy to accelerate when leaving the station as they roll off the hump. In addition, by incorporating humped alignment the depth of the stations is reduced, which consequently reduces the lengths of stations' escalators.



An optimal humped alignment is not always possible because of below ground conditions. This is also the case of the NLE. The underground obstructions make it unfeasible to incorporate optimal sloping. However, the potential to incorporate humped alignment at least partially has been maximised and it is now fully incorporated in the design of the tunnels at both proposed stations.

## 6.2 Energy Efficient Design

The preliminary calculations (Section 5) show that the NLE's highest loads are associated with non-regulated energy uses fuelled by electricity and these therefore represent the best potential for high CO<sub>2</sub> emissions savings.

The key energy efficiency measures, which have been considered for integration into the NLE, are included in the following sub-sections.

### 6.2.1 Energy efficient lighting and controls

High efficiency ballasts will be specified to maximise operational efficiency serving as a tool for energy saving. The best available technology at the time of detailed design will be specified considering the whole life cost of the system (i.e. low energy, low maintenance and long life fittings).

Lighting levels will be specified in line with document Lighting of LU Assets (2011), which lower the levels of lighting required compared to the previous LU standards.

Lighting zones and controls will be provided as appropriate to cater for different operational needs. This will also allow an appropriate level of lighting to be selected at different periods in order to minimise energy consumption.

Daylight sensors will be provided for the external lighting and for the internal areas, which directly benefit from daylighting. Time switches and Passive Infra Red (PIR) sensors will be provided in the staff areas. The controls will be also linked to the BMS. This will allow efficient management, which will prevent the lighting to be switched on when not needed, but still ensure that high security standards are maintained.

### 6.2.2 Heat recovery – Staff areas

Wherever feasible, waste heat from the stations' operation will be recovered and reused. Mechanical ventilation heat recovery systems will be implemented in the offices and staff rooms.

Systems recovering heat from station equipment (such as signalling rooms and IT servers) will be used within both stations. Although this is considered to bring only

a marginal reduction in overall CO<sub>2</sub> emissions of the NLE, it is being considered as good practice.

### 6.2.3 Efficient cooling system – Staff areas

Based on the TfL's and LU's requirements and targets, air conditioning will be avoided wherever possible. The areas, which are currently expected to require cooling, are staff offices, server and signalling rooms.

A number of options exist to provide cooling to these areas efficiently. High efficiency chillers will be considered at this stage of the assessment to provide all cooling loads of the development. The following sections of this report will further investigate opportunities of incorporating CCHP, connecting the development to a DEN or OSDs, or utilising ASHP or GSHP.

### 6.2.4 Heat recovery and efficient cooling system– Tunnels

Although there is currently no need to cool the tunnels, it may be required in future as a result of climate change. Therefore, consideration has been given to future proof the system by incorporating water pipes within the tunnel lining.

Document Potential for Heat Recovery from London Underground Stations and Tunnels (Ref. 40) suggests that 36%-50% of any change in external conditions could manifest itself in the underground temperatures (36% is based on short-term changes and the response to a longer-term change is expected to be a 1:1 correlation with changes in annual average outside temperature). In the longer-term, however, the underground can be assumed to warm as a consequence of climate change at a similar magnitude as the outside, although with some time delay. By incorporating the thermal pipes into the tunnel's structure, the NLE would be future proofed in case of the temperature raise.

The incorporation of this technology early on in the tunnel design stage is more cost effective than incorporating it retrospectively to the concrete segments and much more cost effective than retrofitting completed tunnels.

Installing the pipes inside the tunnel construction would allow either the efficient distribution of cooling medium within the tunnels or the extraction of energy out of the surrounding soil and surplus heat inside the tunnel.

The extraction of heat energy would reduce the energy needed to provide cooling and the tunnels themselves would generate a source of heat for the surrounding heat consumers (OSDs, commercial and/or residential buildings in the vicinity of the NLE or a local DEN). Section 7 of this report analyses this opportunity in further detail. Typical heat extraction would range from 10-30 W/m<sup>2</sup>. Using heat

pumps to extract this heat out of the tunnel construction would be considered as renewable energy. As such this system is further discussed in Section 8.

As the existing rolling stock does not include air-conditioning at present, to provide adequate thermal conditions in the tunnels/trains and on the platforms in summer, mechanical ventilation is used. The associated fans energy in summer months has been identified as one of the largest energy consuming uses of the NLE.

As described above it is expected that in future the temperatures will increase and subsequently the energy consumption of the mechanical ventilation will be higher. Furthermore, mechanical ventilation may not be sufficient under these circumstances as its cooling effect is reduced on warm days. Therefore, air-conditioning will have to be specified. This would typically be provided by Air Handling Units (AHU) with cooling coils, which would represent significantly higher energy consumption than an alternative system providing coolth via thermal pipes incorporated in the tunnel lining.

Should the thermal pipes be incorporated to distribute coolth within the tunnels, the source of cooling could be either a traditional system or renewable technology such as borehole cooling. Renewable technologies are further discussed under Section 8 Be Green – Renewable Energy Technologies.

The decision whether to install thermal pipes within the tunnels of the NLE will be part of the detailed design stage. A detailed thermal modelling exercise must be carried out to identify the most suitable areas for the pipes installation. It should be noted that the thermal pipes would not be installed along the entire length of the tunnels, but only where the structure allows it and also where a sufficient amount of heat is accumulated.

Note that at this stage of the project for calculation purposes it is considered that air-conditioning is not specified for the tunnels of the NLE.

### 6.2.5 Efficient heating system – Staff areas

The heat profile of the NLE will be characterised by insignificant Domestic Hot Water (DHW) loads and minimal space heating loads (refer to Section 5, Table 1 and Table 2).

Although gas fired heating systems are considered energy efficient, in this instance, because of safety risks identified by Mechanical and Electrical (M&E) engineers, it is not recommended to provide gas within the underground station environment if at all possible. If this is not achievable a number of mitigation measures such as locating the gas plant well away from the underground station environment must be addressed.

The following sections of this report will discuss the potential for connecting the NLE to a DEN or to the plant rooms being developed as part of the OSDs or to provide heating by incorporating renewable energy technologies such as Air Source Heat Pumps (ASHP), Ground Source Heat Pumps (GSHP) and/or Solar Hot Water (SHW) systems. At this section of the report electrical heating is considered for the calculation purposes.

### 6.2.6 Thermal zoning and controls

The NLE will be appropriately zoned to allow for an individual temperature control for different areas of the stations.

### 6.2.7 Sub-metering of high energy consuming uses and zones

Energy metering of high consuming uses such as escalators, lifts, fans and pumps, lighting and small power, etc. will be provided to allow for efficient management of the buildings. All sub-meters will be connected to the BMS.

### 6.2.8 BMS

A BMS will be provided for the NLE to control and monitor the building's services. In addition, the BMS will be specified to allow remote control of the systems in future. I.e. the BMS will be linked to network-wide Energy Management systems once these become available.

### 6.2.9 Energy display devices

Alongside the Energy Awareness schemes, which will be run by TfL, energy display devices will be provided where appropriate to show the energy performance of the stations to staff and/or passengers.

### 6.2.10 Efficient fans and pumps

Although natural ventilation strategy is promoted wherever feasible, mechanical ventilation will need to be installed in some areas. To reduce the energy associated with the mechanical ventilation system, high efficiency fans will be incorporated into the design including variable speed drives.

### 6.2.11 Efficient office equipment & staff appliances

Where provided, office equipment and staff appliances will be selected in line with TfL standards and based on whole life cost analysis. This could include energy efficient appliances and low energy computers and screens.

**6.2.12 Efficient lifts and escalators**

A transportation demand analysis was carried out to determine the optimum number and size of the lifts and escalators.

The following measures could provide significant savings in energy consumption associated with the operation of stations lifts and escalators and have been therefore considered for the scheme:

- Energy efficient lighting to be utilised in the lift car and also in all display units associated with the lifts;
- ‘Standby mode’ operation was considered. When the lifts have been inactive for a specified time the internal car lighting and ventilation systems would shut down, resulting in energy savings. However, the lifts will form part of the stations fire fighting strategy, and therefore for safety reasons this measure was found inappropriate for the NLE;
- Regenerative drive unit to be specified for lifts. This unit allows the recovery of energy for example as the lift brakes;
- Drive controller capable of variable speed, variable voltage and/or variable frequency control of the drive motor to be implemented for the escalators as appropriate. Consideration will be also given to incorporation of load sensing devices synchronising motor output to passenger demand.

**6.2.13 Inverter substations utilising energy from regenerative braking**

Regenerative braking is a type of energy recovery when the kinetic energy from braking is converted into another form of energy, which can be re-used either within the trains to supply their auxiliary needs or elsewhere within the network.

The regenerated energy often exceeds the auxiliary energy needs of the train and other trains in the vicinity. To recover the remaining energy and be able to utilise it for example within the station, inverters can be installed in the track to channel the excess energy back into the network to supply auxiliary loads (Source: *Energy Efficiency in Singapore’s Rapid Transit System* (Ref. 41)).

The use of inverters can improve the receptivity of the traction network and consequently reduce the rate of wear on the train’s mechanical brakes. This decreases the costs for train maintenance. Computer simulations including multi-train modelling must be carried out at later stages of the project to determine the optimum location of the inverters (i.e. where the highest global energy is recovered as compared to the number of units of inverter installed).

The feasibility of the inverters installation has not been determined at this early stage of the project. Therefore, its benefits have not been quantified as part of this OES.

Also note that regenerative braking is outside of the scope of this report, although its use will have indirect beneficial impact on the energy consumption of the NLE (i.e. without the regenerative braking, the energy to slow down the train would dissipate as heat, which would give undesirable raise to the temperatures in the tunnels hence increase the cooling/ventilation rates).

**6.3 Summary Be Lean Scheme**

The enhanced scheme considered the incorporation of energy efficiency and passive design measures into the Baseline scheme. The resulting savings in CO<sub>2</sub> emissions for the NLE are savings that exceed the CO<sub>2</sub> emissions associated with the Baseline scheme.

Table 4 summarises the conclusions of the feasibility analysis described in Section 6.1 and 6.2.

**Table 4 Summary of Passive Design and Energy Efficiency Measures and their Feasibility to NLE**

Nr. 6.1	Measures: Be Lean - Passive Design	Feasibility	Potential for CO <sub>2</sub> savings	Note
1	Potential for natural ventilation	Medium	High	CFD modelling will be carried out to determine to which extent is natural ventilation feasible.
2	Platform screen doors	Low	Low	Passive provision will be made to incorporate partial height PDS in future to ensure comfort and safety of the passengers. No direct benefits in CO <sub>2</sub> emissions are accounted for.

3	Promotion of daylighting	TBC at detailed design	Medium/Low	Once the design of OSDs is fully developed, the incorporation of light tubes in the design of the stations buildings will be investigated.
4	Building Orientation	Low	Low	Not feasible for an underground development.
5	Shading systems	Low	Low	Not feasible for an underground development.
6	Thermal mass	Medium	Medium	Materials with high thermal mass will be used.
7	Efficient envelope and reduced air permeability	Low/Medium	Low	Limited only to staff areas (e.g. station office).
8	Trombe walls and wind catchers	Low	Low	Not feasible for an underground development.
9	Active landscaping	Low	Low	To be provided as part of the OSDs' design, which is outside of the scope of this study.
10	Energy awareness scheme	High	Low	Destination Green & Energy Station Challenge
11	Humped alignment	High	Not directly applicable	Partial humped alignment is incorporated into the design as practicably possible.

Nr. 6.2	Measures: Be Lean - Energy Efficiency	Feasibility	Potential for CO <sub>2</sub> savings	Note
1	Energy efficient lighting and controls	High	High	Appropriate low energy, low maintenance and long life lighting fittings will be specified allowing zoning and including controls as appropriate.

2	Heat recovery – staff areas	High	Low	MVHR will be specified for areas where air leakage rates are controllable. Systems recovering heat from station equipment will be used.
3	Efficient cooling system – staff areas	High	Low	Applicable to staff offices, server and signalling rooms.
4	Heat recovery and efficient cooling system – tunnels	TBC at detailed design	Low (short term)/ High (long term)	The feasibility of tunnel lining to be determined at detailed design stages.
5	Efficient heating system – staff areas	High	Low	Applicable to staff offices, server and signalling rooms.
6	Thermal zoning and controls	High	Medium	M&E design will allow appropriate zoning of the building and appropriate controls
7	Sub-metering of high energy consuming uses and zones	High	Low	Sub-meters will be specified to the relevant areas and energy uses and will be connected to BMS.
8	BMS	High	Medium	BMS will be specified, allowing in future remote control.
9	Energy Display Devices	Medium	Low	Energy display devices to display energy consumption to the building users will be provided as appropriate.
10	Efficient fans and pumps	High	High	High efficiency fans and pumps will be specified.
11	Efficient office equipment and staff appliances	High	Low	Appliances and equipment will be selected based on their whole life cost.
12	Efficient lifts and escalators	Medium	Medium	Energy saving lifts and escalators will be specified.

13	Inverter Substations Utilising Energy from Regenerative Braking.	TBC at detailed design	Not directly applicable	The use of inverters located on the track will be considered at detailed design stages. Multi-train modelling must be carried out to determine the exact location of inverters.
<p><i>Key:</i></p> <p><i>Green – measures accounted for within the 'be lean' calculations.</i></p> <p><i>Red – measures identified as not feasible for the NLE.</i></p> <p><i>Orange – measures are being taken forward to the next stages of the project, however, have not been currently included in the OES calculations.</i></p>				

Stations Energy Breakdown - Be Lean

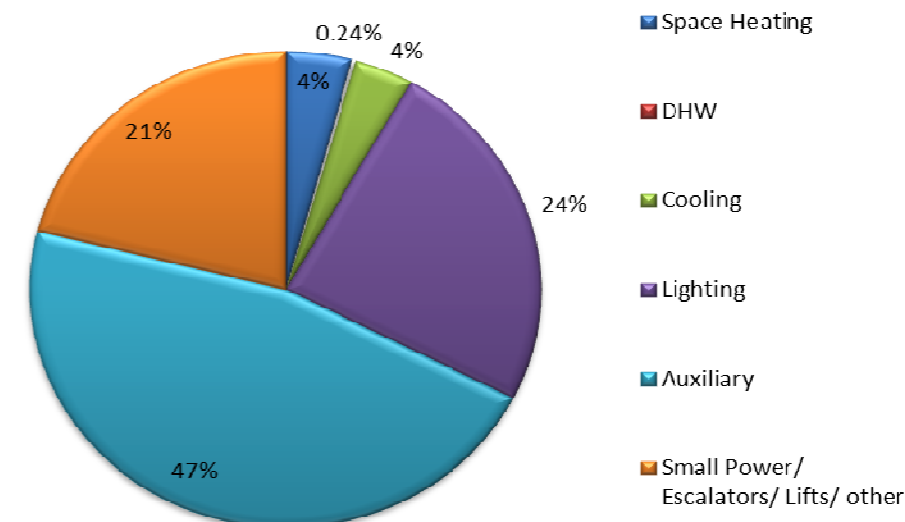


Figure 3 Stations Overall Energy Breakdown (Be Lean)

Table 5 Be Lean Energy Consumption (estimated)

Scheme	Location	Energy Consumption (MWh/year)						Total
		Space Heating	DHW	Cooling	Lighting	Auxiliary	Small Power/ Escalators/ Lifts/ other	
Be Lean Scheme	Battersea station	154	9	110	755	595	770	2,393
	Nine Elms station	152	9	110	904	719	732	2,627
	Kennington Park	1	0	28	78	1070	28	1,204
	Kennington Green	0	0	28	56	1037	20	1,141
TOTAL	NLE	308	18	277	1,793	3,420	1,550	7,366

Table 6 Be Lean CO<sub>2</sub> Emissions (estimated)

Scheme	Location	CO <sub>2</sub> emissions (tonnes CO <sub>2</sub> /year)							Savings in CO <sub>2</sub> emissions
		Space Heating	DHW	Cooling	Lighting	Auxiliary	Small Power/ Escalators/ Lifts/ other	Total	
Be Lean Scheme	Battersea station	80	5	57	391	307	398	1237	24%
	Nine Elms station	79	5	57	468	372	378	1358	
	Kennington Park	1	0	15	40	553	14	623	
	Kennington Green	0	0	15	29	536	10	590	
TOTAL	NLE	159	9	143	927	1,768	801	3,808	

## 7 Be Clean – Efficient Supply of Energy

### 7.1 Introduction to Technology

Conventional thermal electricity generation is typically only around 40% efficient. Almost all of the other 60% is dissipated in the form of heat at the generator before any power is delivered to the distribution system, such as the national grid, where further grid losses are incurred. Overall, national electricity generation and distribution is only about 35% efficient.

CHP technology converts natural gas into both electrical power and heat in a single process at the point of use. CHP is more energy efficient (see Figure 4) due to the utilisation of the waste heat by-product of the electricity generation process and minimal distribution losses due to its close proximity to the load, which results in CO<sub>2</sub> emissions savings and potential utility cost benefits.

Whilst CHP technologies simultaneously produce heat and power, tri-generation implies the simultaneous production of power (electricity), heat and cooling from a single fuel (i.e. CCHP).

A DEN is a system for distributing heat generated in a centralised location. The energy centre serving the area often includes a CHP plant. A DEN with CHP is considered one of the most cost-effective ways of cutting CO<sub>2</sub> emissions for multi-building applications, and has one of the lowest CO<sub>2</sub> footprints of all fossil generation plants. Additionally, DENs are prioritised by the regional and local planning authorities. Specifically, Policy 5.5 of the London Plan expects 25% of the heat and power used in London to be generated through the use of localized decentralized energy systems by 2025.

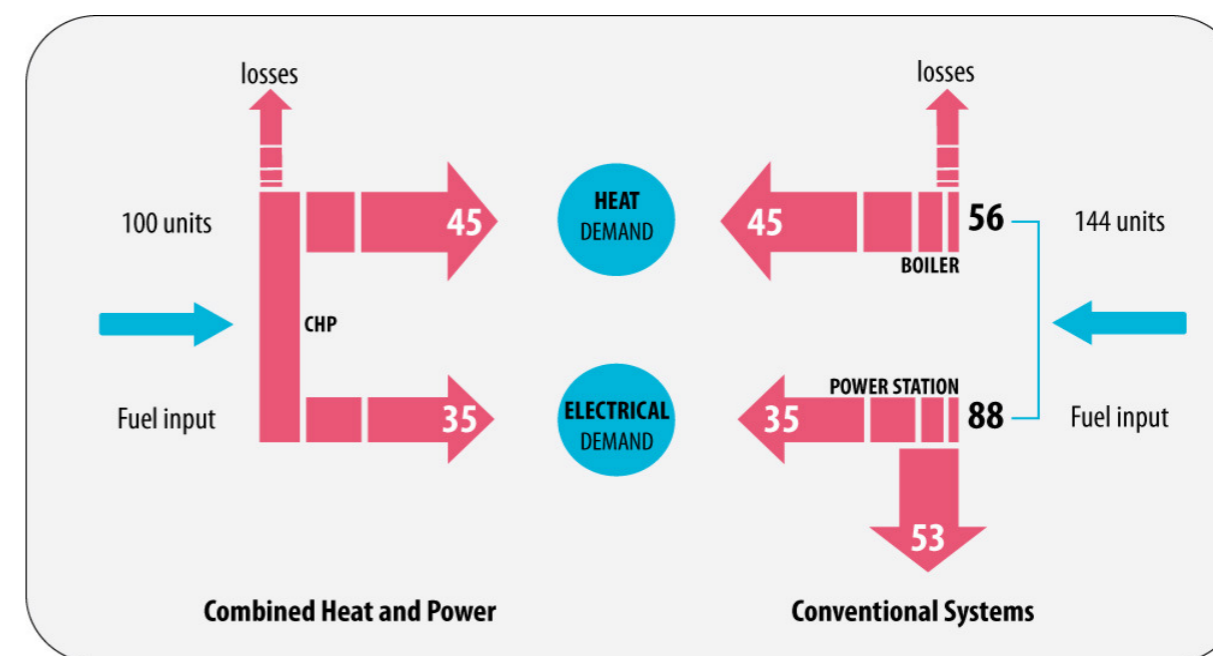


Figure 4 CHP Energy Flow Diagram

## 7.2 Applicability to the NLE

As required by the London Plan and local planning policies, consideration has been given to the use of a decentralised energy supply and connection to existing/proposed CHP distribution networks.

### 7.2.1 Local DEN to Supply Energy

As supported by the VNEB OAPF, the NLE could be designed to connect to the VNEB DEN and procure heat and/or electricity from this network.

The project team participated in the VNEB DEN Steering Group meeting and is currently liaising with the DEN masterplan design team in order to secure connection to the future DEN which, according to the VNEB OAPF, will be powered by a mixture of technologies including CHP.

It should be noted that development of the VNEB DEN network is at an early stage, and therefore there is a degree of uncertainty associated with its availability for the early phases of the NLE, i.e. it is possible that the early phases of the NLE will be brought forward before the DEN is up and running.

The NLE's heat loads will not be significant and the CO<sub>2</sub> emission reductions associated with the heat provided by the DEN would be minimal, therefore it is currently considered that the cost and embodied energy associated with the infrastructure required to allow this connection would significantly exceed the benefits of the direct connection.

However, the LU network could benefit from the electricity generated by the CHP units located within the DEN energy centres. Assessed according to Building Regulations methodology (whereby CO<sub>2</sub> emissions benefits are allocated to the heat provided by the CHP system) the carbon emissions factor of this electricity will be no different from that supplied by the grid and therefore there will be no direct benefits in terms of CO<sub>2</sub> emissions savings. The benefits could be mainly economical and as such these will not be evaluated as part of this study. It should be noted that the location of the electrical sub-stations in relation to the future DEN would be critical to determine feasibility of this solution.

### 7.2.2 NLE to Supply Heat

An initial consideration has been given to utilising waste heat from the tunnels and supplying it to the VNEB DEN or any OSD or other locally available network (see Section 6.2 of this report for further details on the tunnel heat recovery system).

There are currently no examples of actual system with waste heat recovery to third parties on the LU although this system is currently being considered for a number of sites. According to document Potential for Heat Recovery from London Underground Stations and Tunnels the reasons for this include mainly the relatively low grade of heat, the costs and challenges of capturing and transporting heat and difficult financial justification. Note that this document refers to existing tunnel networks.

The new tunnels are expected from the outset to see lower operating temperatures than the existing deep tube network thanks to the incorporation of passive design and energy efficiency measures listed in Section 6. Therefore, the heat available for heat recovery is most likely to be of even lower grade than that available from the existing tunnels.

However, to determine with any certainty the air temperatures in the new network a detailed feasibility study must be carried out. Heat recovery is currently not included in the calculations, but it is recommended that this option is taken forward and considered at detailed design stage of the project.

The potential stakeholders who could benefit from the tunnels heat recovery system could be either nearby DEN providers (such as VNEB DEN) or OSDs (see Section 7.2.3).

Heat pumps could be used to recover a proportion of the waste heat from the tunnels. This system could provide higher seasonal efficiencies compared to a more traditional ASHP or GSHP and it is further discussed in Section 8 Be Green – Renewable Energy Technologies.

### 7.2.3 Integration with OSDs

Opportunities for the development's connection to OSDs energy centres of both stations will be explored. The benefits of such connection could include the following:

- Increased efficiency of plant equipment;
- Reduced space requirements on the stations plant rooms;
- Greater opportunities to recover Underground waste heat (refer to Section 7.2.2); and
- Potential to utilise efficient gas fuelled systems acceptable due to the reduced safety risks associated with the location of the energy centre above ground.

In addition, the OSDs energy centres could include heat exchangers to connect to the VNEB DEN. As discussed in Section 7.2.1 the cost of the infrastructure, which

would be required to connect only the NLE would significantly exceed its benefits. However, if the infrastructure would be developed in conjunction with the OSDs, the NLE could utilise part of the low carbon heat delivered via the VNEB DEN in a cost effective way.

Furthermore, renewable energy technologies such as GSHP could be applicable if a coordinated approach is taken by TfL and the OSDs developers. This could offer more balanced heating and cooling loads than the loads NLE would have on its own. GSHP are discussed in detail in Section 8 of this report.

The potential to integrate with the OSDs by any of the above options could be beneficial for the project in terms of CO<sub>2</sub> reductions, cost effectiveness and space implications. However, the design of the OSDs is not in the scope of this study and the OSDs developers have not been yet selected. Therefore, the details of the integration cannot be currently assessed and neither can be the associated benefits quantified and included in the calculations.

TfL will however actively look for opportunities to link to the OSDs once the developers are selected and the design allows such discussions.

#### 7.2.4 On-site CHP

Based on the initial estimations included in Section 6.3 it was concluded that the heating base loads of the NLE on its own do not allow for an efficient operation of an on-site CHP plant. Specifically, the DHW loads are negligible and the stations space heating loads alone (presented in Table 3) would not ensure that a CHP unit would operate for the optimal number of hours during the year. Additionally, the on-site plant room is restricted in terms of space and also safety requirements (i.e. the requirement to avoid gas within the underground station environment if possible).

#### 7.2.5 On-site CCHP

A CCHP system is a CHP system with the inclusion of an absorption chiller (i.e. a chiller driven by heat) to provide space cooling from the CHP waste heat recovery system. This potentially allows the system to function effectively through the summer period when space heating requirements are low.

Due to the high capital costs for CCHP, limited site heating and cooling loads and therefore limited improvement in CO<sub>2</sub> savings offered by the CCHP system, the level of additional plant space and system complexity, CCHP is not proposed for the NLE.

### 7.3 Summary Be Clean Scheme

The 'be clean' analysis outlined the opportunities to connect to the OSDs and/or VNEB DEN and to install an on-site CHP/CCHP. The connection to the OSDs energy centres have been identified as potentially viable for the NLE.

Since the energy strategy for the OSDs is currently not known the potential benefits of the connections to these networks could not be estimated at this stage.

Table 7 summarises the results of the feasibility analysis described in Section 7.2.



**Table 7 Summary of Be Clean' Measures and Their Applicability to NLE**

Nr. 7.2	Measures: Be Clean	Feasibility	Potential CO <sub>2</sub> emissions savings	Note
1	VNEB DEN supplying electricity and/or heat demand of the NLE	TBC at detailed design	<b>Electricity</b> – Not directly applicable  <b>Heat</b> – Low/Medium	Consultations with VNEB Energy and Utilities Steering Group are being undertaken.  The feasibility of the electrical supply possibilities to be determined at detailed design stages.  The feasibility of heat supply from VNEB would be low if only the NLE would be connected. In case the collaborative approach is taken with OSDs, the feasibility could be higher.
2	NLE supplying waste heat from the tunnels to OSDs/DEN/ etc.	TBC at detailed design	Low/Medium	A detailed study must be carried out to determine whether any waste heat is available and what is the anticipated temperature (grade) of this heat. In addition the potential customers must be identified.
3	Connection to OSDs: Specification of common energy centres for the Underground stations and OSDs	TBC at detailed design	Medium	The OSDs developer has not been identified yet. Once they are appointed, TfL will initiate discussions and pursue common strategy including a combined energy centre.
4	On site CHP	Low	Low	Stand alone CHP not viable due low heat loads and plant constraints.
5	On site CCHP	Low	Low	Stand alone CHP/CCHP not viable due low heatloads, cost and complexity of the system and plant constraints.
Key: <i>Green – measures accounted for within the calculations.</i> <i>Red – measures identified as not feasible for the NLE.</i> <i>Orange – measures are being taken forward to the next stages of the project, however, have not been currently included in the OES calculations.</i>				

## 8 Be Green – Renewable Energy Technologies

In line with national and regional policy guidance, consideration has been given to the inclusion of renewable energy technologies within the NLE and this section provides an appraisal of these technologies.

### 8.1 Appraisal of Renewable Technologies

#### 8.1.1 Wind Technology

The location of wind turbines is critical to their performance and they are typically situated in regions that frequently develop strong winds. London does not generally have a good wind climate for power generation – the high density of buildings considerably slows the wind as it passes across the city. Compared to open spaces with uninterrupted laminar air movement, the highly turbulent air movement in built up urban areas makes this technology poorly suited for this location.

Additionally, wind turbines are subject to vibration and would be detrimental to the sensitive building uses. There are also concerns that the inevitable blade wind noise could prove problematic with regard to the local residents. Alongside with space constraints associated with the development the reasons listed above make wind technology impractical for the NLE.

#### 8.1.2 Solar Thermal (Solar Collectors)

Solar collectors use free energy from the sun to provide DHW.

It is currently understood that OSDs will be developed on top of both proposed stations, it is therefore expected that there will be no available area for incorporation of solar collectors. This has been confirmed for the Battersea station.

In the unlikely situation that the design of the OSD of the Battersea station would allow incorporation of renewable energy systems it is preferable to employ the sun-exposed areas to install PV cells to generate electricity, rather than solar panels to provide DHW as it was estimated that PV cells would provide higher savings in CO<sub>2</sub> emissions than solar thermal. Solar thermal systems are therefore not considered appropriate for the NLE.

#### 8.1.3 Photovoltaic panels

PV panels offer the opportunity to generate electricity from solar energy.

As stated in Section 8.1.2, it is expected that no roof areas will be available for incorporation of PV panels. This has been confirmed for the Battersea station. Once the detailed design of OSD at Nine Elms is developed the potential of incorporation of PV panels will be revisited at this location.

Currently, no PV panels are considered within the calculations of this OES.

#### 8.1.4 Biomass

Biomass heating works effectively where it supplies for the base heating load all year round. However, the implementation of biomass has issues related to space constraint, transport, supply chain and air quality:

- A biomass boiler would require additional plant room space, and fuel storage;
- Transportation of biomass into central London is inherently not a sustainable activity;
- Although the biomass supply chain is rapidly developing, there are constraints linked to the sustainability of biomass sources (i.e. uncertainties about the provision of biomass from certified sources); and
- Biomass boilers emit more NO<sub>x</sub> and PM<sub>10</sub> (i.e. particles with a diameter smaller than 10 µm) than conventional gas boilers, which would cause air quality concerns, particularly considering the NLE is located in an Air Quality Management Area (AQMA). Additionally, document The Mayor's Air Quality Strategy (Ref. 42), states that there is a risk that the widespread inclusion of biomass boilers in developments could compromise the achievement of local air quality objectives in London.

The biomass boilers are therefore not considered viable for the NLE.

#### 8.1.5 Energy from Waste

Methane gas from sewage or waste can be captured and used for firing boilers.

The NLE will not generate sufficient waste to make this option worthwhile. Moreover plant space requirements and emissions (air quality and odour) would be an issue. This option is therefore not considered feasible.

#### 8.1.6 Borehole Cooling

Borehole cooling was considered to provide cooling loads of the tunnels of the NLE.

Borehole systems may be either open, when water is extracted from a borehole and discharged through a heat exchanger to waste in a river or sewer. This could affect the local water table and permission would be required. In a closed system water is circulated through pipes extending below the water table.

Although cooling is currently not required for the tunnels, it may be needed in future (refer to Section 6.2.4). Passive provision for borehole cooling could be therefore provided rather than the full system installation. The cost of installing boreholes as part of the ground works for the NLE would be significantly lower than if this system is installed anytime post completion.

The location of the NLE has likely the potential for efficient borehole cooling operation. This is based on the fact that there are other GSHP boreholes located within 500m of the proposed route and that the area is underlain by the highly productive principal Chalk (and associated Thanet Sands) aquifer.

Two existing and licensed GSHP systems in the area are drilled into and extract from the Chalk aquifer, to depths of 100-150m. One of the licences consists of two boreholes forming part of an open loop system, whereby groundwater is abstracted and returned to the ground. The second system consists of one borehole only and is likely contain a closed loop system.

The route and study area are within the Confined Chalk Groundwater Management Unit (GWMU). This GWMU is classed as being over-licensed; therefore there is a limit on the availability of groundwater resources such that large abstractions (>1-2Ml/d) would generally not be granted unless the applicant can demonstrate that the resources are available.

Borehole cooling could also deplete the aquifer (discharge to drain) or increase the temperature of the aquifer due to heat rejection (rejection borehole).

Therefore a site specific study must be carried out at detailed design stages to confirm that the resources are available.

As cooling is currently not required for the tunnels of the NLE it has not been included in the calculations under this OES.

### 8.1.7 Heat Pumps

As sunlight travels through the atmosphere and falls on the Earth's surface, it warms the air and ground, resulting in a large store of ambient heat energy. However, this heat energy is at low temperatures, usually below that comfortable for homes and workplaces. Heat pumps use electricity to 'pump' this heat to higher temperatures and transfer it into buildings. When run in reverse heat pumps can

provide air-conditioning to cool the inside of buildings in summer. There are two main types of heat pumps: GSHP and ASHP. In addition, heat pumps could utilise low grade waste heat from the underground tunnels (Refer to Section 6.2.4).

GSHP (7a) collect heat by laying pipes under large flat areas. Alternatively, vertical boreholes can be drilled. In order to ensure a sustainable utilisation of the ground/aquifer the coolth and heat abstraction should be balanced over the year. This will however not be the case of the NLE on its own, which will on balance require more cooling (for staff offices, server and signalling rooms) than heating. The necessary heating loads could be provided by the OSDs. It is therefore recommended to consult the potential of incorporation GSHP with the OSD developers.

Based on the information available on the hydrogeology of the site (see Chapter 13: Land Quality and Groundwater of Es Volume I), the ground conditions within the area should be suitable for the GSHP installation; however, this may depend on the resource availability (see Section 5.1.6 for further detail). Therefore, a site specific study must be carried out at detailed design stage to demonstrate viability of the system.

In addition, there is the potential of incorporating closed loop GSHP to recover heat from the tunnel lining. The coefficient of performance (COP) of such heat pump would be greater than of traditional GSHP. As per Section 7.2.2 a site specific thermal analysis for tunnels must be carried out to investigate the opportunities for utilising tunnels waste heat and potential incorporation of heat pumps, which would transform the low grade heat from tunnels to higher grade heat for the NLE or any other potential consumers.

ASHP (7b) extract heat directly from the outside air and transfer it to water (in a water-based central heating system) or air inside buildings.

ASHP can be implemented to meet the whole space cooling demand and part of the space heating demand of staff offices, server and signalling rooms. However, should a connection to the VNEB DEN or any of the OSDs prove feasible (refer to Section 7 for further details), the provision of ASHP should be reconsidered as this system could potentially compete for heat/cooling loads with the DEN or OSD's network.

Table 8 shows the potential CO<sub>2</sub> emissions savings associated with the incorporation of ASHP.

**Table 8 ASHP CO<sub>2</sub> Emissions Savings**

	Source	Tonnes CO <sub>2</sub> /year
Be Green	ASHP contribution	223
	ASHP input	-163
	ASHP Total reduction	60

**8.1.8 Fuel Cells**

A fuel cell is an electrochemical device that produces electricity by using hydrogen (H<sub>2</sub>) or other hydrogenous compounds as a fuel. Heat is generated as a by-product of the process and can be used for other purposes such as heating and hot water generation. Fuel cells using hydrogen are entirely clean technology, but if running on other fuels, a fuel cell will emit CO<sub>2</sub>. Currently, most fuel cells use hydrogen derived from gas.

Fuel cells come in a variety of forms and run on variety of fuels. Environmental performance will greatly vary depending on the fuel production processes, but the following positive aspects are common to all fuel cells:

- NO<sub>x</sub> and PM<sub>10</sub> emissions much lower than any other combustion based process;
- CO<sub>2</sub> emissions of gas fired fuel cells are comparable or lower than standard combustion based CHP systems;
- High fuel flexibility (hydrogen, bio-gas, biodiesel, natural gas, etc.);
- Very high availability (more than 98%);
- Efficiency not affected by part load operation conditions;
- Ability to modulate quickly to adapt electricity generation to demand;
- High modularity: fuel cells can be “stacked” to follow for example a phased construction program;
- Enhanced energy security by allowing a wider choice of fuels;
- Potential to produce energy cleanly in the hypothesis of the development of the hydrogen economy.

There are also some negative aspects of fuel cells, which are mainly linked to the novelty of the technology and are due to be attenuated in the future. The following should be noted:

- Fuel cells are an expensive technology;

- Maintenance expertise and replacement parts supply chain are not developed at the moment, and contribute to the cost of the technology;
- Adjoining systems (water treatment, backup gas tanks, etc.) add to the plant size requirements;
- Life expectancy of the fuel cells is low.

There are two potential options for how to incorporate fuel cells into the NLE. The first option would be a transport application of fuel cells to power the trains (8a). This option would however have to wait until the upgrade of the existing Northern Line train stock, which is outside of the scope of the NLE. In addition, there is currently no commercial application of a fuel cell train and the only existing technologies of this kind are experimental.

The second option would utilise gas fuelled stationary fuel cells, which could produce electricity and heat as a CHP (8b). However, the NLE’s heat loads are currently very low. To make this system feasible additional heat demand would have to be secured, for example from OSDs. Currently, fuel cells are not included in the OES calculations.

**8.1.9 Kinetic Energy Harvesting**

Tiles have been developed, which convert the kinetic energy from footsteps of pedestrians into renewable electricity, which can be stored in a lithium polymer battery or used to power low-wattage, off-grid applications like street lighting, displays, speakers, alarms, signs, and advertising.

The CO<sub>2</sub> emissions savings potentially achievable by this technology are estimated to be very low and would represent only a fraction of percentage reductions in total developments CO<sub>2</sub> emissions. This technology could however be incorporated as part of the Sustainability Awareness scheme to promote green energy to general public.

Kinetic energy from footfall is currently not included in the calculations of this OES, because this technology is new and there is currently a very high payback associated with it. However, this technology should be reconsidered at detailed design stages should it become more affordable in future.

**8.1.10 Micro-Hydro**

Turbines placed within a flow of water produce mechanical energy that drives a generator that converts the mechanical energy into electrical energy.

This option is not feasible for the NLE as there is no suitable running watercourse passing through the site, and this option therefore cannot be applied to the NLE.

## 8.2 Summary Be Green Scheme

The 'be green' scheme considers the incorporation renewable energy technologies. The feasibility analysis of renewable technologies shows ASHP is at this stage considered the most appropriate green energy technology for the NLE. It is currently estimated that ASHP could displace circa 60 tonnes of CO<sub>2</sub>/year.

In addition to ASHP, the following technologies are being taken forward for detailed stages of the project:

- PV arrays could be incorporated into the design of Nine Elms station should the OSD design allow for such installation.
- Passive provision for borehole cooling should be considered at detailed design stages following a thermal modelling exercise, which will identify the need for tunnel cooling in future.
- GSHP could be installed either to supply joint heating and cooling loads of the stations and OSDs or to extract waste heat from tunnel lining once detailed study determines it's potential.
- The incorporation of fuel cells should be also considered at detailed design stages in collaboration with the OSDs.
- A kinetic energy harvesting system could be incorporated either to raise the passengers' sustainability awareness or should it become economically viable and technically reliable a large installation could be installed to contribute to the schemes CO<sub>2</sub> reduction targets.

Table 9 summarises the results of the feasibility analysis described in Section 8.1.

**Table 9 Summary of 'Be Green' Measures and Their Applicability to NLE**

Nr. 8.1	Measures: Be Green	Feasibility	Potential CO <sub>2</sub> emissions savings	Note
1.	Wind technology	Low	Low	Technology is not practical for the NLE.
2.	Solar Thermal	Low	Low	In the unlikely situation that the design of the OSD of the Battersea station would allow incorporation of renewable energy systems it is preferable to employ the sun-exposed areas to install PV cells.
3	PV panels	TBC at detailed design	TBC at detailed design (Medium/Low)	In case the design of the OSD of the Battersea station would allow incorporation.
4	Biomass	Low	Low	Biomass boilers are not considered viable.
5	Borehole cooling	Medium	TBC at detailed design	A site specific study must be carried out at detailed design stages to confirm that the resources are available.
6	Energy from waste	Low	Low	The NLE will not generate sufficient waste to make this option worthwhile.
7a	Heat Pumps - GSHP	TBC at detailed design	Medium/Low	A site specific study must be carried out at detailed design stage to demonstrate viability of the system.  Discussions with OSDs will be needed to identify whether the combined developments heating and cooling loads are balanced.  GSHP could be also used to recover waste heat from the tunnel lining. See point 7.2.2 for further details (Section 7 of this report).
7b	Heat Pumps - ASHP	Medium	Low	ASHP are proposed for staff areas of the stations.  The feasibility of ASHP must be revisited at detailed design stages should the connection to DEN/OSDs would become available.
8a	Fuel Cells (for trains)	Low	Not directly applicable	There is currently no commercial application of a fuel cell train and the only existing technologies of this kind

Nr.	Measures: Be Green	Feasibility	Potential CO <sub>2</sub> emissions savings	Note
8.1				are experimental. In addition, rolling stock does not form part of the scope of the NLE.
8b	Fuel Cells (for stations)	TBC at detailed design	Low	Discussions with OSDs will be needed to identify whether the combined developments heating loads would be sufficient to ensure an efficient operation of this system.
9	Kinetic energy harvesting	Medium	Low	A whole life cost of the system must be considered to assess the feasibility of this technology at detailed design stages. It is currently considered that the savings in CO <sub>2</sub> emissions would be minimal considering the high cost of the technology at present.
10	Micro-hydro	Low	Low	This option is not feasible for the NLE as there is no suitable running watercourse passing through the site.
<p>Key:</p> <p><i>Green</i> – measures accounted for within the 'be lean' calculations.</p> <p><i>Red</i> – measures identified as not feasible for the NLE.</p> <p><i>Orange</i> – measures are being taken forward to the next stages of the project, however, have not been currently included in the OES calculations.</p>				

## 9 Outline Energy Strategy

From the above analysis, the following energy strategy has currently been identified as feasible for the NLE:

- Energy efficiency and passive design measures (i.e. 'be lean' scheme), which could provide approximately 24% savings in CO<sub>2</sub> emissions over the baseline scheme (considering both regulated and non-regulated energy uses);
- A specification of ASHPs to meet the whole space cooling demand and part of the space heating demand of staff offices, server and signalling rooms. This could provide a CO<sub>2</sub> emissions reduction of circa 2% considering both regulated and non-regulated energy uses.

The CO<sub>2</sub> emissions and CO<sub>2</sub> emission savings of the baseline scheme, 'be lean' and 'be green' schemes are shown in Table 10. It should be noted that there is a large potential for incorporation of further measures into the scheme, however, currently their applicability cannot be confirmed due to the early stage of the project.

Currently, the OES could allow the NLE to achieve an overall reduction in CO<sub>2</sub> emissions of 25% (considering both regulated and non-regulated uses) and a 34% reduction in regulated CO<sub>2</sub> emissions.

Depending on the opportunities associated with the connection to the DHN, OSDs or incorporation of further renewable technologies, which will be further investigated at detailed stages of the project, the NLE will aim to achieve the London Plan's target of 25% - 40% reduction in CO<sub>2</sub> emissions on regulated energy uses.

**Table 10 CO<sub>2</sub> Emissions for the Energy Strategy Stages**

Scheme	CO <sub>2</sub> emissions (tonnes CO <sub>2</sub> /year)				
	Regulated	Improvement Regulated	Non-Regulated	Regulated & Non-regulated	Improvement (Regulated & Non-regulated)
Baseline	2,787	-	2,206	4,993	-
Be Lean	1,888	32%	1,920	3,808	24%
Be Green (ASHP)	1,828	3%	1,920	3,748	2%
Overall Over baseline	34%			25%	

## 10 Conclusions

The heating, cooling and electrical demands of the NLE will be met and provide reduced energy consumption and associated CO<sub>2</sub> emissions in accordance with the Mayor's Energy Hierarchy and TfL's guidance.

CO<sub>2</sub> emissions will be reduced by 24% (considering total energy uses) by incorporating passive design measures and specifying energy-efficient building services. To further reduce CO<sub>2</sub> emissions an analysis of the feasibility of LZC energy technologies for the NLE has been undertaken. ASHPs have been identified as the preferred choice, at present, for providing savings in CO<sub>2</sub> emissions of approximately 2%. Connection to a CHP powered DEN should also be considered but no allowance has been made for its beneficial impact at this stage.

The OES could allow the NLE to achieve a 25% reduction over the baseline scheme when considering total energy uses. When considering only regulated energy uses the OES could achieve a 34% reduction in CO<sub>2</sub> emissions over the baseline scheme.

To ensure the energy efficient operation of the building, a comprehensive commissioning strategy and energy management and targeting system will be implemented and all building users will be provided with information and guidance on how to use energy efficiently.



## References

1. Greater London Authority; The London Plan, Spatial Development Strategy for Greater London, 2011
2. Greater London Authority; Guidance on Preparing Energy Assessments, 2011
3. Building Regulations Approved Document L2A 2010
4. Greater London Authority; Delivering London's Energy Future: The Mayor's Climate Change Mitigation Energy Strategy, 2011
5. Transport for London; Business Plan 2011/12 to 2014/2015, 2011
6. Greater London Authority; The London Plan, Sustainable Design and Construction Supplementary Planning Guidance, 2006
7. London Energy Partnership; Integrating Renewables into New Developments: Toolkit for Developers, Planners and Consultants, 2004
8. Greater London Authority; Vauxhall Nine Elms Battersea Opportunity Area Planning Framework, 2012
9. London Borough of Lambeth; The Core Strategy, London Borough of Lambeth, 2011
10. London Borough of Wandsworth; The Core Strategy, 2010
11. London Borough of Southwark, The Core Strategy, 2011
12. The Department of Transport and Industry White Paper; Our Energy Future – Creating a Low Carbon Economy, 2003
13. Parliament of the United Kingdom; Sustainable and Secure Buildings Act 2004
14. Parliament of the United Kingdom; Climate Change and Sustainable Energy Act 2006
15. The Department for Communities and Local Government; Building a Greener Future: Towards Zero Carbon Development, 2006
16. The Department of Trade and Industry White Paper; Meeting the Energy Challenge, 2007
17. Parliament of the United Kingdom; The Climate Change Act 2008
18. Parliament of the United Kingdom; The Planning and Energy Act 2008
19. Department of Energy and Climate Change; The Energy Act 2011,
20. Department of Energy and Climate Change; The Carbon Plan, 2011
21. Department for Communities and Local Government; The National Planning Policy Framework, 2012
22. Greater London Authority, The Mayor's Transport Strategy, 2010
23. London Borough Wandsworth, Development Management Policies Document, 2012
24. London Borough of Lambeth; Unitary Development Plan, 2007
25. London Borough of Lambeth; Sustainable Design and Construction Supplementary Planning Document, 2008

26. London Borough of Southwark, Southwark Plan, 2007
27. London Borough of Southwark, Sustainability Assessment, 2009
28. Transport for London, Health, Safety and Environment Policy, 2012
29. Transport for London, Health, Safety and Environment Report, 2012
30. London Underground, Environment Strategy 2008-2013, 2011
31. Transport for London, The Plan 2012-2013 – Rail & Underground, 2012
32. Transport for London; Lighting of LU Assets, 2011
33. Transport for London; Mechanical Building Services, Utility Provision and Energy Management in LU, 2011
34. London Underground, Assessment Management Strategy and Policy, 2010
35. Transport for London, Business Plan 2011/2012 – 2014/2015
36. The Chartered Institution of Building Services Engineers; CIBSE Guide F: Energy Efficiency in Buildings, 2012
37. The Chartered Institution of Building Services Engineers; CIBSE Guide D: Transportation systems in buildings, 2010
38. The Chartered Institution of Building Services Engineers, CIBSE Guide TM46: Energy Benchmarks, 2008
39. The Chartered Institution of Building Services Engineers; Energy Consumption Guide 19 (ECON 19), 2000
40. Gilbey M.J., Duffy B S., Thompson J.A.; Potential for Heat Recovery from London Underground Stations and Tunnels CIBSE Technical Symposium, 2011
41. Thong M. and Cheong A.; Energy Efficiency in Singapore's Rapid Transit System (RTS), May 2012
42. Greater London Authority; Clearing the Air – The Mayor's Air Quality Strategy, 2010

## Appendix A – Electrical Loads Schedules



<b>Doc Name:</b>	Electrical Load Assessment Schedule
<b>Project Name:</b>	Northern Line Extension to Battersea TWA0 for TfL
<b>Project Number:</b>	200786
<b>Date:</b>	07/02/2013
<b>Revision:</b>	01
<b>Status Condition:</b>	For Comment
<b>Compiled By:</b>	Gary Corker
<b>Checked By:</b>	Steve Beaumont
<b>Approved By:</b>	Simon Lewis

Location	Total CEPS/ Non CEPS (kVA)	Total DNO (kVA)
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Battersea Station	3185	418
Nine Elms station	3551	440
Kennington Park Sub-station	538	33
Kennington Green	521	23

NLEB - Electrical Load Schedule for Battersea Station

Load Type	Floor area (m2)	Load (KW)	Diversity Applied	Power factor (PF)	PROJECT - Northern Line Extension to Battersea TWA0 for TFA - Electrical Load Schedule			Battersea station			Comments	
					NON-CEPS (kW)	NON-CEPS (kVA)	CEPS (kW)	CEPS (kVA)	DNO (kW)	DNO (kVA)		
<b>Lifts</b>												
Lift 1		23	1.00	0.90	23.00	25.56						
Lift 2		15	1.00	0.90	15.00	16.67						
Lift 3 (Fire fighting lift)		23	1.00	0.90			23.00	25.56	23.00	25.56		Typical equipment load ratings (kW) provided by project lift & escalator engineer
Lift 4 (Fire fighting lift)		23	1.00	0.90			23.00	25.56	23.00	25.56		Typical equipment load ratings (kW) provided by project lift & escalator engineer
<b>Escalators</b>												
Escalator 1		37	1.00	0.90			37.20	41.33	37.20	41.33		Typical equipment load ratings (kW) provided by project mechanical engineer
Escalator 2		37	1.00	0.90			37.20	41.33	37.20	41.33		Typical equipment load ratings (kW) provided by project mechanical engineer
Escalator 3		37	1.00	0.90			37.20	41.33	37.20	41.33		Typical equipment load ratings (kW) provided by project mechanical engineer
Escalator 4		23	1.00	0.90			23.40	26.00	23.40	26.00		Typical equipment load ratings (kW) provided by project mechanical engineer
Escalator 5		23	1.00	0.90			23.40	26.00	23.40	26.00		Typical equipment load ratings (kW) provided by project mechanical engineer
Escalator 6		23	1.00	0.90			23.40	26.00	23.40	26.00		Typical equipment load ratings (kW) provided by project mechanical engineer
Escalator 7		23	1.00	0.90			23.40	26.00	23.40	26.00		Typical equipment load ratings (kW) provided by project mechanical engineer
<b>Drainage</b>												
Sump Pump (Duty) IP65 rated		5	0.70	0.80			3.50	4.38	3.50	4.38		Typical equipment load ratings (kW) provided by project mechanical engineer
Sump Pump (Standby) IP65 rated		12	0.70	0.80			8.40	10.50	8.40	10.50		Typical equipment load ratings (kW) provided by project mechanical engineer
<b>CWS</b>												
CWS Pump (Duty)		2.00	0.70	0.80	1.40	1.75						Typical equipment load ratings (kW) provided by project mechanical engineer
CWS Water Treatment Plant		3.00	0.70	0.80	2.10	2.63						Typical equipment load ratings (kW) provided by project mechanical engineer
<b>Fire fighting</b>												
Sprinkler Pump (Duty)		75.00	0.70	0.80			52.50	65.63	52.50	65.63		(15W/m <sup>2</sup> ) refer to electrical load guidance sheet
Fire Main Water Treatment Plant		3.00	0.70	0.80			2.10	2.63	2.10	2.63		
Mist Type Sprinkler Pump (Duty) ***TBC		75.00	0.70	0.80			52.50	65.63	52.50	65.63		
<b>Normal lighting</b>												
Upper Retail mezzanine Plan (+ 11.0m)	372	6	1.00	0.90	5.88	6.20						
Upper Retail Plan (+ 8.0m)	397	6	1.00	0.90	5.96	6.62						
Lower Retail Plan (+ 3.0m)	1056	16	1.00	0.90	15.84	17.60						
Basement Car Park (+ 0.0m)	139	2	1.00	0.90	2.09	2.32						
Ticket Hall Mezzanine level Plan (-3.2 m)	3420	51	1.00	0.90	51.30	57.00						
Ticket Hall Concourse (-6.0 m)	3015	45	1.00	0.90	45.23	50.25						
Upper Concourse Plan (-8.5 m)	1460	22	1.00	0.90	21.90	24.33						
Platform Level Plan (-13.0 m)	1260	19	1.00	0.90	18.90	21.00						
Under Platform Plan (-15.7 m)	2730	41	1.00	0.90	40.95	45.50						
<b>Emergency lighting/Evacuation Signage</b>												
Upper Retail mezzanine Plan (+ 11.0m)	372	2	1.00	0.90					1.86	2.07		
Upper Retail Plan (+ 8.0m)	397	2	1.00	0.90					1.99	2.21		
Lower Retail Plan (+ 3.0m)	1056	5	1.00	0.90					5.28	5.87		
Basement Car Park (+ 0.0m)	139	1	1.00	0.90					0.70	0.77		
Ticket Hall Mezzanine level Plan (-3.2 m)	3420	17	1.00	0.90					17.10	19.00		
Ticket Hall Concourse (-6.0 m)	3015	15	1.00	0.90					15.08	16.75		
Upper Concourse Plan (-8.5 m)	1460	7	1.00	0.90					7.30	8.11		
Platform Level Plan (-13.0 m)	1260	6	1.00	0.90					6.30	7.00		
Under Platform Plan (-15.7 m)	2730	14	1.00	0.90					13.65	15.17		

PROJECT - Northern Line Extension to Battersea TWA0 for TFA - Electrical Load Schedule											
Battersea station											
Location	Floor area (m2)	Load (KW)	Diversity Applied	Power factor (PF)	NON-CEPS (kW)	NON-CEPS (kVA)	CEPS (kW)	CEPS (kVA)	DNO (kW)	DNO (kVA)	Comments (10W/m <sup>2</sup> )
<b>General Power</b>											
Upper Retail Mezzanine Plan (+11.0m)	372	4	0.40	0.90	1.49	1.65					
Upper Retail Plan (+8.0m)	397	4	0.40	0.90	1.59	1.76					
Lower Retail Plan (+3.0m)	1056	11	0.40	0.90	4.22	4.69					
Basement Car Park (+0.0m)	139	1	0.40	0.90	0.56	0.62					
Ticket Hall Mezzanine level Plan (-3.2 m)	3420	34	0.40	0.90	13.68	15.20					
Ticket Hall Concourse (+6.0 m)	3015	30	0.40	0.90	12.06	13.40					
Upper Concourse Plan (-8.5 m)	1460	15	0.40	0.90	5.84	6.49					
Platform Level Plan (-13.0 m)	1260	13	0.40	0.90	5.04	5.60					
Under Platform Plan (-15.7 m)	2730	27	0.40	0.90	10.92	12.13					
Cleaners Sockets		12	0.50	0.90	6.00	6.67					12 outlets through out the station based on 1kW per socket
Microwave Oven		1	1.00	1.00	1.00	1.00					1 No. Microwave provided within the messroom
Baby Belling Cooker		3	1.00	1.00	3.00	3.00					1 No. baby belling provided with the messroom
<b>Extract Fans</b>											Electrical loadings obtained from mechanical equipment schedule
Station Toilet Extract fans											
Station Mess / Kitchen Extract fans		5.00	0.70	0.80	3.50	4.38					
Lift equipment room extract fans (x 2)		1.50	0.70	0.80	1.05	1.31					
		2.00	0.70	0.80	1.40	1.75					
Under Platform Extract (UPE) Fan 1 (1 x 60m3/s)		264	0.70	0.80			184.80	231.00			
Under Platform Extract (UPE) Fan 2 (1 x 60m3/s)		264	0.70	0.80			184.80	231.00			
Tunnel/Over Track Extract (OTE) Fans (East) (2 x 80m3/s)		426	0.70	0.80			298.20	372.75			
Tunnel/Over Track Extract (OTE) Fans (West) (2 x 120m3/s)		624	0.70	0.80			436.80	546.00			
DNO Substation Extract Fan ***TBC		20	0.70	0.80	14.00	17.50					
UPS/Olbi Extract Fan 01		2	0.70	0.80	1.40	1.75					
<b>Station Cooling</b>											
External Outdoor unit		140	0.70	0.90	98.00	108.89					Electrical loadings obtained from mechanical equipment schedule
<b>Smoke Extract</b>											
Smoke Damper actuators		3.00	0.70	0.80			2.10	2.63			Compressor Inverter Motor Output 20 x 2.9kw Fan Motor Output 20 x 05kw Fan Coil Units, c/w elec. heater 20 x 3kw Fan motors 20 x 0.2kw
<b>Stair Press. Fan</b>											
Staircase Pressurisation Fan (East)		15.00	0.70	0.80			10.50	13.13	10.50	13.13	Electrical loadings obtained from mechanical equipment schedule
Staircase Pressurisation Fan (West)		15.00	0.70	0.80			10.50	13.13	10.50	13.13	Electrical loadings obtained from mechanical equipment schedule

PROJECT - Northern Line Extension to Battersea TWA0 for TFA - Electrical Load Schedule											
Battersea station											
Location	Floor area (m2)	Load (KW)	Diversity Applied	Power factor (PF)	NON-CEPS (kW)	NON-CEPS (kVA)	CEPS (kW)	CEPS (kVA)	DNO (kW)	DNO (kVA)	Comments
<b>MCP</b>											
MCP		10.00	0.70	0.80			7.00	8.75	7.00	8.75	MCP associated with Staircase Pressurisation System (allow MCP to provide 10kW)
<b>AHU</b>											
Station AHU		20.00	0.60	0.90	12.00	13.33					Electrical loadings obtained from mechanical equipment schedule
AHU Electric heater battery		150.00	0.60	0.90	90.00	100.00					Supply Fan - allow for 100A starting current, motor rating of 4kW, AHU heater battery 150kW
MCP associated with AHU		12.00	0.70	0.90	8.40	9.33					Extract Fan - allow for 100A starting current, motor rating of 4kW (based on assumed VFR of 5m3/s)
<b>Space Heating</b>											
EH1		1	1.00	0.90	0.50	0.56					MCP associated with AHU (MCP to provide 12kW to AHU)
EH2		1	1.00	0.90	0.50	0.56					Electrical loadings obtained from mechanical equipment schedule
EH3		1	1.00	0.90	0.50	0.56					Electric Space Heating (provision for 7 locations at 230v /500W)
EH4		1	1.00	0.90	0.50	0.56					Electric Space Heating (provision for 7 locations at 230v /500W)
EH5		1	1.00	0.90	0.50	0.56					Electric Space Heating (provision for 7 locations at 230v /500W)
EH6		1	1.00	0.90	0.50	0.56					Electric Space Heating (provision for 7 locations at 230v /500W)
EH7		1	1.00	0.90	0.50	0.56					Electric Space Heating (provision for 7 locations at 230v /500W)
<b>Water Heating</b>											
EWH1		3	0.70	1.00	2.10	2.10					Electrical loadings obtained from mechanical equipment schedule
EWH2		3	0.70	1.00	2.10	2.10					Local Water Heaters (provision for 6 locations at 3kW)
EWH3		3	0.70	1.00	2.10	2.10					Local Water Heaters (provision for 6 locations at 3kW)
EWH4		3	0.70	1.00	2.10	2.10					Local Water Heaters (provision for 6 locations at 3kW)
EWH5		3	0.70	1.00	2.10	2.10					Local Water Heaters (provision for 6 locations at 3kW)
EWH6		3	0.70	1.00	2.10	2.10					Local Water Heaters (provision for 6 locations at 3kW)
<b>Comms</b>											
CER1		5	1.00	0.90			10.00	11.11	5.00	5.56	Local Water Heaters (provision for 6 locations at 3kW)
CER2		5	1.00	0.90			15.00	16.67	5.00	5.56	Assumption
<b>Signalling</b>											
SER1		5	1.00	0.90			10.00	11.11	5.00	5.56	Local Water Heaters (provision for 6 locations at 3kW)
SER2		5	1.00	0.90			15.00	16.67	5.00	5.56	Assumption
<b>Advertising</b>											
Prestige		20	1.00	0.90	20.00	22.22					Assumption

PROJECT - Northern Line Extension to Battersea TWA0 for TFA - Electrical Load Schedule										
Battersea station										
Location	Floor area (m2)	Load (KW)	Diversity Applied	Power factor (PF)	NON-CEPS (kW)	NON-CEPS (kVA)	CEPS (kW)	CEPS (kVA)	DNO (kW)	DNO (kVA)
Load Type										
					NON-CEPS Total (kW)	NON-CEPS Total (kVA)	CEPS Total (kW)	CEPS Total (kVA)	DNO Total (kW)	DNO Total (kVA)
<b>Sub-total</b>					580.48	646.59	1554.90	1901.79	282.25	334.02
<b>25 % capacity</b>					145.12	161.65	388.73	475.45	70.56	83.51
<b>Total</b>					725.60	808.23	1943.63	2377.24	352.81	417.53
<b>Total load (kVA)</b>					3185.47				418	
<b>Total load (kW)</b>					2669				353	
<b>Total load (A)</b>					4282.12				561.27	
					NON-CEPS		CEPS		DNO	

**Notes**

- System Characteristics**  
Default values are 3 phase, 4 wire, 400 Volts and power factor 0.9.
- Expansion**  
Allowance for future expansion 25%.
- Non-Cepts/Cepts transformer selection**  
Based on a calculated total load of  kVA the next available rated size of distribution transformer (class 1) would be 2 x 2000 kVA units.
- DNO power requirement**  
Based on a calculated total load of  Amps the next available rated size supply would be 600 Amp 3 phase service head from the D.N.O. supplier.

PROJECT - Northern Line Extension to Battersea TWA0 for TFL - Electrical Load Schedule										
Nine Elms station										
Location	Floor area (m2)	Load (KW)	Diversity Applied	Power factor (PF)	NON-CEPS (kW)	NON-CEPS (kVA)	CEPS (kW)	CEPS (kVA)	DNO (kW)	DNO (kVA)
Load Type										
					NON-CEPS Total (kW)	NON-CEPS Total (kVA)	CEPS Total (kW)	CEPS Total (kVA)	DNO Total (kW)	DNO Total (kVA)
<b>Lifts</b>										
Lift 1 (Fire fighting lift)		23.00	1.00	0.90			23.00	25.56	23.00	25.56
Lift 2 (Fire fighting lift)		23.00	1.00	0.90			23.00	25.56	23.00	25.56
<b>Escalators</b>										
Escalator 1		60	1.00	0.90			60.00	66.67		
Escalator 2		60	1.00	0.90			60.00	66.67		
Escalator 3		60	1.00	0.90			60.00	66.67		
<b>Drainage</b>										
Sump Pump (Duty) IP65 rated		5.00	0.70	0.80			3.50	4.38	3.50	4.38
Sump Pump (Standby) IP65 rated		5.00	0.70	0.80			3.50	4.38	3.50	4.38
<b>CWS</b>										
CWS Pump (Duty)		2.00	0.70	0.80	1.40	1.75				
CWS Water Treatment Plant		3.00	0.70	0.80	2.10	2.63				
<b>Fire fighting</b>										
Sprinkler Pump (Duty)		75.00	0.70	0.80			52.50	65.63	52.50	65.63
Fire Main Water Treatment Plant		3.00	0.70	0.80			2.10	2.63	2.10	2.63
Mist Type Sprinkler Pump (Duty) ***TBC		75.00	0.70	0.80			52.50	65.63	52.50	65.63
<b>Normal lighting</b>										
Street level Plan (+ 4.0m)	986	14.79	1.00	0.90	14.79	16.43				
Basement Level 01 (-2.48m)	3640	54.60	1.00	0.90	54.60	60.67				
Basement Level 02 (-7.70m)	3550	53.25	1.00	0.90	53.25	59.17				
Basement Level 03 (-13.10m)	3886	58.29	1.00	0.90	58.29	64.77				
Platform Level 04 (-18.50m)	1945	29.18	1.00	0.90	29.18	32.42				
Basement Level 05 (-21.90m)	2180	32.70	1.00	0.90	32.70	36.33				
<b>Emergency lighting/Evacuation Signage</b>										
Street level Plan (+ 4.0m)	986	4.93	1.00	0.90					4.93	5.48
Basement Level 01 (-2.48m)	3640	18.20	1.00	0.90					18.20	20.22
Basement Level 02 (-7.70m)	3550	17.75	1.00	0.90					17.75	19.72
Basement Level 03 (-13.10m)	3886	19.43	1.00	0.90					19.43	21.59
Platform Level 04 (-18.50m)	1945	9.73	1.00	0.90					9.73	10.81
Basement Level 05 (-21.90m)	2180	10.90	1.00	0.90					10.90	12.11
<b>General Power</b>										
Street level Plan (+ 4.0m)	986	9.86	0.40	0.90	3.94	4.38				
Basement Level 01 (-2.48m)	3640	36.40	0.40	0.90	14.56	16.18				
Basement Level 02 (-7.70m)	3550	35.50	0.40	0.90	14.20	15.78				
Basement Level 03 (-13.10m)	3886	38.86	0.40	0.90	15.54	17.27				
Platform Level 04 (-18.50m)	1945	19.45	0.40	0.90	7.78	8.64				
Basement Level 05 (-21.90m)	2180	21.80	0.40	0.90	8.72	9.69				
<b>Cleaners Sockets</b>										
Cleaners Sockets		12.00	0.50	0.90	6.00	6.67				
Microwave Oven		1.00	1.00	1.00	1.00	1.00				
Baby Belling Cooker		3.00	1.00	1.00	3.00	3.00				
<b>Extract Fans</b>										
Station Toilet Extract fans		5.00	0.70	0.80	3.50	4.38				
Station Mess / Kitchen Extract fans		1.50	0.70	0.80	1.05	1.31				



PROJECT - Northern Line Extension to Battersea TWA0 for TFL - Electrical Load Schedule											
Kennington Park Sub-station											
Location	Floor area (m2)	Load (KW)	Diversity Applied	Power factor (PF)	NON-CEPS (kW)	NON-CEPS (kVA)	CEPS (kW)	CEPS (kVA)	DNO (kW)	DNO (kVA)	Comments
<b>Load Type</b>											
<b>Normal lighting</b>											
Ground Level Mezzanine Plan (+6.325 m)	31.5	0.47	1.00	0.90	0.47	0.53					(15W/m <sup>2</sup> ) refer to electrical load guidance sheet
Ground Plan (+ 3.725m)	42.5	0.64	1.00	0.90	0.64	0.71					
Basement Level 01 (-2.60m)	566	8.49	1.00	0.90	8.49	9.43					
Basement Level 02 (-7.30m)	587	8.81	1.00	0.90	8.81	9.78					
Basement Level 03 (-14.35m)	103	1.55	1.00	0.90	1.55	1.72					
Track Level (-19.21 m)	31.5	0.47	1.00	0.90	0.47	0.53					(5 W/m <sup>2</sup> ) refer to electrical load guidance sheet
<b>Emergency lighting/Evacuation Signage</b>											
Ground Level Mezzanine Plan (+6.325 m)	31.5	0.16	1.00	0.90					0.16	0.18	
Ground Plan (+ 3.725m)	42.5	0.21	1.00	0.90					0.21	0.24	
Basement Level 01 (-2.60m)	566	2.83	1.00	0.90					2.83	3.14	
Basement Level 02 (-7.30m)	587	2.94	1.00	0.90					2.94	3.26	
Basement Level 03 (-14.35m)	103	0.52	1.00	0.90					0.52	0.57	
Track Level (-19.21 m)	31.5	0.16	1.00	0.90					0.16	0.18	(10W/m <sup>2</sup> )
<b>General Power</b>											
Ground Level Mezzanine Plan (+6.325 m)	31.5	0.32	0.40	0.90	0.13	0.14					
Ground Plan (+ 3.725m)	42.5	0.43	0.40	0.90	0.17	0.19					
Basement Level 01 (-2.60m)	566	5.66	0.40	0.90	2.26	2.52					
Basement Level 02 (-7.30m)	587	5.87	0.40	0.90	2.35	2.61					
Basement Level 03 (-14.35m)	103	1.03	0.40	0.90	0.41	0.46					
Track Level (-19.21 m)	31.5	0.32	0.40	0.90	0.13	0.14					
<b>Tunnel Ventilation</b>											
Tunnel Ventilation Fan (Duty: 120m3/s)		312.00	1.00	0.90			312.00	346.67			
<b>Extract Fans</b>											
DNO (LV) Substation Extract Fan		12.00	0.70	0.80			8.40	10.50			Electrical loadings obtained from mechanical equipment schedule
UPS/OLBI Extract Fan 01		2.00	0.70	0.80			1.40	1.75			
<b>Station Cooling</b>											
External VRF unit											Electrical loadings obtained from mechanical equipment schedule
VRF Control Unit											Electrical loadings obtained from mechanical equipment schedule
Stair Press. Fan											External VRF unit
Staircase Pressurisation Fan (Duty)		15.00	0.70	0.80			10.50	13.13		13.13	Compressor Inverter Motor Output 6kW
<b>Space Heating</b>											Fan Motor Output 1kW
EH1		0.50	1.00	0.90	0.50	0.56					Refrigerant.
Sump Pump		5.00	1.00	0.90			5.00	5.56		5.56	(Allow for 100A. Total Cooling 30kW, Sensible Cooling 30kW)
Sump Pump (Eas) IP65 rated											Electrical loadings obtained from mechanical equipment schedule
<b>Sub-total</b>					<b>47.51</b>	<b>52.79</b>	<b>337.30</b>	<b>377.60</b>	<b>22.31</b>	<b>26.24</b>	
<b>25 % capacity</b>					<b>11.88</b>	<b>13.20</b>	<b>84.33</b>	<b>94.40</b>	<b>5.58</b>	<b>6.56</b>	

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Part D : Kennington Park Sub-Station  
Created by: G Corker  
Date: 07/02/2013

<b>Total</b>	<b>59.39</b>	<b>65.98</b>	<b>421.63</b>	<b>472.00</b>	<b>27.88</b>	<b>32.81</b>
<b>Total load (kVA)</b>		<b>537.98</b>			<b>33</b>	
<b>Total load (kW)</b>		<b>481</b>			<b>28</b>	
<b>Total load (A)</b>		<b>723.19</b>			<b>44.10</b>	
		<b>NON-CEPS</b>	<b>CEPS</b>		<b>DNO</b>	

NLEB - Electrical Load Schedule for Kennington Park Sub-Station

**Notes**

- System Characteristics**  
Default values are 3 phase, 4 wire, 400 Volts and power factor 0.9.
- Expansion**  
Allowance for future expansion 25%.
- Non-Cepts/Cepts transformer selection**  
Based on a calculated total load of  kVA the next available rated size of distribution transformer (class 1) would be 630 kVA unit.
- DNO power requirement**  
Based on a calculated total load of  Amps the next available rated size supply would be 60 Amp 3 phase service head from the D.N.O. supplier.





**References**

1. The Building Services Research and Information Association (BSRIA) Technical Note 17/95 - Rules of Thumb

BSRIA TN 17-95 Rules of Thumb.pdf - Adobe Reader

File Edit View Window Help

26 / 44 71.1%

Electrical Loads

Rules of Thumb

#### 4. ELECTRICAL LOADS

This section gives guidance rules on the electrical supply requirements for buildings. These are for connected capacity in terms of unit floor area. In addition, simple rules for the total connected load and an allowance for expansion are included.

Current trends in information technology in some buildings are leading to increasing requirements for small power and computing. The rules for these two categories should be used with caution when information technology systems are being incorporated in buildings.

**Table 13 Electrical supply requirements for buildings**

Plant/System	Selection Requirement	Rule of Thumb
Electrical supply in building	Distribution boards and switch gear	Limiting cabling to 25 m length
	Electrical motors above 0.75 kW rating	3 phase supply
	Up to and including 4 kW rating	Direct-on-line starting
	above 4 kW rating	Direct-on-line or star-delta

**Table 14 Electrical loads by type of load**

Category	Type of Load	Electrical Loading/m <sup>2</sup> of building floor area
Services Load	Lighting	20 W/m <sup>2</sup>
	Small power	20 W/m <sup>2</sup>
	Air conditioning	60 W/m <sup>2</sup>
	Passenger lifts	10 W/m <sup>2</sup>
	Computer rooms	270 W/m <sup>2</sup> (net area)
Total	kVA for building	Total kW ÷ 0.8
Future Expansion	Design allowance	Add 25% to capacity

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Comment

O2: Project Sustainability  
Appraisal Report

**Environmental Statement**

Volume II





Northern Line Extension  
**Project Sustainability Appraisal Report**

April 2013

Prepared for  
**Transport for London**

## Revision Schedule

**Northern Line Extension**  
April 2013

Issue	Date	Details	Prepared by	Reviewed by	Approved by
01	04/04/2013	Final	<b>Kristina Schaferova</b> Senior Sustainability Engineer	<b>Howard Waples</b> Senior Environmental Consultant	<b>Ivan Rodriguez</b> Department Head

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## List of Abbreviations

AAP	Area Action Plan	LZC	Low and Zero Carbon
ADL 2A	Building Regulations Approved Document L2A	M&E	Mechanical and Electrical
AQMA	Air Quality Management Area	MOT	Ministry of Transport
ASHP	Air Source Heat Pumps	MTS	Mayor's Transport Strategy
BAP	Biodiversity Action Plan	NLE	Northern line extension
BER	Building Emissions Rate	NOx	Nitrogen Oxide
BMS	Building Management System	OAs	Opportunity Areas
BPS	Battersea Power Station	OAPF	Opportunity Area Planning Framework
BREDEM12	Building Research Establishment Domestic Energy Model 12	ODP	Ozone Depletion Potential
BREEAM	BRE Environmental Assessment Method	OSD	Over Site Development
CCHP	Combined Cooling, Heat and Power	PM10	Particulate Matter (of 10 Microns in diameter or smaller)
CCTV	Closed Circuit Television	PSAR	Project Sustainability Appraisal Report
CE&D	Construction, Excavation and Demolition	PSD	Platform Screen Doors
CEEQUAL	Civil Engineering Environmental Quality and Assessment Scheme	PV	Photovoltaic
CEMP	Construction Environmental Management Plan	SHW	Solar Hot Water
CFD	Computational Fluid Dynamic	SLNT	Strategic Labour Needs and Training
CHP	Combined Heat and Power	SPD	Supplementary Planning Documents
CIBSE	Chartered Institution of Building Services Engineers	SPG	Supplementary Planning Guidance
CLG	Communities and Local Government	SSAT	Strategic Sustainability Analysis Tool
CO <sub>2</sub>	Carbon Dioxide	SUDS	Sustainable Drainage Systems
CoCP	Code of Construction Practice	SWMP	Site Waste Management Plan
CPET	Central Point of Expertise in Timber	TER	Target Emissions Rate
CSH	Code for Sustainable Homes	TfL	Transport for London
DEN	District Energy Network	TMP	Traffic Management Plan
DHN	District Heating Network	TWA Order	Transport and Works Act Order
DHW	Domestic Hot Water	TWUL	Thames Water Utilities Ltd.
DMPD	Development Management Policies Document	UDP	Unitary Development Plan
DSM	Dynamic Simulation Model	UFFI	Urea- Formaldehyde Foam Insulation
DTP	Deep Tube Programme	VNEB	Vauxhall, Nine Elms and Battersea
DTR	Deep Tube Railway	VOCs	Volatile Organic Compounds
EA	Environment Agency	WRAP	Waste and Resources Action Programme
EDA	Energy Demand Assessment	ZED	Zero Carbon Emission Development
ES	Environmental Statement		
FRA	Flood Risk Assessment		
FSC	Forest Stewardship Council		
GLA	Greater London Authority		
GSHP	Ground Source Heat Pump		
GWP	Global Warming Potential		
H <sub>2</sub>	Hydrogen		
HSE	Health, Safety and Environment		
ICE	Institute of Civil Engineers		
IES	Integrated Environmental Solutions		
LBL	London Borough of Lambeth		
LBS	London Borough of Southwark		
LBW	London Borough of Wandsworth		
LDF	Local Development Framework		
LED	Light Emitting Diode		
LNR	Local Nature Reserve		
LU	London Underground		

## Executive Summary

This Project Sustainability Appraisal Report (PSAR) has been prepared in support of a Transport and Works Act (TWA) Order application by Transport for London (TfL) in developing a scheme to extend the Northern line to Battersea (herein referred to as the Northern Line Extension (NLE)).

The Mayor of London set within his Transport Strategy (Ref. 1) a number of goals each of which contribute towards the delivery of sustainable development and the NLE proposals are aligned to these objectives.

In addition, this PSAR has followed the requirements of the Mayor's London Plan 2011 (Ref. 2) and the guidance provided in the Sustainable Design and Construction Supplementary Planning Guidance (SPG) 2006 (Ref. 3).

In the context of this TWA Order application, consideration has been also given to the local policy guidance of London Borough of Lambeth (LBL), London Borough of Wandsworth (LBW) and London Borough of Southwark (LBS) and TfL guidance documentation and sustainability aspirations.

This report has been structured around the TfL Sustainability Framework and aims to capture the above guidance documents through the appraisal of the NLE against the framework's topics:

- Tackle climate change;
- Quality of life;
- Transport for all;
- Safety and security; and
- Economic progress.

Accordingly, this PSAR assesses the NLE against the above sustainability standards. The key beneficial impacts of the scheme in relation to sustainability can be summarised as follows:

### **Tackle Climate Change: Reduce transport's contribution to climate change and improve its resilience**

The Underground is a sustainable transport mode and the NLE will be constructed to the most up-to-date design and environmental standards. The

NLE will contribute to making the area more typical of central London in terms of public transport accessibility, therefore providing alternatives to car travel.

Embodied carbon in the materials associated with the construction of the NLE will be reduced as much as practicable. An effective materials management strategy is being employed to reduce waste and embodied carbon.

Carbon dioxide (CO<sub>2</sub>) emissions associated with the operation of the NLE are being minimised by utilising passive design and energy efficiency measures, efficient supply of energy and renewable energy sources.

The NLE is designed to be resilient. The potential climate change impacts have been considered and addressed. Specifically, the NLE tunnels and platforms are designed to be operated with no need for active cooling. In addition, the tunnels will be future proofed to allow for efficient way of cooling to address the risk of temperature rise as a result of climate change.

The NLE will benefit from existing flood defences and will address flooding risks by using water resistant materials and systems. Sustainable Drainage Systems (SUDS) and water conservation measures will be utilised as feasible.

### **Quality of Life: Enhance the quality of life for all Londoners**

The NLE will help to relieve existing congestion at Vauxhall station, and provide relief to the Victoria line and to the Northern line south of Kennington. As part of a wider package of transport and urban realm improvements, the NLE will bring economic and accessibility benefits to a wide area, including the existing and new communities around Nine Elms station.

The NLE will implement sustainable construction methods through the demolition and construction stages. In addition, the noise and air quality impacts of construction and operation of the NLE will be reduced as low as practical following the best practice guidelines.

The physical wellbeing and health impacts on passengers, staff and neighbouring communities are a high priority for TfL. Open spaces and natural environment in the area will be enhanced as a result of the NLE. Cycling and walking will be promoted by the project. A healthy indoor environment and indoor comfort will be achieved via the provision of natural ventilation, presence of non-toxic materials, use of natural daylight, optimised levels of lighting, appropriate acoustic performance of the building structures and temperature control systems.

The historic environment and built heritage have been considered during the design process. Measures will be implemented, to ensure that no harm will be caused to any potential assets of archaeological value.

An improved community facility will be provided as part of the NLE and the opportunities to make the stations 'community stations' will be promoted.

**Transport for All: Improve transport opportunities for all Londoners:**

The primary aim of the NLE is to facilitate the sustainable regeneration and development of the Vauxhall, Nine Elms and Battersea (VNEB) Opportunity Area. The NLE will improve accessibility across the area and deliver benefits available elsewhere in central London, assisting and complementing London's transport network.

Both new stations will be step-free from street to train and will significantly enhance transport accessibility to all by creating new access points to the Underground network.

In addition to complete step-free access, the designs have also considered the needs of individuals that may experience hearing or sight impairment, or suffer from dementia or other mental illness.

The overall passenger journey experience will be elevated by the provision of two high quality design stations and new track.

**Safety and Security: Improve the safety and security of all Londoners:**

The Underground is a safe and secure transport mode whilst stations provide safe and attractive meeting points. By introducing new stations at Battersea and Nine Elms, new and existing communities will benefit from modern, well-designed landmarks which are integrated with high quality urban realm.

The NLE stations will be designed to reduce opportunities for crime by providing active frontages, on well-used and well lit areas and by providing natural surveillance. The permanent shafts will incorporate a number of security measures to prevent unauthorised access.

Safety of passengers, construction staff and staff operating the stations is one of the priorities of TfL, which will be addressed throughout the design of the NLE. Measures such as safe access to the stations have been addressed as part of the design works at this stage.

**Economic Progress: Support economic development and population growth:**

By enabling the sustainable regeneration and development of the VNEB Opportunity Area, the NLE will catalyse the creation of up to 16,000 new homes and 20 - 25,000 new jobs. In addition, it will enhance access to employment for local people in the surrounding area and integrate the VNEB Opportunity Area with the remainder of central London.

In addition, TfL's strong responsible procurement policies will encourage applications for tender from local small and medium-sized enterprises.

The NLE will significantly improve connectivity between the local area and employment areas in central London. The stations will be linked to open space with key pedestrian routes through the use of improved crossings, lighting and materials surfacing.

**Conclusions**

The appraisal demonstrated that the NLE currently achieves a balanced level of sustainability over the TfL Sustainability Framework categories, which demonstrates that social, environmental and economic factors have been considered thorough the design process.

To secure that the NLE's objectives are implemented Strategic Sustainability Analysis Tool (SSAT) has been developed. The SSAT is a bespoke sustainability benchmarking tool, which supports the implementation of the requirements of CEEQUAL and the TfL Sustainability Toolkit relevant to this stage of the design process.

The preliminary CEEQUAL v5 score shows that the NLE is on track to achieving a score of 'Excellent'. It is recommended that a preliminary CEEQUAL assessment is carried out at detailed design stages to list all commitments of the design team required to secure the desired score.

TfL will assess and benchmark the NLE against the CEEQUAL Whole Project award. The proposed Underground stations will be assessed under BREEAM and will aim to achieve a BREEAM rating of Very Good.

## 1 Introduction

This Project Sustainability Appraisal Report (PSAR) has been prepared in support of a Transport and Works Act (TWA) Order application by Transport for London (TfL) in developing a scheme to extend the Northern Underground line to Battersea (herein referred to as the 'Northern line extension' (NLE)).

The primary aim of the NLE is to encourage economic growth in London and the wider UK economy by facilitating the sustainable regeneration and development of the Vauxhall Nine Elms Battersea (VNEB) Opportunity Area. This includes the creation of a major new sustainable residential, business and leisure district in London's Central Activities Zone.

The London Plan (2011) designates VNEB as an Opportunity Area with the potential for up to 16,000 new homes and 20,000 - 25,000 new jobs. This level of development cannot happen sustainably without the appropriate transport infrastructure to catalyse and support economic growth and regeneration of this scale.

The NLE will achieve this primary aim by providing two new stations to improve access to the London Underground network in an area which is in part characterised by poor access to public transport, thereby benefiting both new and existing residential and business communities.

The PSAR sets out how TfL have taken into account relevant sustainability policies and guidance, including:

- The National Planning Policy Framework, Department of Communities and Local Government, 2012 (Ref. 4);
- The London Plan, Spatial Development Strategy for Greater London, Greater London Authority (GLA), 2011 (particularly Policy 5.3 Sustainable Design and Construction);
- Sustainable Design and Construction Supplementary Planning Guidance (SPG), GLA, 2006;
- The Mayor's Climate Change Mitigation and Energy Strategy, GLA, 2011 (Ref. 5);
- The Mayor's Biodiversity Strategy, GLA, 2002 (Ref. 6);
- The Mayor's Climate Change Adaptation Strategy, GLA 2011 (Ref. 11);
- The Mayor's Transport Strategy (MTS), GLA, 2010;

- The Mayor's Water Strategy, GLA, 2011 (Ref. 7);
- The Mayor's Business Waste Management Strategy, GLA, 2011 (Ref. 8);
- The Mayor's Ambient Noise Strategy, GLA, 2004 (Ref. 9);
- The Mayor's Air Quality Strategy, GLA, 2010 (Ref. 10);
- The Mayor's Economic Development Strategy, GLA, 2010 (Ref. 12);
- The Mayor's Health Inequalities Strategy, GLA, 2009 (Ref. 13);
- London Borough of Wandsworth (LBW) Core Strategy, LBW, 2010 (Ref. 14);
- London Borough of Lambeth (LBL) Core Strategy, LBL, 2011 (Ref. 15);
- London Borough of Southwark (LBS), Core Strategy, 2011 (Ref. 16);

Consequently, this PSAR:

- Demonstrate TfL's support for sustainable project development ensuring that social, environmental and economic factors are considered and balanced;
- Demonstrate how the NLE contributes to the national, regional and local policies on sustainability; and
- Collates all information on sustainability relevant to the NLE.

The primary aim of the NLE is consistent with a number of objectives set out in the aforementioned documents such as National Planning Policy Framework (2012), the London Plan, the VNEB Opportunity Area Planning Framework (2012) and Borough planning policies.

### Mayor's Transport Strategy

TfL is committed to improve the sustainability of the city's transport network in accordance with the MTS and its vision:

*"London's transport system should excel among global cities, providing access to opportunities for all its people and enterprises, achieving the highest environmental standards and leading the world in its approach to tackling urban transport challenges".*

According to the MTS achieving this vision will mean making sure the transport system offers enhanced capacity and connectivity, is more efficient, integrated, safe and secure, supports London's growth and economic development and is

fair to all users. It should encourage a cycling revolution and mode shift to walking, public transport and use of the river. Moreover, the transport system should contribute to improving Londoners' quality of life, opportunities and the environment in all parts of London.

Specifically, the MTS sets six goals of how to achieve the vision. Whilst the sixth goal is specific to the 2012 Olympic Games and its legacy, the others are considered as secondary aims of the NLE. Those goals are:

1. Support economic development and population growth
2. Enhance the quality of life for all Londoners
3. Improve the safety and security of all Londoners
4. Improve transport opportunities for all Londoners
5. Reduce transport's contribution to climate change and improve its resilience

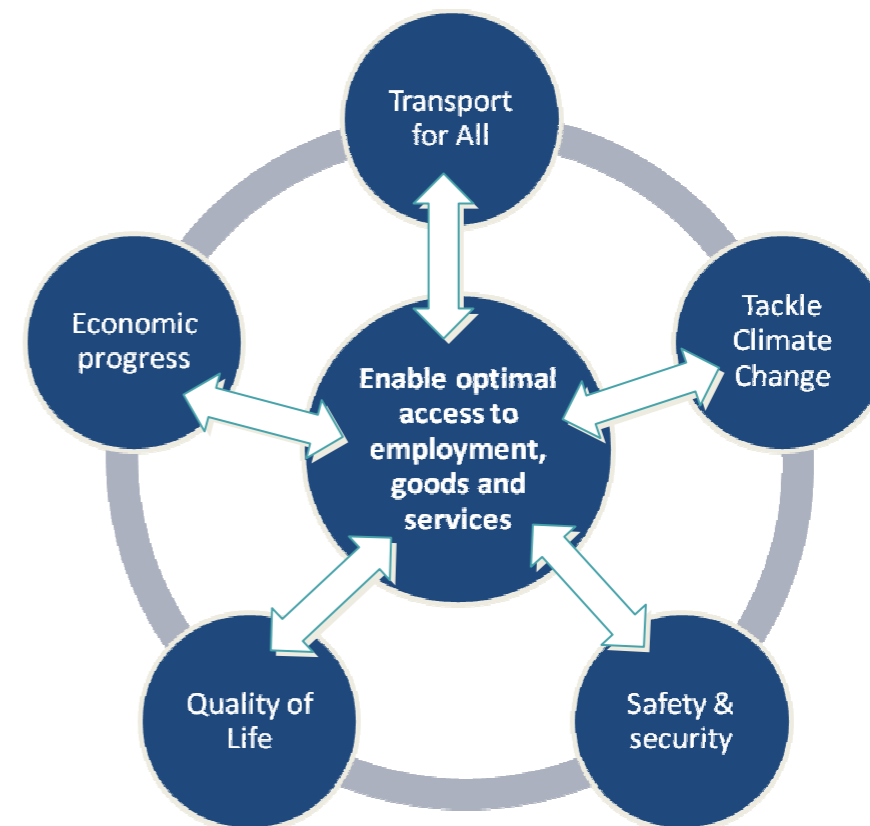
**TfL and Sustainability**

TfL makes sustainability central to their work and as an organisation uses a structured approach to ensure that the economic, social and environmental aspects of its activities are balanced and optimised. This approach is based upon the TfL Sustainability Framework, and is mainstreamed into major project development. As such, TfL is committed to safeguard the NLE's economic, social, health and environmental sustainability and physical accessibility for generations to come.

In line with the above, TfL Sustainability Framework has been used as a basis for assessing the NLE project and for planning the range of sustainability related design aims. In line with the MTS goals, the framework recognises that in providing transport that enables access to employment, goods and services, it is important to:

- Support economic development and population growth;
- Enhance the quality of life for all Londoners, now and for generations to come;
- Improve safety and security;
- Improve transport opportunities; and
- Reduce transport's contribution to climate change and improve its resilience.

The TfL Sustainability Framework is illustrated in Figure 1.



**Figure 1 TfL Sustainability Framework**

The PSAR has been structured around TfL Sustainability Framework and covers sustainability topics derived from the relevant planning policies and industry best practice sustainability guidance documents and assessment methods.

**Sustainability Tools supporting the PSAR**

The bespoke URS sustainability benchmarking tool Strategic Sustainability Analysis Tool (SSAT) has been used to review the NLE. SSAT incorporated themes of TfL's Sustainability Toolkit and questions from an independent evidence-based sustainability assessment scheme for civil engineering and infrastructure projects, Civil Engineering Environmental Quality and Assessment Scheme (CEEQUAL).

The NLE will be formally assessed under CEEQUAL Version 5 with a target score of 'Excellent'. The SSAT has been used to support the achievement of the available CEEQUAL points relevant to the early stages of the development process.

In addition, TfL will assess the proposed Underground stations under BRE Environmental Assessment Method (BREEAM), which is an environmental assessment method and rating system for buildings and will aim to achieve a minimum rating of Very Good.

This PSAR has been prepared using information included in a number of technical studies that form part of the TWA Order application submission for the NLE and are included in the Environmental Statement (ES). Reference should be made to the specific ES Volume I chapters, which are referred to within the relevant sections of this PSAR and which form part of the ES when a detailed understanding of the topic is required. The sustainability measures described herein have been developed in consultation with members of the design and consultant team.

The PSAR presents principles and sustainable development commitments that inform the design development stage. The performance of the project will be confirmed through the CEEQUAL and BREEAM certification process.

The PSAR comprises commitments that TfL aims to deliver during the detailed design, construction and operational phases of the NLE. In some cases, it is currently unclear whether particular sustainability initiatives can be delivered because, for instance, there are no formal Over Site Development (OSD) designs for the station sites yet, as these rely on other developers. Therefore, TfL through this report provides recommendations for such instances, which will be tested and refined at appropriate stages.

The remainder of this document is structured as follows:

- Section 2 provides an overview of the NLE;
- Section 3 outlines the policy context;
- Section 4 sets out the assessment methodology;
- Section 5 includes the sustainability appraisal of the NLE;
- Section 6 presents the conclusions;
- Appendix A presents the summary outputs of the Sustainability Workshops held in July 2012;
- Appendix B responds to each of the objectives included in the Sustainable Design and Construction SPG 2006 incorporating additional London Plan 2011 objectives; and

- Appendix C includes the completed assessment using the TfL Sustainability Assessment Toolkit.

## 2 Overview of the Northern Line Extension

The NLE works comprise the construction of an underground railway to form an extension of the Northern line (Charing Cross branch) from Kennington to Battersea. It will diverge from the existing railway south of Kennington station from a section of track used by terminating trains (known as the Kennington Loop) and will comprise the following:

- Railway approximately 3,150 metres long northbound and approximately 3,250 metres long southbound including overrun / stabling tunnels west of the terminus at Battersea, a crossover east of the terminus and junctions serving each of the tunnels to link with the existing railway at the Kennington Loop;
- A terminus at Battersea between Battersea Park Road and Battersea Power Station (BPS) and an intermediate station at Nine Elms west of Wandsworth Road and north of Pascal Street, both providing step-free access from trains to street level;
- Intervention and ventilation shafts with head houses at Kennington Green and Kennington Park to provide emergency access, tunnel ventilation and smoke control; and
- Ancillary and mitigation works within the limits of deviation including (but not limited to) providing power supply, additional cross passages at platform level at Kennington station and works related to highways, footways and utilities.

The NLE works also include:

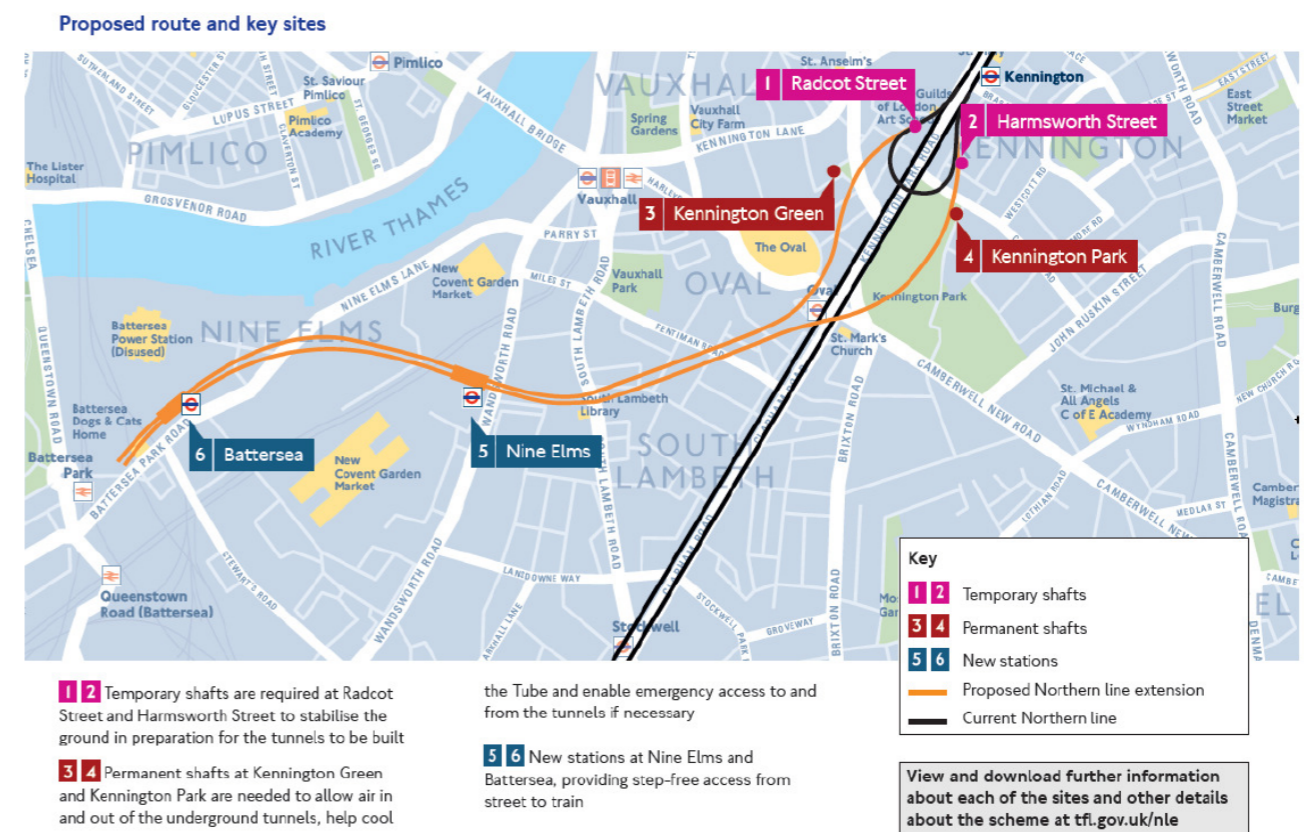
- Accommodation works for affected landowners / occupiers including (but not limited to):
  - Temporary facilities for Battersea Dogs and Cats Home and Covent Garden Market Authority;
  - Temporary and permanent facilities for occupiers of the park lodge at Kennington Park; and
  - The installation of a water tank for the benefit of the Beefeater Gin Distillery.
- Temporary works including worksites at the locations of the proposed stations and shafts / head-houses, temporary shafts at Radcot Street and Harmsworth Street (only for Construction Option A – see Chapter 4: Description of the NLE in ES Volume I) and a temporary conveyor and

associated alterations to the jetty at BPS to facilitate the transfer of material onto barges.

The location of the proposed stations and ventilation shafts is indicated on Figure 2.

The proposed Nine Elms and Battersea stations are excavated deep box structures. Ticketing and staff accommodation at Nine Elms will be at surface level, with the majority of the plant located in basement level plant rooms. At Battersea, staff accommodation, ticketing and plant will all be at basement level within the box structure.

The stations have been designed to take account of future OSDs, although these are not sought by this TWA Order application and are outside of TfL's control. At Battersea, this OSD is subject to the adjacent proposals being progressed at BPS. At Nine Elms, the station will allow a comprehensive development to come forward.



**Figure 2 Map Showing the Proposed Route and Key Sites of the NLE – Option A (TfL)**

### 3 Planning Policy Context and TfL Guidance

Rising international and national aspirations on sustainability have led to the strengthening of national planning policies and building control processes that contribute to the Government's long-term commitment to support sustainable development. In this context, the development proposals address a number of policy documents which are detailed below.

This section provides a brief overview of the policy framework that informs the development of NLE.

#### 3.1 National Planning Policy

The Government has launched measures to combat climate change. The following publications include measures that form the UK national policy framework:

- The National Planning Policy Framework, 2012, sets out the Government's planning policies for England and how these are expected to be applied. It must be taken into account in the preparation of local and neighbourhood plans, and is a material consideration in planning decisions. The document presents the Government's view of what sustainable development in England means in practice for the planning system. At the heart of the National Planning Policy Framework is a presumption in favour of sustainable development. Policies in Local Plans should follow the approach of the presumption in favour of sustainable development so that it is clear that development which is sustainable can be approved without delay.
- The Department of Transport and Industry White Paper entitled Our Energy Future – Creating a Low Carbon Economy, 2003 (Ref. 19), sets a target for 10% of electricity to be produced from renewable sources nationally by 2010 and twice this by 2020, with a goal for 60% reduction in carbon dioxide (CO<sub>2</sub>) emissions by 2050;
- Sustainable and Secure Buildings Act, 2004 (Ref. 20), sets out the purposes for which Building Regulations may be made to further the conservation of fuel and power, ensure water use efficiency, protect and enhance the environment, and prevent/detect non-compliance;
- Climate Change and Sustainable Energy Act, 2006 (Ref. 21), enhances the contribution of the UK to combating climate change, alleviating fuel poverty and securing a diverse and viable long-term energy supply;
- The Department for Communities and Local Government (CLG), Building a Greener Future: Towards Zero Carbon Development, 2006 (Ref. 22) demonstrates the step change required in the Building Regulations to achieve zero carbon housing in order to ensure energy security, which is a risk of climate change;
- The Department of Trade and Industry, A White Paper entitled Meeting the Energy Challenge, 2007 (Ref. 23) sets out the UK strategy, which recognises the need to tackle climate change and energy security;
- The Climate Change Act, 2008 (Ref. 24) sets up a framework for the UK to achieve its long-term goals of reducing greenhouse gas emissions by 34% over the 1990 baseline by 2020 and by 80% by 2050 and to ensure steps are taken towards adapting to the impact of climate change. The Act introduces a system of carbon budgeting which constrains the total amount of emissions in a given time period, and sets out a procedure for assessing the risks of the impact of climate change for the UK, and a requirement on the Government to develop an adaptation programme;
- The Carbon Plan, 2011 (Ref. 27), sets out the Government's plans for achieving the emissions reductions committed to in the first four carbon budgets (introduced in the Climate Change Act), on a pathway consistent with meeting the 2050 target. This publication brings together the Government's strategy to curb greenhouse gas emissions and deliver climate change targets, as well as the updated version of actions and milestones for the next five years, replacing the draft Carbon Plan published in March 2011;
- The Energy Act, 2011 (Ref. 26) provides for a step change in the provision of energy efficiency measures to homes and businesses, and makes improvements to our framework to enable and secure low carbon energy supplies and fair competition in the energy markets. The Bill tackles barriers to investment in energy efficiency by launching the Green Deal and measures to maximise uptake, introducing a new Energy Company Obligation from 2012, extending powers to direct the roll out of smart meters, requiring cheapest tariff information on energy bills and making energy performance data from Energy Performance Certificates more widely available; and
- The Planning and Energy Act, 2008 (Ref. 25) enables local planning authorities to set requirements for energy use and energy efficiency in local plans.



### 3.2 Regional Planning Policy

#### 3.2.1 The London Plan, 2011

The London Plan establishes policy over the next 20 – 25 years, and retains the fundamental objective of accommodating London’s population and economic growth through sustainable development. The Mayor’s vision is for London to excel among global cities, expanding opportunities for all its people and enterprises, achieving the highest environmental standards and quality of life and leading the world in its approach to tackling the urban challenges of the 21<sup>st</sup> century, particularly that of climate change.

The London Plan sets out policy and guidance in the London context and identifies six objectives related to improving the living and working conditions in London, giving more detail about how the vision should be implemented and ensuring London is:

- A city that meets the challenges of economic and population growth;
- An internationally competitive and successful city;
- A city of diverse, strong, secure and accessible neighbourhoods;
- A city that delights the senses;
- A city that becomes a world leader in improving the environment; and
- A city where it is easy, safe and convenient for everyone to access jobs, opportunities and facilities.

Table 1 below lists London Plan policies relevant to NLE.

**Table 1 London Plan Policies Relevant to NLE**

London Plan Policies	
<b>London’s places</b>	
• <b>Policy 2.9</b>	– Enhance economic and demographic growth, improve environment, neighbourhoods and public realm, improve quality of life and health
• <b>Policy 2.10</b>	– Enhance Central Activities Zone, enhance distinctive environment and heritage, enhance links between Central Activities Zone and labour markets, address urban heat island and realise district energy networks, improve public transport, walking and cycling, optimise regeneration
• <b>Policy 2.11</b>	– Support Central Activities Zone
• <b>Policy 2.13</b>	– Provide social and other infrastructure for growth, realise intensification, promote inclusive access, support regeneration
• <b>Policy 2.18</b>	– Incorporate green infrastructure, encourage links with green infrastructure, improve accessibility

<b>London’s people</b>	
• <b>Policy 3.1</b>	– Ensuring equal access for all, enhance facilities and services for particular groups
• <b>Policy 3.2</b>	– Assess health impacts, improve health and addressing health inequalities
• <b>Policy 3.16</b>	– Proposals with high quality social infrastructure to be supported
• <b>Policy 3.19</b>	– Protection and enhancement of sport and recreation facilities
<b>London’s economy</b>	
• <b>Policy 4.1</b>	– Drive a low carbon economy, sustain regeneration, aid innovation
• <b>Policy 4.12</b>	– Support local employment, skills and training
<b>London’s response to climate change</b>	
• <b>Policy 5.1</b>	– Reduce carbon dioxide emissions
• <b>Policy 5.2</b>	– Minimise carbon dioxide emissions, demonstrate reduction in energy assessment using energy hierarchy, meet reporting requirements
• <b>Policy 5.3</b>	– High standards of sustainable design and construction, adapt to climate change, demonstrate integral sustainable design and construction, minimise carbon emissions, avoid overheating, efficient use of natural resources, minimise waste, maximise reuse or recycling, avoid natural hazards impacts, ensure comfort and security, secure sustainable materials and local supplies, promote biodiversity and green infrastructure
• <b>Policy 5.5</b>	– Connection to existing or planned decentralised energy networks
• <b>Policy 5.6</b>	– Evaluate combined heat and power, follow energy hierarchy, design for connect to future energy networks
• <b>Policy 5.7</b>	– Reduce carbon dioxide emissions by renewable energy where feasible,
• <b>Policy 5.9</b>	– Adopt cooling hierarchy, demonstrate how construction and operation minimises overheating and cooling, avoid energy intensive air cooling as much as possible
• <b>Policy 5.10</b>	– Integrate green infrastructure at beginning of design to contribute to urban greening and public realm
• <b>Policy 5.11</b>	– Major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible
• <b>Policy 5.12</b>	– Comply with the flood risk assessment and management, remain safe and operational during flooding, safe evacuation, provision of key services, quick recovery following a flood
• <b>Policy 5.13</b>	– Use sustainable drainage, green field runoff rates, follow drainage hierarchy
• <b>Policy 5.15</b>	– Minimise use of mains water, use water saving measures
• <b>Policy 5.17</b>	– Provide waste and recycling storage
• <b>Policy 5.18</b>	– Remove construction waste and bring site materials by water or rail where practicable
• <b>Policy 5.21</b>	– Avoid spread of contamination

London's transport	
• <b>Policy 6.1</b>	– Integration of transport and development, reduce need for travel, improve capacity and accessibility of public transport, walking and cycling, improve interchange, encourage modal shift, use low carbon technology, promote walking by an improved public realm, safety in use including step free access
• <b>Policy 6.2</b>	– Improve the integration, reliability, quality, accessibility, frequency, attractiveness and environmental performance of the public transport system, deliver safe and secure network, increase capacity
• <b>Policy 6.9</b>	– Provide cycle parking, changing facilities, showers and facilitate Cycle Super Highways
• <b>Policy 6.10</b>	– Ensure high quality pedestrian environment
• <b>Policy 6.13</b>	– Ensure electric charging point, parking for disabled people, meet cycle parking, needs for delivery and servicing

London's living places and spaces	
• <b>Policy 7.1</b>	– Improve people's access to social and community infrastructure, enable healthy active lives, maximize the opportunity for community diversity, inclusion and cohesion, contribute to people's sense of place, safety and security, meet the principles of lifetime neighbourhoods, reinforce or enhance the permeability and accessibility of the neighbourhood
• <b>Policy 7.2</b>	– Achieve the highest standards of accessible and inclusive design, the design and access statement should explain how inclusive design have been integrated into the development and how it will be maintained and managed
• <b>Policy 7.3</b>	– Reduce opportunities for crime, contribute to a sense of security, provide for convenient movement, surveillance of publicly accessible spaces, maximize activity throughout the day and night, promote sense of ownership and respect, incorporate security features, design for management and future maintenance costs for safety and security
• <b>Policy 7.4</b>	– Provide a high quality design reflecting existing pattern and grain, contribute to a positive relationship between the urban structure and natural landscape, create a positive relationship with street level activity, make a positive contribution to the character of a place, be informed by the surrounding historic environment
• <b>Policy 7.5</b>	– Make a comprehensible public realm, landscape treatment. Street furniture and infrastructure should be of the highest quality, have a clear purpose, maintain uncluttered spaces and should contribute to the easy movement of people, consider public art, maximise greening through planting and trees, public realm should be informed by the heritage values, incorporate local social infrastructure, reinforce the connection between public spaces and existing local features
• <b>Policy 7.6</b>	– Buildings to be of the highest architectural quality, enhance public realm, use details and materials that complementing local architectural character, avoid unacceptable harm to amenity spaces, incorporate best practice in resource management and climate change mitigation and adaptation, provide high quality indoor and outdoor spaces, adaptable to different activities and land uses, meet the principles of inclusive design, optimise the potential of sites
• <b>Policy 7.8</b>	– Identify, value, conserve, restore, re-use and incorporate heritage assets, where appropriate. Protect of archaeological resources, landscapes and significant memorials
• <b>Policy 7.13</b>	– Minimise risk of fire, flood and related hazards, include measures to design out crime . Deter terrorism, assist in the detection of terrorist activity and help defer its effects
• <b>Policy 7.14</b>	– Minimise increased exposure to existing poor air quality, reduce emissions from demolition and construction, be at least 'air quality neutral', focus on on-site measures
• <b>Policy 7.15</b>	– Minimise existing and potential noise impacts, promote new technologies
• <b>Policy 7.18</b>	– Avoid loss of local open space, replace loss with equivalent or better quality provision
• <b>Policy 7.19</b>	– Where possible, protect, enhance, create and manage biodiversity, assist biodiversity action plans
• <b>Policy 7.20</b>	– Retain trees and any loss to be replaced

**3.2.2 London Plan Implementation Plan Consultation Draft**

The Implementation Plan (Ref. 28) consultation draft seeks to improve the quality of urban planning and give greater consideration to health inequalities in planning decisions.

**3.2.3 Mayor's Strategies**

The Mayor published the following strategies of relevance to the PSAR:

- The Mayor's Climate Change Mitigation and Energy Strategy;
- The Mayor's Biodiversity Strategy;
- The Mayor's Waste Management Strategies;
- The Mayor's Ambient Noise Strategy;
- The Mayor's Air Quality Strategy;
- The Mayor's Water Strategy;
- The Mayor's Climate Change Adaptation Strategy;
- The Mayor's Transport Strategy;
- The Mayor's Economic Development Strategy; and
- The Mayor's Health Inequalities Strategy.

The sustainability aspects and implications of the strategies are summarised in the following subsections.

**3.2.3.1 Delivering London's Energy Future: The Mayor's Climate Change Mitigation and Energy Strategy**

The Mayor's Climate Change Mitigation and Energy Strategy sets out the Mayor's strategic approach to limiting further climate change and securing a low carbon energy supply for London.

To limit further climate change the Mayor has set a target to reduce London's CO<sub>2</sub> emissions by 60% of 1990 levels by 2025. The Strategy details the programmes and activities that are ongoing across London to achieve this. These include:

- RE:NEW – retrofitting London's homes with energy efficiency measures, and helping Londoners save money off their energy bills.

- RE:FIT – retrofitting London's public sector buildings, saving millions of pounds every year.
- RE:CONNECT – ten low carbon zones in London aiming to reduce CO<sub>2</sub> emissions by 20% by 2012 across the community.
- Decentralised energy programme – aiming to supply 25% of London's energy from secure, low carbon local sources.

The Strategy also details policies and activities underway to reduce CO<sub>2</sub> emissions from new development and transport through the London Plan and the Mayor's Transport Strategy.

**3.2.3.2 Connecting with London's nature: The Mayor's Biodiversity Strategy**

The objectives of the Biodiversity Strategy are:

- Ensuring all Londoners have ready access to wildlife and natural green spaces;
- Conserving London's plants, animals and their habitats;
- Encouraging businesses to incorporate green design into their development proposals;
- Promoting the functional benefits of biodiversity, for example flood and erosion prevention and the amelioration of ambient noise and absorption of pollutants; and
- Providing sustainable development: good quality open spaces together with green footpaths and cycle ways; growing food locally and organically in allotments and gardens (providing wildlife habitat) and composting green waste and growing energy crops in London to reduce its wider ecological footprint.

**3.2.3.3 The Mayor's Waste Management Strategies**

The Mayor has published his waste management strategies: London's Wasted Resource, on the management of municipal waste (not directly relevant to NLE), and Making Business Sense of Waste. This Business Waste Management Strategy, which sets out initiatives to help all kinds of London's businesses, from shops, restaurants, office buildings, manufacturers to construction companies to save money and reduce harm to the environment through better waste management.

3.2.3.4 Souder City: The Mayor’s Ambient Noise Strategy

The overall aim of the Mayor’s Ambient Noise Strategy is to “*minimise the adverse impacts of noise on people living and working in, and visiting London using the best available practise and technology within a sustainable development framework*”.

The initial priorities identified as part of this strategy, which are relevant to NLE are:

- Seeking improved railway track quality and maintenance on national rail and Underground as far as organisation and funding allow.
- Securing support for exemplary noise barrier-integrated photovoltaic power generation along suitable roads and railways, and noise screening from safety and security fencing.
- Reducing noise through better planning and design, where London’s growth in people and jobs presents challenges, but redevelopment and refurbishment also offer opportunities - high density, mixed-use development can create quiet outdoor spaces away from traffic.

The Mayor expects noise and vibration to be minimised through better design and maintenance of London Underground as far as feasible. Issues to be addressed include groundborne vibration from underground lines, noise from trains on the surface, and in-train noise for passengers.

3.2.3.5 Clearing London’s Air: The Mayor’s Air Quality Strategy

The first priority of the Mayor’s Air Quality Strategy is to achieve European Union limit values for particulate matter (PM<sub>10</sub>), (PM<sub>2.5</sub>) and nitrogen dioxide (NO<sub>2</sub>) in London.

The Mayor’s vision for air quality is to protect and improve the health of Londoners and increase their quality of life by significantly improving the quality of the air in London. This will:

- Make London a more pleasant place to live and work in;
- Reduce the burden on health services in the capital;
- Enhance London’s position as a green city – making it more attractive to tourists and businesses; and
- Make London cleaner, whilst safeguarding its biodiversity.

3.2.3.6 Securing London’s Water Future: The Mayor’s Water Strategy

The Mayor’s Water Strategy promotes increasing water efficiency and reducing water wastage to balance supply and demand for water, safeguard the environment and help tackle water affordability problems. It also sets out how the Mayor will help communities at risk of flooding to increase their resilience to flooding.

3.2.3.7 Managing Risks and Increasing Resilience: The Mayor’s Climate Change Adaptation Strategy

The Mayor’s Climate Change Strategy identifies who and what is vulnerable to extreme weather today, considers how climate change will affect the existing climate risks, or create new risks or opportunities in the future and provides a framework for action.

3.2.3.8 The Mayor’s Transport Strategy

The MTS, 2010 sets out the Mayor’s transport vision and describes how TfL and its partners, including the London boroughs, will deliver integrated and dynamic 21<sup>st</sup> century transport system.

The MTS was developed alongside the London Plan (see Section 3.2.1) and Economic Development Strategy (see Section 3.2.3.9) as part of a strategic policy framework intended to support and shape the economic and social development of London over the next 20 years.

MTS is shaped by the Mayor’s transport vision:

*“London’s transport system should excel among those of world cities, providing access to opportunities for all its people and enterprises, achieving the highest environmental standards and leading the world in its approach to tackling urban transport challenges of the 21<sup>st</sup> century.”*

Achieving this vision for an integrated and dynamic 21<sup>st</sup> century transport system can be broken down in to the following aims:

- Enhanced capacity and connectivity;
- Efficient and integrated;
- Encourages mode shift to cycling, walking and public transport;
- Easily accessible and fair to users;
- Ensuring value for money;
- Environment and quality of life are improved;

- Extends opportunities for all Londoners.

The MTS identifies and sets out six goals for implementing the Mayor’s vision.

The transport strategy should:

- Support economic development and population growth;
- Enhance the quality of life for all Londoners;
- Improve the safety and security of all Londoners;
- Improve transport opportunities for all Londoners;
- Reduce transport’s contribution to climate change and improve its resilience; and
- Support delivery of the London 2012 Olympic and Paralympic Games and its legacy.

The MTS desired outcomes associated with each of the goals and challenges are detailed in the table ‘Proposed outcomes’ in Table 2.

The MTS highlights the Northern line Extension to Battersea, and lists it in its “significant additions to transport capacity and connectivity in London”.

**Table 2 Proposed Outcomes**

Goals	Challenges	Outcomes
Support economic development and population growth	Supporting sustainable population and employment growth	• Balancing capacity and demand for travel through increasing public transport capacity and/or reducing the need to travel
	Improving transport connectivity	• Improving people’s access to jobs • Improving access to commercial markets for freight movements and business travel, supporting the needs of business to grow
	Delivering an efficient and effective transport system for people and goods	• Smoothing traffic flow (managing delay, improving journey time reliability and resilience) • Improving public transport reliability • Reducing operating costs • Bringing and maintaining all assets to a state of good repair • Enhancing use of the Thames for people and goods
Enhance the quality of life for all Londoners	Improving journey experience	• Improving public transport customer satisfaction • Improving road user satisfaction (drivers, pedestrians, cyclists) • Reducing public transport crowding
	Enhancing the built and natural environment	• Enhancing streetscapes, improving the perception of the urban realm and developing ‘better streets’ initiatives • Protecting and enhancing the natural environment
	Improving air quality	• Reducing air pollutant emissions from ground-based transport, contributing to EU air quality targets
	Improving noise impacts	• Improving perceptions and reducing impacts of noise
	Improving health impacts	• Facilitating an increase in walking and cycling
Improve the safety and security of all Londoners	Reducing crime, fear of crime and antisocial behaviour	• Reducing crime rates (and improving perceptions of personal safety and security)
	Improving road safety	• Reducing the numbers of road traffic casualties
	Improving public transport safety	• Reducing casualties on public transport networks
Improve transport opportunities for all Londoners	Improving accessibility	• Improving the physical accessibility of the transport system • Improving access to services
	Supporting regeneration and tackling deprivation	• Supporting wider regeneration
Reduce transport’s contribution to climate change and improve its resilience	Reducing CO2 emissions	• Reducing CO2 emissions from ground-based transport, contributing to a London-wide 60 per cent reduction by 2025
	Adapting to climate change	• Maintaining the reliability of transport networks
Support delivery of the London 2012 Olympic and Paralympic Games and its legacy	Developing and implementing a viable and sustainable legacy for the 2012 Games	• Supporting regeneration and convergence of social and economic outcomes between the five Olympic boroughs and the rest of London • Physical transport legacy • Behavioural transport legacy

### 3.2.3.9 The Economic Development Strategy

The Mayor's vision is for London to be the best big city in the world. The Economic Development Strategy (2010) sets out this vision with respect to the London economy, and how it can be realised.

Underlying the Economic Development Strategy is a projection of continuing growth in London's economy and population to 2031 and beyond.

A number of themes thread through The Economic Development Strategy, including the statutory cross-cutting themes of equality of opportunity, community safety, health, health inequalities, sustainable development, and climate change adaptation and mitigation.

### 3.2.3.10 Health Inequalities Strategy

The Greater London Authority Act 2007 requires that the Mayor sets out the health inequalities facing London, the priorities for reducing them and the role to be played by a defined list of key partners in order to deliver the strategy's objectives. This was addressed in the very first London Health Inequalities Strategy

The Health Inequalities Strategy refers to health inequalities in respect of life expectancy or general state of health which are wholly or partly a result of differences in respect of general health determinants, which are described as:

- a) standards of housing, transport services or public safety;
- b) employment prospects, earning capacity and any other matters that affect levels of prosperity;
- c) the degree of ease or difficulty with which persons have access to public services;
- d) the use, or level of use, of tobacco, alcohol or other substances, and any other matters;
- e) of personal behaviour or lifestyle that are or may be harmful to health; and
- f) any other matters that are determinants of life expectancy or the state of health of persons generally, other than genetic or biological factors.

### 3.2.4 London-wide Supplementary Planning Guidance (SPG)

The following SPG and policy documents have been considered with respect to the sustainability performance of the NLE:

- Sustainable Design and Construction (2006);

- Adapting to Climate Change: A Checklist for Development (2005) (Ref. 31);
- Land for Industry and Transport (2012) (Ref. 32);
- Vauxhall / Nine Elms / Battersea Opportunity Area (2012) (Ref. 33);
- The GLA Group Responsible Procurement Policy (2008) (Ref. 30)

### 3.2.4.1 Sustainable Design and Construction SPG

The Sustainable Design and Construction SPG, published in 2006, applies to all 'major' developments, which may be referable to the Mayor. Although NLE is not referable to the Mayor, it is a major development in London and should respect the London SPG. In addition, the SPG is considered good practice guidance for sustainable development.

The SPG offers a series of 'Essential Standards', which apply to all major developments in London, and a second tier of 'Mayor's Preferred Standards', which indicate exemplary benchmarks that are not policy requirements.

Although the SPG provides some guidance on how the Standards might be achieved, it is not prescriptive. Likewise, it identifies the various methods and tools by which performance against the Standards might be measured, but again it is not prescriptive. It is, therefore, the responsibility of the applicant to ensure that performance is appropriately assessed and demonstrated.

Many of the standards set out in the SPG are targeted at residential development, or buildings that will be occupied for some period of time. The proposed NLE proposals differ from a residential development and hence some of the Standards are not directly relevant.

The SPG sets out the following measures to meet the London Plan objectives:

- Re-use land and buildings;
- Conserve energy, materials, water and other resources;
- Ensure designs make the most of natural systems both within, in and around the building;
- Reduce the impacts of noise, pollution, flooding and micro-climatic effects;
- Ensure developments are comfortable and secure for users;
- Conserve and enhance the natural environment, particularly in relation to biodiversity; and

- Promote sustainable waste behaviour in new and existing developments, including support for local integrated recycling schemes, Combined Heat and Power (CHP) schemes and other treatment options.

The SPG provides a series of essential and preferred standards that projects are expected to seek to achieve, however these refer to a superseded version of the London Plan.

#### 3.2.4.2 Adapting to Climate Change: A Checklist for Development

This document, published by the GLA in 2005, contains a checklist and guidance for new developments to adapt to climate change.

#### 3.2.4.3 Draft Land for Industry and Transport

The draft SPG 'Land for Industry and Transport' issued in February 2012 notes that the 'Making Walking Count' programme aims to increase overall mode share of walking to 25% of transport by 2031, through better information, active travel programmes and physical improvements to the urban realm. It also records that the Mayor is seeking to increase cycle trips by 400% by 2026, against the 2001 baseline, taking cycling's overall mode share from 2 to 5%.

#### 3.2.4.4 Vauxhall Nine Elms Battersea (VNEB) Opportunity Area Planning Framework (OAPF)

The London Plan identifies OAs across the capital, identifying them as places in London with the potential to accommodate substantial numbers of new jobs and homes. VNEB is one of these areas.

The GLA has published in March 2012 an Opportunity Area Planning Framework (OAPF) for VNEB, which sets out current challenges and opportunities. The OAPF objectives include:

- Deliver housing including affordable housing to meet the highest access, design and environmental standards; secure social infrastructure to support new and existing residents; protect and enhance open spaces and the natural environment;
- Ensure London's continued economic success;
- Promote social inclusion;
- Deliver transport and other infrastructure needed to support growth;
- Make London an exemplary world city in mitigating and adapting to climate change; and

- Improve the public realm.

The OAPF supports the delivery of a high density mixed use development, and significant public realm improvements and substantial social infrastructure delivery to support existing and new communities in the area. It is anticipated that new schools, health facilities, community centres, libraries and churches will be required.

The public realm strategy for the OA seeks to address the longstanding segregation of the residential hinterland from the riverside.

The OAPF sets out an energy master plan, which connects key sites within the OA to a District Energy Network (DEN) and requires developments to connect to the VNEB DEN. Where a development is completed before the VNEB network is completed, the development should be designed to ensure it can connect to the VNEB network with the minimum delay and modifications.

In terms of transport infrastructure improvements, new development in the OA will be required to:

- Integrate and where necessary facilitate enhanced walking and cycling infrastructure (including provision of cycle parking);
- Provide adequate bus standing/stopping space, whilst maintaining and extending existing stops and stands where appropriate;
- Maximise the use for water/rail to deliver in construction materials;
- Undertake transport assessments;
- Mitigate any transport impacts generated by the development proposals;
- Provide low levels of car parking (car free where possible) to encourage mode shift and sustainable travel patterns; and
- Provide electric vehicle charging points.

#### 3.2.4.5 The GLA Group Responsible Procurement Policy

The GLA's Responsible procurement policy outlines the Mayor's commitment to using responsible procurement as a mechanism for achieving the key principles for the sustainable development of London. These key principles are outlined as; strong and diverse economic growth, social inclusivity and fundamental improvements in environmental management and use of resources.

### 3.3 Local Planning Policy

Alongside the London Plan the relevant adopted Local Development Frameworks (LDF) for the LBL, LBS and LBW have been considered within this PSAR and are listed in the following sections.

#### 3.3.1 London Borough of Wandsworth (LBW)

From October 2010 the adopted Development Plan for LBW includes amongst other documents the Core Strategy and Development Management Policies Document (DMPD) (Ref 34).

##### 3.3.1.1 LBW Core Strategy

The LBW Core Strategy was adopted in October 2010 and sets out the Council's spatial vision and strategic objectives on how the borough should develop over the next fifteen years along with core policies and information on monitoring and implementation.

The following policies of the Core Strategy are being taken into consideration in regards to the NLE:

- Policy PL 2: b) Where development is permitted within flood risk areas it must demonstrate that where possible, it will reduce fluvial, tidal and surface water flood risk and manage residual risks through appropriate flood risk measures; d) Potential flooding from groundwater and sewers should be taken into account in dealing with proposals for buildings, extensions, basements and paved areas.
- Policy PL 4: b) New developments will be expected to incorporate appropriate elements of public open space, and to make a positive contribution to the wider network of open spaces. g) New development should avoid causing ecological damage and propose full mitigation and compensation measures for ecological impacts which do occur. Where appropriate new development should include new or enhanced habitat or design and landscaping which promotes biodiversity, and provision for management, particularly in areas identified as deficient in nature conservation.
- Policy IS 1: a) Maximising the use of previously developed land and vacant and underused buildings, taking account of the suitability of sites for high density mixed use development and the impact that development will have on the borough's natural resources, environmental and cultural assets and the health of local people.

- Policy IS 2: b) All development will be required to make efficient use of natural resources (e.g. energy and water), employing good standards of sustainable design and construction, including sustainable drainage, working towards low carbon and zero carbon standards. New buildings should be designed for the climate they will experience over their lifetime. Major development proposals will be expected to demonstrate and justify their approach as part of an Energy Assessment.
- Policy IS 3: b) The layout, form and design of new buildings and the spaces around them should contribute positively to the local environment, creating places, streets and spaces which meet the needs of people, are visually attractive, safe, accessible to all, sustainable, functional, adaptable, durable, inclusive, and while having their own distinctive identity maintain and reinforce local character
- Policy IS4: a) Mitigate the impact of flood risk in line with the findings of the Strategic Flood Risk Assessment. b) Improve air quality in line with the Council's Air Quality Action Plan. c) Reduce the impact of noise, d) Ensure development is safe regarding the re-use of contaminated land, in relation to proposals involving hazardous processes and materials and development located close to hazardous installations. e) Ensure efficient water management to reduce the impact of water take.

##### 3.3.1.2 LBW Development Management Policies Document

The LBW DMPD published in February 2012 is part of the LDF and supports the LBW Core Strategy and London Plan, and sets out the Council's detailed policies for managing development in the borough.

Policy DMS 3 requires applications for major development to be accompanied by an energy assessment stating how Core Strategy Policy IS2 will be addressed. This should include information on how the following energy hierarchy has been applied:

- Calculation of baseline energy demand and CO<sub>2</sub> emissions including regulated and unregulated energy usages;
- Proposals to reduce CO<sub>2</sub> emissions through the use of passive design and energy efficient design measures that aim to reduce the demand for energy;
- Proposals to reduce CO<sub>2</sub> emissions through connection to existing or planned heating and cooling networks and/or through the installation of on-site communal energy systems (prioritising CHP), where feasible;



- Proposals to reduce CO<sub>2</sub> emissions further through the use of on-site renewable energy technologies.

Other relevant DMPD Policies include:

- Policy DMS 5 Flood risk management requiring Flood Risk Assessment to be carried out for new developments.
- Policy DMS 6 Sustainable Drainage Systems requires all new developments should seek to incorporate Sustainable Drainage Systems (SUDS) or demonstrate alternative sustainable approaches to the management of surface water.
- Policy DMS 7 Consultation with the Environmental Agency states that the Environment Agency should be consulted on all developments adjacent to watercourses.
- Policy DMO 1 Protection and Enhancement of Open Spaces includes the Council's commitment to protect and enhance existing open spaces.
- Policy DMO 3 Open Spaces in New Development will be promoted particularly in areas of open space deficiency.
- Policy DMO 4 Nature Conservation states that all development proposals should aim to provide gains for biodiversity.

### 3.3.2 London Borough of Lambeth (LBL)

The adopted Development Plan for LBL includes amongst other documents the Core Strategy of the LDF and the Unitary Development Plan (UDP) (2007) (Ref. 35) saved policies beyond 5 August 2010. In addition, Supplementary Planning Documents (SPD) (Ref. 36) provide detailed guidance to the policies in Lambeth's UDP and site specific guidance for the development of sites.

#### 3.3.2.1 LBL Unitary Development Plan

The LBL UDP was adopted 2007 and similarly to the LBW UDP some of its policies have expired whereas others remain part of the Lambeth's Development Plan.

Lambeth is committed to achieving sustainable development, which is reflected in the objectives of the plan such as to promote energy conservation and sustainable design.

Policy 35 of the LBL UDP states, that all development proposals should show, how they incorporate sustainable design and construction principles, (including employing built forms, materials, orientation and layout and renewable energy

production, natural ventilation and cooling, where practical), that will contribute to reduced energy consumption and associated emissions. Larger schemes should, wherever feasible, include CHP and community heating.

#### 3.3.2.2 LBL Core Strategy

The Core Strategy was adopted in January 2011 and is the first and most important document in the LBL LDF as it sets out the Council's spatial strategy, vision and strategic objectives to be achieved. One of the key themes of the LBL Core strategy is tackling and adapting to climate change.

- Policy S1 Delivering the Vision and Objectives addresses the spatial aspects of Lambeth's sustainable community strategy.
- Policy S3 Economic Development states that the Council will support local economic development, Lambeth's contribution to the central and wider London economy and a range of local business and job opportunities, by giving priority to a diverse range of economically beneficial uses in appropriate locations.
- Policy S4 Transport details how the Council will contribute to a sustainable pattern of development in the borough, minimising the need to travel and reducing dependence on the private car and seek improvements for better connectivity, quality and capacity in public transport.
- Policy S5 Open Space states that the Council will meet requirements for Open Space by protecting and maintaining existing open spaces, increasing the quantity of open space and improving the quality of, and access to, existing open space, including the range of facilities available and its bio-diversity and nature conservation value and heritage value.
- Policy S6 Flood Risk includes the Council's commitment to collaborate with the Environmental Agency in order to manage and mitigate flood risk.
- Policy S7 Sustainable Design and Construction aims to ensure that future development, including construction of the public realm, highways and other physical infrastructure, achieves the highest standards of sustainable design and construction and subsequent operation by requiring all major development to achieve a reduction in CO<sub>2</sub> emissions in line with London Plan targets through energy efficient design, decentralised heat, cooling and power systems, and on-site renewable energy generation. In addition, this policy aims to safeguard existing heat,

cooling and power networks and support the development of new networks.

- Policy S8 Sustainable Waste Management details how the Council will contribute to the sustainable Waste management in Lambeth.
- Through its Policy S9 Quality of the Built Environment the Council aims to improve and maintain the quality of the built environment and its liveability, in order to sustain stable communities.
- Policy PN2 Vauxhall appreciates the link between areas of Nine Elms and Battersea and Vauxhall which make up the London Plan OA. This policy recognises that public transport capacity of this area is currently limited and seeks substantial improvements in the quality, access and capacity of public transport in the OA as a whole.

### 3.3.2.3 LBL Sustainable Design and Construction SPD

This SPD explains and provides further guidance to the interpretation and application of LBL UDP policies, the London Plan and relevant Government policies.

The SPD requires that a sustainability assessment is prepared for new developments. This must include an assessment of the energy demand and CO<sub>2</sub> emissions from proposed major developments.

### 3.3.3 London Borough of Southwark (LBS)

The Development Plan for LBS includes amongst other documents the Southwark Core Strategy of the LDF and the saved policies within the Southwark Plan (Ref. 37). In addition, the LBS Sustainability Assessment SPD (Ref. 38) provide detailed technical guidance for masterplans/ developments.

#### 3.3.3.1 The Southwark Plan

The Southwark Plan was adopted in 2007. In 2010 some of the more detailed policies mainly for urban design, open space, housing tenure and transport along with some detailed site allocations were 'saved' until July 2013. The relevant Southwark Plan saved policies includes:

- Policy SP 14 Sustainable Buildings;
- Policy SP 18 Sustainable Transport;
- Policy 3.4 Energy Efficiency; and
- Policy 3.5 Renewable Energy.

#### 3.3.3.2 LBS Core Strategy

The Core Strategy was adopted by Council Assembly on the 6<sup>th</sup> April 2011 and sets long term vision, spatial strategy and strategic policies with an implementation plan in the LBS for the next 15 years until 2026. It sets demanding standards and targets as reduction in CO<sub>2</sub> emissions, protection of other natural resources and environment.

Policy 13 High Environmental Standards expects the proposed development to meet the energy targets as set in the London Plan and sustainability targets below:

- Where relevant non-residential development should achieve at least BREEAM "excellent"; and
- Major developments must reduce surface water run-off by more than 50%.

#### 3.3.3.3 LBS Sustainability Assessment SPD

The SPD gives further guidance on the detail of the LBS's development plan. The Sustainability Assessment SPD 2009 requires that sustainability assessments take place to ensure social, environmental and economic factors are considered and balanced to get the most sustainable development possible. The Council requires a sustainability assessment to be submitted with all development applications proposing ten or more dwellings, or 1,000 m<sup>2</sup> or more of floorspace.

### 3.4 TfL and London Underground (LU) Policy, Standards and Guidance Documents

This section includes a number of relevant TfL documents within the LU and TfL Management System. It should be noted that LU Management System conforms to the principles of ISO 14001.

#### 3.4.1 TfL Health, Safety and Environment (HSE) Policy

LU's HSE Policy (Ref. 39) aims to improve TfL's HSE performance through:

- Complying with the spirit and letter of HSE legislation;
- Setting progressive objectives and targets to improve HSE management and performance;

- Taking account of HSE risks and benefits in decision making and business planning process;
- Striving to realise environmental benefits, in addition to pollution prevention, with a focus on managing emissions and mitigating the effects of, and adapting to climate change; and
- Actively supporting the Mayor in delivering the environmental strategies on air quality, ambient noise, biodiversity, energy and municipal waste.

TfL has set environmental objectives and targets and has reported annually on its environmental performance since 2004.

### 3.4.2 LU Asset Management Strategy & Policy 2010

The London Underground Assessment Management Strategy and Policy (Ref. 41) outlines LU's approach to asset management decisions based on whole life assessment, optimisation of cost, risk and performance, whilst ensuring safety, environmental and legal statutory compliance.

### 3.4.3 Policy for The Mayor's Green Procurement Code

The Policy for the Mayor's Green Procurement Code (Ref. 30), sets out TfL's commitment to applying the principles established in the Mayor's Code for activities undertaken by TfL, where the criteria for performance and cost effectiveness can be met. The core principles of the code include:

- Reduce, Reuse, Recycle;
- Buy Recycled;
- Green the supply chain;
- Deliver Green Benefits within Best Value.

TfL's level of commitment to each of the minimum code requirements are as follows:

- A1 - Contribute to general discussions about recycling;
- A2 – Have specific one to one discussions about experiences and opportunities for specifying and buying recycled products;
- B1 – Provide baseline data about recycled purchases and specifications;
- B2 – Commit to measurable targets for specifying and buying recycled products.

### 3.4.4 Ethical Sourcing Policy

The Ethical Sourcing Policy (Ref. 48), issued in 2008, sets out TfL's procurement strategy for the ethical sourcing of all goods, works and services. Working within its obligations as a Best Value Authority, and in compliance with EU and UK legislation, the policy outlines TfL's conduct as part of the procurement process to be in line with the internationally recognised Ethical Trading Initiative (ETI) Base Code standards of the International Labour Organisation (ILO).

The guiding principles outlined in the policy are as follows:

- Identify suitable applications of ethical sourcing considerations;
- Improve labour conditions in the supply chain;
- Monitor working conditions;
- Engage with suppliers; and
- Deliver Benefits within Law and Best value.

### 3.4.5 TfL HSE Report

In 2012 TfL has produced an integrated HSE report (Ref. 40), which focuses on:

- Health and safety performance data covering employee safety, customer safety, contractor safety and staff sickness absence;
- Road safety data; and
- Environmental performance data relating to London's public transport operations.

TfL has set environmental objectives and targets and has reported annually on its environmental performance since 2004. The key targets relevant to this PSAR are as follows.

- Reduce the normalised emissions (measured in grams CO<sub>2</sub> per passenger km) from its main public transport services by 20% in 2017/18, against a 2005/2006 baseline;
- Achieve a 40% reduction in total NO<sub>x</sub> emissions by 2017/18 against 2005/06 levels;
- Reduce transport related noise and vibration;

- A commitment to increasing the recycling rate of Commercial & Industrial waste to 70% and Construction and Demolition waste to 95% by 2017/18.

#### 3.4.6 Business Plan 2011/2012 - 2014/2015

The TfL Business Plan (Ref. 42) outlines how TfL intend to implement The Mayor's Transport Strategy in order to support the capital's growth over the period to 2031. The Business Plan focuses on the six MTS goals presented in Section 3.2.3.8.

#### 3.4.7 TfL Vision (The Plan – Value and Sustainability Workstream)

The Plan (Ref. 18) sets out where Rail & Underground is focusing its efforts in 2012/13 in delivering step-change in performance.

The Value & Sustainability Programme Board, which forms part of The Plan, takes responsibility for the long-term strategic view of costs and revenues in providing services. One of the projects undertaken by the board is the development of a sustainable business. The key activities of the project are listed as follows:

- Embedding sustainability considerations across Rail & Underground's processes and activities;
- Sourcing of low carbon and/or high-thermal efficiency power for direct delivery to Rail & Underground's power network;
- Improvements to Rail & Underground's energy metering capability; use of energy data to inform operational and maintenance performance management;
- Trialling of low-energy assets and technologies and adoption into business as usual activities;
- Setting out the roadmap for long-term sustainable development in Rail & Underground.

#### 3.4.8 LU Environment Strategy 2008-13

The LU Environment Strategy (revised in 2011) (Ref. 17) focuses on the impact of LU activities on the environment and sets environmental priorities until 2013.

LU is committed to continual environmental improvement by embedding good environmental practices into the business. One LU objective is to reduce greenhouse gas emissions and to deliver a low carbon transport service.

Note that the strategy will be revised in 2013 and the updated TfL Environment Strategy will follow the current LU Environment Strategy. The revision will be TfL wide and updated objectives and targets will be implemented to support the Business Plan and the implementation of the TfL Vision (see Section 3.4.7).

#### 3.4.9 S1-352 Station Ambience

The Station Ambience Standard 1-352 (Ref. 43), provides the ambience requirements with regards to stations. This covers the following areas:

- Station condition;
- Cleanliness;
- Spillages, seepages, snow and ice;
- Barriers;
- Litter;
- Graffiti and unauthorised stickers;
- Air Quality; and
- Noise and vibration.

#### 3.4.10 LU Biodiversity Action Plan (BAP)

The LU BAP (Ref. 44) was released in 2010. Following its first publication in 2007, where LU outlined its commitments to retaining a healthy wildlife-rich network while maintaining safety and efficiency, the plan has been updated to reflect the shift in ecology and habitat management methods towards the management of large swathes of land rather than small pockets. This supports national and regional targets in terms of: projection of endangered species and habitats, flood protection, water conservation, carbon dioxide storage, recreation facilities and quality of life.

The LU's key objectives, which align with the Mayor's Biodiversity strategy, are as follows:

- Conserve, and where reasonably practical to enhance, the biodiversity value of LU property;
- Increase awareness amongst staff and the travelling public of biodiversity in London.

#### **3.4.11 Valuing the Urban Realm TfL Guidelines**

The latest version of the Valuing the Urban Realm (VUR) toolkit (Ref. 45) was released in April 2012. The toolkit is used to quantify and evaluate the financial benefits of public urban realm investment and can compare different magnitudes of interventions. The Toolkit aims to inform the evaluation of proposed streetscape improvements, undertake cost-benefit analysis, development of business cases and justification of investment in public realm projects.

#### **3.4.12 LU G1323 Asset Design Guidance**

The Asset Design Guide (Ref. 46), issued in April 2012, outlines LU's approach to defining noise and vibration assessment methodologies and design criteria for new assets and those undergoing major upgrade or reinstatement.

The aim of these criteria is to reduce the occurrences of uncontrolled noise and vibration complaints from vibration sensitive receptors (e.g. residential properties, offices and theatres) and the resulting expenditures required to rectify installations.

#### **3.4.13 Project Management Framework 10565 Site Noise and Vibration Evaluation and Control**

The Project Management Framework 10565 (Ref. 47) provides a template for evaluating and assessing the risk of significant site noise and vibration and guidance on appropriate control measures for proposed works and it is used during construction.

In order to provide this information site noise and vibration are assessed as part of the Environmental Risk Assessment and identified risks included on the risk register.

## 4 Appraisal Methodology

TfL recognises that delivering a project with sustainable development outcomes necessitates that the design, construction and operational phases are delivered with sustainability in mind. To ensure that all sustainability planning requirements and TfL ambitions are captured, the following approach of embedding sustainability has been taken:

1. Review of relevant planning policy documents and guidance;
2. Consideration of the opportunities for the project to deliver various sustainable outcomes through a scoping workshop (held in May 2012);
3. Delivery of three sustainable design and innovation workshops in July 2012, during which opportunities to incorporate sustainability measures were further examined;
4. Capturing evidence from parallel studies, design and assessment activities carried out as part of the NLE project; and
5. Evaluation and appraisal of potential sustainability measures.

This report has been structured using TfL Sustainability Framework and aims to capture the above five-step process through the appraisal of the NLE against the framework's topics:

- Tackle climate change;
- Quality of life;
- Transport for all;
- Safety and security; and
- Economic progress.

Throughout the process outlined above, a number of guidance documents and sustainability tools have been used to:

- Guide the project decisions;
- Align the project proposals with the planning requirements and TfL guidance; and
- Allow the NLE to achieve high scores against a formal independent assessment method, at appropriate project stages.

The sustainability tools used are:

- Strategic Sustainability Analysis Tool (SSAT);
- CEEQUAL;
- TfL Sustainability Toolkit; and
- SPG 2006 Checklist.

Details on these tools are presented in the following sections, while Table 2 shows how the topics covered by each of these tools align with the TfL Sustainability Framework and therefore fit within the structure of this report. .

### 4.1 Sustainability Tools

As described above a number of guidance documents and tools have been considered to identify relevant sustainability objectives for the NLE. These include planning policy guidance, such as the Sustainable Design and Construction SPG 2006 Checklist (incorporating requirements of London Plan 2011), and the SSAT tool (incorporating CEEQUAL Version 5 questions and the TfL Sustainability Assessment Toolkit).

#### 4.1.1 Strategic Sustainability Analysis Tool (SSAT)

The bespoke URS sustainability benchmarking tool, SSAT, has been used to evaluate the project to ensure that all sustainability objectives have been taken into consideration and that no potential sustainability measures are discounted at later stages. The SSAT tool was used to prioritise the sustainability decisions and to structure workshops during which sustainability initiatives were evaluated.

Three Sustainability Design and Innovation workshops were conducted in July 2012, during which opportunities to incorporate sustainability measures were examined. A summary of the outcomes from the Sustainability Design and Innovation workshops is included in Appendix A.

TfL will submit the NLE project for an award under the CEEQUAL scheme and aims to achieve a rating of 'Excellent'. Some of the CEEQUAL issues must be considered at early design stages of the project to achieve the relevant points. SSAT incorporates these CEEQUAL questions to ensure that they are addressed at the correct design stages.

In addition to CEEQUAL, the TfL Sustainability Toolkit has been incorporated within the SSAT, alongside a series of other sustainability aspects derived from

the Sustainable Development Commission National Infrastructure Report 2011 (Ref. 51) and the Environment Agency’s guide (Ref. 52) for developers.

The SSAT tool uses closed questions generally demanding “Yes”, “No” or “Uncertain” responses.

The SSAT scores across a series of sustainability themes. It combines CEEQUAL and TfL toolkit and records the percentage score based upon the extent to which the cost of sustainability initiatives delivers various sustainability returns. These returns include short and long term financial returns, corporate image and assistance with the consent process.

A graph is produced using the SSAT outcomes, showing the project's contribution towards each sustainability theme. This provides a visual indication of the project's strengths, weaknesses and gaps.

4.1.1.1 TfL Sustainability Assessment Toolkit

TfL has developed a Sustainability Assessment Toolkit to help assess proposed policies or major projects at an early stage in line with the TfL Sustainability Framework. The TfL Toolkit was developed to optimise the sustainability performance of the project design, construction and operation. The toolkit provides constructive feedback on sustainability performance, allowing the management and mitigation of risks and targeting areas of under-performance.

The TfL Toolkit explores sustainability within the topics of the TfL Sustainability Framework:

- **Economic Progress** - Enable reliable, safe, comfortable and affordable access to goods, jobs, education, improve productivity and support wealth generation;
- **Climate Change** - Reduce CO<sub>2</sub> emissions, be prepared for rising temperatures and increased flood risk;
- **Safety and Security** - Reduce accidents or criminal acts on public transport and road network, anticipate and prepare for terrorist attacks, and improve community safety;
- **Quality of Life** - Enable access to health and leisure facilities, improve passenger comfort, improve passenger and staff fitness, enhance London's built and natural environment, improve air quality and reduce noise; and

- **Transport for All** - Ensure equal and fair treatment of all people, access to opportunities (housing, jobs), promote regeneration and tackle deprivation.

Based upon the answers to a series of questions against each sustainability theme, a ranking is allocated representing the project's contribution to the indicator, as well as the magnitude and likelihood of the indicator occurring. Where the project has an adverse impact, a negative marking is allocated.

The TfL Sustainability Toolkit questions have been populated in detail and are included in Appendix C of this PSAR to demonstrate the NLE’s adherence to TfL’s own sustainability standards.

4.1.1.2 CEEQUAL

CEEQUAL is an evidence-based sustainability assessment and awards scheme for civil engineering, infrastructure, landscaping and public realm projects, which recognises the achievement of high environmental and social performance. CEEQUAL rewards projects and design teams that go beyond the legal, environmental and social minima to achieve distinctive environmental and social performance in their work.

It is a self-assessment process that CEEQUAL–trained assessors use to rigorously assess project or contract performance on management and a range of environmental and social issues of concern, arranged in 9 sections.

While a CEEQUAL award can be sought at an interim stage in the delivery of a project, the award is structured around both the design and construction stages. Hence, for the purposes of developing sustainable solutions for the NLE, only those topics relevant to the current stage of design, i.e. to support the TWA Order submission, have been included.

4.1.2 Sustainable Design and Construction SPG 2006 Checklist and London Plan 2011

The Sustainable Design and Construction SPG 2006 includes a checklist to provide clarity on how the measures identified in the SPG are implemented. The SPG and subsequently the SPG 2006 Checklist refer to the superseded version of the London Plan. To adhere to the most up to date requirements of the GLA, the policies of the latest version of the London Plan (i.e. London Plan 2011) have been incorporated in the SPG Checklist 2006 as part of this appraisal.

The NLE has been assessed against the following eight objectives of the Sustainable Design and Construction SPG 2006:

- Reuse land and buildings;
- Maximise use of natural systems;
- Conserve energy, water and other resources;
- Reduce the impacts of noise, pollution, flooding and microclimatic effects;
- Ensure developments are comfortable and secure for users;
- Open space, natural environment and biodiversity;
- Sustainable waste behaviour; and
- Sustainable construction.

Based on the London Plan 2011, the following two objectives have been identified as relevant to the NLE and added to the SPG Checklist:

- Sustainable Transport; and
- Support Economic Development.

To ensure that each of the standards in the SPG 2006 has been given proper consideration, the assessment of performance is presented in a tabular format using the eight objectives set out in the SPG 2006 plus the two additional objectives arising from the London Plan 2011. Appendix B of this PSAR presents the NLE's response to these ten objectives, taking into account that many of the standards are not directly relevant to the NLE as they are

specifically related to residential development or buildings that will be occupied for some period of time.

## 4.2 Appraisal of Sustainability Measures

Table 3 maps the connection between the objectives and sustainability indicators of the relevant sustainability tools with the TfL Sustainability Framework. Section 5 of this report includes the appraisal of the NLE's sustainability commitments in relation to the TfL Sustainability Framework topics.

It should be noted that some of the TfL Sustainability Framework topics are linked between each other and their impact should be considered with the related sections in mind.



**Table 3 Summary of PSAR Sustainability Topics**

TfL Sustainability Framework	Topics under TfL Sustainability Framework	TfL Toolkit	SPG 2006 & London Plan 2011	CEEQUAL
Tackle Climate Change	Reduction CO <sub>2</sub> emissions	Tackling CO <sub>2</sub> emissions	Conserve: <ul style="list-style-type: none"> <li>Energy</li> </ul>	-
	Climate change adaptation	Adapting to a climate change. Improving resource efficiency.	Maximise the use of natural systems: <ul style="list-style-type: none"> <li>Adapting to climate change</li> </ul> Reduce the impacts of: <ul style="list-style-type: none"> <li>Water pollution and Flooding</li> </ul> Conserve: <ul style="list-style-type: none"> <li>Water resources</li> <li>Materials</li> </ul> Maximise the use of natural systems: <ul style="list-style-type: none"> <li>Location and urban design</li> </ul> Promote sustainable waste behaviour: <ul style="list-style-type: none"> <li>Waste and Recycling</li> </ul>	Land use and landscape The water environment Physical resources - use and management
Quality of Life	Enhancing the built and natural environment	Improving built structures and streetscapes. Improving greenscapes.	Sustainable construction Maximise re-use land and buildings. Conserve and enhance the natural environment and biodiversity: <ul style="list-style-type: none"> <li>Biodiversity</li> </ul>	Project Strategy Project Management Ecology and biodiversity The historic environment
	Improving air quality	Enhancing physical wellbeing.	Reduce the impacts of: <ul style="list-style-type: none"> <li>Air pollution</li> </ul>	-
	Improving noise impacts	Improving built structures and streetscapes. Addressing noise levels.	Reduce the impacts of: <ul style="list-style-type: none"> <li>Noise</li> </ul>	-
	Improving health impacts	Enhancing physical wellbeing: <ul style="list-style-type: none"> <li>Improve passenger comfort</li> <li>Access to health and leisure facilities</li> <li>Improve passenger and staff fitness</li> </ul> Enhance London's built/ local residence and natural environment.	Ensure developments are comfortable and secure: <ul style="list-style-type: none"> <li>Indoor comfort</li> </ul> Sustainable transport: <ul style="list-style-type: none"> <li>Walking, Cycling and Parking</li> </ul> Conserve and enhance the natural environment and biodiversity: <ul style="list-style-type: none"> <li>Open space</li> </ul>	-
	Improving journey experience	Enhancing physical wellbeing.	-	-
Transport for All	Improving accessibility	Improving access to the transport system.	<ul style="list-style-type: none"> <li>Designing inclusive environments</li> </ul>	-
	Improving connectivity	Improving access to the transport system: <ul style="list-style-type: none"> <li>Public transport connectivity</li> </ul>	Sustainable transport: <ul style="list-style-type: none"> <li>Enhancing London's transport connectivity</li> </ul>	Transport
	Supporting regeneration and tackling deprivation	Supporting regeneration and spatial development. Enhancing diversity.	-	People and communities
Safety and Security	Reducing crime, fear of crime and antisocial behaviour	Tackling crime and disorder.	Ensure developments are comfortable and secure: <ul style="list-style-type: none"> <li>Secure design</li> </ul>	-
	Improving road and public safety	Improving security and resilience. Improving transport safety.		-
Economic Progress	Supporting population and employment growth	Improving productivity and competitiveness.	Support economic development: <ul style="list-style-type: none"> <li>Developing London's economy</li> </ul>	-
	Delivering an efficient and effective transport system	Tackling congestion and soothing traffic flow.	-	-

## 5 Sustainability Appraisal

### 5.1 Tackle Climate Change

#### 5.1.1 Reduction in CO<sub>2</sub> emissions

##### Conserve Energy - Construction Stage

A CoCP has been developed for the NLE project, which sets out standards and procedures for managing the environmental impact of constructing the NLE.

The CoCP states that TfL will implement working methods that reduce energy consumption and continually improve energy efficiency on site during the construction. This will include, but not be limited to:

- Avoiding unnecessary day and night time site, accommodation and office lighting;
- Installing energy efficient security and task lighting, e.g. LED;
- Providing well insulated site accommodation; and
- Metering, data collection, communication and reporting.

TfL will ensure that energy management considerations are integral to the design of the works and to the construction strategy. To achieve this, an energy management plan will be developed, which will include but not be limited to:

- Energy audits that identify all energy-using processes, activities and equipment on site (aligned with significant changes in site(s) activities through the project life cycle);
- Action plan, including staff engagement and training, to reduce energy consumption by all energy consuming processes, activities and equipment on site and in the site offices;
- Monitoring regime that assess the effectiveness of energy efficiency measures in the plan; and
- Reporting effectiveness of the plan annually.

##### Conserve Energy - Operational Stage

An Outline Energy Strategy has been produced (see Appendix O2 of ES Volume II) based on the principles set out in the Mayor's Energy Hierarchy (i.e. use less

energy, then supply energy efficiently, and finally use renewable energy) and the London Plan. The Outline Energy Strategy includes an assessment of anticipated energy demand, measures to be employed to minimise demand, and details on how this demand will be met.

In compliance with the GLA requirements, the NLE will be designed to achieve in operation energy consumption reductions through the implementation of passive design and energy efficiency measures and meet part of the remaining energy demand through the incorporation of Low and Zero Carbon (LZC) technologies.

The resulting savings in CO<sub>2</sub> emissions due to the incorporation of the passive design and energy efficiency measures could be a 24% over the baseline scheme considering all energy uses.

The potential for connection to any existing neighbouring low carbon heat distribution networks including Combined Heat and Power (CHP) was investigated and is currently being considered. The viability of connection to any of the following energy networks will be determined at later stages when design has progressed sufficiently to allow detailed feasibility analyses:

- VNEB District Energy Network (DEN)
- OSD at Battersea
- OSD at Nine Elms

To further reduce CO<sub>2</sub> emissions, an analysis of the feasibility of renewable energy technologies for the NLE has been undertaken and Air Source Heat Pumps (ASHP) have been identified as feasible at this stage.

In addition to ASHP, the following technologies are being taken forward for consideration during the detailed stages of the project:

- Photovoltaic (PV) arrays could be incorporated into the design of the Nine Elms station should the OSD design allow for such installation.
- Passive provision for borehole cooling should be considered at detailed design stages following a thermal modelling exercise, which will identify the need for tunnel cooling in the future.
- Ground Source Heat Pump (GSHP) could be installed either to supply joint heating and cooling loads of the stations and OSDs or to extract waste heat from the tunnel lining once a detailed study determines its potential.

- The incorporation of Fuel Cells should also be considered at detailed design stages in collaboration with the OSDs.
- A kinetic energy harvesting system could be incorporated either to raise the passengers' sustainability awareness or, should it become economically viable and technically reliable, a large installation could be installed to contribute to the scheme's CO<sub>2</sub> reduction targets.

It is currently estimated that the NLE has the potential to achieve circa 25% savings in total CO<sub>2</sub> emissions via the incorporation of passive design and energy efficiency measures and specification of ASHPs. There is a large potential to incorporate further measures into the scheme; however, their applicability cannot be confirmed as yet due to the early stage of the project and uncertainties associated with the development of OSDs.

When considering only the regulated energy uses of the stations (i.e. heating, domestic hot water (DHW), cooling, ventilation and lighting) the proposed energy strategy could achieve a 34% reduction in CO<sub>2</sub> emissions over the baseline Part L 2010 scheme, which exceeds the current London Plan targets of 25% reduction in CO<sub>2</sub> emissions.

## 5.1.2 Adapting to Climate Change

### 5.1.2.1 Climate Change Adaptation and Mitigation

The latest UK climate change scenarios indicate that summers will become hotter and drier. There will be an intensification of the urban heat island effect; winters will be milder and wetter leading to increased flood risk. Extreme climate events such as very hot days and intense downpours of rain will become more common.

Adaptation, along with mitigation, is an essential part of addressing the challenges associated with climate change. While adaptation addresses the impacts resulting from a changing climate, mitigation refers to efforts to limit the anthropogenic effects of climate change.

A Climate Change Adaptation and Mitigation chapter has been produced as part of the ES (Chapter 16 of ES Volume I). The strategy reports on the estimated carbon emissions that would be produced by the NLE project, both during construction and throughout operation. Potential adaptation mitigation measures to reduce these estimated emissions are included within this PSAR and also listed within the chapter.

### 5.1.2.2 Flooding

A Flood Risk Assessment (FRA) has been prepared for the NLE (Flood Risk Assessment, Appendix H of ES) which details the full assessment of flood risk and the proposed mitigation measures.

The route of the NLE, including the location of Battersea station and Nine Elms station, lies mainly within Flood Zone 3, i.e. flood zone with high probability of flooding. However, the area is defended by the Thames Tidal Defences, which are maintained to a high standard and the risk of failure is considered to be very low.

According to the FRA, the NLE is located in the area where groundwater flood risk as well as surface water flood risk are low.

A benefit to the Thames Water combined sewers will be provided in terms of a reduction in storm water discharge volumes entering the system. This will be achieved by re-routing drainage for 94% of the land (at the Battersea site) so that it drains directly to the Thames as opposed to the Thames Water Utilities Ltd. (TWUL) network (refer to Chapter 12 of ES for further detail). This is an improvement to the current situation; the reduction in surface water run-off will increase capacity in the surrounding sewer network and thereby reduce flood risk.

In addition, a range of SUDS measures will be incorporated into the design of the NLE development, including:

- Green roof at the head house and community centre at Kennington Park;
- Incorporation of a water attenuation tank at Nine Elms station; and
- Other measures such as the use of permeable areas, where this is appropriate / feasible.

### 5.1.2.3 Water Pollution

#### Construction Stage

Throughout the construction phase of the NLE, there are potential sources of pollution that may affect water resource receptors. These pollution sources comprise suspended sediments, leaks and spillages from oils/hydrocarbons, concrete and cement products, disturbance of contaminated land; and disturbance to TWUL assets.

Potential sources of suspended sediments include excavations and dewatering of excavations, exposed ground and stockpiles, grouting, plant and wheel

washing and dust and sediment generated during this construction works. A number of mitigation measures will be incorporated to prevent the release of suspended sediments, oils and hydrocarbons and concrete and cement products. These measures are included in the CoCP.

Disturbance of potentially contaminated soils during the construction works may affect the River Thames. In the event that contamination is discovered, work will stop immediately and measures will be taken to prevent disturbance and mobilisation of contaminants, until the contamination has been treated in-situ or removed for off-site disposal.

#### **Operational Stage**

Pollution sources arising during the operational phase, which could affect surface and groundwater comprise the following:

- Leaks, spillages, application of fertilisers and pesticides within landscaped areas; and
- Contamination from in-situ materials.

A residual risk of a spillage of contaminating material, for example fuels and oils, which could potentially be released to the drainage network may occur post construction. This will be managed by operational measures such as:

- Speed limits and road markings and procedures during delivery or movement of materials;
- Cut-off measures on the drainage system that will allow a spill to be contained within the site;
- Emergency spillage response plan will be put in place and education/information on waste treatment / emergency events/spills etc. will be provided to the staff; and
- Interceptors will be used in association with the drainage network that serves high-risk areas.

The presence of below ground structures, such as drainage network, basements, foundations and the tunnels can present a source of pollutants, through water coming into contact with the materials used leaking into the drainage network and then being discharged into the River Thames. However, it is envisaged that all the proposed drainage/service runs will be surrounded by appropriate granular bedding materials and in addition confirmatory tests of the

new systems may be carried out in accordance with statutory requirements. As a consequence, leakage into the drainage network is likely to be minimal.

In addition, a planned preventative maintenance regime will be in place for all new assets to ensure that these are kept in good condition, which will minimise risk of faults and therefore leaks and spillages.

#### 5.1.2.4 Water Conservation

##### **Construction Stage**

Processes during the construction phase of the NLE which may require significant volumes of water supply include:

- Mixing (especially relating to concrete);
- Supply for washing down; and
- Potable water for sanitary facilities for site staff.

The most intensive use of water, for the mixing of concrete, will be done off-site where possible and therefore will not affect water supply to the site.

Water supply for demolition and construction processes may represent a short term, increase in supply volumes to the site. Water saving measures will be adopted where possible thereby reducing the impact on the water supply network. Means of reducing water consumption include, (as described in the CoCP):

- Selection and specification of equipment to reduce the amount of water required;
- Implementation of staff-based initiatives such as turning off taps, plant and equipment when not in use both on-site and within site offices;
- Use of recycling water systems such as wheel washes, site toilets hand wash; and
- Use of a rainwater harvesting system for use in equipment and vehicle washing.

TfL will ensure a water conservation plan is prepared and implemented for the worksites. The plan will include but not limited to:

- Water audits that identify all water-using processes, activities and equipment on site (aligned with significant changes in site(s) activities through the project life cycle);
- An action plan, including staff engagement and training, to reduce water consumption by all water-using processes, activities and equipment on site;
- A monitoring regime that assess the effectiveness of water conservation measures in the plan; and
- Reporting effectiveness of plan annually.

**Operational Stage**

The design of all areas of the NLE will aim to minimise internal potable water consumption for sanitary uses. This will entail installing water efficient sanitary ware (such as low-water, dual flush toilet cisterns and low-pressure spray taps in bathrooms).

Given the prospect of future OSD, provision of systems to capture rainwater would need to be built into the operation of the overall site. Rainwater harvesting could be used for toilet flushing and other non-potable uses, which would reduce overall water consumption.

Furthermore, a water meter with a pulsed output will be installed on the mains supplies and a leak detection system will be integrated into the water metering, with an audible signal when a leak is detected, to reduce the impact of water leaks that would otherwise go undetected. Flow control devices, such as solenoid valves connected to presence detectors, are being considered to be fitted to each toilet area/facility to ensure water is supplied only when needed and therefore prevent minor water leaks.

5.1.2.5 Overheating

The energy saving measures specified for the development include a number of measures reducing the NLE’s need for cooling. The NLE will be designed with a cooling system specified only for limited areas, such as staff offices and communication rooms.

Ticket halls and other passenger circulation areas will be naturally ventilated as well as underground platforms. Complex natural ventilation modelling will be carried out at detailed design stages of the project to ensure that sufficient

ventilation levels are achieved in all relevant areas. In addition, thermal mass will be used efficiently to manage the risk of overheating wherever feasible.

Although the proposed strategy will allow the tunnels to be operated with no need for cooling at the current climate, mechanical cooling may be required in the future as a result of climate change. Therefore, to future proof the system, it is proposed to incorporate water pipes within the tunnel lining where feasible. Installing the pipes inside the tunnel construction would allow either the efficient distribution of cooling medium within the tunnels or the extraction of energy out of the surrounding soil and surplus heat inside the tunnel.

For further details on energy saving measures (including measures reducing cooling loads) refer to Outline Energy Strategy for the NLE (Appendix O2 of Es Volume II).

5.1.2.6 Management of Materials

TfL’s procurement policy that will be applied to the delivery of the NLE states that:

*“Where possible environmental benefits will be considered as part of the procurement process with consideration given to all relevant aspects of whole life-cycle costs of products. TfL is committed to specific environmental obligations as a signatory of the Mayor’s Green Procurement Code.”*

Responsible sourcing will encourage contractors to apply the best practice standards to source construction materials from suppliers with responsible sourcing certification as far as practicable.

Where timber products are used, they will be obtained from sustainable sources. At least 50% of the timber and timber products will be sourced from a Forest Stewardship Council (FSC) or equivalent source, with the remainder being obtained from a known temperate source using the Defra’s Central Point of Expertise in Timber (CPET). All temporary timber used during construction will also be legally sourced.

The need to use primary aggregates will be minimised by the selection of secondary materials, where possible. The maximum amount of secondary materials will be specified for the concrete mixes subject to not compromising performance.

In addition, TfL will expect that evidence will be provided by contractors to demonstrate that the concrete proposed is not over-specified.

Following consideration of the technical specification of the concrete mix for specific applications, TfL will then expect the contractor to demonstrate that the carbon cost associated with the import of materials does not adversely affect the overall sustainability performance of the concrete.

The selection and application of the materials comprising the NLE will respect the scale and setting of the surroundings. On that basis, the materials will be suitable and robust, with durable long-life properties.

Wherever feasible, materials employed in key building elements of the stations and hard landscaping will be selected in line with the Green Guide to Specification with a low environmental impact over the full life cycle of the buildings. The Green Guide to Specification is BRE's methodology to provide a simple 'green guide' to the environmental impacts of building materials.

Embodied carbon in materials has been assessed in Climate Change Adaptation and Mitigation (Chapter 16 of ES Volume I).

The use of insulants with a high Global Warming Potential (GWP) will be avoided. Chipboard and expanded polystyrene will be avoided and alternatives given preference. Where required, these will be specified to include glues and additives with low VOC content.

All thermal insulation products used in the building will have a low embodied impact relative to their thermal properties. Furthermore, where feasible, thermal insulation products used in the buildings will be responsibly sourced.

### **Materials Generated at Construction Stage**

A Materials Management Strategy has been developed for the NLE (see Appendix B1 of Es Volume II), which follows the hierarchy for sustainable waste management as described in the Waste Framework Directive. The most favoured option is the prevention of waste production and the least favoured option is disposal of waste to landfill.

The evolution of the NLE's design has sought to minimise the waste materials arising from demolition by locating the stations in areas where no demolition is required. Although a significant quantity of excavated material is anticipated to be produced, the NLE will aim to minimise this as far as practically possible, by routing the tunnels in the optimally shortest route and keeping the dimensions of the excavated parts to the minimum.

The works contracts for the NLE will set stringent requirements on contractors to minimise the waste from construction activities. The main contractor will be

required to produce an environmental management plan (EMP) describing the procedures that are in place to ensure that all parties involved comply with the Waste (England and Wales) Regulations (2011) (Ref. 53).

The majority of uncontaminated excavated material that is suitable for reuse offsite will be exported by barge from the jetty at BPS to a trans-shipment facility where the material will be loaded onto sea going vessels to allow it to be transported to a pre-identified receptor site (such as the nature reserve at Wallasea Island in the Thames Estuary).

In line with the Site Waste Management Plan (SWMP) regulations (Ref. 54), a SWMP will be developed for the proposed scheme to identify the types and quantities of waste produced during every stage of construction. The contractor will be required to implement the Waste and Resources Action Programme (WRAP) Demolition Best Practice Code (Ref. 55), including the Institute of Civil Engineers (ICE) Demolition Protocol (Ref. 56). Waste from the demolition and enabling works will be subject to onsite screening and sorting in accordance with the contractor's SWMP.

The SWMP will be produced before on-site works begin and will look into the opportunities to minimise and reduce waste generation, such as:

- Agreements with material suppliers to reduce the amount of packaging or to participate in a packaging take back scheme;
- Implementation of a 'just in time' material delivery system to avoid materials being stockpiled on-site for long periods of time, increasing the risk of their damage and disposal as waste;
- Attention to material quantity requirements to avoid over ordering and generation of wasted materials;
- Reuse of materials on-site wherever feasible;
- Segregation of waste at source where practical; and
- Reuse and recycling of materials off-site where reuse on-site is not practical (e.g. through use of an off-site waste segregation facility and re-sale for direct reuse or reprocessing).

As a result of these measures it is expected that the NLE will divert from landfill at least 95% by weight or by volume of non-hazardous construction waste generated by the project with an aspiration to divert 100% of non-hazardous waste.

During subsurface construction works Sprayed Concrete Lining (SCL) will be used for the station boxes and some tunnel sections. Waste produced during this process is assumed to account for 30% of the sprayed concrete used in construction. The SCL waste will be mixed with some excavated material at construction sites where it is used.

TfL will maximise the opportunities to use barge wherever practicable. It is estimated that 68% - 70% (by volume) of material will be removed by barge.

At the worksites associated with the temporary shafts and the ventilation shafts removal of material by road is the only viable option. A study will be carried out to identify whether there are any construction sites local to the NLE works that require the types of material being generated. The majority of the excavated material will be 'clean' London Clay; this is suitable for the engineering of ground works and landscape projects. TfL will seek to reuse clean materials off-site for habitat enhancement as priority before exploring other options, once reuse on site has been discounted.

### Operational Stage

Once the NLE is operational, recycling opportunities will be maximised through the provision of dedicated waste management facilities for the collection of the station's operational-related recyclable waste streams, so that such waste is diverted from landfill. Both stations will be designed with sufficient space for bin rooms to separate and store materials.

## 5.2 Quality of Life

### 5.2.1 Enhancing the Built Environment

#### 5.2.1.1 Sustainable Construction

The NLE is a major construction project and will involve many different types of construction activities. These will include: demolition; site clearance; site investigation; remediation (as necessary); tunnelling; piling; excavation; services diversion and new installations; highway works; and below ground and surface building works. It will also involve changes/modifications to existing TfL infrastructure.

The CoCP developed for the NLE project sets out standards and procedures for managing the environmental impact of constructing the NLE.

The CoCP requires that the main contractor produces a design EMP as well as one for construction phase, to ensure that as many impacts as possible are eliminated and that design changes are assessed for their environmental impacts.

The EMPs will include roles and responsibilities, detail on control measures and activities to be undertaken to minimise environmental impact, and monitoring and record-keeping requirements. A commitment will be made to periodically review the EMP and undertake regular environmental audits of its implementation during the construction phase.

TfL will ensure, as far as reasonably practicable and appropriate, that site layouts and appearance will be designed using the following principles:

- The sites will be visually screened and fully secured;
- Storage sites, fixed plant, machinery, equipment and temporary offices will be located to limit environmental effects, as far as reasonably practicable, and having due regard to neighbouring accommodation, as far as allowed by the constraints of the sites;
- Site lighting will be located and directed so as not to intrude into occupied residential properties, on sensitive areas or constitute a road hazard; and
- Fixed site plant and facilities will be powered from mains electrical sources.

TfL will ensure that the visual intrusion of construction sites on nearby residents and users of local facilities and amenities is contained and limited.

Individual contractors will incorporate relevant requirements in respect of environmental control, based largely on the standard of 'good working practice' as outlined within the CoCP and EMPs as well as statutory requirements. All trade contractors will be required to demonstrate how they will adhere to procedures set out within the CoCP and EMP satisfying regulations and best practices regarding environmental control.

TfL will require all contractors to ensure that the construction activities comply with the requirements of the Considerate Contractor Scheme, and all contractors will be required to sign up to this.

#### 5.2.1.2 Maximise Reuse Land and Buildings

Re-use of land and buildings is an important means by which resource use can be minimised. In addition, the re-use of land and buildings can help alleviate

pressure from new development on open spaces and green field sites which can be of nature conservation, agricultural or recreational value.

The NLE will utilise land that has been previously developed as far as practicable. The NLE would require the use of the following sites:

- The Battersea station will be located at the southeast corner of the BPS site. The BPS site has been for many years derelict and underdeveloped. It has the potential for contaminated land due to its historic land use, and the development of the NLE will promote the on-going efforts for regeneration of the entire site.
- The Nine Elms station is located at the southern corner of the Sainsbury' car park. The station will be located on land predominantly occupied by car parking in addition to Banham Security (locksmiths and alarms) and part of the New Covent Garden Market site. The land is currently underused. The Banham Security site is currently a subject to a planning application. The opportunities are currently being explored on how to incorporate these plans into an eventual potential OSD to maximise development density.
- The temporary shaft sites have been selected so as to avoid the need to demolish any properties and also to limit the need for trees removal, and have chosen roadways for the sites, which can then be reinstated completely.
- The Kennington Park site will require temporary land take of the park itself which will be reinstated so as to not result in loss of the local open/amenity space. It will result in the replacement of Kennington Park Lodge, so this building's footprint will be reused.
- Kennington Green will also be reinstated to improve the local amenity space.

Careful consideration has been given to the routing of the tunnelled sections and locating the shafts. The tunnelled sections are as short as possible thereby reducing the amount of spoil to be disposed.

#### 5.2.1.3 Natural Environment and Biodiversity

An ecological assessment has been carried out for the Kennington Green, Kennington Park, Nine Elms and BPS sites. An extended Phase 1 habitat survey was undertaken to map the habitats on the sites and the presence or suitability

of the sites to support notable and protected species. In addition, an arboricultural survey, bat surveys, fish surveys and winter bird surveys were undertaken. For full details of the surveys please refer to Appendix H Ecology and Trees of ES Volume II.

#### Construction Stage

Based on the ecological assessment the construction of the NLE could have an impact on the local ecology as follows:

- Demolition and construction activities are likely to require the clearance of vegetation and habitats falling within each site's construction area;
- Works have the potential to degrade or damage habitat. Dredging activities at the BPS site have the potential to degrade aquatic environments through introduction of pollutants to the watercourse and / or disturbance to sediments (however the impact should be maximum 200m from the source);
- Demolition and construction activities such as building or vegetation removal, digging, or hazardous chemical spills may kill or injure plants or animals. Furthermore, species sensitive to vibration can be killed or injured by excessive noise and vibration; and
- Noise and light pollution arising from construction activities are the key impacts likely to affect sensitive species.

To reduce the potential impacts of the NLE construction activities, mitigation and compensation measures are specified, which aim to not only conserve and safeguard existing ecological features, but also to provide enhancements for biodiversity.

The mitigation and compensation measures have been informed by the CoCP, the LU BAP, the local borough BAPs (Lambeth, Southwark, and Wandsworth), and consultation with statutory bodies (including Natural England and the Environment Agency).

Demolition and construction activities have the potential to disturb bats if works are undertaken at night during the bat activity season. This disturbance would be temporary, would not lead to the severance of any commuting route, and would not affect the ability of the local bat population to commute and forage within the area (for further details on the potential areas of disturbance refer to Chapter 14 Ecology of the ES). In addition, sensitive lighting will be implemented during construction to ensure that any adjacent commuting routes and foraging habitat for bats are not disturbed.



At Battersea station site dredging is proposed to facilitate the creation of a berth-pocket, requiring the removal of approximately 4500 m<sup>3</sup> of sub-tidal habitat. The extent of the dredging will be limited as far as reasonably practical. It is anticipated that following the cessation of spoil removal activities for the NLE, the sediments will no longer be disturbed and the riverbed will revert back to its natural state.

The Battersea station site is the only survey area with the potential to support protected or notable fish species. The effect of construction on feeding and/or sheltering fish would be most significant when estuarine fish fry and Atlantic salmon are migrating along the margins of the river. Therefore, dredging will be timed to avoid this period. Furthermore, best practice guidance will be adhered to during the dredging works to reduce impacts on fish.

The habitat surveys showed that the sites have the potential to support mammal species such as hedgehog and fox. Measures will be employed to mitigate potential impacts including the covering of all deep holes and trenches overnight and/or the provision of planked escape routes for any trapped wildlife. In addition, any liquids held on-site will be stored in a secure lock-up.

As described in Appendix J2 of ES Volume II, an arboriculture report has been produced that describes which trees will be removed during construction.

The majority of the loss will be temporary and only a small area of amenity grassland will be lost permanently. The loss of habitat will not affect the integrity of the Kennington Park and it will continue to function as a haven for wildlife and amenity resource for the community.

In accordance with the CoCP, the tree removal will be scheduled outside the breeding bird season to avoid impacts on nesting birds.

After construction, habitats or ecological features that have been affected by construction activities will be reinstated or allowed to re-colonise so that, habitat will be of better quality than its pre-construction condition. Reinforcing the existing character of the affected parks and enhancing the site's ecology and biodiversity are key aims of the soft landscaping strategy at Kennington Green and Kennington Park. Where appropriate, landscape planting will be undertaken using native species typical of the area and from local sources.

Specific ecology reinstatement plans will be produced for each NLE site in consultation with relevant local authorities and wildlife bodies, as appropriate.

These plans are likely to include measures which:

- Create and enhance habitats for protected and notable species;

- Increase the quantity of priority BAP habitat (where possible); and,
- Increase habitat connectivity within the local environment and across priority habitats.

In addition to the above habitat creation and enhancement measures, the following control measures (contained in the CoCP) will be adhered to during construction to safeguard habitats from damage and degradation:

- Appropriate control measures will be adopted in the event that legally controlled habitats and alien invasive species are found on site;
- Impacts on adjacent wetland habitats and watercourses will be avoided by appropriate design of site drainage and by use of construction techniques;
- TfL will use reasonably practicable measures to minimise the loss of trees. Any essential remedial or protective work to trees adjacent to construction activity will be carried out by suitably trained or qualified personnel using recognised methods in accordance with the relevant British Standards;
- The extent of the dredging will be limited as far as reasonably practical to limit the extent of the temporary damage and disturbance. Best practice dredging methods will be employed to limit the amount of sediment spill into the river; and
- A detailed Construction EMP will be produced (as part of CoCP Part B) for each site to cover all enabling and construction work activities. The plan will be approved by the Local Biodiversity Officer prior to any works beginning on the site.

Furthermore, TfL will comply with all relevant UK and EU legislation relating to protection and enhancement of ecology during the construction works and operation and will seek to work with partners (including the developers of BPS) to enhance habitats for protected species, where appropriate.

#### **Operational Stage**

Based on the ecological assessment the NLE during operation is unlikely to generate impacts (noise, light, air quality) which could significantly affect protected or notable habitats and species.

#### 5.2.1.4 Historic Environment (Built Heritage)

Chapter 8 Archaeology and Built Heritage of the ES has been prepared for the NLE, which assesses the impacts and effects of the NLE on buried heritage

assets (archaeological remains) and above ground heritage assets (i.e. structures or features of historic interest such as listed buildings, conservation areas and Registered Parks and Gardens) and their setting.

There are no listed buildings proposed for demolition on any of the sites.

Preliminary site specific and targeted archaeological field evaluation will be carried out prior to the commencement of works. The results of the evaluation would allow the formulation of an appropriate mitigation strategy, if required.

The mitigation might comprise targeted archaeological investigations if significant remains are identified, e.g. excavation and/or watching brief. Where the deposits are likely to be shallow, e.g. the shaft sites on the terrace gravels, this would take place in advance of construction. Where deposits are potentially deep, e.g. the Nine Elms station box on the alluvium, the work would be carried out as the ground is excavated downwards following insertion of the diaphragm walls.

The Archaeology and Built Heritage ES chapter recommends that the buildings scheduled for demolition at the Nine Elms station site and within Kennington Park are subject to archaeological standing building recording to an appropriate level in advance of the commencement of works.

Although the demolition of Kennington Park Lodge will have an adverse impact upon Kennington Park, it is considered that the NLE will not have an effect upon the Park's significance as a heritage asset. A Heritage Statement for works within the Kennington and St Marks Conservation Areas is provided in the Design and Access Statement (see Appendix M of ES Volume II).

There is a possible impact on Whittington Lodge from settlement, which will be prevented by underpinning as part of the Battersea station development.

The scope of historic environment mitigation will be agreed with the archaeological advisors for each local planning authority concerned.

### 5.2.2 Improving Air Quality

The NLE is located within areas of which large proportions have been declared as Air Quality Management Areas.

#### Construction Stage

During construction works it is anticipated that emissions to air will be associated with road traffic movements (deliveries and movement of building materials), construction equipment and vehicles, and earth moving and construction

operations (construction dust). Chapter 10 Air Quality of the ES provides an assessment of the potential impacts on local air quality from these sources of pollution.

The CoCP includes measures, which ensure a high level of mitigation. According to the CoCP, TfL will seek to control and limit emissions to the atmosphere in terms of air pollution from the construction site activities. An Air Quality and Dust Management Plan will be developed, which will identify potential sources of air pollution and appropriate control techniques that will be applied.

#### Demolition

The sites have been located so that there is only a small requirement for the demolition of buildings and structures as part of the works. The following measures will be implemented to limit the impact of demolition:

- Appropriate hoarding of each worksite;
- Use of water suppression;
- Use of rubble shoots;
- Consideration of material storage locations; and
- Sheeting off of the most affected façades of the demolished buildings.

#### Vehicle and Plant Emissions

Measures for limiting emissions and avoiding nuisance associated with vehicle movement and construction plant operation will include the following, as appropriate:

- Ensure that the engines of all vehicles and plant on site are not left running unnecessarily;
- Use low emission vehicles and plant fitted with catalysts, diesel particulate filters or similar devices and use ultra-low sulphur fuels in plant and vehicles;
- Require that plant will be well maintained, with routine servicing of plant and vehicles in accordance with the manufacturers recommendations and records are maintained for the work undertaken;

- Require that all project vehicle, including off-road vehicles, hold current Ministry of Transport (MOT) certificates and that they comply with exhaust emission regulations for their class;
- Locate site plant away from potential sensitive receptors;
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment, where possible;
- Maximise energy efficiency, which may include optimising vehicle utilisation by ensuring full loading and efficient routing;
- In compliance with the London Low Emissions Zone, all vehicles, cars and vans and all heavy duty road vehicles and non-road diesel engines shall meet or exceed the European emission standards (Euro standards) listed in the CoCP;
- Contractors will also be encouraged to include zero or ultra-low carbon vehicles in their fleet such as electric, plug-in hybrid or biomethane vehicles, where possible; and
- All members of the contractor's staff who drive vehicles shall undertake a fuel-efficient driver training course.

#### *Dust*

An Air Quality and Dust Management Plan will be prepared and implemented for the sites, which will detail controls to limit dust emissions, including the consideration of using green walls, screen and other green infrastructure to minimise the impact of dust and pollution and also to improve the local ambience during construction.

TfL will ensure that all contractors comply with the provisions of all legislation relevant to the control of dust and emissions.

Three levels of control for dust impacts are planned, with the standard level, Tier 1, as the minimum that will be implemented on any site. A risk-based approach will be used to identify construction sites with potential to generate significant quantities of dust near sensitive receptors and which require additional levels of control (Tiers 2 and 3). This will be addressed in the Air Quality and Dust Management Plan. The CoCP lists the control procedures required for each Tier level.

#### **Operational Stage**

Operation of the LU gives rise to few direct emissions, although the consumption of power is associated with generation of indirect emissions such as CO<sub>2</sub>, oxides of nitrogen and other gases from the power stations providing the electricity. Minor sources of emissions are associated with items of heating and cooling equipment.

In relation to the NLE, efforts are being made to reduce the energy consumption as shown in Section 5.1.1 of this report as part of the effort of reducing the indirect emissions associated with the use of heat and power.

Other sources of emissions are the particulates to emerge from the ventilation shafts as the trains pass through the tunnels.

For the vast majority of the time, emissions from the NLE ventilation shafts will occur passively, as the ventilation strategy is designed to operate without mechanical assistance under normal operating procedures.

The air quality of the London Underground is monitored regularly in order to ensure that no hazardous levels of gases and particulates occur. As long as this remains the case, it is considered that the concentration of these pollutants will be greatly diluted within a short distance of the above ground vents.

To mitigate any adverse effects from the operation of the NLE, a series of standard design and management procedures will be incorporated when selecting the proposed plant during the detailed design and the maintenance of the plant over the lifetime of the NLE. Examples include regular inspection of the machinery, operation to the manufacturer's instructions, and ensuring that equipment is well maintained during operation.

#### **5.2.3 Noise Impacts**

##### **Construction Stage**

TfL will, as far as reasonably practicable, seek to control and limit noise and vibration levels so that affected properties and other sensitive receptors are protected from excessive or prolonged noise and vibration associated with construction and demolition activities.

The noise generated during the demolition and construction may potentially have an impact on the local residents, workers and pedestrians. Thus, an assessment of the likely significant impacts of the NLE with respect to noise and vibration has been carried out and is included in Chapter 9: Noise and Vibration of the ES.

The assessment considers the likely impacts with respect to noise and vibration to identified sensitive receptors in terms of:

- Predicted noise and vibration levels from the demolition and construction works including excavation and piling operations;
- Noise from the NLE during operation (detailed below); and
- Any increases to road traffic attributed to the NLE construction.

Mitigation measures to manage construction noise and vibration are included in the CoCP, these include, but are not limited to, the following:

- TfL will adopt the recommendations for the control of noise, as set out in the relevant British Standards (refer to the CoCP for details).
- Plant and equipment liable to create noise and/or vibration whilst in operation will, as far as reasonably practicable, be located away from sensitive receptors. The use of barriers to absorb and/or deflect noise away from noise sensitive areas will be employed where required and reasonably practical.
- All plant, equipment, and noise control measures applied, shall be maintained in good and efficient working order and operated such that noise emissions are minimised as far as reasonably practical.
- Vehicles and mechanical plant utilised on site for any activity associated with the construction works will be fitted with effective exhaust silencers and shall be maintained in good working order.
- Machines in intermittent use will be shut down or throttled down to a minimum when not in use. Static noise-emitting equipment operating continuously will be housed within suitable acoustic enclosure, where appropriate.
- The site layout will be designed to limit, and where reasonably practical, avoid the need for the reversing of vehicles to avoid the use of reversing alarms. When in use reversing alarms will be set to the minimum output noise level required for health and safety compliance.

Furthermore, all tunnel ventilation plant with connections to the atmosphere in any noise-sensitive location will be subject to mitigation measures appropriate to its local environment. The CoCP includes a list of additional measures for underground activities, which will mitigate the transmission of noise and vibration.

### Operational Stage

The operation of the NLE has the potential to produce noise and vibration effects due to two primary sources, namely:

- Ground borne noise and vibration from underground rail traffic; and
- Noise due to fixed plant and equipment from ventilation shafts and stations.

The NLE will comply with the LU's Noise and Vibration Asset Design Guidance (G1323), which sets out the key parameters for noise and vibration assessment methodologies and criteria for new operational assets.

The operational ground borne vibration levels are predicted to be minor. Therefore, no mitigation is required specifically for operational ground borne vibration. However, the ground borne noise effects of the railway have been predicted to introduce a significant impact during the operational stages of the NLE.

The design of modern railway tracks incorporate resilience into the track for a variety of engineering reasons and this resilience has a beneficial effect in terms of ground borne noise. Although the track to be used in the NLE running tunnels has not been yet selected, it is assumed that the track to be installed will provide a resilient layer underneath the rail baseplate between the baseplate and the concrete track slab. The use of this system is expected to provide a significant reduction of the overall ground borne noise levels.

The form of mitigation for the reduction of noise from ventilation fans and equipment will be through the use of careful acoustic design. This process will involve an iterative design to select the most effective attenuators in terms of noise reduction, while taking into account the relevant non-acoustic factors (e.g. pressure loss on the fans and the effect on the efficiency of the ventilation regime).

All fixed plant and equipment for stations and ventilation shafts will be designed to meet a target noise level that is 5 dB below the background noise level. Where this is not possible, best reasonable endeavours will be used to reduce noise levels as much as possible.

In addition, a planned preventative maintenance regime will be in place for all new assets to ensure that all assets are kept in good condition, which will minimise risk of faults.

**5.2.4 Health Impacts**

**5.2.4.1 Indoor Comfort**

The NLE will aim to provide a healthy environment that reduces environmental stresses, facilitates physical activity and promotes mental well-being. While LU stations are places of travel where, the duration of stay is relatively short, the comfort of users is important in terms of:

- Internal air quality;
- Presence of non-toxic materials;
- Use of natural ventilation;
- Use of natural light;
- Temperature control.

Accordingly, a healthy and comfortable environment for staff and visitors will be promoted through the following measures:

- Design of internal and external lighting in line with best practice for visual performance and comfort;
- Optimisation of the acoustic performance of the building through early design consideration and expert advice on external sources of noise impacting the site, site layout and zoning for good acoustics, acoustic requirements for users with special hearing and communication needs, and acoustic treatment of different zones and facades; and
- Utilisation of design tools to ensure that spaces achieve appropriate thermal comfort levels throughout the year.

Temperature control and in particular the consequences of heat waves upon customers is an important consideration for London Underground, particularly in the context of climate change. Advice to customers to minimise risks during periods of high temperatures would be provided at the stations.

A healthy internal environment will be further promoted through the specification of internal finishes and fittings with low emissions of Volatile Organic Compounds (VOCs). Specifically, VOCs are emitted from products such as paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, glues and adhesives, Urea-formaldehyde foam insulation (UFFI), pressed wood products (hardwood plywood wall panelling,

particleboard, fibreboard) and furniture made with these pressed wood products. Where these products are specified, efforts would be made to ensure that these have been tested against and meet the relevant standards for VOC emissions.

Building services will be designed to reduce the risk of legionellosis when in operation. Plant rooms will be easily accessible for maintenance and a programme of regular inspection and maintenance of the machinery and operation to manufacturers' instructions will be implemented to ensure unsafe plant emissions that affect internal air quality (i.e. harmful carbon monoxide emissions) are avoided.

**5.2.4.2 Cycling and Walking**

To promote cycling and walking to and from the stations no car parking will be provided at the stations apart from one parking bay for disabled users.

TfL will produce a green travel plan for the project to encourage walking and cycling. It is assumed that there will be approximately 90 secure cycle parking spaces around Nine Elms station. According to the BPS Transport Assessment 100 secure cycle parking will be provided in the area.

There will be an extension of Barclay's Cycle Hire facilities in the VNEB OA with a minimum 10 docking stations planned in the area, including two in the BPS development and a minimum of 30 spaces at the Sainsbury's development (Nine Elms OSD). There are not any plans for docking stations at the stations themselves.

At Nine Elms, the proposals include footway width of approximately 6-7 metres along the Wandsworth Road frontage to cater for movements to/from the Nine Elms station and transport interchange, as well as with the bus stops located on Wandsworth Road.

There is also a proposed new pedestrian access route to the north of Nine Elms station, beneath the existing railway line, which will further encourage walking.

**5.2.4.3 Open Space**

Of the surface development sites associated with the proposed NLE, two are located within areas of publicly accessible open space:

- Kennington Green Ventilation Shaft – within Kennington Green; and
- Kennington Park Ventilation Shaft – within Kennington Park.

Kennington Green is of 0.09 ha in size and its quality has been assessed by the LBL as similar to unrestricted open spaces in the area. The construction works required for the NLE will result in the temporary cordoning-off of Kennington Green, resulting in the temporary loss of public access to this area.

Users of Kennington Green would need to use other open spaces for the duration of these works. The nearest parks or open space providing comparable (or better) amenity to Kennington Green are Kennington Park, located approximately 190m away and Spring Gardens, approximately 550m away.

Kennington Park is identified by the LBL as a major park of 15.5 hectares (ha) in size. The LBL assessed the park as having the fourth highest quality in the borough. Approximately 250m<sup>2</sup> (or 2% of the total park area) of space in the north of the park will be cordoned off for the construction works, resulting in the temporary loss of public access to this area during the construction works for the NLE. Although the park is well used, the number of users likely to be impacted by a short-term temporary closure of the affected area is judged to be relatively few. As such, they would not be likely to experience significant disruption as a result of the construction works.

The two open spaces used during the construction phase would be returned to use as open space. To ensure that the reinstated open space is of a greater standard of design quality than it currently is, the following design principles will be applied (for further details refer to Design and Access Statement in Appendix M of ES Volume II):

*Kennington Green*

- Positively respond to its setting within a Conservation Area with neighbouring Georgian properties by creating a simple yet elegant open space;
- Create a coherent streetscape and identify for the Green which unites the residential properties with the open space;
- Create a pedestrian-orientated space through the use of shared surfaces on the roads surrounding the Green;
- Provide amenity space for local residents; and
- Provide a buffer of trees along Kennington Road to screen the Green from the busy arterial road.

*Kennington Park*

- Ensure that the outdoor spaces are of a high quality and in keeping with the design of the park and neighbouring residential properties;
- Provide two outdoor spaces - one fronting Kennington Park Place, and the other looking in towards the park - but which can be read as one coherent space;
- Provide planting which enhances the area's biodiversity and allows a bee keeping use, but which is also in keeping with the existing mature trees within the park;
- Use planting as a buffer to partly screen the buildings from view from the streets and park; and
- Re-provide the existing avenue of trees with a single species of tree.

Chapter 7 Socio-Economics of the ES includes further details on the assessment of the NLE's impact on local open space. Based on the results of the assessment, the NLE would have a long term positive effect on the provision of open space in the local area.

**5.2.5 Improving Journey Experience**

The two new stations will be designed to highest quality standards to provide improved journey experience for passengers travelling on Northern line. A number of measures have been specified, which include (For further details on the measures refer to Design and Access Statement of the ES):

- Step free access;
- Intuitive way-finding;
- Congestion free circulation;
- Ticketing facilities (all ticketing at both stations will be via person operated machines);
- Security control and communication systems; and
- Evacuation facilities.

In addition, a key feature of the design of the NLE track line was to minimise the horizontal curvature as to allow as smooth journey for the passengers as possible. To enhance the passengers experience further, the Underground is currently rolling out WiFi across the network. This network will be considered to be enabled for customers at Battersea and Nine Elms.

## 5.3 Transport for All

### 5.3.1 Accessibility (Designing Inclusive Environments)

Step-free access will be provided at the stations. The stations will have lifts or ramps so that passengers don't have to use escalators or stairs. As well as increasing accessibility for passengers with disabilities, step-free access will provide benefits for other passengers with reduced mobility, including:

- People with children;
- People carrying heavy luggage or shopping; and
- Older people.

The design brief for the stations specifies unsupervised wheelchair access onto the trains. The designs have also recognised the needs of individuals that may experience hearing or sight impairment, or suffer from dementia or other mental illness. As such, consideration will be given to surfaces, directions, safety, lighting and sounds.

TfL has subjected the designs to external review by representatives of those with mobility impairment.

In addition to complete step free access for wheelchair and those with young children, the following measures are being taken at both stations:

- Textured paving to provide complete coverage on pedestrian routes to delineate the edge of paths and roads;
- Textured surfacing within the station to direct users to the ticket office and gates;
- Provision of low level customer activated buttons;
- Bright colours and landmark features external to the station to provide landmarks for those with early stages of dementia; and
- Inductive loops for those who are hard of hearing; and
- Raised platform allowing easy access between the platform and train.

### 5.3.2 Connectivity

As described in Chapter 6: Traffic and Transport of Es Volume I, the NLE will allow reduced travel time from Battersea to central London and improve the connectivity between employment areas.

The NLE will provide two new stations to improve access to the London Underground network in an area which is in part characterised by poor access to public transport.

Specifically, In comparison with other parts of central London, the VNEB Opportunity Area is currently poorly served in terms of public transport accessibility and also in absolute terms, as evidenced by its Public Transport Accessibility Levels (PTALs) which indicate the relative density of the public transport network at a given location.

While most of central London achieves a PTAL of 6 (on a six-point scale), the central and western sections of VNEB have PTALs of 1 and 2, with Level 6 only at the eastern end around Vauxhall. The NLE would therefore benefit both new and existing residential and business communities.

Both stations will be integrated with the public realm and be accessible and clearly visible to pedestrians as well as cyclists at surface level and from the street. The stations will link open space with key pedestrian routes through the use of improved crossings, lighting, and materials/surfacing.

In addition, the project team participated in the VNEB DEN Steering Group meeting and is currently liaising with the DEN masterplan design team to secure connection to the future DEN which, according to the VNEB OAPF, will be powered by a mixture of technologies including CHP.

The coordination of the station design with that of the OSDs is also being prioritised as it would offer the following advantages:

- Structural foundations;
- Fire strategies, emergency exit and access;
- Rainwater harvesting; and
- Common energy strategies achieving savings in CO<sub>2</sub> emissions.

In addition, an initial consideration has been given to utilising waste heat from the tunnels and supplying it to the any locally available network.

### 5.3.3 Supporting regeneration and tackling deprivation

#### 5.3.3.1 Regeneration

The primary aim of the NLE is to facilitate the sustainable regeneration and development of the VNEB Opportunity Area. This includes the creation of a

major new sustainable residential, business and leisure district in London's Central Activities Zone.

The NLE is critical to achieving the regeneration of the VNEB OA and would also bring benefits to the surrounding area in terms of improving transport accessibility and access to employment as discussed further in Section 5.3.1 and 5.3.2 of this report.

The NLE will support regeneration and tackle deprivation by:

- Expanding the central London activity zone, the most productive district in the UK;
- Supporting creation of up to 25,000 new jobs; and
- Supporting the development of 16,000 new homes in the area.

#### 5.3.3.2 Community

It is currently intended that each station entrance would be provided with a community board.

The perceptions of community ownership of the stations can be enhanced by providing opportunities to make the stations as 'community' stations. Community stations include community displays within which initiatives such as local school art can be displayed. It might be possible to engage with local schools to deliver educational projects linked to the subject of transport in London.

There is a community facility in the north west of Kennington Park (housed in Kennington Park Lodge), which is owned by LBL and used by a number of not for profit organisations, including Bee Urban (a bee-keeper) and Edible Lambeth who use the upper floor of the building. Kennington Park Lodge would be demolished as a result of the NLE. This would result in the two occupiers being displaced for the duration of the works at this site, probably to temporary facilities to the west of the proposed worksite.

The NLE would result in a rebuilt Lodge providing a new-build facility. The improvements to the lodge would constitute an improvement in the value of the facility as a community resource. This is described in the Design and Access Statement for the NLE.

Chapter 7 Socio-Economic of the ES includes further details on the assessment of the NLE's impact on local community. Based on the results of the assessment, the NLE would have a long term positive effect on the provision of community space in the local area.

## 5.4 Safety and Security

### 5.4.1 Reducing Crime (Secure design)

The station designs are intended to help people feel safe and to design out crime.

The NLE will incorporate effective design measures that promote low risk, safe and secure access to and use of the building. The 'Secured by Design' principles will be observed. 'Secured by Design' (owned by Association of Chief Police Officers) is a police initiative to encourage the building industry to adopt crime prevention measures in the design of developments to assist in reducing the opportunity for crime.

The design of both sites allows for the stations to be easily accessible by all. The entrances will be overlooked by active frontages, on well-used and well-lit routes and inappropriate screening will not be caused by any landscaping and other vegetation.

Also, at Nine Elms, although bicycle facilities will not be inside a building they will be close to the main entrance, lit and unobstructed and under Closed Circuit Television (CCTV) surveillance.

CCTVs will be provided at both stations in addition to Help Points, which will have a red fire alarm and a green emergency button so passengers can report disturbances, vandalism, unattended packages or suspicious activity. Pressing the green emergency button will connect passengers to the station control room or the police if station staff are not available within 30 seconds.

### 5.4.2 Safety

LU has an excellent safety record, and will maintain and improve on this record by following legislation such as CDM to design out risks, and best practice.

A safety management system is integrated into LU's Management System and that this has been verified by the Office of Rail Regulation (ORR) under their Safety Certification.

Customer and staff safety is paramount through construction and operations.

The delivery of safety by design is addressed through measures incorporated into layout, materials and landscape.



Sprinkler and alarm systems would be installed at both stations. Also at both stations external lighting would be installed providing coverage of the entrance(s) and bike storage and hire areas.

During construction external white lighting will be provided on hoardings surrounding the worksite to illuminate adjacent footpaths.

TfL recognises its customer safety responsibilities and as part of the design works will seek improvements to the NLE operation to mitigate accidents and injuries.

One of the TfL's corporate priorities is employee safety. Accidents and assaults are monitored to ensure that adequate controls are in place to minimise workplace risk and injuries.

While much of the focus is upon safety within the Underground stations, there is also a need to focus upon enabling safe routes to the stations.

Introduction of the Battersea and Nine Elms stations will create new patterns of movement. Such movement patterns can create new opportunities to avoid risks or indeed may create new risks.

In the case of the Battersea station, although a signal controlled crossing is in place (see Figure 3), introduction of the station creates a new attraction for people to cross the road.

A pedestrian refuge could be installed at later stage on Battersea Park Road in proximity to the proposed station entrance. It is assumed that the new development on the BPS site would be designed with secure access to the station in mind.

At the Nine Elms station, the configuration of land use and the proposed station is such that a series of hazards exist to those wishing to access the station from along Wandsworth Road or from the housing estates on the opposite side of the road (see Figure 3).

It is noted that the pedestrian crossing at the junction is light controlled, however traffic does exit from the supermarket onto Pascal Street and then into the junction, potentially increasing the risk to pedestrians. The need to re-sequence the traffic lights at the Pascal Street – Wandsworth Road junction to provide an adequate pedestrian phase would be investigated.



**Figure 3 Access to the proposed Underground station (Battersea Park Road on the left and Wandsworth Road to the right)**

**5.4.3 Resilience**

The NLE will enhance the resilience of the Victoria line and Vauxhall Underground station as customers use the NLE.

The design of stations is governed by the LU Category 1 Standards, which are mandatory standards. In terms of functional requirements, stations must be capable of:

- Being structurally sound with a life span of up to 125 years;
- Providing a ticket hall, platforms and vertical circulation elements which are designed to accommodate projected passenger demand;
- Enabling passengers to evacuate the station safely under emergency conditions; and
- Providing systems for ventilation, draught relief and emergency intervention.

## 5.5 Economic Progress

### 5.5.1 Population and Employment Growth

The primary aim of the NLE is to encourage economic growth in London and the wider UK economy by facilitating the sustainable regeneration and development of the VNEB Opportunity Area. This includes the creation of a major new sustainable residential, business and leisure district in London's Central Activities Zone.

It is forecast that, by 2031, there will be around 1.25 million more people and over 750,000 new jobs in the Capital. The growth of London will lead to more trips, up from 24 million per day within London to more than 27 million in 2031. The NLE will bring significant transport improvement which is needed to support this growth.

The investment in stations at Battersea and Nine Elms would radically alter the image of the area in terms of its strategic attractiveness for inward investment within the VNEB OA. The extra travel option will enable the growth of the VNEB OA.

The NLE will be the catalyst for delivering up to 5,500 additional residential units and 14,000 additional jobs in the VNEB OA compared to what would happen if the NLE was not built. This is a significant share of the London Plan targets and of the Boroughs' housing targets. In Wandsworth's case, VNEB is critical to delivering its housing target.

More jobs will be accessible within a given travel time for existing residents of the local area, which can in turn mean they move to more productive jobs. These impacts have previously been estimated to have a net present value of £1.6 billion. There will also be benefits for local unemployed or economically inactive residents. The improvement in employment levels would also help alleviate poverty in the area.

It is considered that the NLE would have an overall positive economic effect on the economy of the VNEB OA as well as Greater London as a whole, through:

- Direct and indirect employment generation;
- Improving access to employment opportunities for residents; and
- Improving connectivity between employment areas.

In addition, the NLE would create a number of construction jobs and a number of jobs for operational staff. Of the operational staff, TfL would advertise positions locally to assist with local job creation as feasible.

TfL would emphasise that the construction contractors provide employment opportunities for local people. TfL procurement processes will require suppliers, where appropriate, to be aligned with TfL's corporate objectives for equality and inclusion as outlined in TfL's Equality & Inclusion Policy and as specifically outlined under TfL's duty under the Public Equality Duty under the Equality Act 2010.

TfL through its Strategic Labour Needs and Training (SLNT) initiative requires suppliers under contract to offer jobs and training opportunities to local communities, the long-term unemployed and under-represented groups. SLNT helps suppliers find skills and training programmes.

SLNT's 'Routes into Work' project, developed by TfL supports people in education or training to boost their employability. Young people are offered interactive learning to improve employment skills before meeting TfL suppliers.

TfL Procurement encourages applications for inclusion in TfL tendering processes from small and medium-sized enterprises and from London's diverse communities.

### 5.5.2 Efficient and effective transport system

The NLE will allow reduced travel time from Battersea to central London. Introduction of the NLE would, according to the VNEB OA:

- Reduce demand and provide relief to Vauxhall Underground station;
- Ease congestion on the Victoria line by providing an alternative route; and
- Relieve Battersea Park station through a reduction in boarding passengers in the morning peak.

Provision of a coordinated bus and Underground information system at the Underground stations would permit customers to choose which mode to use in the event of service delays. An information display board would communicate expected journey times to key destinations by mode.

## 6 Sustainability Tools - Results

The sustainability appraisal presented above demonstrates that the NLE currently achieves a balanced level of sustainability over the following objectives, demonstrating that social, environmental and economic sustainability have been considered thorough the design process:

- Tackle Climate Change: Reduce transport’s contribution to climate change and improve its resilience;
- Quality of Life: Enhance the quality of life for all Londoners;
- Transport for All: Improve transport opportunities for all Londoners;
- Safety and Security: Improve the safety and security of all Londoners; and
- Economic Progress: Support economic development and population.

Furthermore, this section summarises the quantifiable results of the performance assessment of the NLE against the three sustainability tools used throughout the sustainability appraisal process.

### 6.1 TfL Toolkit

The completed TfL Sustainability Toolkit is attached in Appendix C. Figure 4 shows the results of the assessment using TfL Toolkit.

The best performance is shown under ‘Supporting regeneration and spatial development’. This is in line with the NLE’s primary aim to encourage economic growth by facilitating the sustainable regeneration and development of the VNEB Opportunity Area.

Economic progress and Safety and Security also perform well under the assessment, which is in line with the NLE aims and TfL’s corporate objectives.

The lowest performance is displayed under category Climate Change, which covers under TfL Toolkit issues such as materials (the reasons for lower performance are discussed under Section 6.3).

Overall, the TfL Toolkit spider chart shows that the NLE achieved a balanced score over all categories, which demonstrates that social, environmental and economic factors have been considered thorough the design process.

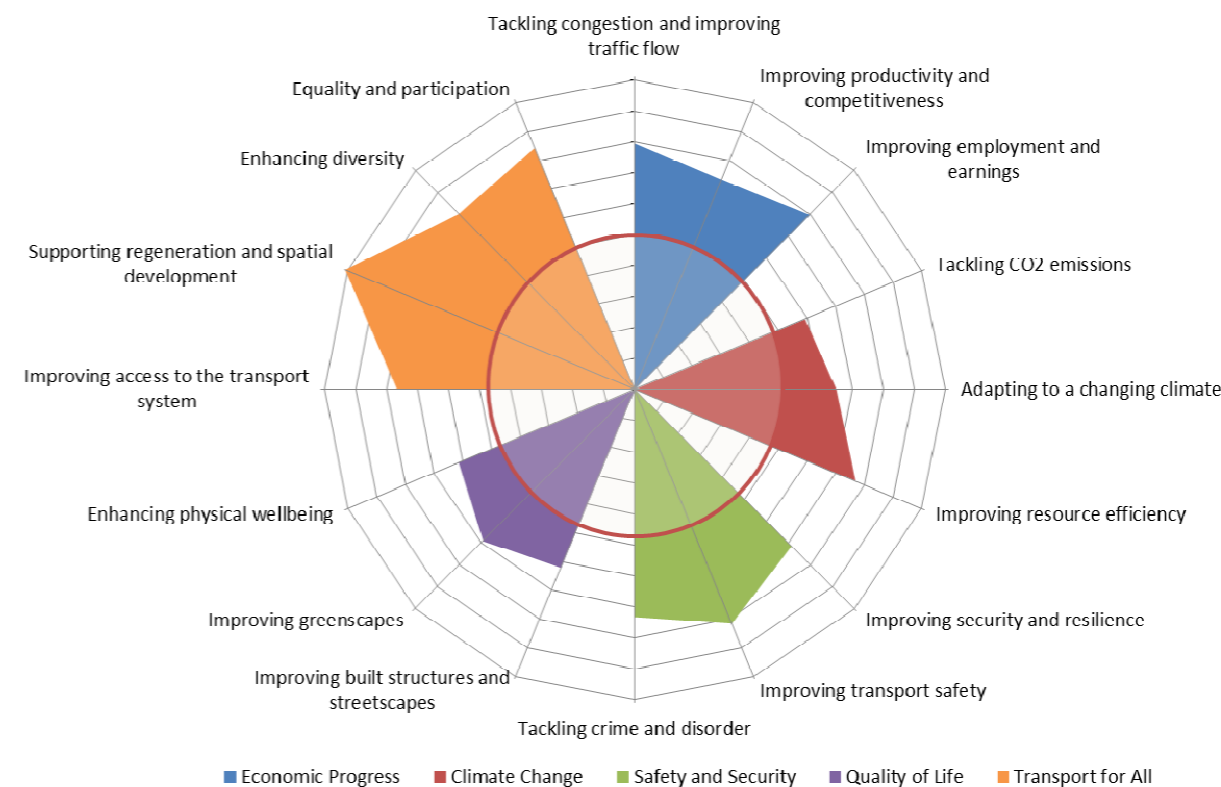


Figure 4 TfL Sustainability Toolkit Spider Chart

### 6.2 SSAT

The SSAT provides a view of a project’s sustainability performance by expressing the percentage of points scored across 11 topics. In doing so, the tool weights the scoring for each question according to the cost of the sustainability initiative and its sustainability return. Hence, initiatives that cost little to adopt and provide short term financial returns are weighted higher than those with a high cost, thus delivering corporate financial objectives.

The tool also recognises those questions where it has not been possible to give a response during the outline design stages and hence the available points have not been assigned to the score.

The NLE achieves 59.2% of positive sustainability points under SSAT. 30.3% of the points are uncertain due to early stages of the project. Only 10.5% of the points have not been achieved.

Figure 5 shows the score currently achieved by the project under each topic.

The highest potential is currently under topic Ecology and Biodiversity. Although the ecological impact of the NLE has been assessed and protection measures

plus high level enhancement measures have been identified, further work will be needed such as detailed planting schedules, work programmes, detailed landscape strategy, etc. to achieve additional points under this category.

The highest positive score is currently achieved under Project Strategy, which is appropriate for the stage of the project and demonstrates that sustainability is being embedded within the design process from early stages.

The highest negative score was obtained at this stage under category Public Health, which under SSAT covers topics such as Air Quality and Noise. However, the negative score under this category accounts for only 22% of the total potential score compared to 60% positive points. In addition, the NLE will implement a number of measures, which will mitigate the negative impact on local air quality and noise levels as far as practicable (See Section 5 for further details) to achieve additional positive points under this section during the next stages.

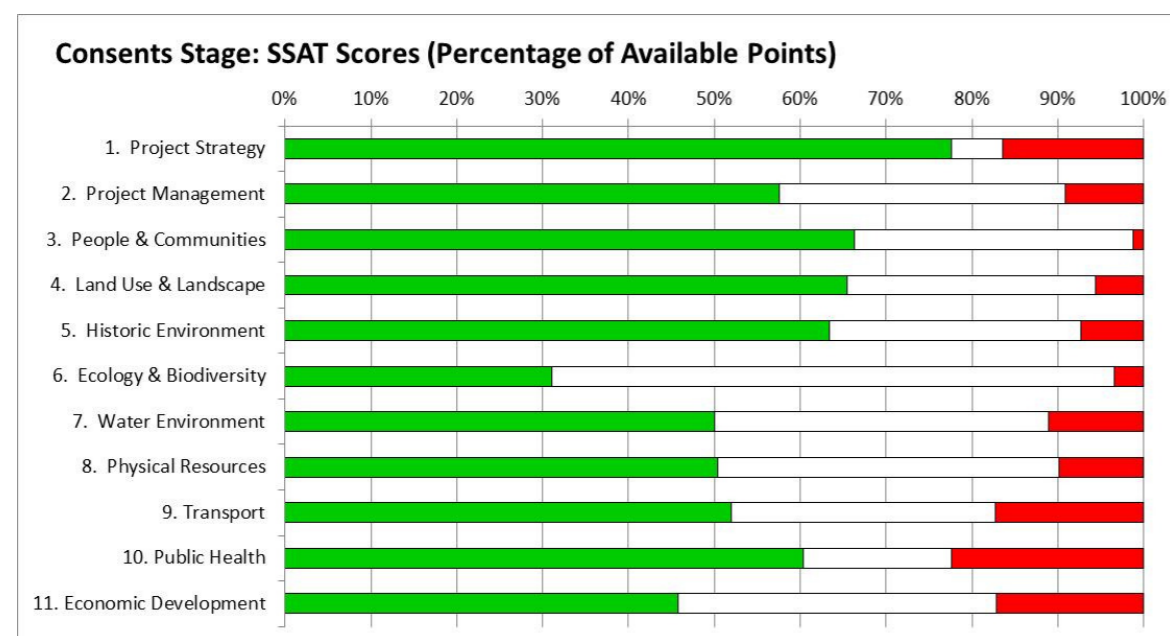


Figure 5 SSAT Score under each topic

### 6.3 CEEQUAL

The potential CEEQUAL v.5 score has been also estimated using the SSAT tool. The NLE is currently on track to achieve an 'Excellent' CEEQUAL rating (i.e. > 70%). 55.8% of the score is currently assumed achievable, 31.3% uncertain and 13% is currently deemed unachievable by the NLE. Hence the potential score of the NLE could be up to 87% (provided that all uncertain points are achieved).

Figure 6 shows the score currently achieved by the project under each topic.

Similarly to SSAT results, CEEQUAL results currently show that the best performing category is Project Strategy and the lowest positive score is currently achieved under Ecology and Biodiversity.

Physical Resources are the category with the highest percentage of negative points at this stage. This category includes topics such as embodied impact of materials. The nature of the project requires a large amount of materials with high embodied impact to be used. In addition, the requirements on resilience of Underground tunnels limit the opportunities for reuse of materials within their structure.

To address this issue, the design team investigated possibilities of how to reduce embodied carbon and identified opportunities such as using wharves to transport materials.

Additional positive points under this category may be also achieved via collaboration with the OSDs on the implementation of LZC technologies. As described in Section 5, the opportunities to incorporate LZCs within the NLE on its own are limited. Collaboration with OSDs could allow for coordinated LZC strategy for the sites.

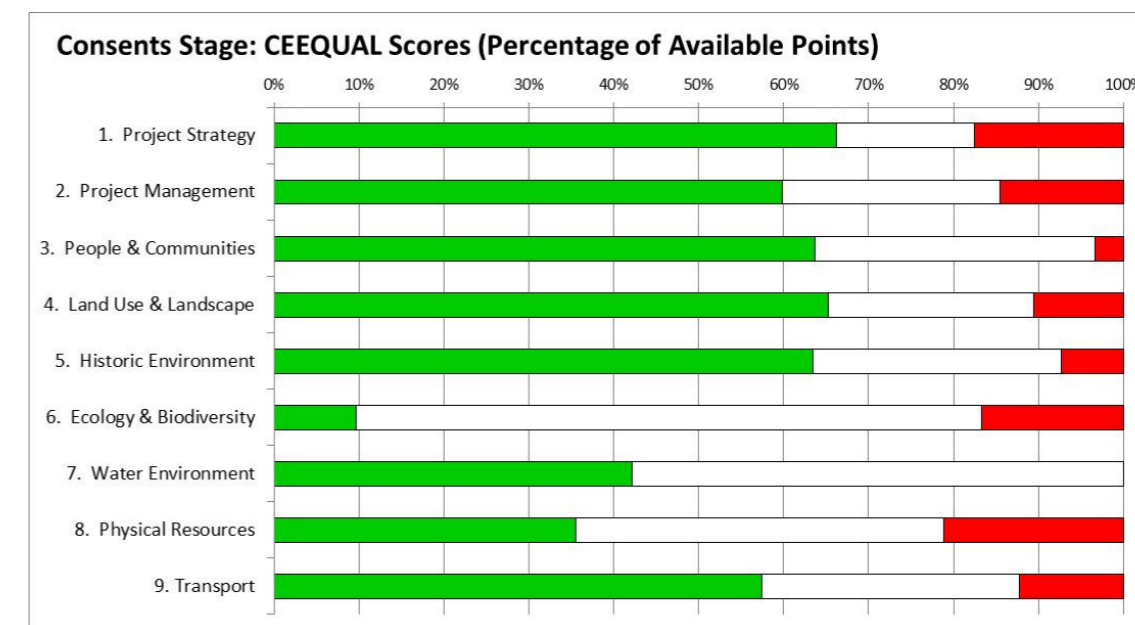


Figure 6 CEEQUAL Score

It is recommended that a CEEQUAL assessment (e.g. Client & Design Award or as required) is carried out at the detailed design stages and all commitments of the design team and contractor, are set out, the verifier is engaged and adequate procedures are put in place for the collation of evidence.

The difference between SSAT and CEEQUAL scores result from additional questions posed by SSAT and because SSAT is scored to reflect sustainability investment and return. Hence a negligible or low investment for a short term financial return is scored more highly than a more costly investment that perhaps results in benefit in consenting, legal protection or corporate profile for example.

The ultimate aim is to have a balanced graph with as many indicators as possible making a positive enhancement to sustainability.

## 7 Conclusions

The PSAR assessed the NLE against relevant sustainability standards as well as sustainability policies aims and objectives.

The PSAR demonstrates that the NLE achieves high sustainability standards in its design and aims to retain these standards throughout its construction, operation and 'end of life' phases.

The NLE has been designed around the objectives and goals of TfL and MTS. Specifically the NLE supports economic development and population growth, improves transport opportunities and addresses the safety and security of all Londoners.

The NLE project reduces its contribution to climate change and improves its resilience as far as practicable. However, as it is for infrastructure projects of this scale, the NLE will be associated with extensive use of materials with high embodied carbon (e.g. in-situ concrete). In addition, the construction phases of a project of this nature inevitably has environmental impacts on its surroundings.

Nevertheless, as demonstrated thorough this report, these impacts have been assessed and mitigated as far as practical. In addition, enhancements to the local area (e.g. to open spaces) will be provided as part of the NLE project.

The NLE will enable the redevelopment of the VNEB, which includes new open spaces and green areas, it will provide improved infrastructure, and result in a positive impact on communities and employment. It is concluded that this and mitigation measures tailored to the scheme will help to exceed any potential negative impacts.

To secure that the NLE's objectives are implemented, the bespoke sustainability benchmarking tool SSAT has been developed. The SSAT will support the implementation of the requirements of CEEQUAL and the TfL Sustainability Toolkit relevant to this stage of the design process.

The preliminary CEEQUAL v.5 score shows that the NLE is on track to achieving a score of 'Excellent'. It is recommended that a preliminary CEEQUAL assessment is carried out at detailed design stages to list all commitments of the design team required to secure the desired score.

In addition, TfL will assess and benchmark the proposed LU stations under BREEAM methodology, aiming for a 'Very Good' category.

## 8 References

1. Greater London Authority, The Mayor's Transport Strategy, 2010
2. Greater London Authority, The London Plan, Spatial Development Strategy for Greater London, 2011
3. Greater London Authority, The London Plan, Sustainable Design and Construction Supplementary Planning Guidance, 2006
4. Department of Communities and Local Government, The National Planning Policy Framework, 2012
5. Greater London Authority, Delivering London's Energy Future: The Mayor's Climate Change Mitigation and Energy Strategy, 2011
6. Greater London Authority, The Mayor's Biodiversity Strategy, 2002
7. Greater London Authority, Securing London's water future: The Mayor's Water Strategy, 2011
8. Greater London Authority, Making Business Sense of Waste: The Mayor's Business Waste Management Strategy, 2011
9. Greater London Authority, The Mayor's Ambient Noise Strategy, 2004
10. Greater London Authority, The Mayor's Air Quality Strategy, 2010
11. Greater London Authority, Managing risks and increasing resilience: the Mayor's climate change adaptation strategy, 2011
12. Greater London Authority, The Mayor's Economic Development Strategy for London, 2010
13. Greater London Authority, The Mayor's Health Inequalities Strategy, 2009
14. London Borough of Wandsworth, Core Strategy, 2010
15. London Borough of Lambeth, Core Strategy, 2011
16. London Borough of Southwark, Core Strategy, 2011
17. London Underground, Environment Strategy 2008-2013, 2011
18. Transport for London, The Plan 2012-2013 – Rail & Underground, 2012
19. The Department of Transport and Industry White Paper; Our Energy Future – Creating a Low Carbon Economy, 2003
20. Parliament of the United Kingdom, Sustainable and Secure Buildings Act, 2004
21. Parliament of the United Kingdom, Climate Change and Sustainable Energy Act, 2006
22. The Department for Communities and Local Government, Building a Greener Future: Towards Zero Carbon Development, 2006
23. The Department of Trade and Industry, Meeting the Energy Challenge, A White Paper on Energy, 2007
24. Parliament of the United Kingdom, The Climate Change Act, 2008
25. Parliament of the United Kingdom, The Planning and Energy Act, 2008
26. Department of Energy and Climate Change, The Energy Act, 2011
27. Department of Energy and Climate Change; The Carbon Plan, 2011
28. Greater London Authority, London Plan Implementation Plan 1, 2013

29. Greater London Authority, VNEB Opportunity Area Planning Framework, 2012
30. Greater London Authority, The GLA Group Responsible Procurement Policy, 2006
31. London Climate Change Partnership, Adapting to Climate Change: A Checklist for Development, 2005
32. Greater London Authority, Land for industry and transport, Supplementary Guidance, 2012
33. Greater London Authority, Vauxhall Nine Elms Battersea Opportunity Area Planning Framework, 2012
34. London Borough Wandsworth, Development Management Policies Document, 2012
35. London Borough of Lambeth; Unitary Development Plan, 2007
36. London Borough of Lambeth, Sustainable Design and Construction SPD, 2008
37. London Borough of Southwark, Southwark Plan, 2007
38. London Borough of Southwark, Sustainability Assessment, 2009
39. Transport for London, Health, Safety and Environment Policy, 2012
40. Transport for London, Health, Safety and Environment Report, 2012
41. London Underground, Assessment Management Strategy and Policy, 2010
42. Transport for London, Business Plan 2011/2012 – 2014/2015
43. Transport for London, Station Ambience
44. Transport for London, LU Biodiversity Action Plan: Connecting Nature, 2010
45. Transport for London, Valuing the Urban Realm Toolkit, 2012
46. Transport for London, Guidance Document G1323: Noise and Vibration Asset Design Guidance, 2012
47. Transport for London, Project Management 10565 Site Noise and Vibration Evaluation and Control
48. Transport for London, The Ethical Sourcing Policy, 2008
49. Transport for London, Procurement Policy, 2005
50. Responsible Sourcing of Construction Products, Framework Standard for the Responsible Sourcing of Construction Products (BES 6001), Information Paper, Building Research Establishment, Garston), 2009
51. Sustainable Development Commission, National Infrastructure - Embedding sustainable development in decision making, 2011
52. Environment Agency, Building a better environment, 2006
53. No. 988 Environmental Protection, The Waste (England and Wales) Regulations, 2011
54. Waste Framework Directive, EC of the European Parliament and of the Council, 2008
55. WRAP, Demolition Best Practice Code
56. Demolition Protocol, Institution of Civil Engineers, 2008



## Appendix A –Sustainability Workshops

### Introduction

The initial workshop has been held to identify those elements of a sustainability framework, based around the CEEQUAL award, that are relevant to the NLE. At this meeting sustainability questions were examined with responses being either:

- No – Not applicable;
- Unclear – Answer not available at present;
- Yes – The necessary deliverable either has been undertaken or would be undertaken in advance of the TWA Order submission.

The next part of the process of reporting upon the sustainability of the NLE was to explore and record sustainability initiatives that are either:

- Have been undertaken;
- To be undertaken prior to submission of the TWA Order;
- Commitments made regarding activities following the TWA Order.

A number of workshops have been held at which various TfL managers explored the contributions that they are making towards the delivery of a sustainable NLE.

The workshops identified a series of outputs that will be required in advance of the TWA Order in order to support the position in the PSAR.

### Objectives

The following specific objectives have been set for the Sustainability Workshops:

- Increase awareness of the concept of sustainability and its relevance to TfL;
- Review the sustainability outcomes anticipated to be either delivered or confirmed as commitments;
- Identify where opportunities to sustainability initiatives can be identified or adopted for NLE;
- Provide early input on the design objectives and measures to be taken;

- Identify documentary evidence to support the PSAR.

### Outcomes

The workshops achieved the following outcomes:

- Awareness of the sustainability initiatives that are being delivered as part of existing practice;
- Opportunities where sustainability benefits can be delivered for little or no cost;
- Enhanced recognition of how different skills sets interact to deliver a sustainable project;
- A prioritised list of sustainability measures for consideration by the project team;
- An important contribution toward benchmarking the sustainability performance of the NLE proposal and the preparation of the PSAR.

### Scoping Workshop

A scoping workshop was held by TfL in May 2012 during which sustainability and engineering staff examined a total of 409 questions and scoped out 61 on the basis of not being relevant to the NLE. Most of the questions scoped out related to flood protection, water quality and pollution, as well as community services and housing.

During the workshop those questions that were answered were reported so that an initial benchmark sustainability score could be provided and thereby enable the efforts during the design stage to be captured.

### Design and Innovation Workshops

The purpose of the design and innovation workshops held in July 2012 was to explore the potential sustainability initiatives that may be delivered through the NLE.

The workshops were held at an early stage in the design process to confirm that the sustainability commitments being made were feasible within the design envelop being put forward under the TWA Order procedures.

The workshops also had the objective of providing a schedule of actions to be undertaken, including those needed to be included in project design briefs for later stages in project delivery.

### Workshop 1 – Energy, Climate Change Mitigation and Adaptation

The first workshop focused on energy demand, efficiency, and use of renewable energy technologies before then considering climate change mitigation and then adaptation. Finally future proofing was discussed based upon the STEEP concept, namely:

- Social risks;
- Technological risks;
- Environmental risks;
- Economic risks;
- Political/governance risks.

Key considerations to emerge from the workshop were:

- Ventilation Shafts: Review the potential to increase the diameter of the vent shaft to increase reliance upon natural ventilation and thus reduce the use of ventilation fans. Where forced ventilation is required, the size and energy use of the fans increases as does the potential for noise disturbance to nearby residents.
- Regenerative Braking: In addition to the use of regenerative braking on modern Underground trains, lifts could also be equipped with regenerative braking.
- Train Heat Recovery: Consider design of platforms to cater for heat recovery from train braking.
- Tunnel Cooling: Installation of water pipes in the tunnel lining to extract heat would be explored.
- Humped Alignment: The use of a ramp up to and from would be investigated so that train speed would be reduced by gravity when approaching the platform and departure aided on the down slope reducing energy use.
- Sub-Metering: Sub-metering is to be installed to improve the evidence base for the management of energy use.
- Management of Escalators: The key benefit is in extending the life of the equipment rather than frequent off/on systems. The findings of the trial at

South Wimbledon of slowing down escalators at peak periods would be considered for the NLE.

- Back of House Heat Recovery: Adopt measures to recover heat from signalling rooms and IT servers based upon experience at Leicester Square.
- Use of PaveGen: Experimental use of a system of generating energy from the passage of pedestrians over a surface would be examined for potential application.
- Hydrogen Fuel Cells: A fuel cell has been installed at TfL Southwark offices. There is rapid evolution in this technology and hence it will be monitored for potential application in the NLE.
- Synergies with Neighbouring Developers: Explore potential synergies in the use of waste heat from the Underground and the use of surplus electrical energy from the neighbouring development's energy systems. To be explored with the GLA. Also the ability to install inverted substations in the NLE or elsewhere would be explored.
- Lower Lighting Levels: Investigate the lowering of lighting levels and the use of energy efficient lighting recognising maintenance implications.
- Common Construction Activities: The potential to exploit a single set of piling activities for the Underground Station and that for the over site development at Nine Elms would be investigated, also having the potential benefit of reducing nuisance to neighbours as well as saving embodied energy.
- Influencing the Lifestyle of Customers during Heat Waves: Individuals can be at increased risk from elevated temperatures. Advice to customers to minimise risks during periods of high temperatures could be provided at the stations.
- Provision of Drinking Water: Installation of drinking water fountains would be considered.

### Workshop 2 – Community and Socio-Economics

The second workshop considered the social and community implications of the proposed NLE, in addition to potential implications upon transport, public health, and sustainable economic development. In particular, the following key considerations were discussed in the workshop:

- Sustainability: The extent to which TfL can go in providing sustainability within the NLE and whether or not the sustainability measures will all be implemented by TfL or as a combined effort by all developers.

- **Lift Options at Nine Elms Station:** The incorporation of two lifts in individual shafts, two lifts in one combined shaft, or one lift in one shaft. Explore options whilst taking emergency access and servicing of lifts into consideration.
- **Way Finding:** As a principle of the proposed NLE, all way finding is to be generalised and linked to encourage safety and security for all.
- **Physical Activity Levels:** Consider TfL's wider remit to encourage walking and cycling to ensure sufficient levels of physical activity for future users of the proposed NLE. Members of the public and users of the NLE are more likely to use routes which require more physical activity if such routes are provided by TfL.
- **Potential Fast Food Unit(s) within Nine Elms Station:** The incorporation of a potential fast food unit(s) within Nine Elms Station was explored, taking potential impacts such as ambience, litter and crime into consideration.
- **Employment within the Wider VNEB Area:** The potential opportunities of involving the local community are to be established as procurement is most likely to be from the local area.
- **TfL Owned OSDs:** The key benefit of TfL owning OSDs is in the potential establishment of community enterprise hubs. For example, at shaft location sites, such as Kennington Park, an OSD could be used for a teacher training room to provide lessons / skills training.

Given the current stage in the project design, a number of topics remained open to be examined during later stages in the design process.

### **Workshop 3 – Land Use and the Environment**

The third workshop focused on land use, landscape, heritage, ecology, public realm, and resources and construction. Specifically, the below primary considerations were discussed:

- **Land Use and Flood Risk / Drainage:** Water should be kept at the source, as should the treatment of water, as this can be beneficial to ecology. Water re-use and different types of toilet flushing are to be explored, along with potential opportunities of sharing between properties.
- **Drainage Plans:** Potential risks are to be investigated. Explore large water mains and effects of the proposed NLE on the underground, establish the location of sewers, and locate surface water flooding and attenuation points.
- **Landscape and Architectural Design:** Investigate potential enhancement measures following the construction of the NLE. For example, the lodge and

bee hives at Kennington Park, which is a green flag award area, can be improved with landscaping after construction works are finished.

- **Resources and Construction:** Investigate initiatives that will need to be created to address this agenda. Consider the extent to which TfL will be able to re-use material in other build or potential restoration projects.
- **Sustainable Construction:** TfL will comply with all of the 2006 SPG requirements as a minimum; however, investigate where TfL could go beyond the minimum.
- **Waste Management:** Nine Elms station is to be designed with sufficient space for bin rooms to separate and store materials. Explore space design with consideration for the collection of waste, to ensure HGV access to collect waste.

## Appendix B –SPG 2006 Checklist incorporating London Plan 2011

Note: Only London Plan 2011 policies and sections relevant to the NLE project are included. For full text of the policies please refer to London Plan 2011 directly.

SPG 2006 Objective 1: Maximise Re-use of Land and Buildings			
SPG Guidance & Section	Essential (E) and Preferred (P) Standards as per SPG 2006 referring to London Plan 2004	Relevant London Plan 2011 Standards	Performance of NLE
Re-use of Land	E. 100% of development on previously developed land, unless very special circumstances can be demonstrated.	Maximise the proportion of development taking place on previously developed land.	<p>The NLE will utilise land that has been previously developed as far as practicable:</p> <ul style="list-style-type: none"> <li>• Battersea station, which is derelict and underdeveloped, is located on the site; in addition it has the potential for contaminated land.</li> <li>• Nine Elms station will be located predominantly on land occupied by car parking.</li> <li>• The temporary shaft sites have been selected so as to avoid the need to demolish any properties and to minimise the need to remove any trees.</li> <li>• The green areas and land taken by permanent shafts will be reinstated to enhance the affected open/amenity spaces.</li> </ul> <p>Overall, the proposals will aim for a positive change in the ecological value of the site.</p>
	E. Development density should be maximised based on local context (Policy 4B.7) design principles (Policy 4B.1) open space provision (Policy 3D.10) and public transport capacity (Policy 3D.10).	<p>Policy 7.1 Building London's Neighbourhoods and Communities: In their neighbourhoods, people should have a good quality environment in an active and supportive local community with the best possible access to services, infrastructure and public transport to wider London.</p> <p>Policy 7.6 Architecture: Architecture should make a positive contribution to a coherent public realm, streetscape and wider cityscape. It should incorporate the highest quality materials and design appropriate to its context.</p> <p>Policy 6.2 Providing public transport capacity and safeguarding land for transport.</p>	<p>The NLE scheme is critical to achieving the regeneration of the VNEB OA. Although not providing significant amenity areas as part of the proposed works, NLE will allow the development of the VNEB OA and will contribute to realising the vision of a high quality environment that includes a new linear park and amenity spaces supporting the local community. In addition, the amenity spaces affected by the NLE construction will be enhanced as a result of the NLE.</p> <p>The architecture of the stations themselves will have a small impact on the area, as the stations will be predominantly located below ground. However, the design of the proposed head houses at Kennington Park and Kennington Green is much more important due to their sensitive townscape setting. The designs have aimed to achieve high aesthetic aspirations, while complying with appropriate design standards, responding to its urban context, and providing functionality.</p> <p>The OSDs will also have a large visual effect; however, these are not in the scope of the NLE works.</p> <p>The selection and application of the materials comprising the NLE will respect the scale and setting of the surroundings. On that basis, the materials will be suitable and robust, with durable long-life properties.</p> <p>The NLE will provide two new stations to improve access to the London Underground network in an area which is in part characterised by poor access to public transport, thereby benefiting both new and existing residential and business communities.</p> <p>By providing two new stations, the NLE project's main objective is to improve access to the London Underground network, in an area which is in part characterised by poor access to public transport. The scheme aims to secure sufficient public transport capacity for the VNEB OA and has been selected from a number of alternative options.</p>

<p>Re-use of Buildings</p>	<p><b>E.</b> Existing buildings are re-used where practicable, where the density of development is optimised and where the building conforms or has the potential to meet the standards for energy, materials, water and biodiversity conservation set out in the SPG.</p>	<p>Policy 5.4 Retrofitting: The environmental impact of existing urban areas should be reduced through policies and programmes that bring existing buildings up to the Mayor’s standards on sustainable design and construction. In particular, programmes should reduce carbon dioxide emissions, improve the efficiency of resource use (such as water) and minimise the generation of pollution and waste from existing building stock.</p>	<p>In line with the objectives of the VNEB OAPF, the proposed scheme delivers new transport infrastructure to support growth. Due to the nature of the NLE (new underground line supporting development areas), it is not practical that it reuses any existing buildings.</p> <p>NLE’s design will minimise the material arising s from demolition by locating the stations and temporary shafts largely in areas where no demolition is required. Reuse of material streams will be maximised and stringent targets will be set for contractors to minimise the waste from construction activities.</p>
	<p><b>P.</b> Existing roof space is re-used where practicable to create new outdoor spaces and enhance biodiversity alongside the integration of renewable energy.</p>	<p>Policy 5.11 Green roofs and development site environs: Major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible, to deliver as many of the following objectives as possible:</p> <ul style="list-style-type: none"> <li>• adaptation to climate change (i.e. aiding cooling)</li> <li>• sustainable urban drainage</li> <li>• mitigation of climate change (i.e. aiding energy efficiency)</li> <li>• enhancement of biodiversity</li> <li>• accessible roof space</li> <li>• improvements to appearance and resilience of the building</li> <li>• growing food.</li> </ul>	<p>The NLE will comprise predominantly below ground structures and the roof areas will form part of the OSDs. Therefore, there is currently no scope for green roof integration for the stations, as well as minimal scope for the creation of new outdoor space. Brown and/or green roofs are considered for Kennington Park Lodge and TfL will aim to encourage the OSDs’ developers to provide green roofs and open space as part of their design.</p> <p>Opportunities to include green walls on the shafts and soft landscaping wherever feasible will be further investigated.</p>

SPG Objective 2: Maximise the Use of Natural Systems			
SPG Guidance & Section	Essential (E) and Preferred (P) Standards as per SPG 2006 referring to London Plan 2004	Relevant London Plan 2011 Standards	Performance of NLE
Location and Urban Design	E. All development to follow the principles of good design set out in Consolidated London Plan policy 4B.1.	<p>Policy 1.1 Delivering the strategic vision and objectives for London.</p> <p>In addition, policies included in Section 5, Section 6 and Section 7 of London Plan 2011 address the design principles set out in policy 4B.1 of London Plan 2008.</p>	<p><b>Maximise the potential of sites</b> – The underground stations are being designed so that OSDs can be developed on top of them, therefore maximising the potential of the proposed sites.</p> <p><b>Promote high quality inclusive design and create or enhance the public realm</b> – The principles of inclusive design, including the specific needs of disabled people, have been integrated into the NLE. An inclusive environment will be provided for all those visiting the site. Inclusive design has been an integral part of the design philosophy and will continue to inform the design process as it develops at later stages.</p> <p><b>Contribute to adaptation to, and mitigation of, the effects of climate change</b> – The NLE incorporates a large number of features designed to contribute to adaptation to, and mitigation of, the effects of climate change. These features include incorporating SUDS and water conservation measures, preventing overheating, minimising waste and reusing materials, reducing CO<sub>2</sub> emissions, etc.</p> <p><b>Respect local context, history, built heritage, character and communities</b> – The scheme aims to respond to the sites' locations, including their surrounding physical character. The aim is to bring about the rejuvenation of the sites through a comprehensive assessment of their history, context and surrounding character, while having regard to consultation responses from key statutory and non-statutory consultees.</p> <p><b>Provide for or enhance a mix of uses</b> –The NLE will allow OSDs to be built, which will maximise the utilisation of the building footprint and provision of mixture of uses.</p> <p><b>Be accessible, usable and permeable for all users</b> – Both stations will be integrated with the public realm and be accessible and clearly visible to pedestrians as well as cyclists at surface level and from the street. The stations will link open space with key pedestrian routes through the use of improved crossings, lighting, and materials/surfacing.</p> <p><b>Be sustainable, durable and adaptable in terms of design, construction and use</b> – The NLE will be constructed to a high standard to ensure durability over its lifetime. The proposed stations inevitably have to be designed for the operation of Underground trains and thus are not designed for alternative uses.</p> <p><b>Address security issues and provide safe, secure and sustainable environments</b> – The NLE will provide a safe, secure and sustainable environment.</p> <p><b>Be practical and legible</b> – The NLE will offer modern transport stations designed to serve the needs of passengers. The pursuit of clear legibility and intention will be the primary drivers in the design of the form.</p> <p><b>Be attractive to look at and, where appropriate, inspire, excite and delight</b> – The design will aim to achieve high aesthetic aspirations, while complying with appropriate design standards, responding to its urban context, and providing functionality.</p> <p><b>Respect the natural environment and biodiversity, and enhance green networks and the Blue Ribbon Network</b> – The NLE respects the natural environment through its commitment to sustainability and will aim to result in a positive change in the ecological</p>

			<p>value of the site, based on the advice and recommendations from a suitably qualified ecologist. The open spaces affected by the NLE construction works will be improved as a result of the NLE.</p> <p><b>Address health inequalities</b> – The NLE will promote healthy lifestyles by providing a safe and healthy environment and by encouraging active travel, such as walking and cycling.</p>
	<p><b>E.</b> Minimise need for use of mechanical ventilation, heating and cooling systems</p>	<p>Policy 5.3 Sustainable Design and Construction: Sustainable design principles to be achieved include Minimise CO<sub>2</sub> emissions across the site, avoid internal overheating and contributing to the urban heat island effect, efficient use of natural resources, including making the most of natural systems both within and around buildings, minimise pollution and the generation of waste and maximise reuse or recycling, avoid impacts from natural hazards (including flooding), ensure developments are comfortable and secure for users, secure sustainable procurement of materials, and promote and protect biodiversity and green infrastructure.</p> <p>Policy 5.9 Overheating and cooling: Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the Mayor's cooling hierarchy.</p>	<p>The CO<sub>2</sub> emissions associated with the operation of the NLE will be minimised through a series of passive and energy efficiency measures including:</p> <ul style="list-style-type: none"> <li>• Provision of natural ventilation, where feasible, in order to reduce the need for mechanical fans; in detail, ticket halls and other passenger circulation areas, as well as underground platforms, will be naturally ventilated. Complex natural ventilation modelling will be carried out at detailed design stages of the project to ensure that sufficient ventilation levels are achieved in all relevant areas.</li> <li>• Specification of efficient ventilation systems, utilising heat recovery, where possible.</li> <li>• Ventilation shafts will be designed to operate without fan assisted ventilation under normal operating conditions.</li> </ul> <p>In addition, a range of additional measures are currently considered, such as the an incorporation of water pipes within the tunnel lining, which would reject excessive heat from the tunnels.</p> <p>As part of TfL's overall approach on reducing energy consumption of the London Underground, regenerative braking is being rolled out for the trains. Although this is not part of the scope of the NLE, the NLE will benefit from its application as regenerative braking is associated with significantly lower undesirable waste heat rejected to the tunnels (for further details refer to Outline Energy Strategy for the NLE).</p> <p>Heat gains will be mitigated by passive measures to prevent overheating, such as the efficient use of thermal mass to manage the risk of overheating.</p>
Adapting to Climate Change	<p><b>E.</b> Buildings provide for flexibility of uses during their projected operational lives</p>	<p>Policy 7.2 An Inclusive Environment Policy 5.4Retrofitting</p>	<p>Due to the unique nature of the NLE there is only a negligible potential for flexibility in use. It is anticipated that during the NLE's projected operational life it will be always used for the purposes of providing underground public transport.</p>
	<p><b>E.</b> Buildings adapt to and mitigate for the effects of the urban heat island and the expected increases in hot dry summers and wet mild winters</p>	<p>Policy 5.3 Sustainable Design and Construction Policy 5.9 Overheating and cooling</p>	<p>The NLE will be designed to effectively use thermal mass to manage the risk of overheating.</p> <p>The NLE will predominantly contain below ground structures. Solar gains are therefore not expected to contribute to overheating and passive design measures such as shading systems will not only be necessary, but also not practical.</p> <p>The overheating could in future be caused by the heat gains accumulated within the tunnels. The design considerations currently include incorporation of water pipes in the tunnels structure to thermally activate it and to be used to reject the undesirable waste heat from the tunnels and possibly utilize it by OSD developments (for further details refer to Outline Energy Strategy for the NLE).</p> <p>In terms of the external environment, removal of trees will be avoided during construction as far as possible and new trees will be planted and vegetation will be incorporated into the design of the vent shafts to help reduce the re-radiation of heat in order to combat the</p>

			<p>urban heat island effect.</p> <p>In addition to the above, TfL aims to encourage the OSDs' developers to provide green roofs and open space as part of their design.</p>
	<p><b>E.</b> Design in facilities for bicycles and electric vehicles</p>	<p>Policy 6.9 Cycling: provide secure, integrated and accessible cycle parking facilities; provide on-site changing facilities and showers for cyclists and facilitate the Cycle Super Highways and the central London cycle hire scheme.</p> <p>Policy 6.13 Parking: ensure that 1 in 5 spaces (both active and passive) provide an electrical charging point to encourage the uptake of electric vehicles.</p>	<p>To promote sustainable means of transport it is assumed that there will be approximately 90 secure cycle parking spaces around Nine Elms station. According to the BPS Transport Assessment 100 secure cycle parking will be provided in the area.</p> <p>There will be an extension of Barclay's Cycle Hire facilities in the VNEB OA with a minimum 10 docking stations planned in the area, including two in the BPS development and a minimum of 30 spaces at the Sainsbury's development (Nine Elms OSD).</p> <p>It is not proposed to provide any car parking at the stations; therefore no electrical charging points need to be provided.</p>

SPG Objective 3: Conserve Energy, Materials and Water Resources			
SPG Guidance & Section	Essential (E) and Preferred (P) Standards as per SPG 2006 referring to London Plan 2004	Relevant London Plan 2011 Standards	Performance of NLE
Energy	<p><b>E.</b> Carry out an energy demand assessment</p>	<p>Policy 5.2 Minimising CO<sub>2</sub> Emissions: Major development proposals should include a detailed energy assessment to demonstrate how the London Plan targets for CO<sub>2</sub> emissions reduction are to be met within the framework of the energy hierarchy.</p>	<p>An Energy Demand Assessment has been undertaken and is reported in Outline Energy Strategy for the NLE.</p> <p>Outline Energy Strategy was developed following the Mayor's energy hierarchy (i.e. be lean, be clean and be green).</p> <p>It is currently estimated that the NLE could achieve a reduction of CO<sub>2</sub> emissions of 34% considering regulated energy uses (i.e. heating, DHW, cooling, auxiliary energy and lighting), which is in line with the current London Plan targets of 25%.</p>
	<p><b>E.</b> Maximise use of energy efficiency</p>	<p>Policy 5.2 Minimising CO<sub>2</sub> Emissions: The energy assessment should include proposals to reduce CO<sub>2</sub> emissions through the energy efficient design of the site, buildings and services.</p>	<p>The Outline Energy Strategy report includes details of how the NLE intends to reduce its energy demand by incorporating passive design measures, such as provision of natural ventilation, incorporation of partial 'humped' alignments, promotion of daylighting, efficient use of thermal mass and promotion of energy saving behaviour of staff.</p> <p>It is proposed to achieve a further reduction in the energy demand by specifying energy efficiency measures, such as:</p> <ul style="list-style-type: none"> <li>• Energy efficient internal and external lighting with appropriate control system;</li> <li>• High efficiency heat recovery systems for mechanically ventilated areas;</li> <li>• Waste heat rejection and/or recovery from the tunnels, if feasible;</li> <li>• Efficient fans and pumps;</li> <li>• Energy efficient equipment and appliances;</li> <li>• Thermal zoning and controls;</li> <li>• Building Management System (BMS);</li> </ul>



			<ul style="list-style-type: none"> <li>• Energy display devices; and</li> <li>• Efficient lifts and escalators.</li> </ul> <p>The resulting savings in CO<sub>2</sub> emissions due to the incorporation of the passive design and energy efficiency measures could be a 24% over the baseline scheme considering all energy uses.</p>
	<p><b>E.</b> Major commercial and residential developments to demonstrate that consideration has been given to the following ranking method for heating and cooling systems: Passive design; Solar water heating; then CHP (if possible trigeneration), preferably fuelled by renewables; then Community heating; then Heat pumps; then Gas condensing boilers; and then Gas central heating.</p>	<p>Policy 5.2 Minimising CO<sub>2</sub> Emissions: Development proposals should make the fullest contribution to minimising CO<sub>2</sub> emissions in accordance with the following energy hierarchy:</p> <ol style="list-style-type: none"> <li>a. Be lean: use less energy</li> <li>b. Be clean: supply energy efficiently</li> <li>c. Be green: use renewable energy.</li> </ol>	<p>The Outline Energy Strategy demonstrates how the designers are considering the aspirations set in the London Plan 2011 by following the Mayor’s energy hierarchy and the detailed guidance provided in the GLA Energy Team Guidance on Planning Energy Assessments, and including:</p> <ul style="list-style-type: none"> <li>• Passive design and energy efficiency (i.e. ‘be lean’);</li> <li>• Energy efficient supply of services (i.e. ‘be clean’); and</li> <li>• On site renewable energy technologies to provide energy (i.e. ‘be green’).</li> </ul> <p>From the analysis following the above steps, the following energy strategy has currently been identified feasible for the NLE:</p> <ul style="list-style-type: none"> <li>• Energy efficiency and passive design measures (i.e. ‘be lean’ scheme), which could provide approximately 24% savings in CO<sub>2</sub> emissions over the baseline scheme considering total energy uses and 32% reduction considering regulated energy uses only;</li> <li>• Connection to any existing neighbouring low carbon heat distribution networks including Combined Heat and Power (CHP). The viability of connection to any of the following energy networks will be determined at later stages when design has progressed sufficiently to allow detailed feasibility analyses: VNEB DEN, OSD at Battersea and/or OSD at Nine Elms.</li> <li>• Specification of ASHPs. This could provide a CO<sub>2</sub> emissions reduction of circa 1.6% considering total energy uses and 3.2% considering regulated energy uses only.</li> </ul> <p>In addition to ASHP, the following technologies are being taken forward for detailed stages of the project:</p> <ul style="list-style-type: none"> <li>• Photovoltaic (PV) arrays could be incorporated into the design of the Nine Elms station should the OSD design allow for such installation.</li> <li>• Passive provision for borehole cooling will be considered following thermal modelling exercise, which will identify the need for tunnel cooling in future.</li> <li>• GSHP could be installed either to supply joint heating and cooling loads of the stations and OSDs or to extract waste heat from tunnel lining.</li> <li>• The incorporation of fuel cells will be also considered at detailed design stages in collaboration with the OSDs.</li> <li>• A kinetic energy harvesting system could be incorporated either to raise the passengers’ sustainability awareness or should it become economically viable and technically reliable, a large installation could be installed to contribute to the scheme’s CO<sub>2</sub> reduction targets.</li> </ul>

			When considering only the regulated energy uses of the stations (i.e. heating, domestic hot water (DHW), cooling, ventilation and lighting) the proposed energy strategy could achieve a 34% reduction in CO <sub>2</sub> emissions over the baseline scheme, which is in line with the current London Plan targets of 25% reduction in CO <sub>2</sub> emissions. It is estimated that the total CO <sub>2</sub> reduction would be 34%.
<b>E.</b> Wherever on-site outdoor lighting is proposed as part of a development it should be energy efficient, minimising light lost to sky.	Policy 5.2 Minimising CO <sub>2</sub> Emissions		High efficiency ballasts will be specified to maximise operational efficiency. The best available technology at the time of detailed design will be specified considering the whole life cost of the system (i.e. low energy, low maintenance and long life fittings).  Daylight sensors will be provided for the external lighting. Time switches and presence detector sensors will be provided in the areas of irregular use.
<b>E.</b> Carbon emissions from the total energy needs (heat, cooling and power) of the development should be reduced by at least 10% by the on-site generation of renewable energy.  Note: the Consolidated London Plan sets a requirement for 20% carbon dioxide emission reductions from on-site renewable sources.	Policy 5.7 Renewable Energy: Within the framework of the energy hierarchy, major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.  Note that although not required by a specific policy, there is a presumption within the London Plan that all major development proposals will seek to reduce CO <sub>2</sub> emissions by at least 20% through the use of on-site renewable energy generation wherever feasible.		Consideration has been given to the inclusion of renewable energy technologies within the NLE and the Outline Energy Strategy report provides an appraisal of the following technologies: wind technology, solar thermal, photovoltaic panels, biomass, borehole cooling, energy from waste, heat pumps, fuel cells, kinetic energy harvesting, and micro-hydro.  The feasibility analysis showed that ASHP is at this stage considered the most appropriate green energy technology for the NLE. In addition to ASHP, PV arrays could be incorporated into the stations design should the design of the future OSDs allow for such installation. The incorporation of fuel cells will be also considered at detailed design stages in collaboration with the OSDs. GSHPs and kinetic energy harvesting system are also being taken forward for consideration at later stages.  Due to the constraints associated with the NLE project, which are detailed in Outline Energy Strategy, it is currently anticipated that the NLE will not achieve the London Plan presumed target of 20% reduction in CO <sub>2</sub> emissions via renewable energy technologies.
<b>P.</b> Lighting, heating and cooling controls should enable services to operate efficiently under different loadings and allow for localised control.	Policy 5.2 Minimising CO <sub>2</sub> Emissions		The NLE will be appropriately zoned to allow for an individual temperature control for different areas of the stations.  Energy metering of high consuming uses such as escalators, lifts, fans and pumps, lighting and small power, etc. will be provided to allow for efficient management of the buildings. A BMS will be provided for the NLE to control and monitor the building's services and will be design so it can be adapted for remote control in future.  Although natural ventilation strategy is promoted wherever feasible, mechanical ventilation will need to be installed in some areas. To reduce the energy associated with the mechanical ventilation system, high efficiency fans will be incorporated into the design including variable speed drives.  Lighting zones and controls will be provided as appropriate to cater for different operational needs. This will also allow an appropriate level of lighting to be selected at different periods in order to minimise energy consumption.
<b>P.</b> Major developments should be zero carbon emission developments (ZEDs).	Policy 5.2 Minimising CO <sub>2</sub> Emissions: zero carbon residential buildings from 2016and zero carbon non-domestic buildings from 2019. Zero carbon residential buildings from 2016and zero carbon non-domestic		Outline Energy Strategy developed for the NLE demonstrates that the CO <sub>2</sub> emissions of the NLE's operation will be reduced to realistically low levels. However, based on the results of the detailed energy options appraisal undertaken it is considered that this type of development cannot aspire to become a ZED.

		buildings from 2019.	
	<p><b>P.</b> Major developments should make a contribution to London's hydrogen economy through the adoption of hydrogen and/or fuel cell technologies and infrastructure.</p>	<p>Policy 5.8 Innovative energy technologies</p> <p>Hydrogen fuel cell vehicles are being trialled in London and the Mayor actively supports the greater deployment of electric vehicles.</p>	<p>A consideration has been given to fuel cells within Outline Energy Strategy. There are two potential options for how to incorporate fuel cells into the NLE. The first option would be a transport application of fuel cells to power the trains. However, this option would have to wait until the upgrade of the existing Northern line train stock. In addition, there is currently no commercial application of a fuel cell train and the only existing technologies of this kind are experimental.</p> <p>The second option would utilise gas fuelled stationary fuel cells, which could produce electricity and heat as a CHP. However, the NLE's heat loads are currently very low. To make this system feasible additional heat demand would have to be secured, for example from OSDs. This option will therefore be taken to the next stages of the project when design of the OSDs is fully developed.</p>
		<p><b>Additional Standard - Decentralised Energy:</b></p> <p>Policy 5.5 Decentralised Energy Networks: Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.</p> <p>Policy 5.6 Decentralised Energy in Development Proposals: Major development proposals should select energy systems in accordance with the following hierarchy:</p> <ol style="list-style-type: none"> <li>a. Connection to existing heating or cooling networks (Where future network opportunities are identified, proposals should be designed to connect to these networks.)</li> <li>b. Site wide CHP network</li> <li>c. Communal heating and cooling.</li> </ol>	<p>The potential for connection to any existing neighbouring low carbon heat distribution networks including CHP was investigated and is currently being considered. The viability of connection to any of the following energy networks will be determined at later stages when design has progressed sufficiently to allow detailed feasibility analyses:</p> <ul style="list-style-type: none"> <li>• VNEB DEN</li> <li>• OSD at Battersea</li> <li>• OSD at Nine Elms</li> </ul> <p>The use of an on-site CHP and CCHP in the NLE has been assessed. Based on the current estimates of the stations heat demands an on-site CHP/CCHP unit is not considered feasible for the NLE.</p>
Materials	<p><b>P.</b> No construction material nor specification with high-embodied impact is to be used (as defined by the summary ratings within the Green Guide to Specification) unless a compelling whole life energy or technical case for its use exists.</p>	<p>Policy 5.3 Sustainable design and construction.</p> <p>Note: Use of appropriate materials is key and where practicable those with a high embodied energy should be avoided.</p> <p>SPG 2006 standards are still applicable (i.e. no change to the second column)</p>	<p>The selection, installation and procurement of the materials comprising the NLE will respect the scale and setting of the surroundings. On that basis, the materials will be suitable and robust, with durable long-life properties.</p> <p>Following consideration of the technical specification of the concrete mix for specific applications, TfL will then expect the contractor to demonstrate that the carbon cost associated with the import of materials does not adversely affect the overall sustainability performance of the concrete.</p> <p>Wherever feasible, materials employed in key building elements of the stations will be selected in line with the Green Guide to Specification with a low environmental impact (including embodied carbon) over the full life cycle of the buildings.</p>

	<p><b>E.</b> 50% timber and timber products from Forest Stewardship Council (FSC) source and balance from a known temperate source</p>	<p>Policy 5.3 Sustainable design and construction: h) securing sustainable procurement of materials, using local supplies where feasible.</p> <p>SPG 2006 standards are still applicable (i.e. no change to the second column)</p>	<p>Where timber products are used, they will be obtained from sustainable sources. At least 50% of the timber and timber products will be sourced from a FSC or equivalent source, with the remainder being obtained from a known temperate source using the Defra's CPET.</p> <p>Temporary timber used during construction will also be legally sourced.</p>
	<p><b>P.</b> No peat or natural weathered limestone used in buildings or landscaping.</p>	<p>Policy 5.3 Sustainable design and construction</p> <p>SPG 2006 standards are still applicable (i.e. no change to the second column)</p>	<p>Use of peat or natural weathered limestone will be avoided.</p>
	<p><b>E.</b> Insulation materials containing substances known to contribute to stratospheric ozone depletion or with the potential to contribute to global warming must not be used</p>	<p>Policy 5.3 Sustainable design and construction</p> <p>SPG 2006 standards are still applicable (i.e. no change to the second column)</p>	<p>All thermal insulation products used in the building will have a low embodied impact relative to their thermal properties and the use of insulants with a high GWP will be avoided. Furthermore, where feasible, thermal insulation products used in the buildings will be responsibly sourced.</p>
	<p><b>P.</b> Before demolition, appraisal of maximising recycling of materials by use of ICE's Demolition Protocol</p>	<p>Policy 5.3 Sustainable design and construction</p> <p>Note: The Mayor encourages the use of the Demolition Protocol developed by London Remade to support recycling and reuse of construction materials.</p>	<p>NLE's design will minimise the material arising from demolition by locating the stations in areas where no demolition is required. Reuse/recycling of material streams will be maximised and stringent targets will be set for contractors to minimise the waste from construction activities.</p> <p>Commercial buildings at Nine Elms, Kennington Park Lodge and the outbuilding at the Beefeater Distillery at Kennington Green will be demolished as part of the NLE. The contractor will be required to implement the WRAP Demolition Best Practice Code, including the Institute of ICE Demolition Protocol. Waste from the demolition and enabling works will be subject to onsite screening and sorting in accordance with the contractor's SWMP.</p>
	<p><b>P.</b> 50% of materials by mass to be sourced from within 35 miles of site</p>	<p>Policy 5.3 Sustainable design and construction</p> <p>SPG 2006 standards are still applicable (i.e. no change to the second column)</p>	<p>The percentage targets of materials by mass to be sourced from within 35 miles of site have not been set at this stage. The NLE will adopt best practise policies and procedures for responsible sourcing. TfL green procurement policies will be adhered to during the construction process.</p>
	<p><b>E.</b> Minimise use of new aggregates</p>	<p>Policy 5.20 Aggregates: The Mayor will work with all relevant partners to ensure an adequate supply of aggregates to support construction in London. This will be achieved by:</p> <ul style="list-style-type: none"> <li>a. Encouraging re-use and recycling of construction, demolition and excavation waste within London</li> <li>b. Extraction of land-won aggregates within London</li> <li>c. Importing aggregates to London by sustainable transport modes.</li> </ul>	<p>The need to use primary aggregates will be minimised by the selection of secondary materials where possible. The maximum amount of secondary materials will be specified for the concrete mixes subject to not compromising performance.</p> <p>Following consideration of the technical specification of the concrete mix for specific applications, TfL will then expect the contractor to demonstrate that the carbon cost associated with the import of materials does not adversely affect the overall sustainability performance of the concrete.</p> <p>The amount of aggregates needed for the project will be significant and it is unlikely that such an amount will be available locally (i.e. in London). Importing aggregates to London by sustainable transport modes will be promoted, which may include transport via wharfs for Battersea station. For the aggregates transferred by road vehicles, the drivers will be required to undertake a fuel efficient driving course.</p>
	<p><b>P.</b> 10% total value of materials used to be derived from recycled and re-used content in products and materials</p>	<p>Policy 5.3 Sustainable design and construction</p>	<p>Due to the unique nature of the NLE and its specific requirements the potential to use recycled materials within its structure is minimal. However, recycled materials will be</p>

	selected	SPG 2006 standards are still applicable (i.e. no change to the second column)	promoted wherever it will have no impact on the performance of the required element.
Water	Residential developments to achieve average water use in new dwellings of less than 40m <sup>3</sup> per bed space per year (approximately 110 litres / head / day). Residential developments to achieve average water use in new dwellings of less than 25m <sup>3</sup> per bed space per year (approximately 70 litres / head / day).	Policy 5.15 Water use and supplies: Development should minimise the use of mains water by: <ul style="list-style-type: none"> <li>• Incorporating water saving measures and equipment</li> <li>• Designing residential development so that mains water consumption would meet a target of 105 litres or less per head per day.</li> <li>• New development for sustainable water supply infrastructure, which has been selected within water companies' Water Resource Management Plans, will be supported.</li> </ul>	The design of all areas of the NLE will aim to minimise internal potable water consumption for sanitary uses. This will entail installing water efficient sanitary ware (such as low-water, dual flush toilet cisterns and low-pressure spray taps in bathrooms).
	100% metering of all newly built property.	Policy 5.3 Sustainable design and construction: c) Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings.	A water meter with a pulsed output will be installed on the mains supply to the building and a leak detection system can be integrated into the water metering, with an audible signal when a leak is detected, to reduce the impact of water leaks that would otherwise go undetected. Flow control devices, such as solenoid valves connected to presence detectors, are being considered to be fitted to each toilet area/facility to ensure water is supplied only when needed and therefore prevent minor water leaks.
	Use of greywater for all non potable uses.	Policy 5.15 Water use and supplies Note: Alternative sources of water, such as rainwater and greywater, particularly for uses other than drinking, will be increasingly important to reducing the consumption of mains water.	Given the prospect of OSD, provision of systems to capture rainwater would need to be built into the operation of the overall site. No showers will be provided as part of the NLE, therefore greywater recycling is not being proposed.

SPG Objective 4: Reduce the impacts of noise, pollution, flooding and microclimatic effects			
SPG Guidance & Section	Essential (E) and Preferred (P) Standards as per SPG 2006 referring to London Plan 2004	Relevant London Plan 2011 Standards	Performance of NLE
Noise	<b>E.</b> Demonstrate that any adverse impacts of noise have been minimised, using measures at source or between source and receptor (including choice and location of plant or method, layout, screening and sound absorption) in preference to sound insulation at the receptor, wherever practicable.	Policy 7.15 Reducing noise and enhancing soundscapes: Development proposals should seek to reduce noise by: <ol style="list-style-type: none"> <li>Minimising the existing and potential adverse impacts of noise on, from, within, or in the vicinity of, development proposals</li> <li>Separating new noise sensitive development from major noise sources wherever practicable through the use of distance, screening, or internal layout in preference to sole reliance on sound insulation</li> </ol>	TfL will, as far as reasonably practicable, seek to control and limit noise and vibration levels so that affected properties and other sensitive receptors are protected from excessive or prolonged noise and vibration associated with construction and operational activities  In addition, all tunnel ventilation plant with connections to the atmosphere in any noise-sensitive location will be subject to mitigation measures appropriate to its local environment.

		c. Promoting new technologies and improved practices to reduce noise at source.	
	<b>P.</b> For residential development achieve BS 8233:1999 (Table 5) 'good' standards for external to internal noise and improve on Building Regulations (2003) Part E for internal sound transmission standards by 5dB (See EcoHomes)	Policy 5.3 Sustainable Design and Construction: The Government has implemented the Code for Sustainable Homes as a national standard for the sustainable design and construction of new homes. The Mayor's approach is compatible with this, and it is expected that new development in London will seek to achieve the highest code levels possible.  Refer to CSH November 2010 Hea 2 issue – Sound insulation.	Not Applicable as there are no residential areas proposed as part of the NLE.
Air Pollution	<b>E.</b> All new gas boilers should produce low levels of NO <sub>x</sub>	Policy 5.3 Sustainable design and construction SPG 2006 standards are still applicable (i.e. no change to the second column)	No gas boilers are currently proposed for the NLE.
	<b>P.</b> Low emission developments that are designed to minimise the air quality impact of plant, vehicles and other sources over the lifetime of the development	Policy 7.14 Improving air quality: Development proposals should:  a. Minimise increased exposure to existing poor air quality and make provision to address local problems of air quality such as by design solutions, buffer zones or steps to promote greater use of sustainable transport modes through travel plans  b. Promote sustainable design and construction to reduce emissions from the demolition and construction of buildings following the best practice guidance  c. Be at least 'air quality neutral' and not lead to further deterioration of existing poor air quality  d. Ensure that where provision needs to be made to reduce emissions from a development, this is usually made on-site.  e. Where the development requires a detailed air quality assessment and biomass boilers are included, the assessment should forecast pollutant concentrations. Permission should only be granted if no adverse air quality impacts from the biomass boiler are identified	Efforts are being made to reduce energy consumption of the NLE as part of the effort of reducing the indirect emissions associated with the use of power. Through measures to reduce operational energy consumption and substitute renewable sources, TfL continues to strive to reduce its emissions.  The emissions associated with the demolition and construction will be minimised through the implementation of an Air Quality and Dust Management Plan and a series of measures outlined within the CoCP. These measures will be implemented predominantly on-site.  No biomass boilers are proposed for the NLE.
	<b>E.</b> Take measures to reduce and mitigate exposure to air pollution	Policy 7.14 Improving air quality	The emissions associated with the demolition and construction will be minimised through the implementation of an Air Quality and Dust Management Plan and a series of measures outlined within the CoCP.

Water Pollution and Flooding	E. Use sustainable drainage systems (SUDS) measures, wherever possible	Policy 5.13 Sustainable Drainage: Development should utilise SUDS unless there are practical reasons for not doing so, and should aim to achieve Greenfield run-off rates	The NLE supports the inclusion of SUDS in a form of green or brown roofs. However, as the NLE's structure will be predominantly below ground and the roof of the stations will be occupied by the OSDs it is currently not possible to confirm that green/brown roofs will be incorporated. However, the OSDs' developers will be encouraged to incorporate such SUDS into their design.  Brown/green roof will be provided for Kennington Park Lodge.
	E. Achieve 50% attenuation of the undeveloped site's surface water run off at peak times	Policy 5.13 Sustainable Drainage	The NLE will aim to achieve 50% attenuation of the undeveloped site's surface water run off at peak times.  A major benefit to the Thames Water combined sewers will be provided in terms of a reduction in storm water discharge volumes entering the system. This will be achieved by re-routing drainage for 94% of the land so that it drains directly to the Thames as opposed to the TWUL network. This represents an improvement to the current situation; the reduction in surface water run-off will increase capacity in the surrounding sewer network and thereby reduce flood risk.
	P. Achieve 100% attenuation of the undeveloped site's surface water run off at peak times	Policy 5.13 Sustainable Drainage	As above.
		Policy 5.13 Sustainable Drainage: The developments should ensure that surface water run-off is managed as close to its source as possible in line with the Mayors drainage hierarchy.  1. store rainwater for later use 2. use infiltration techniques, such as porous surfaces in non-clay areas 3. attenuate rainwater in ponds or open water features for gradual release 4. attenuate rainwater by storing in tanks or sealed water features for gradual release 5. discharge rainwater direct to a watercourse 6. discharge rainwater to a surface water sewer/drain 7. discharge rainwater to the combined sewer  Drainage should be designed and implemented in ways that deliver other policy objectives of the London Plan 2011, including water use efficiency and quality, biodiversity, amenity and recreation.	As above.  The NLE will not include significant areas which would need irrigation. In addition, the catchment areas for rainwater will be minimal. It is therefore not proposed to include rainwater storage.  External areas of the stations will be limited and due to their nature (e.g. parking bay for disabled users) these will not be in a form of porous surfaces.
Micro-Climate	E. Mitigate any negative impact on the microclimate of existing surrounding public realm and buildings to meet the Lawson criteria for wind comfort and safety	Policy 7.6 Architecture: B, d) Not cause unacceptable harm to the amenity of surrounding land and buildings, particularly residential buildings, in relation to privacy, overshadowing, wind and microclimate. This is particularly important for tall buildings	As the NLE consists predominantly of underground structures, it is anticipated that there will be no impact on the local microclimate.  The design of the OSDs may have an impact on the local microclimate and as such it should be established to avoid wind tunnel effects, casting of deep shadows, deliver a

		Policy 7.7 Location and design of tall and large buildings	well-designed landscape. The design of the OSDs, however, is not part of the NLE works.
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SPG Objective 5: Ensure Developments are Comfortable and Secure			
SPG Guidance & Section	Essential (E) and Preferred (P) Standards as per SPG 2006 referring to London Plan 2004	Relevant London Plan 2011 Standards	Performance of NLE
Indoor comfort	E. Inert and low emission finishes, construction materials, carpets and furnishings should be used wherever practical.	Policy 5.3 Sustainable design and construction SPG 2006 standards are still applicable (i.e. no change to the second column)	A healthy internal environment will be promoted through the specification of internal finishes and fittings with low emissions of VOCs. Where products, which can emit VOCs are specified, efforts will be made to ensure that these have been tested against and meet the relevant standards for VOC emissions.
	P. Design buildings for indoor comfort of users	Policy 5.3 Sustainable design and construction SPG 2006 standards are still applicable (i.e. no change to the second column)	<p>The NLE will aim to provide a healthy environment that reduces environmental stresses, facilitates physical activity and promotes mental well-being. Accordingly, a healthy and comfortable environment for staff and visitors will be promoted through the following measures:</p> <ul style="list-style-type: none"> <li>• Design of internal and external lighting in line with best practice for visual performance and comfort;</li> <li>• Optimisation of the acoustic performance of the building through early design consideration and expert advice on external sources of noise impacting the site, site layout and zoning of the building for good acoustics, acoustic requirements for users with special hearing and communication needs, and acoustic treatment of different zones and facades; and</li> <li>• Utilisation of design tools to ensure that spaces achieve appropriate thermal comfort levels throughout the year.</li> </ul> <p>Temperature control and in particular the consequences of heat waves upon customers is an important consideration for London Underground particularly in the context of climate change. Advice to customers to minimise risks during periods of high temperatures would be provided at the stations.</p>



Designing Inclusive Environments	<p><b>E.</b> All developments should meet the principles of inclusive design, adopting the principles of SPG “Accessible London: Achieving an Inclusive Environment” 2004.</p>	<p>Policy 7.2 An inclusive environment: Design and access statements submitted with development proposals should explain how, the principles of inclusive design, have been integrated into the proposed development, whether relevant best practice standards such as British Standard BS 8300:2009 have been complied with.</p> <p>Refer to updated SPG “Accessible London: Achieving an Inclusive Environment”. The most up to date version of this SPG is 2004 (as per SPG 2006, i.e. the second column of this table).</p>	<p>The stations will permit unsupervised wheelchair access directly onto the underground trains, should a disabled person cannot seek assistance. The designs have also recognised the needs of individuals that may experience hearing or sight impairment, or suffer from dementia or other mental illness.</p> <p>TfL has subjected the designs to external review by representatives of those with mobility impairment.</p> <p>The following measures are being taken at both stations:</p> <ul style="list-style-type: none"> <li>• Textured paving to provide complete coverage on pedestrian routes to delineate the edge of paths and roads;</li> <li>• Textured surfacing within the station to direct users to the ticket office and gates;</li> <li>• Provision of low level customer activated buttons;</li> <li>• Bright colours and landmark features external to the station to provide landmarks for those with early stages of dementia;</li> <li>• Inductive loops for those who are hard of hearing; and</li> <li>• Complete step free access for wheelchair and those with young children.</li> </ul>
	<p><b>E.</b> All residential development should meet Lifetime Home standards and 10% should meet wheelchair accessibility standards (Consolidated London Plan Policy 3A.5)</p>	<p>Policy 3.8 Housing choice: B</p> <p>c) all new housing is built to ‘The Lifetime Homes’ standards</p> <p>d) ten per cent of new housing is designed to be wheelchair accessible, or easily adaptable for residents who are wheelchair users</p>	<p>Not applicable as there are no residential areas proposed as part of the NLE.</p>
	<p><b>P.</b> All residential development should be designed to meet wheelchair accessibility standards or be easily adaptable to meet wheelchair standards</p>	<p>Policy 3.8 Housing choice</p>	<p>Not Applicable as there are no residential areas proposed as part of the NLE.</p>
	<p><b>P.</b> Developments should be fully e-enabled</p>	<p>No comparable requirements.</p>	<p>LU is currently rolling out WiFi across the network. This network will be considered to be enabled for customers at Battersea and Nine Elms.</p>
Secure Design	<p><b>E.</b> Developments should incorporate principles of “Secured by Design”</p>	<p>Policy 7.3 Designing out crime</p> <p>Note: Measures to design out crime should be integral to development proposals and be considered early in the design process, taking into account the principles contained in Government guidance on ‘Safer Places’ and other guidance such as ‘Secured by Design’ published by the Police.</p>	<p>The station designs are intended to help people feel safe and to design out crime. The NLE will incorporate effective design measures that promote low risk, safe and secure access to and use of the building. The ‘Secured by Design’ principles will be observed.</p> <p>Sprinkler and alarm systems would be installed at both stations. Also at both stations external lighting would be installed providing coverage of the entrance(s) and bike storage and hire areas. The design allows for the stations to be easily accessible by all. The entrances will be overlooked by active frontages, on well-used and well-lit routes and inappropriate screening will not be caused by any landscaping and other vegetation.</p>

SPG Objective 6: Conserve and Enhance the Natural Environment and Biodiversity			
SPG Guidance & Section	Essential (E) and Preferred (P) Standards as per SPG 2006 referring to London Plan 2004	Relevant London Plan 2011 Standards	Performance of NLE
Open Space	E. No net loss of publicly accessible open space	Policy 7.18 Protecting local open space and addressing local deficiency: The loss of local protected open spaces must be resisted unless equivalent or better quality provision is made within the local catchment area. Replacement of one type of open space with another is unacceptable unless an up to date needs assessment shows that this would be appropriate.	The proposed ventilation shafts (not those at the stations) will be located in the areas of open space and will result in a temporary loss of this space. However, an equivalent area will be provided to ensure that there is no net loss of publicly accessible open space. It is intended that the open spaces affected by the NLE are enhanced as a result of the NLE.
	E. Create appropriate new open, green, publicly accessible spaces where these can redress identified areas of deficiency of public open space	Policy 7.18 Protecting local open spaces and addressing local deficiency: The Mayor supports the creation of new open space in London to ensure satisfactory levels of local provision to address areas of deficiency.	The scope of works of the NLE does not allow the creation of new open spaces, however, it will allow the development of the VNEB OA, which includes new extensive linear park providing green and publicly accessible spaces for the area.  It is intended that the open spaces affected by the NLE are enhanced as a result of the NLE.
	P. Net gain of publicly accessible open space	Policy 7.18 Protecting local open space and addressing local deficiency	As above.
Biodiversity	E. No net loss of biodiversity and access to nature on the development site	Policy 7.19 Biodiversity and access to nature: C; Development proposals should: <ul style="list-style-type: none"> <li>a. Wherever possible, make a positive contribution to the protection, enhancement, creation and management of biodiversity</li> <li>b. Prioritise assisting in achieving targets in BAPs set out in the London Plan and/or improve access to nature in areas deficient in accessible wildlife sites</li> <li>c. Not adversely affect the integrity of European sites, and be resisted where they have significant adverse impact on European or nationally designated sites or on the population or conservation status of a protected species, or a priority species or habitat</li> </ul>	The NLE stations will utilise land that has limited value to wildlife and will aim to enhance the site ecology. Apart from the trees and grassed areas in the vicinity of the vent shafts, there are few biodiversity resources affected by the proposals.  It is the design team's aim that positive change in the site's existing ecological value will occur as a result of the NLE project. During the design development process, opportunities to achieve an enhancement in the ecological value of the site will be investigated in more detail and the ecological enhancement that may be achieved will be quantified.  A number of trees will have to be removed as a result of the NLE however, careful construction site planning has allowed the retention of the most valuable trees.  The NLE will not adversely affect the integrity of European sites and will have no adverse impact on the population or conservation status of a protected species or priority species or habitat.
	P. Net gain of biodiversity on the development site	Policy 5.10 Urban greening: Development proposals should integrate green infrastructure from the beginning of the design process to contribute including the public realm. Elements that can contribute to this include tree planting, green roofs and walls, and soft landscaping.  Policy 7.19 Biodiversity and access to nature	The scope of works of the NLE does not allow the creation of new open spaces, however, it will allow the development of the VNEB OA, which includes new extensive linear park providing green and publicly accessible spaces for the area.  In addition, opportunities to include green walls on the shafts and soft landscaping wherever possible will be further investigated.
	E. Reduction in areas of deficiency in access to nature	Policy 7.19 Biodiversity and access to nature	The NLE will allow the development of the VNEB OA, which includes new extensive linear park providing green and publicly accessible spaces for the area.

		Policy 7.21 Trees and Woodlands: Existing trees of value should be retained and any loss as the result of development should be replaced following the principle of 'right place, right tree'. Wherever appropriate, the planting of additional trees should be included in new developments, particularly large-canopied species.	Existing trees of value will be retained wherever possible and any loss as the result of the NLE will be replaced following the advice of an experienced arboriculturist.
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SPG Objective 7: Promote Sustainable Waste Behaviour			
SPG Guidance & Section	Essential (E) and Preferred (P) Standards as per SPG 2006 referring to London Plan 2004	Relevant London Plan 2011 Standards	Performance of NLE
Waste	E. Minimise, re-use and recycle demolition waste on site where practicable	Policy 5.18 Construction, excavation and demolition waste: New construction, excavation and demolition (CE&D) waste management facilities should be encouraged at existing waste sites, including safeguarded wharves, and supported by: <ul style="list-style-type: none"> <li>a. Using mineral extraction sites for CE&amp;D recycling</li> <li>b. Ensuring that major development sites are required to recycle CE&amp;D waste onsite, wherever practicable, supported through planning conditions.</li> </ul>	Commercial buildings at Nine Elms, Kennington Park Lodge and the outbuilding at the Beefeater Distillery at Kennington Green will be demolished. The contractor will be required to implement the Waste and Resources Action Programme (WRAP) <i>Demolition Best Practice Code</i> , including the ICE <i>Demolition Protocol</i> . For further detail refer to Waste Management Strategy.  Contractors will be required to identify local sites that are either licensed or exempt from licensing, to accept, process and recycle demolition materials that cannot be reused on site.  TfL will maximise the opportunities to use barge wherever practicable. It is estimated that 68% - 70% (by volume) of material will be removed by barge. However, at the worksites associated with the temporary shafts and the ventilation shafts at Kennington Green and Kennington Park, removal of material by road is the only viable option.  Excavating the tunnels from Battersea towards Nine Elms would permit the extraction of spoil at Battersea with its removal via the wharf.
	P. Use prefabricated and standardised modulation components to minimise waste. If this is not feasible use low waste fabrication techniques	Policy 5.3 Sustainable design and construction SPG 2006 standards are still applicable (i.e. no change to the second column)	Throughout the design and construction phases of the NLE emphasis will be on pre-assembly and pre-fabrication of elements, wherever practicable, to minimise on-site waste and improve quality.
	E. Specify use of re-used or recycled construction materials	Policy 5.3 Sustainable design and construction Note: The Mayor also encourages the use of the Demolition Protocol developed by London Remade to support recycling and reuse of construction materials. SPG 2006 standards are still applicable (i.e. no change to the second column)	Due to the nature of the development (i.e. underground line), there will be only limited opportunities to specify re-used materials of significant volumes. However, the need to use primary aggregates will be minimised by the selection of secondary materials, subject to not compromising performance.  TfL will avoid where possible the use of composite materials that are particularly hard to recycle.  The majority of material that is suitable for reuse offsite will be exported by barge to a trans-shipment facility at BPS where the material will be loaded onto sea going vessels to allow it to be transported to a pre-identified receptor site (such as the nature reserve at Wallasea Island).

Recycling	<b>E.</b> Provide facilities to recycle or compost at least 25% of household waste by means of separated dedicated storage space. By 2010 this should rise to 35%.	Policy 5.16 Waste self-sufficiency: c) Exceeding recycling/composting levels in municipal solid waste of 45% by 2015, 50% by 2020 and aspiring to achieve 60% by 2031	Once NLE is operational, recycling opportunities will be maximised through the provision of dedicated waste management facilities for the collection of the building's operational-related recyclable waste streams, so that such waste is diverted from landfill. Recycling bins easy to access will be provided within the station and the passengers and staff will be encouraged to use them.
	<b>P.</b> Provide facilities to recycle or compost at least 35% of household waste. By 2015 this should rise to 60%.	Policy 5.16 Waste self-sufficiency: c)	As above.
	<b>P.</b> Provide facilities to recycle 70% of commercial and industrial waste by 2020	Policy 5.16 Waste self-sufficiency: d) exceeding recycling/composting levels in commercial and industrial waste of 70% by 2020	As above.
	<b>P.</b> Incorporation of or access to new waste recovery facilities (anaerobic digestion, pyrolysis / gasification) especially to provide a renewable source of energy (e.g. methane or hydrogen)	Policy 5.16 Waste self-sufficiency Note: The Mayor wants to make the most of London's waste to harness its energy and employment benefits. For the purposes of meeting self-sufficiency, in addition to prevention, reduction and re-use, waste is deemed to be managed in London if: <ul style="list-style-type: none"> <li>• It is used in London for energy recovery(e.g. through anaerobic digestion, pyrolysis/gasification or through existing incinerators)</li> <li>• It is compost or recycle sorted or bulked in London material recycling facilities for reprocessing either in London or elsewhere</li> <li>• It is a 'biomass fuel' as defined in the Renewable Obligation Order.</li> </ul>	It is currently expected that the waste streams arising from the operation of the NLE will be minimal. In addition, there is currently no waste to energy plant within the vicinity of the sites and therefore the option of sending NLE's operational waste to such facility has not been deemed viable.  Recycling bins will be however provided within the station and the passengers and staff will be encouraged to use them.
	<b>E.</b> Recycling facilities should be as easy to access as waste facilities	Policy 5.17 Waste capacity: Suitable waste and recycling storage facilities are required in all new developments.	Suitable waste and recycling storage facilities, which will be easy to access will be provided through the NLE.

SPG Objective 8: Sustainable Construction			
SPG Guidance & Section	Essential (E) and Preferred (P) Standards as per SPG 2006 referring to London Plan 2004	Relevant London Plan 2011 Standards	Performance of NLE
Sustainable Construction	<b>E.</b> Reduce waste during construction and demolition phases and sort waste stream on site where practical	Policy 5.3 Sustainable design and construction Note: The Mayor also encourages the use of the Demolition Protocol developed by London Remade to support recycling and reuse of construction materials. SPG 2006 standards are still applicable (i.e. no change	In line with the SWMP regulations, a SWMP will be developed for the NLE to identify the types and quantities of waste produced during every stage of construction. The SWMP will be produced before on-site works begin and will list the opportunities to minimise waste, such as: <ul style="list-style-type: none"> <li>• Reuse of materials on-site wherever feasible;</li> </ul>

		to the second column).	<ul style="list-style-type: none"> <li>• Segregation of waste at source where practical; and</li> <li>• Reuse and recycling of materials off-site where reuse on-site is not practical (e.g. through use of an off-site waste segregation facility and re-sale for direct reuse or reprocessing).</li> </ul> <p>During the demolition phase, the contractor will be required to implement the WRAP Demolition Best Practice Code, including the ICE Demolition Protocol.</p> <p>Waste from the demolition and enabling works will be subject to onsite screening and sorting in accordance with the contractor's SWMP. In particular, opportunities for the reuse of demolition material onsite (for example reusing clean demolition material for the construction of temporary haul roads) will be investigated.</p>
<b>E.</b> Reduce the risk of statutory nuisance to neighbouring properties as much as possible through site management.	Policy 5.3 Sustainable design and construction SPG 2006 standards are still applicable (i.e. no change to the second column)		<p>A CoCP has been developed for the NLE project, which sets out standards and procedures for managing the environmental impact of constructing the NLE.</p> <p>The CoCP requires that a number of Environmental Management Plans (EMP) are developed, which will include roles and responsibilities, detail on control measures and activities to be undertaken to minimise environmental impact, and monitoring and record-keeping requirements. A commitment will be made to periodically review the EMP and undertake regular environmental audits of its implementation during the construction phase.</p>
<b>E.</b> All developers should consider and comply with the Mayor and ALG's London Best Practice Guidance (BPG) on the control of dust and emissions during construction and demolition.	Policy 7.14 Improving air quality: b) Policy 5.3 Sustainable design and construction SPG 2006 standards are still applicable (i.e. no change to the second column).		<p>Best Practice Guidance in terms of air quality and dust control during demolition and construction in line with the Mayor's Air Quality Strategy will be adopted by TfL and required to be followed by all contractors by tender.</p> <p>A series of mitigation measures would be implemented, as appropriate, as part of the Air Quality and Dust Management Plan that will be produced. The Air Quality and Dust Management Plan will include details of proposed dust monitoring during construction works, along with measures for controlling other emissions to the environment from the works.</p>
<b>P.</b> All contractors should be required by tender requirements to sign up to the Mayor and ALG's London BPG on the control of dust and emissions during construction and demolition.	Policy 5.3 Sustainable design and construction SPG 2006 standards are still applicable (i.e. no change to the second column).		As above.
<b>E.</b> Comply with protected species legislation.	Policy 7.19 Biodiversity and access to nature: C; c)		All relevant UK and EU legislation relating to protection and enhancement of ecology will be complied with during the construction works.
<b>E.</b> All developers should sign up to the relevant Considerate Constructors Scheme or in the City of London to the Considerate Contractor scheme.	Policy 5.3 Sustainable design and construction SPG 2006 standards are still applicable (i.e. no change to the second column).		TfL will require that all contractors sign up to the Considerate Contractor Scheme.
<b>P.</b> All contractors should be required to sign up to the Considerate Constructors scheme or in the City of London to the Considerate Contractor scheme	Policy 5.3 Sustainable design and construction SPG 2006 standards are still applicable (i.e. no change to the second column)		As above.

Additional Objective 9: Sustainable Transport			
SPG Guidance & Section	Essential (E) and Preferred (P) Standards as per SPG 2006 referring to London Plan 2004	Relevant London Plan 2011 Standards	Performance of NLE
N/A	N/A	<p>Policy 6.1 Strategic approach: The Mayor will encourage the closer integration of transport and development by:</p> <ul style="list-style-type: none"> <li>a. Encouraging patterns and nodes of development that reduce the need to travel, especially by car</li> <li>b. Seeking to improve the capacity and accessibility of public transport, walking and cycling, particularly in areas of greatest demand</li> <li>c. Supporting development that generates high levels of trips at locations with high public transport accessibility</li> <li>d. Improving interchange between different forms of transport, particularly around major rail and Underground stations</li> <li>e. Seeking to increase the use of the Blue Ribbon Network,</li> <li>f. Facilitating the efficient distribution of freight</li> <li>g. Supporting measures that encourage shifts to more sustainable modes and appropriate demand management</li> <li>h. Promoting greater use of low carbon technology so that CO<sub>2</sub> and other contributors to global warming are reduced</li> <li>i. Promoting walking by ensuring an improved urban realm</li> <li>j. Seeking to ensure that all parts of the public transport network can be used safely, easily and with dignity by all Londoners, including by securing step free access where this is appropriate and practicable.</li> </ul>	<p>The NLE would represent a sustainable transport option for commuters to the area and:</p> <ul style="list-style-type: none"> <li>• Reduce demand and provide relief to Vauxhall and Kennington underground station;</li> <li>• Reduce crowding of the Victoria line;</li> <li>• Reduce journey times; and</li> <li>• Increase PTALs in the VNEB OA.</li> </ul> <p>Therefore, the NLE will improve the capacity and accessibility of public transport.</p> <p>It is not proposed to provide any car parking at the stations. A parking bay would be provided at the stations for disabled users.</p> <p>Interchange between different forms of transport could be improved by provision of a coordinated bus and LU information system at the Underground stations that would permit customers to choose which mode to use in the event of service delays.</p> <p>Cycling will be promoted by provision of approximately 90 secure cycle parking spaces around the Nine Elms station. According to the BPS Transport Assessment 100 secure cycle parking will be provided in the area.</p> <p>In addition, there will be an extension of the Barclay's Cycle Hire facilities in the VNEB OA with a minimum of 10 docking stations planned in area, including two in the BPS development and a minimum of 30 spaces at the Sainsbury's development (Nine Elms OSD). There are not any plans for docking stations at the stations themselves.</p> <p>The NLE will adopt a number of measures that would reduce the operational CO<sub>2</sub> emissions of the scheme and may also support low carbon technologies in the OA.</p> <p>Both stations will be integrated with the public realm and be accessible and clearly visible to pedestrians as well as cyclists at surface level and from the street. The stations will link open space with key pedestrian routes through the use of improved crossings, lighting, and materials/surfacing.</p> <p>The stations designs are intended to help people feel safe and to design out crime. The NLE will incorporate effective design measures that promote low risk, safe and secure access to and use of the building. The 'Secured by Design' principles will be observed.</p>
	N/A	<p>Policy 6.4 Enhancing London's transport connectivity: B; The Mayor will support increase public transport capacity by: b) completing upgrades to, and extending, the London Underground network</p>	<p>The NLE will comprise the construction of an underground railway to form an extension of the Northern line (Charing Cross branch) from Kennington to Battersea. It will diverge from the existing railway south of Kennington station from a section of track used by terminating trains (known as the Kennington loop).</p>
	N/A	<p>Policy 6.9 Cycling: Developments should:</p> <ul style="list-style-type: none"> <li>a. Provide secure, integrated and accessible cycle parking facilities in line with the minimum standards</li> </ul>	<p>Cycling will be promoted by provision of approximately 90 secure cycle parking spaces around the Nine Elms station. According to the BPS Transport Assessment 100 secure cycle parking will be provided in the area.</p>

		<p>set out in the London Plan</p> <p>b. Provide on-site changing facilities and showers for cyclists</p> <p>c. Facilitate the Cycle Super Highways where relevant</p> <p>d. Facilitate the central London cycle hire scheme.</p>	<p>In addition, there will be an extension of the Barclay's Cycle Hire facilities in the VNEB OA with a minimum of 10 docking stations planned in area, including two in the BPS development and a minimum of 30 spaces at the Sainsbury's development (Nine Elms OSD). There are not any plans for docking stations at the stations themselves.</p>
	N/A	<p>Policy 6.10 Walking Planning decisions: B; Development proposals should ensure high quality pedestrian environments and emphasise the quality of the pedestrian and street space.</p>	<p>The NLE stations will be integrated with the public realm and be accessible and clearly visible to pedestrians as well as cyclists at surface level and from the street. The stations will link open space with key pedestrian routes through the use of improved crossings, lighting, and materials/surfacing.</p>
N/A	N/A	<p>Policy 6.13 Parking developments must:</p> <ul style="list-style-type: none"> <li>• Ensure that 1 in 5 spaces (both active and passive) provide an electrical charging point to encourage the uptake of electric vehicles</li> <li>• Provide parking for disabled people in line with Table 6.2 of the London Plan 2011</li> <li>• Meet the minimum cycle parking standards set out in Table 6.3 of the London Plan 2011</li> <li>• Provide for the needs of businesses for delivery and servicing.</li> </ul>	<p>Above: Policy 6.9 Cycling.</p> <p>It is not proposed to provide any car parking at the stations. A parking bay would be provided at the stations for disabled users.</p> <p>As there will be no car parking spaces provided, it is considered that no electrical charging points for electric vehicles need to be specified.</p>

Objective 10: Support Economic Development			
SPG Guidance & Section	Essential (E) and Preferred (P) Standards as per SPG 2006 referring to London Plan 2004	Relevant London Plan 2011 Standards	Performance of NLE
N/A	N/A	<p>Policy 4.1 Developing London's economy:</p> <p>a. Promote and enable the continued development of a strong, sustainable and increasingly diverse economy</p> <p>b. Drive London's transition to a low carbon economy and to secure the range of benefits this will bring</p> <p>c. Support and promote the distinctive and crucial contribution to London's economic success made by central London</p> <p>d. Sustain the continuing regeneration of inner London and redress its persistent concentrations of deprivation</p>	<p>The NLE would enable the development of the VNEB OA by providing necessary transport infrastructure to support the VNEB OA's ambition for around 16,000 new homes and a range of 20,000 - 25,000 jobs the VNEB OA is the most centrally located regeneration opportunity in London.</p> <p>In addition, the NLE would create a number of construction jobs and a number of jobs for operational staff. Of the operational staff, TfL would advertise positions locally to assist with local job creation as feasible.</p> <p>The NLE would represent a sustainable transport option for commuters to the area. The investment in stations at Battersea and Nine Elms would radically alter the image of the area in terms of its strategic attractiveness for inward investment within the VNEB.</p>

## Appendix C – TfL Sustainability Assessment Toolkit

### Appendix C 1. Sustainability Toolkit: Economic Progress

Indicator	Guiding Question	NLE Response
Tackling congestion and smoothing traffic flow	Will freight be transferred through rail or other sustainable mode?	Yes, a jetty will be utilised for the transport materials generated by the project by river.
	Will reliability be affected for all users (station and approach users)?	Yes, the new underground line will achieve high levels of reliability.
	Will public transport capacity be improved?	Not directly, however by introduction of NLE public transport capacity can be improved for the area in future, in addition to transport coverage.
	Will the scheme affect journey times?	Yes, 40% reduction in travel time from Battersea to central London.
	Will it encourage people to travel less using private transport?	Yes, the NLE will offer an extra travel option for people travelling to and from the area.
Improving productivity and competitiveness	Will the scheme affect growth in key sectors?	Yes, the NLE project is considered to be a key project allowing the redevelopment of the VNEB OA.
	Will the project impact local/ regional businesses?	Yes, by the indirect benefit of opening the VNEB OA to inward investment. (as above)
	Will the scheme affect operating costs?	It is not expected that there would be a direct effect on operating costs of businesses.
	Will the project deliver value for money through responsible procurement practices?	Responsible procurement practices will be promoted through the procurement stages of the project. TfL has strong Green Procurement Policy framework, which will be implemented to the NLE.
	Will the scheme have long term affect on costs through knowledge sharing and bringing firms closer	It is currently not anticipated that the scheme will affect cost through knowledge sharing and bringing firms closer.

	together?	
	Will it alleviate poverty in the area?	The improvement in employment levels would also help alleviate poverty in the area.
	Will employers' access to labour markets be affected?	Yes, the connectivity between employment areas will be significantly improved by development of the NLE.
	Will it affect employment levels in the local area?	The NLE will be the catalyst for delivering a significant number of additional jobs in the VNEB OA compared to what would happen if the NLE was not built.  In addition, the NLE would create directly a number of construction jobs and a number of jobs for operational staff.
	Will it impact the essential skills levels in the workforce?	Yes, TfL will through SLNT's "Routes into Work" project, support people in education or training to boost their employability.
	Will the London Living Wage be paid to all employees in the supply chain?	It is currently assumed that the London Living Wage will be paid to all employees in the supply chain.
	Will it impact the accessibility to employment and training opportunities, particularly for disadvantaged sections of the community?	Yes, the connectivity between employment areas will be significantly improved as a result of the NLE.

### Appendix C 2. Sustainability Toolkit: Climate Change

Indicator	Guiding Question	NLE Response
Tackling CO <sub>2</sub> emissions	Will the scheme impact CO <sub>2</sub> emission levels from private transport (i.e. cars)?	Although the NLE will offer an extra travel option for people commuting to and from the area, modal switch from car to Underground is negligible.
	Will the scheme use or change the level of use of cleaner technologies, renewable energy and regenerative energy	Yes, the scheme will use cleaner technologies, renewable energy and regenerative energy



	renewable energy, regenerative energy or energy conservation techniques?	wherever feasible. An Outline Energy Strategy was developed for the NLE to maximise the opportunities of utilising low and zero carbon energy sources.
	Will the scheme use or change the level of use of low carbon materials and resources?	As for a similar scale infrastructure projects, a large amount of concrete with high embodied carbon will be used due to the requirements on its resilience.  To mitigate this impact, a Life cycle assessment was carried out for the project to ensure that low carbon materials are selected and prioritised through the design process wherever feasible.
	Will it impact public transport emissions?	It is not expected that there would be a change in surface transport emissions.
Adapting to a climate change	Does the scheme consider retrofitting to climate change? For example alter insulation, building fabric to increase energy efficiency.	N/A as this scheme does not include any retrofit works.
	Is this project at a risk of flooding?	No, an FRA has been undertaken to identify appropriate measures to abate the risk. The NLE will benefit from existing flood defences.  In addition, a one-metre high impermeable concrete wall will be installed around construction excavations.
	Will this project be able to adapt to a changing climate?	Yes, a Climate Change Adaptation Strategy has been developed for the project to ensure that the NLE is adaptable to a changing climate.
Improving resource efficiency	Will the project impact material efficiency in all aspects of the design (i.e., not overdesign)?	Locally sourced materials will be promoted in accordance with TfL requirements.  Additionally, Life Cycle Impact assessment of the project is being undertaken to ensure materials with low embodied impact are utilised where feasible.
	Will it promote efficient water use?	Yes, efficient water consuming fittings will be incorporated alongside appropriate water metering

		equipment.
	Will it impact the proportion of waste that is reused, recycled or converted to energy?	A Site Waste Management Plan (SWMP) will be developed, which will include procedures and commitments to minimize non-hazardous construction waste with an aspiration of 100% of non-hazardous waste to be diverted from landfill.  In line with the London Plan 2011 targets, the development will aim to minimise operational waste by provision of recycling bins on-site.
	Will the scheme use ethically sourced materials?	Yes, TfL policy supports ethical sourcing and sustainable and ethical procurement strategies will be applied to the NLE.
	Will the project influence the construction supply chain with regard to resource efficiency and quantity of all forms of waste?	Yes, TfL will prioritise suppliers and products with certification on responsible sourcing of materials. The NLE's aspiration is to divert 100% of non-hazardous waste from landfill, will require the construction supply chain to improve resource efficiency and quantity of waste.
	Will it impact the levels of energy efficiency?	Yes, the project will incorporate a number of measures significantly improving the levels of energy efficiency.

**Appendix C 3. Sustainability Toolkit: Safety and Security**

Indicator	Guiding Question	NLE Response
Improving security and resilience	Will it impact the security of the transport network?	The security of the new stations will include sufficient lighting levels and will be designed for natural surveillance. In addition, the Nine Elms station's ground level ticket hall will include a station operation room (SOR) which will have clear visibility of whole ticket hall. Battersea station's ground level just includes lift and escalators down to sub-surface ticket hall which has an SOR.  Both entrances/exits at Nine Elms are clearly marked and allow clear visibility from the street into the station and out. Single entrance/exit at Battersea is also clearly marked and with clear

		visibility from the street into the station and out.
	Will the scheme reduce the perception of crime on the public transport network?	The security measures of the new stations are described above. It is anticipated that these will help to reduce the perception of crime.
	Will the resilience and reliability of the transport network be affected?	The resilience of the Victoria line and Vauxhall and Kennington LU stations would be enhanced as customers use the NLE.  In addition, as the NLE will be new network, it will be designed to high resiliency standards.
Improving transport safety	Will it affect the number of people killed or seriously injured on London's roads?	The high safety standards will be embedded within the design of the stations and platforms to prevent serious injuries.  In addition a passive provision for Platform Screen Doors is being incorporated in the design, which will in future allow for safer environment.
	Will it impact the safety of users and all people involved in the project?	The NLE stations and platforms will be designed to high safety standards, which will have positive impact on the safety of users and all people involved in the project. In addition, safety improvements will be provided for crossing Battersea Park Road and Wandsworth Road at the stations.
Tackling crime and disorder	Will it affect the level of crime on the public transport system?	It is anticipated that security measures specified for the stations and permanent shafts will positively affect the level of crime on the public transport system.
	Will it affect the perception of crime?	The security measures of the new stations are described previously. It is anticipated that these will help to reduce the perception of crime.

**Appendix C 4. Sustainability Toolkit: Quality of Life**

Indicator	Guiding Question	NLE Response
Improving built structures and streetscapes	Will it promote high quality design and sustainable construction methods?	Yes, high quality design and sustainable construction methods will be employed as far as feasible.
	Will it affect noise levels?	A number of mitigation measures have been specified to mitigate noise impact of the NLE's construction and operation. As a result of their implementation, no significant change in noise levels is anticipated.
	Will it affect the condition of the built environment (including litter and graffiti)?	The appearance of the built environment would be enhanced. Operational waste strategy will provide sufficient amount of bins.
	Will it affect the physical quality of the built environment?	Yes, the NLE's stations will provide high quality build environment.
Improving greenscapes	Will it affect the number and/or quality of open/public spaces?	Loss of public open spaces will occur due to ventilation shafts temporarily. The open spaces will be replaced and enhanced as a result of the NLE project.
	Will it enhance the quality of the public realm?	The local public realm will be enhanced as a result of the NLE. In addition, the NLE will support the redevelopment of the VNEB OA, which will provide an extensive linear park.
	Will it conserve or enhance natural or semi-natural habitats?	The NLE aims to conserve and enhance local natural habitats in line with LU BAP.
Enhancing physical wellbeing	Will this project affect road or public transport customer satisfaction?	Yes, as a result of reduced journey time. In addition, the new stations' design will be of high quality to improve customer satisfaction. The track was designed so that the horizontal curvature is minimised to allow for smooth journeys.

Will the project affect healthy lifestyle choices (including promoting walking and cycling)?	Yes, the project will include links to cycling and walking paths to encourage healthy lifestyle choices. In addition, secure cycle parking spaces will be provided.
Will this project impact London's air quality including levels of air pollutants such as nitrogen oxides and particulates?	An air quality assessment was prepared for the site to identify potential impacts on local air quality and specify appropriate mitigation measures.  As a result the air quality in the area will not be adversely affected by the NLE.
Will the project impact stress levels of users?	It is anticipated that reduced journey time and ease of congestion on the Victoria line resulting from the NLE will lower stress levels.
Will it impact the health of the local residence?	It is anticipated that the NLE will have indirect positive effects resulting from regeneration and employment opportunities, enhanced open spaces and promotion of walking and cycling.

Supporting regeneration and spatial development	Will it impact the provision of appropriate services and facilities for new residents?	The NLE will enable significant regeneration of the area and provide appropriate services for the local residents.
	Will it affect the attraction of the area to new people and businesses?-	The area will attract new businesses providing new 20-25,000 jobs.
Enhancing diversity	Does this project meet the diverse needs of all users now and in the future?	The NLE is designed to meet the needs of all users including disabled passengers, passengers travelling with children etc.
	Does this project meet the diverse needs of all people involved in the project?	Equalities assessment is being developed for the NLE to ensure that the project will meet the diverse needs of all people involved.
	Does this project promote personal well-being, social cohesion and inclusion?	Design of the stations is as 'community' stations to help social cohesion. Measures to promote personal well-being of staff and passengers will be incorporated in the design where feasible.
	Does this project create equal opportunity for all users / passengers?	An Equalities Assessment is being developed for the NLE to ensure that the project will meet the diverse needs of all people involved.
	Will the project promote stakeholder relationships at all stages?	Stakeholder engagement was undertaken throughout the project and the results are included on the TfL website.

**Appendix C 5. TfL Sustainability Toolkit: Transport for All**

Indicator	Guiding Question	NLE Response
Improving access to the transport system	Does it impact physical or attitudinal barriers to using the transport network?	With the design being accessible to all members of the community, the NLE ought to reduce barriers to using the transport network.
	Will it affect access to high quality public services?	Yes, travel time from Battersea to central London will be significantly reduced.
	Will it cause modal shift to or from more sustainable forms of travel?	Yes, the NLE will provide an extended public transport mode for the area.
	Will it impact public transport connectivity?	One of the main priorities of the NLE is to improve the connectivity of the local area to central London.
	Will the affordability of travel be affected?	It is not anticipated that the NLE project would have impact on the affordability of travel.



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