TRANSPORT FOR LONDON

RIVER CROSSINGS: SILVERTOWN TUNNEL

SUPPORTING TECHNICAL DOCUMENTATION

FURTHER DEVELOPMENT OF TUNNEL ENGINEERING

Mott MacDonald

July 2013

This report builds upon previous studies to develop the bored tunnel concept and addresses design development of key areas.

This report is part of a wider suite of documents which outline our approach to traffic, environmental, optioneering and engineering disciplines, amongst others. We would like to know if you have any comments on our approach to this work. To give us your views, please respond to our consultation at www.tfl.gov.uk/silvertown-tunnel

Please note that consultation on the Silvertown Tunnel is running from October – December 2014.

Silvertown Tunnel

Further development of Tunnel Engineering

298348/MNC/TUN/002

July 2013

Transport for London

Mott MacDonald

Silvertown Tunnel

Further development of Tunnel Engineering

298348/MNC/TUN/002

July 2013

Transport for London

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Mott MacDonald

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
1.0	15/04/13				Draft Issue
2.0	23/04/13	D Naylor S Johnson M Dilling G Taylor F Ellis	J Baber	J Baber	Formal Issue to TfL
3.0	26/04/13	D Naylor S Johnson M Dilling G Taylor F Ellis	J Baber	J Baber	Document updated in line with TfL comment log and addition of drawing volume (Appendix A)
4.0	24/06/13	D Naylor	J Baber	J Baber	Revision to close out comment log
4.1	17/07/13	D Naylor	J Baber	J Baber	Minor revision to wording in commercial section

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A.1. Mott MacDonald Tunnel Engineering Drawings

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Silvertown River Crossing Bored Tunnel Option Greenwich Approach Principal Tunnel Services Building Compound Structures Plan	MMD-298348-H-DR-00-ZZ-1001
Silvertown River Crossing Bored Tunnel Option Silvertown Approach Secondary Tunnel Services Building Compound Structures Plan	MMD-298348-H-DR-00-ZZ-1002
Silvertown River Crossing Bored Tunnel Option Principal Tunnel Services Building - Building Plan	MMD-298348-H-DR-00-ZZ-1003
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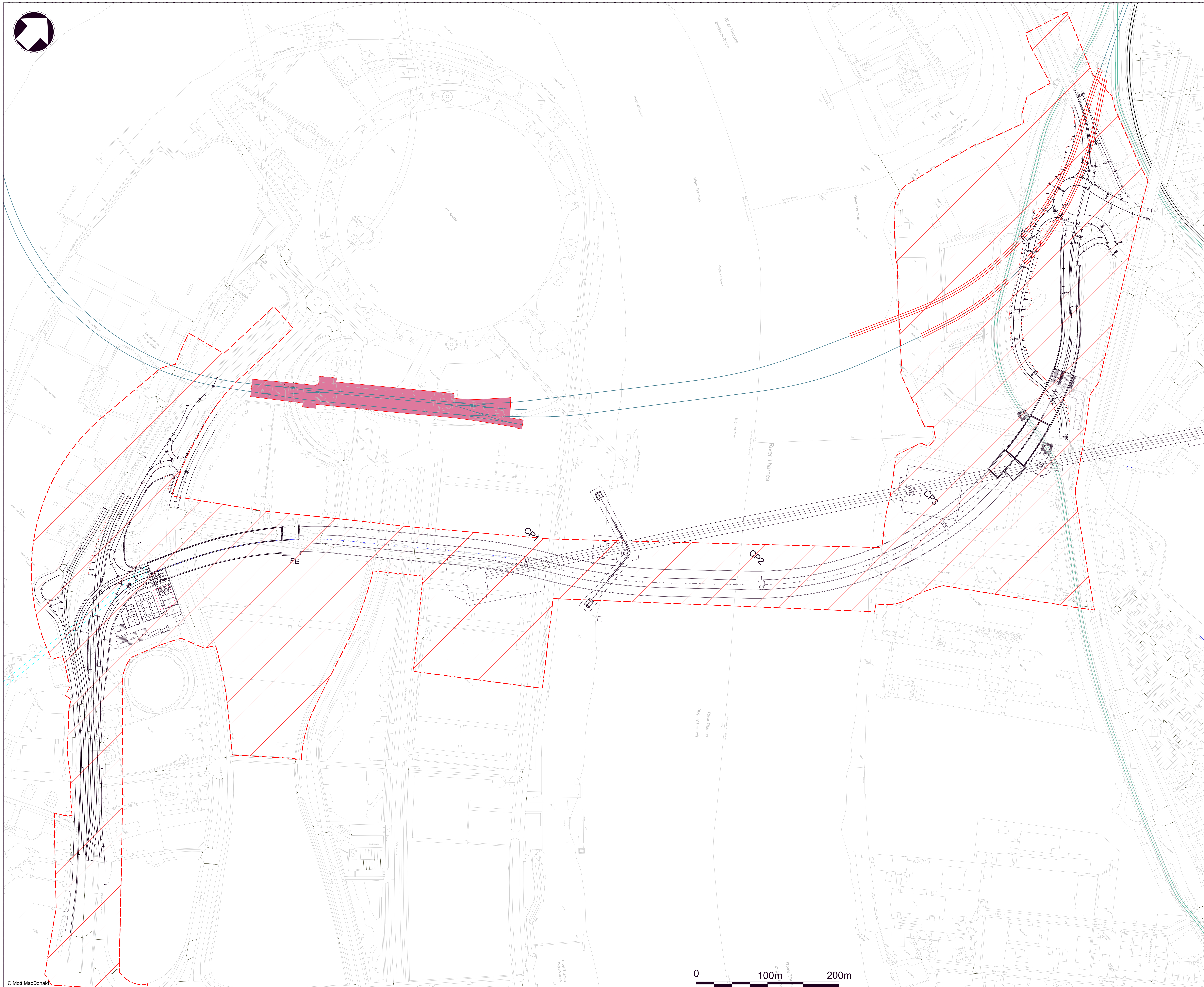
Silvertown River Crossing Bored Tunnel Option Silvertown Approach Compound Visualisation	MMD-298348-H-DR-00-ZZ-1009
Silvertown River Crossing Bored Tunnel Option Silvertown Approach Portal Visualisation	MMD-298348-H-DR-00-ZZ-1010



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Formerly Drawing No:- P:\Croydon\MMH\Tunnels\298348 Silvertown Tunnel\Drawings\Perament Works\Bored\MMD-298348-TUN-101.dwg Feb 21, 2012 - 8:50AM kni56149

Notes

Key to symbols

- Safeguarded Area
- Safeguarding Boundary
- LUL North Greenwich Station Box
- Tunnel centreline

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd

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Client

Transport for London

Transport for London
50 Victoria Street
London
SW1H 0TL

Title

Silvertown Tunnel Crossing
General
Safeguard Areas

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		

Scale at A1	Status	Rev
1:2500 @ A1		

Drawing Number
MMD-298348-C-DR-00-ZZ-1001

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North Station

Approximate route of Royal Victoria Dock drainage

Proposed diversion of Royal Victoria Dock drainage

DLR Viaduct

DLR Viaduct pier foundations

North intermediate tower

Potential for buildings to be listed

Western Entrance closed

LUL Jubilee Line

Old western entrance (backfilled)

CP3

North Main Tower

DLR Viaduct

CABLE CAR

CP2

Proposed tunnels

LUL Jubilee line North Greenwich station box

South Main Tower

Ship Impact protection

CP1

South Station

0 100m 200m

Horizontal Scale 1:2750 @ A1

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Formerly Drawing No:- M:\267759 New Thames River Crossing\H Reports and Drawings\H.03 Outgoing Drawings\working drawings\OPTIONS 2 & 3\DWG\Option 2\267759_TUN_1001.dwg ---- kni56149

Notes

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd

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London
SW1H 0TL

Title

Silvertown River Crossing
General
Constraints

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		

Scale at A1	Status	Rev
1:2750		

Drawing Number

MMD-298348-C-DR-00-ZZ-1002

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Notes

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Reference drawings

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London
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Title

Silvertown Tunnel Crossing
General
Borehole Data

Designed			Eng check	
Drawn			Coordination	
Dwg check			Approved	
Scale at A1 1:2,750 @ A1		Status	Rev	

Drawing Number
MMD-298348-C-DR-00-ZZ-1003

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North Station

OPEN CUT

Approximate route of Royal Victoria Dock drainage

Proposed diversion of Royal Victoria Dock drainage

DLR Viaduct

CUT AND COVER

North intermediate tower

DLR Viaduct pier foundations

Western Entrance closed

Silvertown launch / reception chamber

Potential for buildings to be listed

LUL Jubilee Line

Old western entrance (backfilled)

CP3

North Main Tower

DLR Viaduct

CABLE CAR

NORTHBOUND

CP2

LUL Jubilee line North Greenwich station box

SOUTHBOUND

BORED TUNNEL

South Main Tower

CP1

Ship Impact protection

South Station

EE

Greenwich launch / reception chamber

CUT AND COVER

0 100m 200m

Horizontal Scale 1:2750 @ A1

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Formerly Drawing No:- M:\267759 New Thames River Crossing\H Reports and Drawings\H.03 Outgoing Drawings\working drawings\OPTIONS 2 & 3\DWG\Option 2\267759_TUN_1001.dwg ---- kn56149

Notes

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd

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Transport for London

Transport for London
50 Victoria Street
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SW1H 0TL

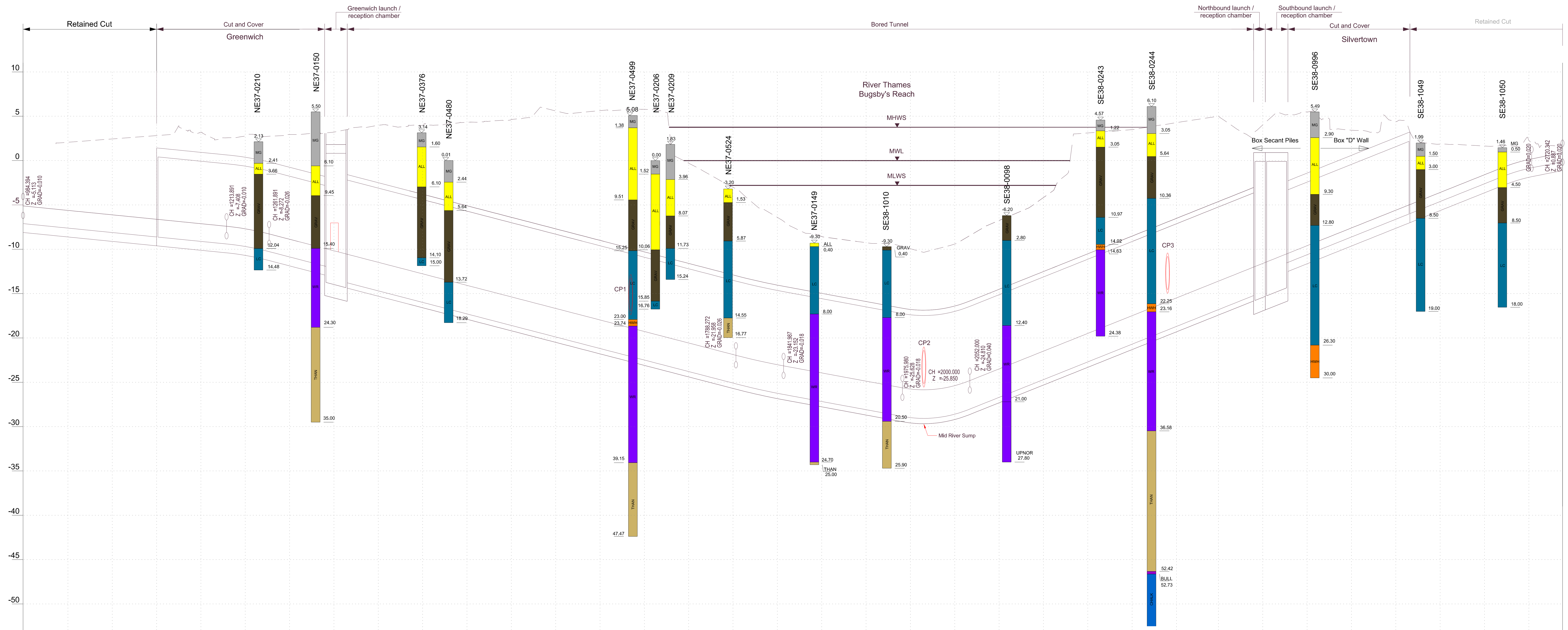
Title

Silvertown Tunnel Crossing
Bored Tunnel
Scheme Layout Plan

Designed	DN		Eng check	JB	
Drawn	RGH		Coordination	JB	
Dwg check	DN		Approved	MS	
Scale at A1 1:2750		Status		Rev	

Drawing Number

MMD-298348-C-DR-00-ZZ-1004



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1590.00		

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Vertical Scale 1:250 @ A1 (0, 5m, 10m, 20m, 30m)

0 100m 200m 500m
Horizontal Scale 1:2,500 @ A1

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P:\Croydon\MMH\Tunnels\298348 Silvertown Tunnel\Drawings\Perament Works\Bored\MMD-298348-TUN-202.dwg Feb 21, 2012 - 8:51AM kni56149

Notes

1. All dimensions in millimetres unless otherwise stated.
2. Do not scale this drawing.

Key to Symbols

Symbol	Description
MG	Made Ground
ALL	Alluvium
GRAV	Terrace Deposits (Sands & Gravels)
LC	London Clay
HWH	Blackheath Beds (Now Harwich Formation)
LG	Woolwich & Reading Beds (Pebble Bed & Glauconitic Sand) (Lambeth Group)
TS	Thanet Beds (Now Thanet Sand Formation)
CH	Upper Chalk
-·-·-	Mean high water spring (MHWS) +3.76m
-·-·-	Mean water level (MWL) +0.00m
-·-·-	Mean low water spring (MLWS) -2.80m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	15/04/2013	RGH	Preliminary Issue	DN	JB

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Transport for London

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SW1H 0TL

Title

Silvertown Tunnel Crossing
Bored Tunnel
Geological Long Section

Designed	DN		Eng check	JB
Drawn	RGH		Coordination	JB
Dwg check	DN		Approved	MS
Scale at A1: As Shown		Status: PRE		Rev: P1

Drawing Number
MMD-298348-C-DR-00-ZZ-1005

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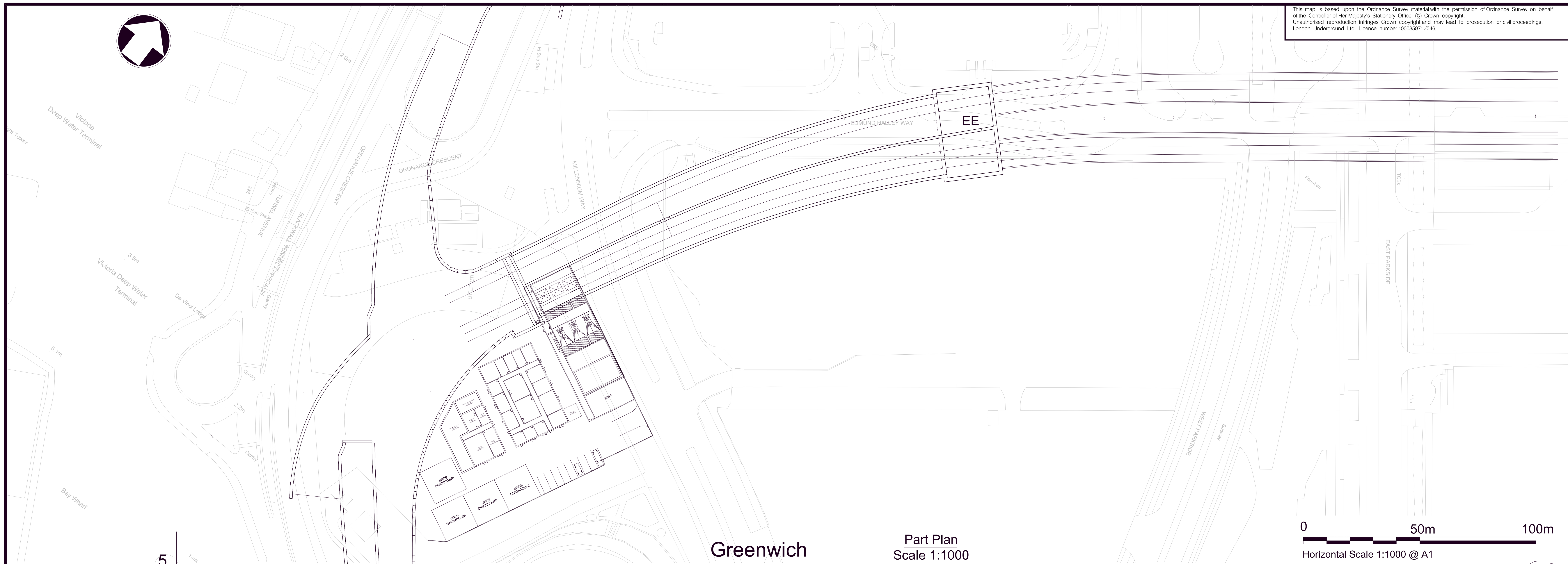
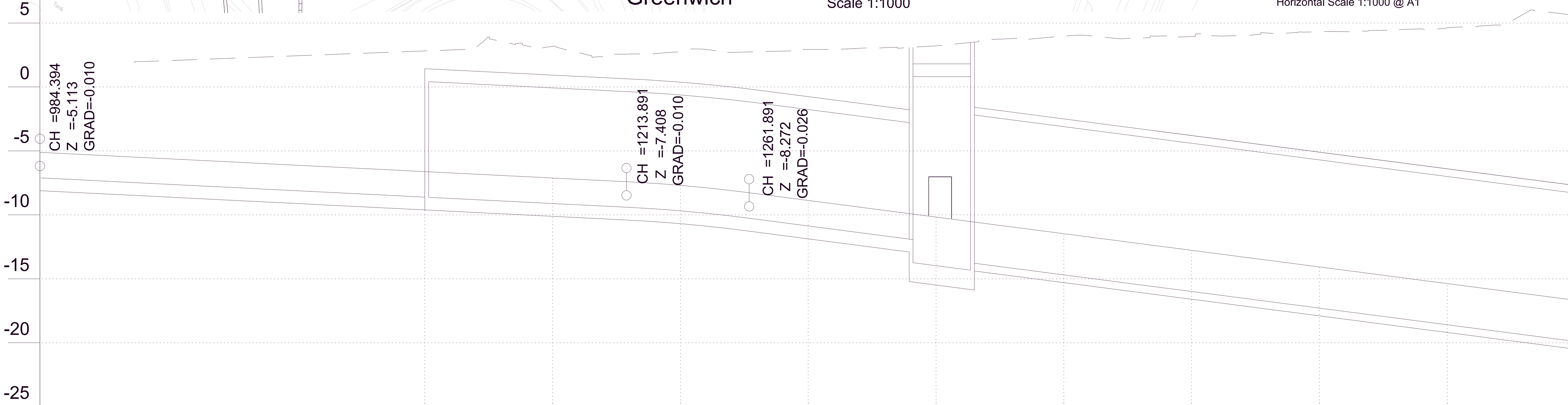


Greenwich

Part Plan
Scale 1:1000



CHAINAGE (M)	PROPOSED LEVEL (M)	EXISTING LEVEL (M)
0.000	-6.619	-999.00
10.00	-6.719	-999.00
20.00	-6.819	-999.00
30.00	-6.919	2.966
40.00	-7.019	3.622
50.00	-7.119	3.422
60.00	-7.219	2.960
70.00	-7.319	2.925
80.00	-7.419	2.538
90.00	-7.539	2.458
100.00	-7.693	2.577
110.00	-7.880	2.595
120.00	-8.101	2.714
130.00	-8.353	2.970
140.00	-8.613	2.809
150.00	-8.873	2.731
160.00	-9.133	2.782
170.00	-9.393	2.826
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190.00	-9.913	2.976
200.00	-10.173	3.045
210.00	-10.433	3.091
220.00	-10.693	3.157
230.00	-10.953	3.297
240.00	-11.213	3.507
250.00	-11.473	3.739
260.00	-11.733	3.814
270.00	-11.933	3.895
280.00	-12.253	3.933
290.00	-12.513	3.828
300.00	-12.773	3.994
310.00	-13.033	3.931
320.00	-13.293	3.970
330.00	-13.553	4.043
340.00	-13.813	4.188
350.00	-14.073	4.246
360.00	-14.333	4.309
370.00	-14.593	4.326
380.00	-14.853	4.355
390.00	-15.113	4.461
400.00	-15.373	4.544
410.00	-15.633	4.564
420.00	-15.893	4.712
430.00	-16.153	4.844
440.00	-16.413	5.709

HORIZONTAL GEOMETRY: D=183.790 | CL | R=-510.000 L=196.786 | CL | D=155.305

VERTICAL GEOMETRY: P=-1.000% L=229.497 | R | P= - 2.600% L=526.381

Scheme Layout Long Section
Horizontal Scale 1:1000 Vertical Scale 1:250

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Formerly Drawing No:- P:\Croydon\MMH\Tunnels\298348 Silvertown Tunnel\Drawings\Perament Works\Bored\MMD-298348-TUN-203.dwg Feb 20, 2012 - 3:58PM kni56149

Notes

1. All dimensions in millimetres unless otherwise stated.
2. Do not scale this drawing.

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	22/04/2013	RGH	PRELIMINARY ISSUE	DN	JB

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Title

Silvertown Tunnel Crossing
Bored Tunnel
Plan and Part Longitudinal Section
Sheet 1

Designed	DN		Eng check	JB	
Drawn	RGH		Coordination	JB	
Dwg check	DN		Approved	MS	

Scale at A1: As Shown | Status: PRE | Rev: P1

Drawing Number: MMD-29348-C-DR-00-ZZ-1006

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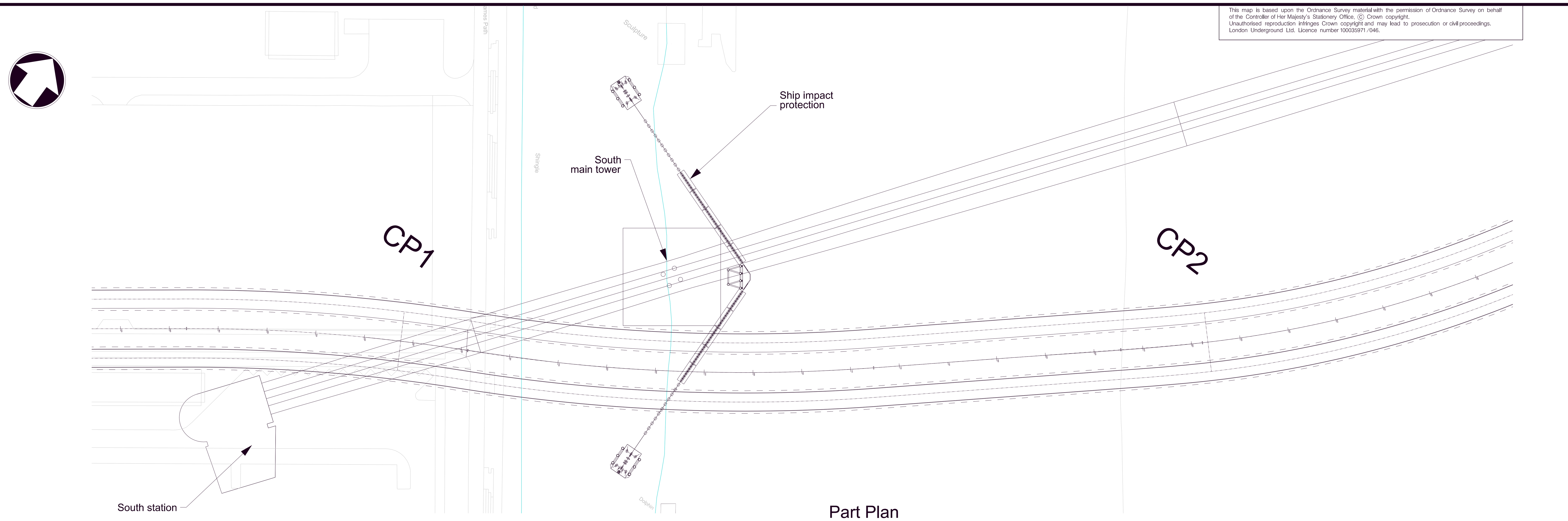
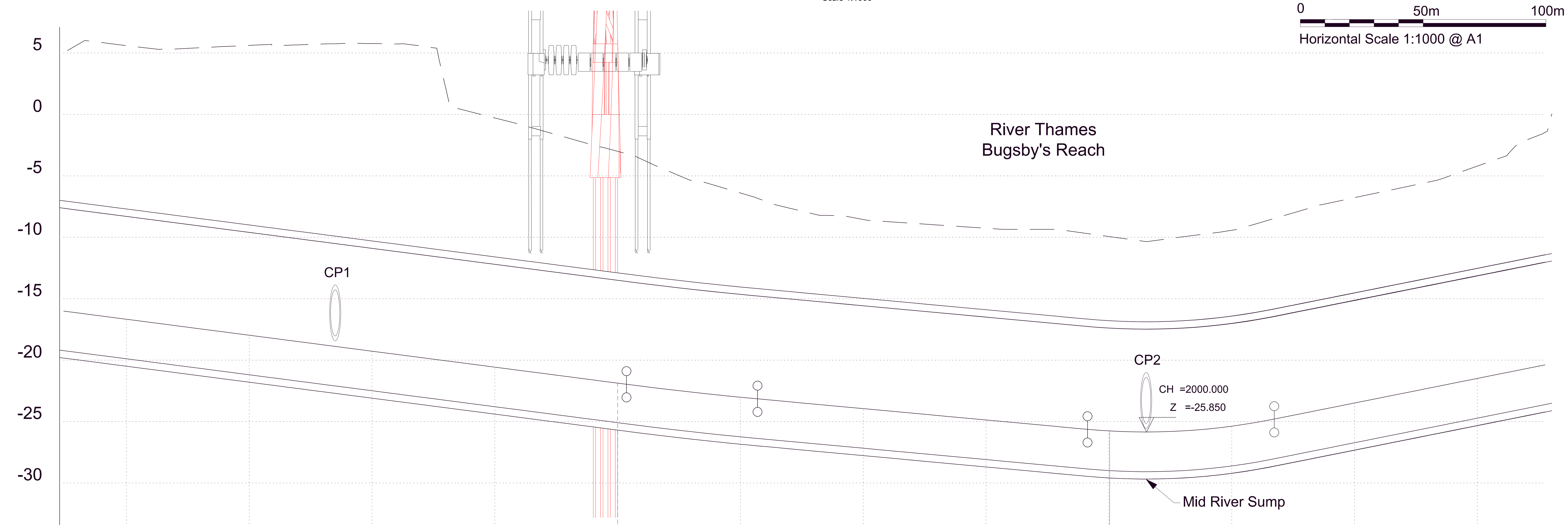


Part Plan
Scale 1:1000



CHAINAGE (M)	PROPOSED LEVEL (M)	EXISTING LEVEL (M)
430.00	-16.153	4.844
440.00	-16.413	5.709
450.00	-16.673	5.882
460.00	-16.933	5.676
470.00	-17.193	5.484
480.00	-17.453	5.353
490.00	-17.713	5.441
500.00	-17.973	5.544
510.00	-18.233	5.632
520.00	-18.493	5.707
530.00	-18.753	5.675
540.00	-19.013	5.744
550.00	-19.273	5.792
560.00	-19.533	5.781
570.00	-19.793	5.760
580.00	-20.053	5.695
590.00	-20.313	5.457
600.00	-20.573	0.468
610.00	-20.833	-0.041
620.00	-21.093	-0.551
630.00	-21.353	-1.090
640.00	-21.613	-1.656
650.00	-21.873	-2.222
660.00	-22.129	-2.694
670.00	-22.373	-3.186
680.00	-22.603	-4.079
690.00	-22.818	-4.999
700.00	-23.020	-5.516
710.00	-23.208	-6.109
720.00	-23.393	-6.700
730.00	-23.578	-7.350
740.00	-23.762	-7.878
750.00	-23.947	-8.214
760.00	-24.132	-8.368
770.00	-24.317	-8.658
780.00	-24.501	-8.791
790.00	-24.686	-8.925
800.00	-24.871	-9.059
810.00	-25.056	-9.192
820.00	-25.240	-9.326
830.00	-25.425	-9.350
840.00	-25.610	-9.350
850.00	-25.763	-9.526
860.00	-25.840	-9.801
870.00	-25.840	-10.076
880.00	-25.763	-10.348
890.00	-25.610	-10.079
900.00	-25.379	-9.822
910.00	-25.071	-9.571
920.00	-24.690	-9.169
930.00	-24.290	-8.578
940.00	-23.890	-7.990
950.00	-23.490	-7.392
960.00	-23.090	-6.967
970.00	-22.690	-6.543
980.00	-22.290	-6.120
990.00	-21.890	-5.699
1000.00	-21.490	-5.350
1010.00	-21.090	-4.527
1020.00	-20.690	-3.819

HORIZONTAL GEOMETRY: R=-720.000 L=115.642 | R=-720.000 L=166.780 | D=101.493 | CL

VERTICAL GEOMETRY: R | P= - 1.848% L=133.992 | R=1300.000 L=76.020

Scheme Layout Long Section
Horizontal Scale 1:1000 Vertical Scale 1:250

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Key to symbols

Reference drawings

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P1	22/04/2013	RGH	PRELIMINARY ISSUE	DN	JB

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Client
Transport for London
Transport for London
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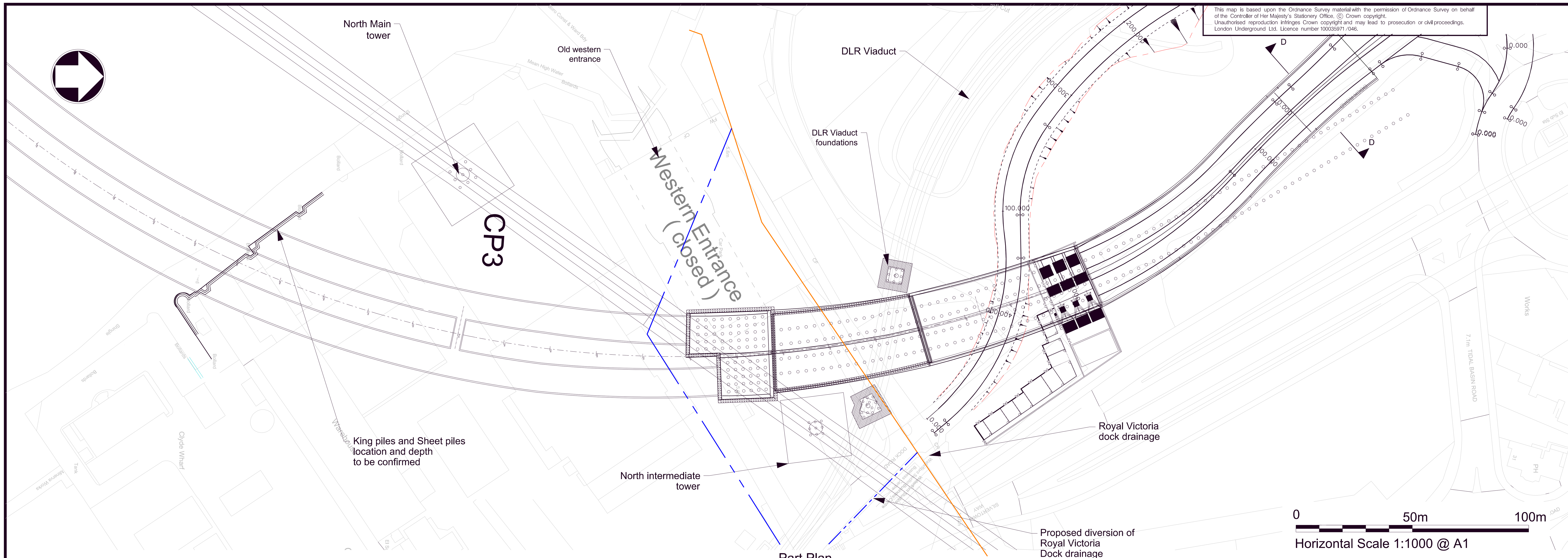
Title
Silvertown Tunnel Crossing
Bored Tunnel Option
Plan & Longitudinal Section
Sheet 2 of 3

Designed	DN		Eng check	JB	
Drawn	RGH		Coordination	JB	
Dwg check	DN		Approved	MS	
Scale at A1: As shown		Status: PRE		Rev: P1	

Drawing Number MMD-298348-C-DR-00-ZZ-1007



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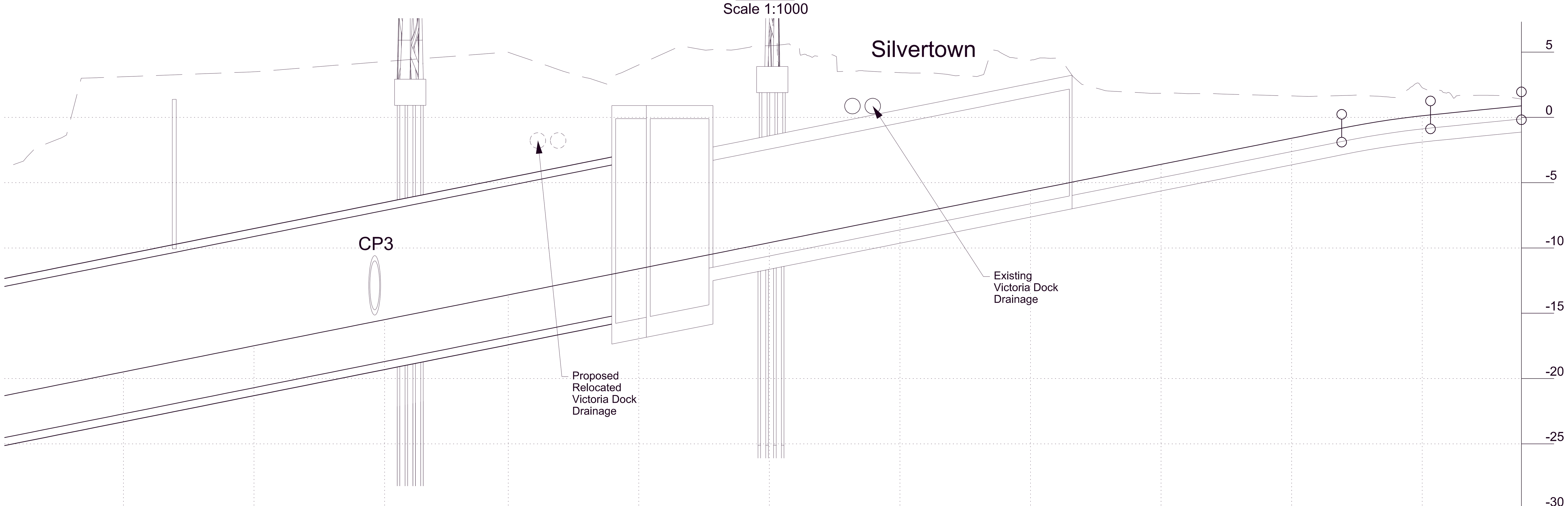
Part Plan
Scale 1:1000



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PROPOSED LEVEL (M)	-21.090	-20.690	-20.290	-19.890	-19.490	-19.090	-18.690	-18.290	-17.890	-17.490	-17.090	-16.690	-16.290	-15.890	-15.490
EXISTING LEVEL (M)	-4.527	-3.819	-3.026	-1.661	2.234	3.077	3.152	3.227	3.303	3.379	3.454	3.566	3.727	3.869	4.000

CHAINAGE (M)	1160.00	1170.00	1180.00	1190.00	1200.00	1210.00	1220.00	1230.00	1240.00	1250.00	1260.00	1270.00	1280.00	1290.00	1300.00
PROPOSED LEVEL (M)	-15.090	-14.690	-14.290	-13.890	-13.490	-13.090	-12.690	-12.290	-11.890	-11.490	-11.090	-10.690	-10.290	-9.890	-9.490
EXISTING LEVEL (M)	4.116	4.265	4.435	4.587	4.739	4.892	4.804	4.121	3.070	2.558	3.812	4.725	5.470	5.144	5.152

CHAINAGE (M)	1310.00	1320.00	1330.00	1340.00	1350.00	1360.00	1370.00	1380.00	1390.00	1400.00	1410.00	1420.00	1430.00	1440.00	1450.00
PROPOSED LEVEL (M)	-9.090	-8.690	-8.290	-7.890	-7.490	-7.090	-6.690	-6.290	-5.890	-5.490	-5.090	-4.690	-4.290	-3.890	-3.490
EXISTING LEVEL (M)	5.441	5.498	5.531	4.676	3.519	3.577	3.450	3.394	3.322	3.220	3.925	4.586	4.414	2.535	2.103

CHAINAGE (M)	1460.00	1470.00	1480.00	1490.00	1500.00	1510.00	1520.00	1530.00	1540.00	1550.00	1560.00	1570.00	1580.00
PROPOSED LEVEL (M)	-3.090	-2.690	-2.290	-1.890	-1.490	-1.090	-0.694	-0.343	-0.052	-0.180	-0.380	-0.580	-0.780
EXISTING LEVEL (M)	1.938	1.841	1.858	1.798	1.738	1.684	1.629	1.638	1.689	1.642	1.532	2.389	

HORIZONTAL GEOMETRY	R=-460.000 L=600.009	CL	D=88.954
VERTICAL GEOMETRY	P= - 4.000% L=599.514	R	P

Scheme Layout Long Section
Horizontal Scale 1:1000 Vertical Scale 1:250

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Notes

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Key to symbols

Reference drawings

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50 Victoria Street
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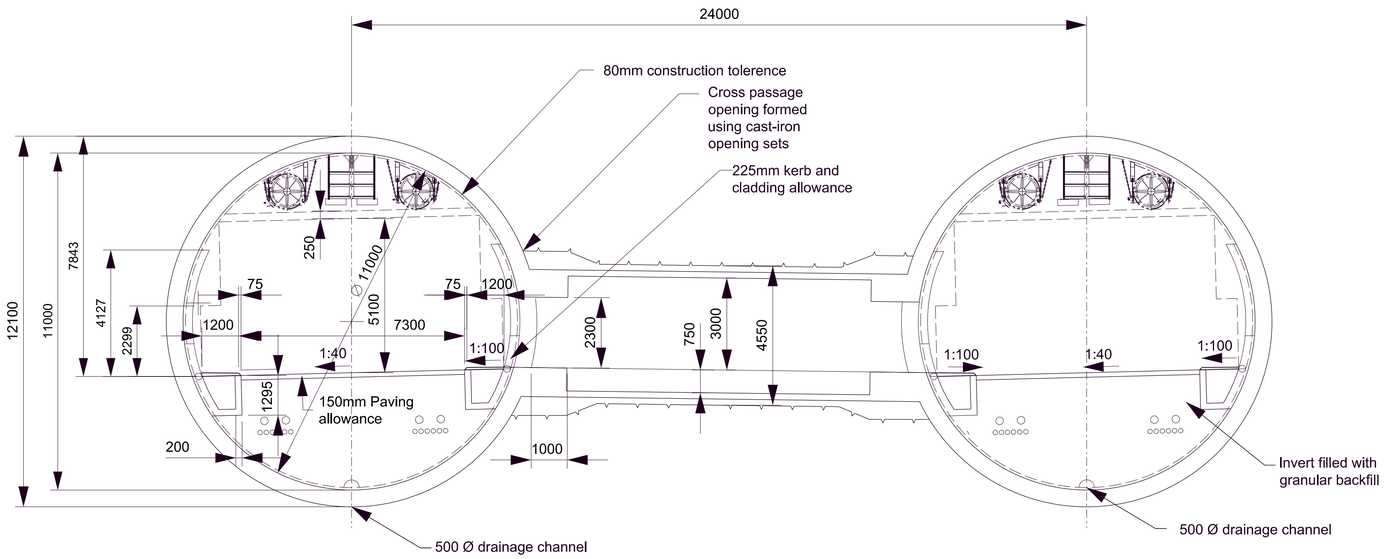
SW1H 0TL

Title

Silvertown Tunnel Crossing
Bored Tunnel Option
Plan & Longitudinal Section
Sheet 3 of 3

Designed	DN	Eng check	JB
Drawn	RGH	Coordination	JB
Dwg check	DN	Approved	MS
Scale at A1: As shown	Status: PRE	Rev: P1	

Drawing Number
MMD-298348-C-DR-00-ZZ-1008



Cross Section

0 5m 10m

Horizontal Scale 1:100 @ A1

Notes

1. All dimensions in millimetres unless otherwise stated.
2. Do not scale this drawing.

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
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Title

Silvertown Tunnel Crossing
Bored Tunnel Option
Bored Tunnel Cross Section

Designed	DN		Eng check	JB	
Drawn	RGH		Coordination	JB	
Dwg check	DN		Approved	MS	
Scale at A1 1:100		Status PRE		Rev P1	

Drawing Number MMD-29348-C-DR-00-ZZ-1009

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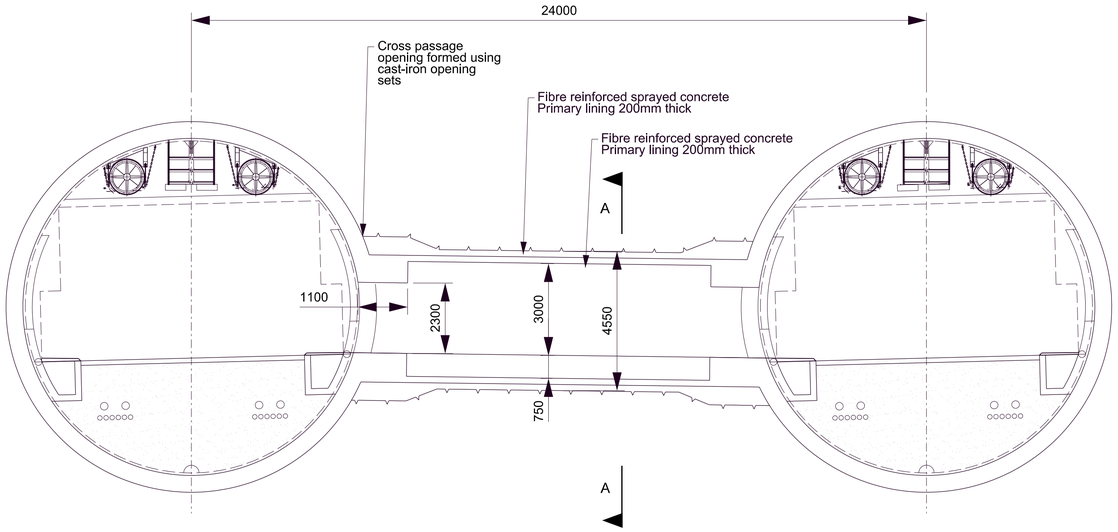
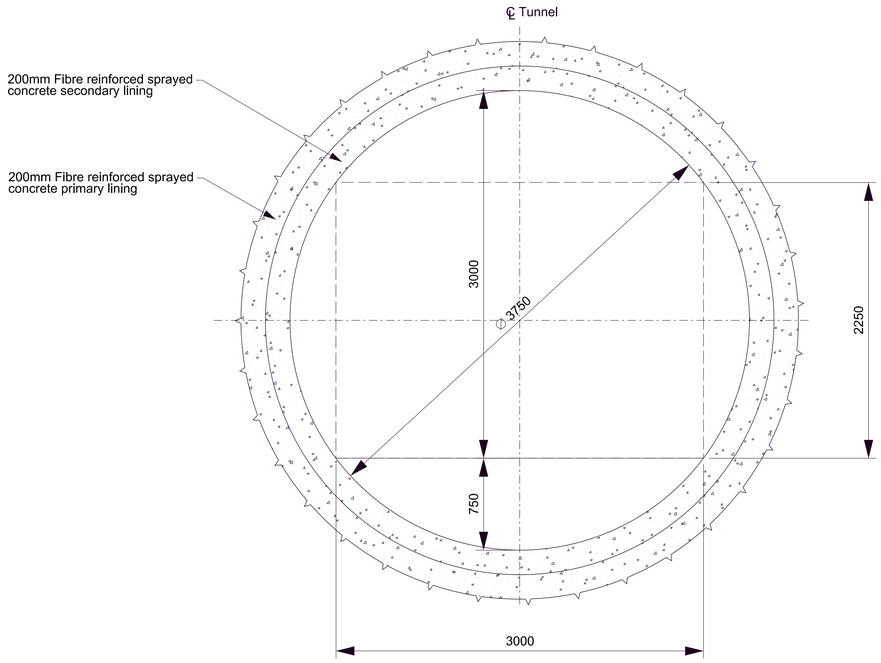
P:\Croydon\MMH\Tunnels\298348 Silvertown Tunnel\Drawings\Perament Works\Bored\MMD-298348-TUN-206.dwg Jun 22, 2012 - 10:18AM kni56149



Typical Emergency Escape Cross Passage

Scale 1:100



Emergency Escape Cross Passage Section A-A

Scale 1:25

0 5m 10m

Horizontal Scale 1:100 @ A1

Notes

1. All dimensions in millimetres unless otherwise stated.
2. Do not scale this drawing.

Key to symbols

Reference drawings

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Title

Silvertown Tunnel Crossing
Bored Tunnel
Emergency Escape Cross Passages

Designed	DN		Eng check	JB	
Drawn	RGH		Coordination	JB	
Dwg check	DN		Approved	MS	
Scale at A1	As shown	Status	PRE	Rev	P1

Drawing Number

MMD-29348-C-DR-00-ZZ-1010

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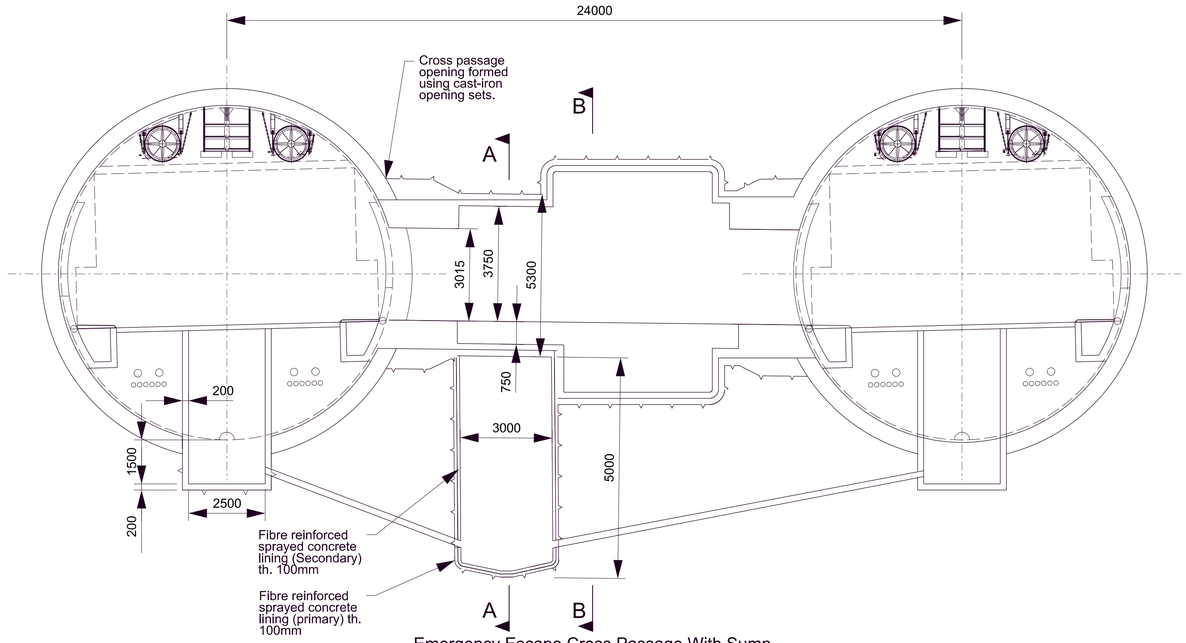
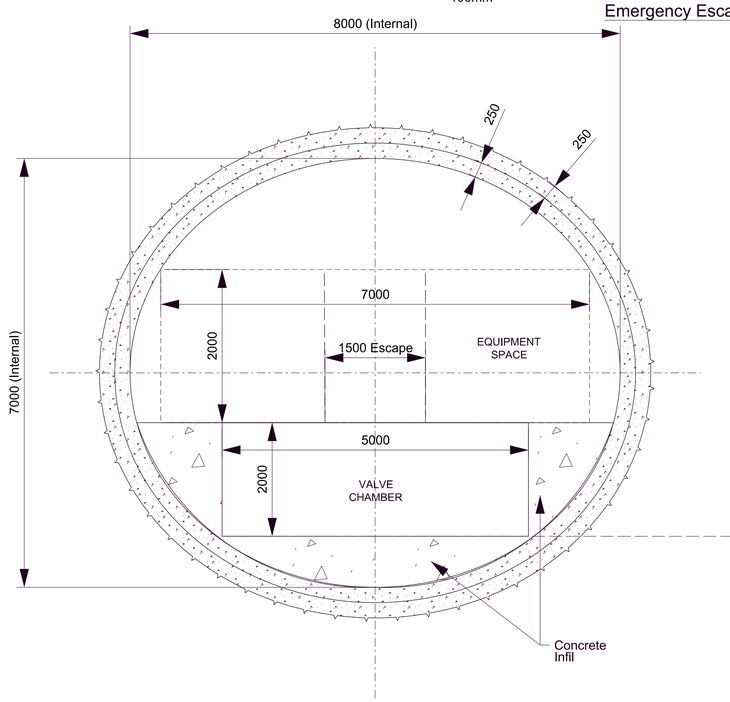
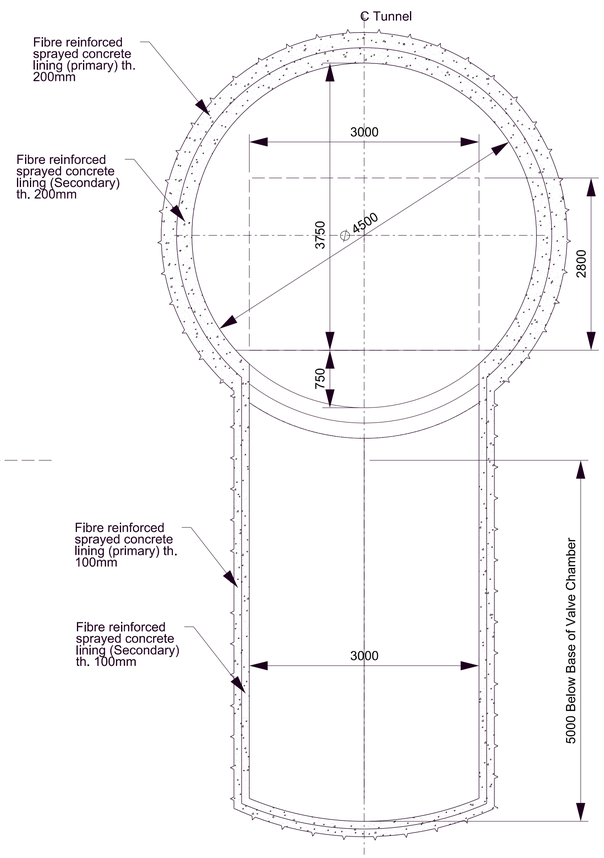


Emergency Escape Cross Passage With Sump
Bored Tunnel
Scale 1:100



Section B - B
Scale 1:25



Emergency Escape Cross Passage With Sump Section A-A
Scale 1:25

5m 10m
Horizontal Scale 1:100 @ A1

Notes

1. All dimensions in millimetres unless otherwise stated.
2. Do not scale this drawing.

Key to symbols

Reference drawings

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Title

Silvertown Tunnel Crossing
Bored Tunnel
Emergency Escape Cross Passages

Designed	DN		Eng check	JB	
Drawn	RGH		Coordination	JB	
Dwg check	DN		Approved	MS	
Scale at A1	As shown	Status	PRE	Rev	P1

Drawing Number MMD-29348-C-DR-00-ZZ-1011

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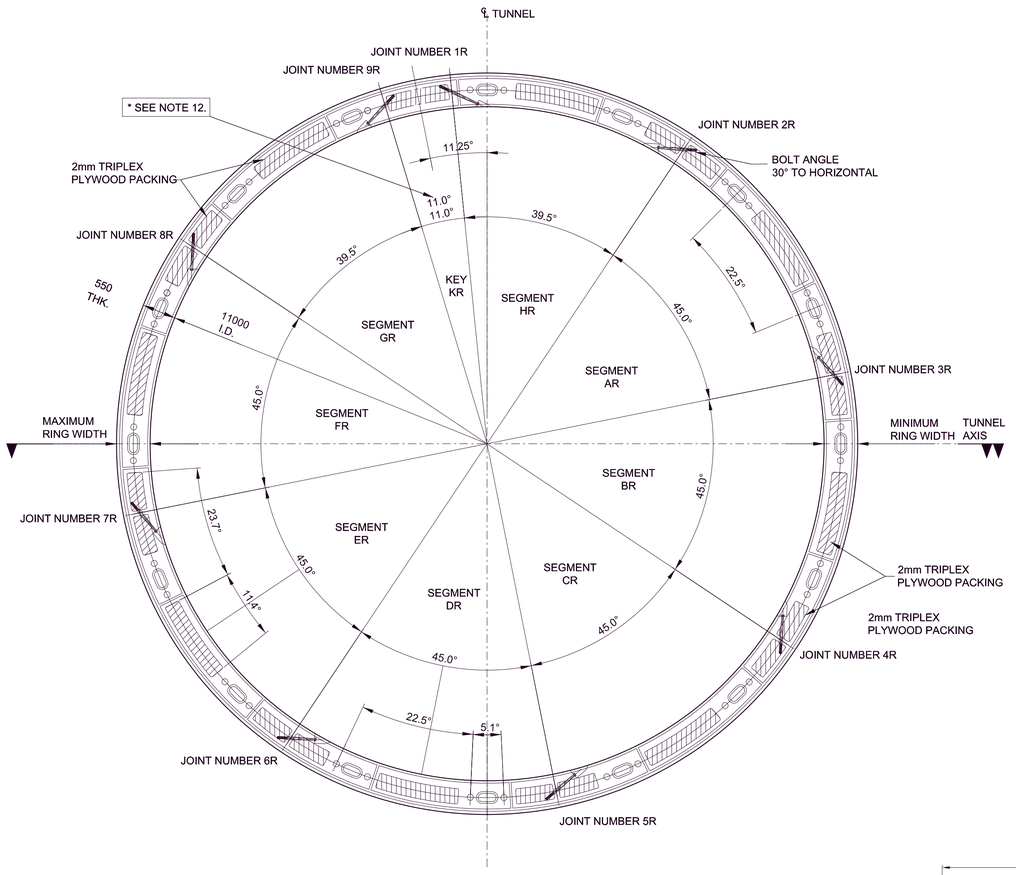
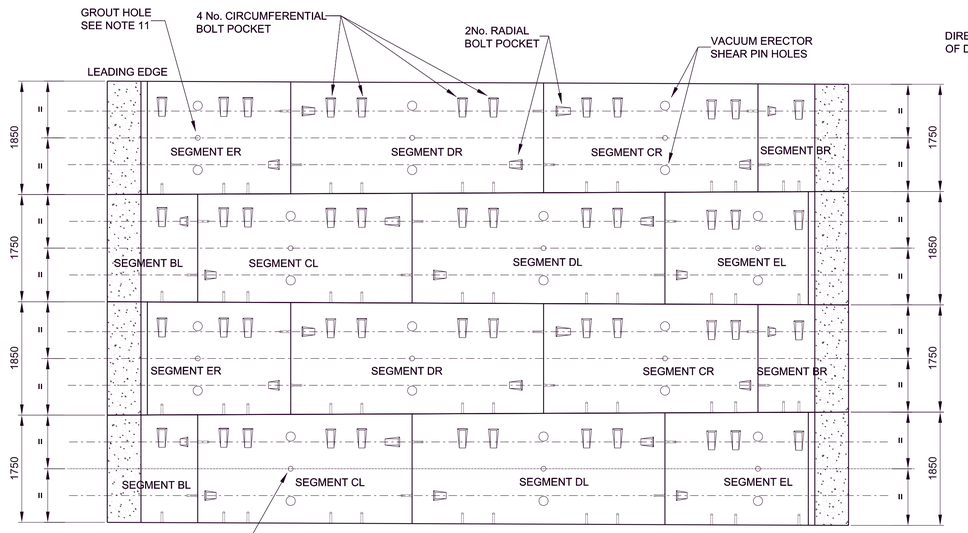


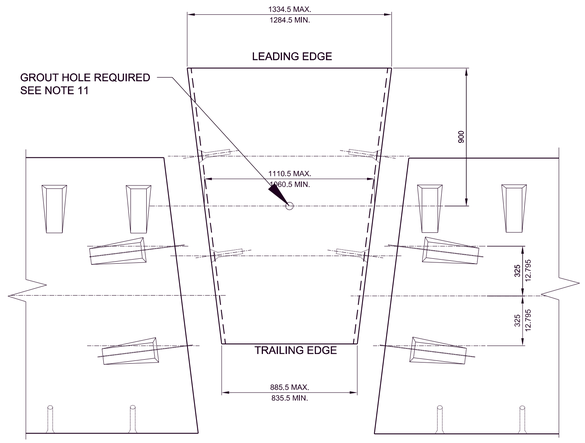
TYPICAL SECTION OF RIGHT HAND TAPER RING (TRAILING EDGE)

Scale 1:50



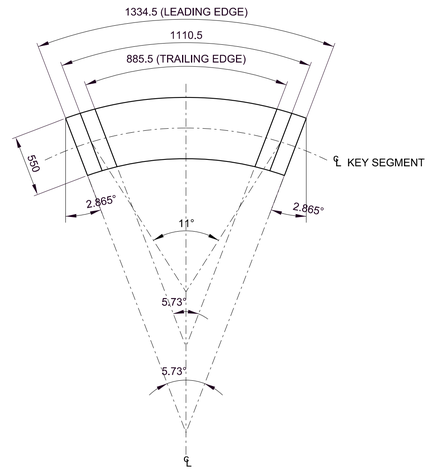
SECTION A-A THROUGH 4 No. RINGS

Scale 1:50



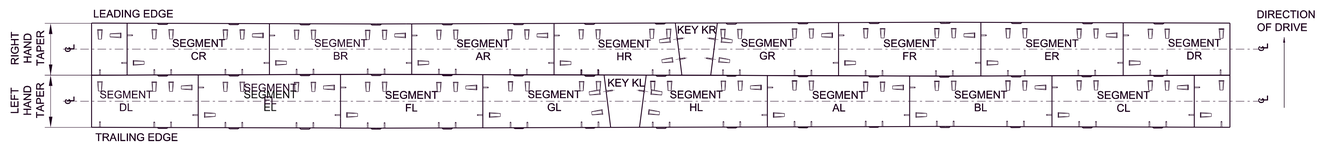
KEY SEGMENT VIEWED FROM MID-POINT OF LINING

Scale 1:20



KEY SEGMENT RADIAL JOINT GEOMETRY

Scale N.T.S.



DEVELOPED PLAN VIEW ON INTRADOS

N.T.S

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P:\Croydon\MMH\Tunnels\298348 Silvertown Tunnel\Drawings\Perament Works\Bored\MMD-298348-TUN-206.dwg Jun 22, 2012 - 10:18AM kni56149

Notes

1. All dimensions are in millimetres except where otherwise stated.
2. Concrete to segmental lining to have a characteristic strength of 50n/mm at 28 days.
3. Minimum concrete cover to reinforcement to be 40mm.
4. Taper of the rings to be taken from the trailing edge of the left hand and right hand rings.
5. Mould manufacturers to propose segment lifting positions for approval by the designer.
6. Design of segment lifting system to be coordinated with tbm supplier.
7. Minimum cube strength of concrete for mould de-moulding is 10 n/mm.
8. All bolts to be m24 grade 8.8.
9. Grout holes to be provided on each segment.
10. Angles taken at mid-point of ring.
11. Right hand taper shown. Left hand taper similar.
12. Linings to be provided with composite EPDM / hydrophilic gasket.
13. Do not scale this drawing.

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	22/04/2013	RGH	PRELIMINARY ISSUE	DN	JB

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Client

Transport for London

Transport for London
50 Victoria Street
London
SW1H 0TL

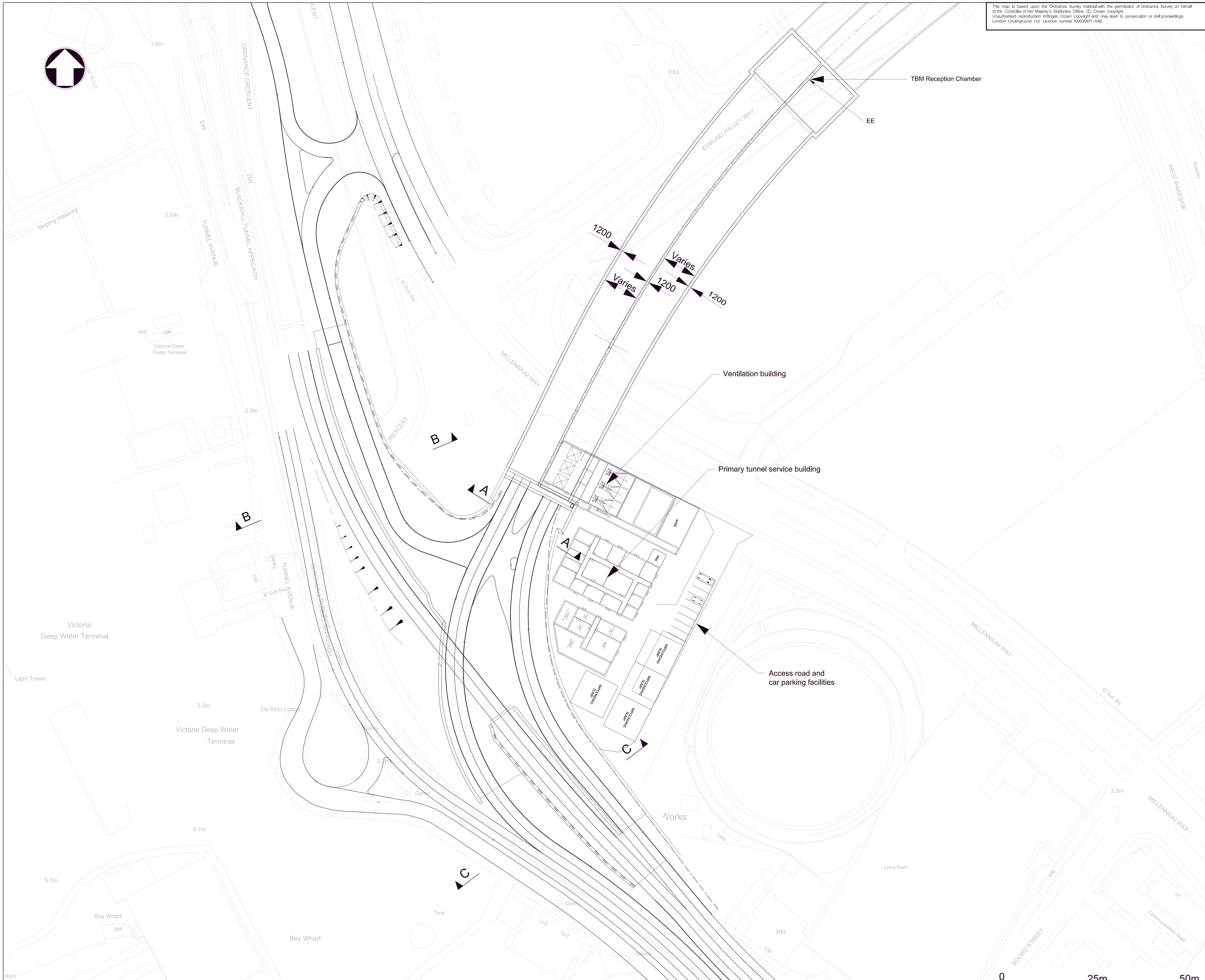
Title

Silvertown Tunnel Crossing
Bored Tunnel Option
Precast Concrete
Segmental Lining

Designed	DN		Eng check	JB	
Drawn	RGH		Coordination	JB	
Dwg check	DN		Approved	MS	

Scale at A1: As Shown
Status: PRE
Rev: P1

Drawing Number: MMD-29348-C-DR-00-ZZ-1012



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Notes

For Sections See Drawing MMD- 298348-C-DR-00-ZZ-1016 and 1017

Key to symbols

Reference drawings

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Transport for London

Transport for London
50 Victoria Street
London
SW1H 0TL

Title

Silvertown Tunnel Crossing
Bored Tunnel
Greenwich Cut and Cover
Approach Structures Plan

Designed			Eng check	
Drawn			Coordination	
Dwg check			Approved	

Scale at A1: As Shown | Status | Rev

0 25m 50m

Horizontal Scale 1:750 @ A1

Drawing Number: MMD-29348-C-DR-00-ZZ-1013

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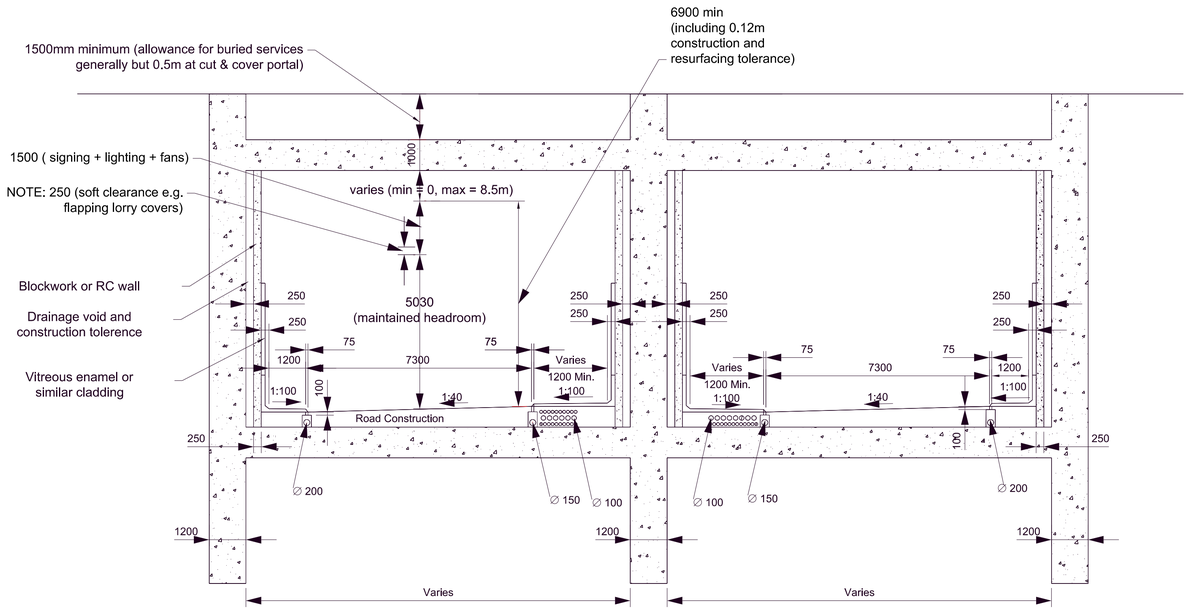

Cut and Cover Twin Tunnels
Cross Section

0 5m 10m
Horizontal Scale 1:100 @ A1

Notes

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd

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SW1H 0TL

Title
Silvertown Tunnel Crossing
Bored Tunnel Option
Greenwich Approach Structures
Cut and Cover
Section Sheet 1

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		

Scale at A1	Status	Rev
1:100	PRE	P1

Drawing Number
MMD-298348-C-DR-00-ZZ-1014

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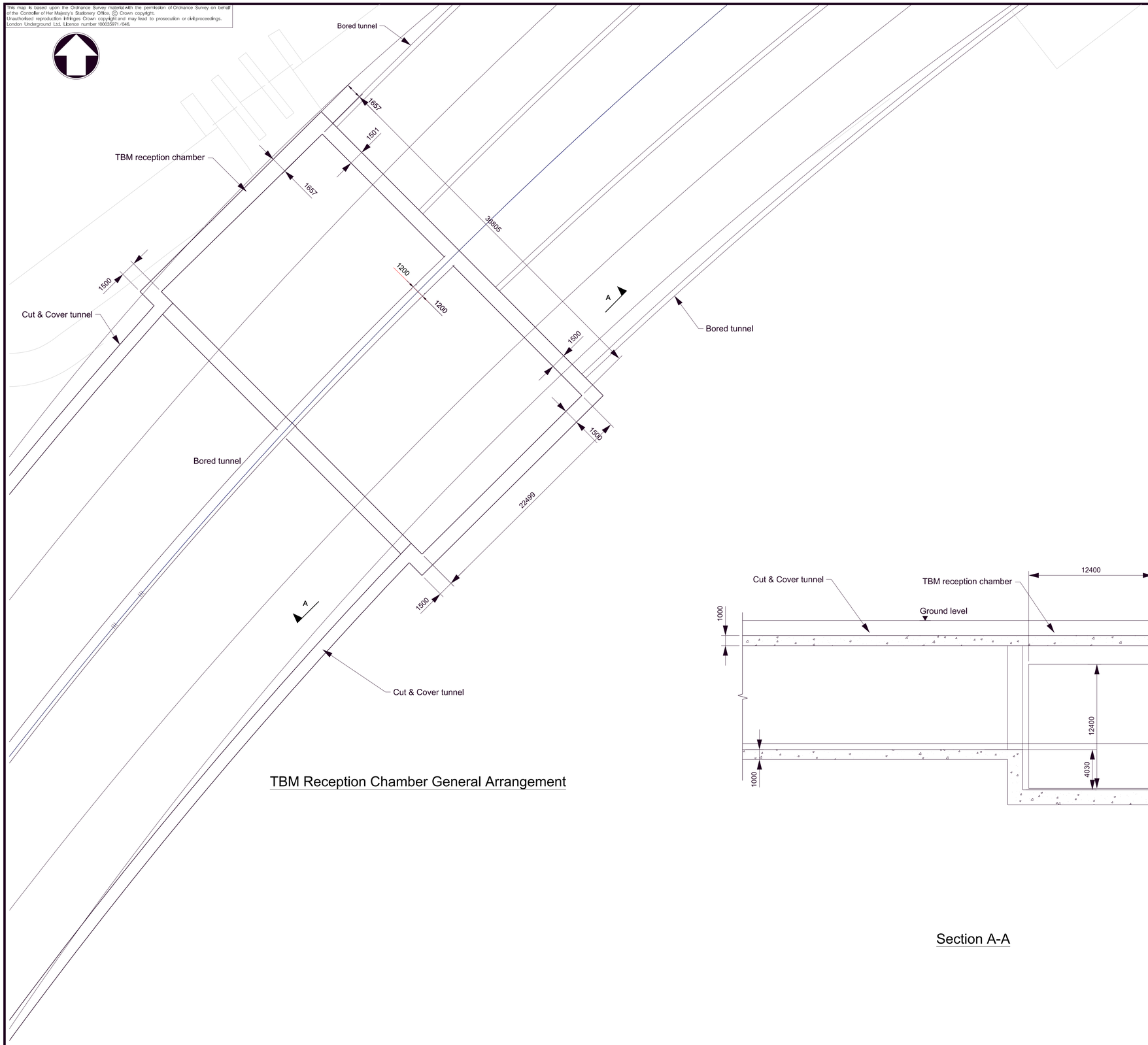

TBM Reception Chamber General Arrangement

Section A-A

Notes

1. All dimensions in millimetres unless otherwise stated.
2. Do not scale this drawing.

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	22/04/2013	RGH	PRELIMINARY ISSUE	DN	JB

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Title

Silvertown Tunnel Crossing
Bored Tunnel Option
Greenwich Cut and Cover
Approach Structures Section
Sheet 2 of 2

Designed	DN		Eng check	JB	
Drawn	RGH		Coordination	JB	
Dwg check	DN		Approved	MS	

Scale at A1: 1:200

Status: PRE

Rev: P1

Drawing Number: MMD-29348-C-DR-00-ZZ-1015

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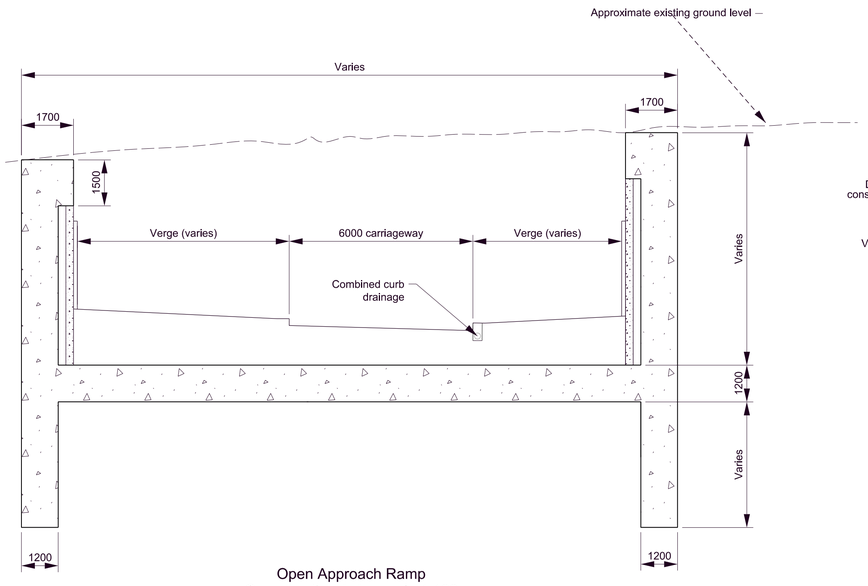
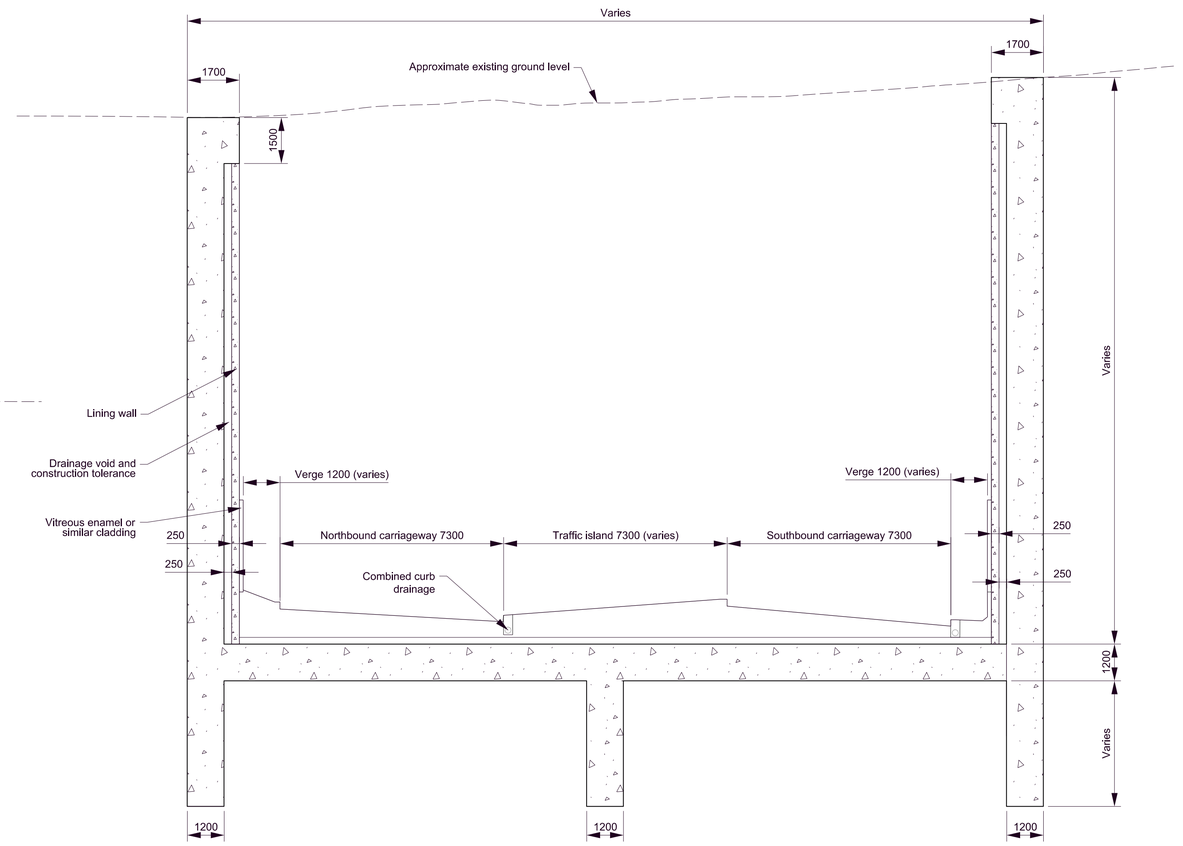
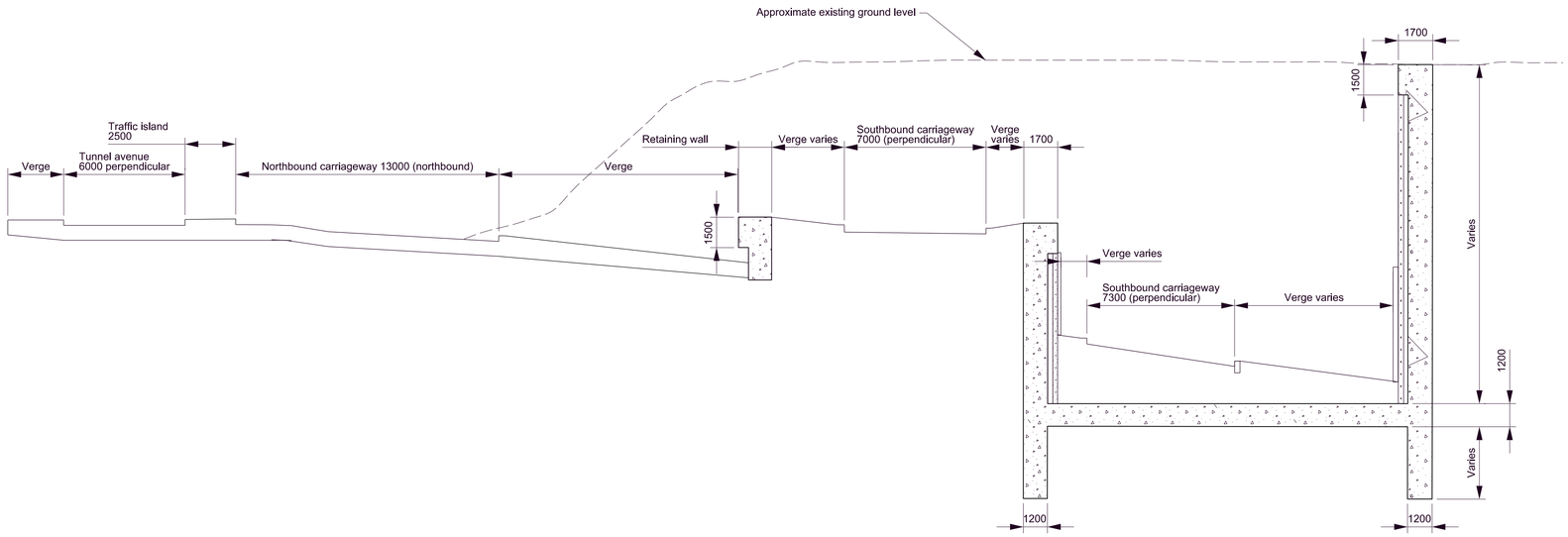


Open Approach Ramp
Cross section A-A scale 1:100



Open Approach Ramp
Cross section B-B scale 1:100



Open Approach Ramp
Cross section C-C scale 1:150

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Notes

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Key to symbols

Reference drawings

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Title

Silvertown Tunnel Crossing Bored Tunnel Greenwich Open Approach Structures Sections Sheet 1

Designed	DN		Eng check	JB	
Drawn	RGH		Coordination	JB	
Dwg check	DN		Approved	MS	
Scale at A1	As Shown	Status	PRE	Rev	P1

Drawing Number

MMD-29348-C-DR-00-ZZ-1016

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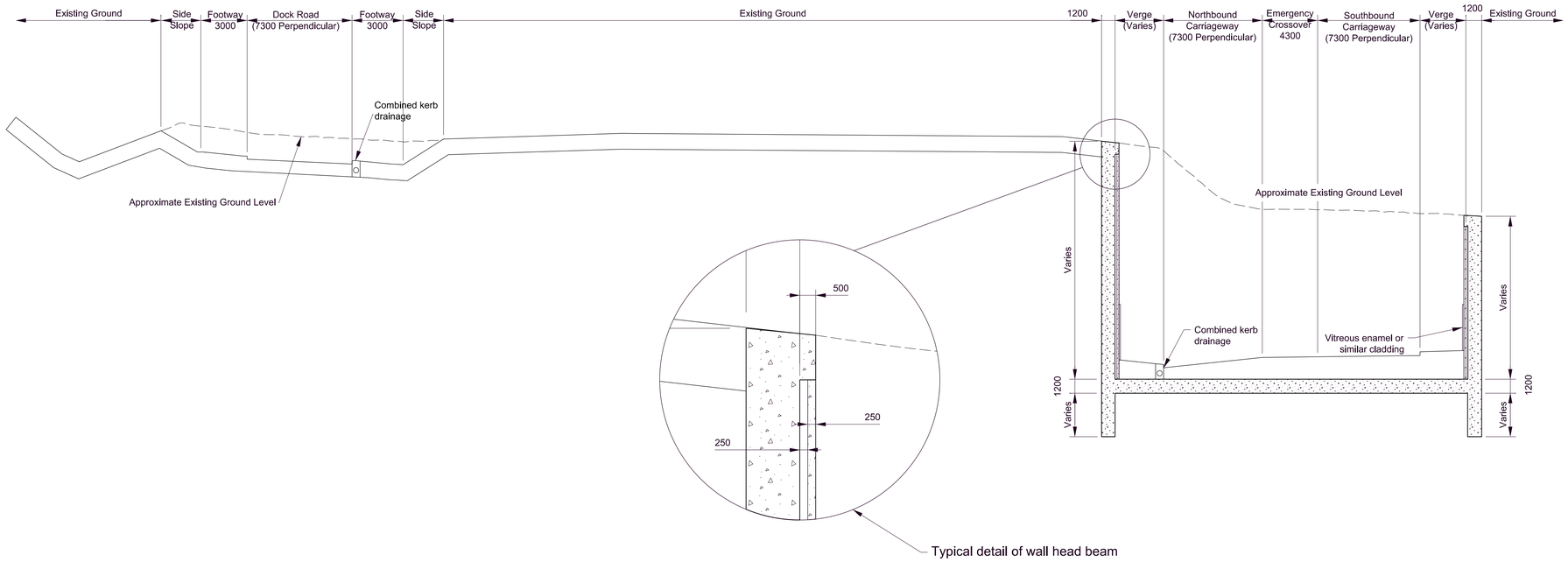

Open Approach Ramp
Cross Section D - D

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Notes

1. All dimensions in millimetres unless otherwise stated.
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Reference drawings

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Title

Silvertown Tunnel Crossing
Bored Tunnel
Silvertown Open
Approach Structures
Sections Sheet 2

Designed	DN		Eng check	JB	
Drawn	RGH		Coordination	JB	
Dwg check	DN		Approved	MS	

Scale at A1	Status	Rev
NTS	PRE	P1

Drawing Number
MMD-29348-C-DR-00-ZZ-1017

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DOCK ROAD

Diaphragm wall

Diaphragm wall

124800 Extent of open box

Secondary tunnel service building

Diaphragm wall

Central dividing wall

Secant Pile wall

Dock Road diversion over cut and cover tunnel is not shown for clarity

119730 Extent of covered box

DLR viaduct

DLR foundation

Approximate alignment of Royal Victoria Dock drainage

Proposed new alignment of Royal Victoria Dock drainage

Waterfront Studios Business Centre

DOCK ROAD

DLR foundation

Cable car north intermediate tower foundation

A

B

C

25500 TBM chamber

37660 TBM chamber

5.6m

Bored tunnels

Car Park

Royal Albert and Victoria Docks Cut

Royal Albert and Victoria Docks Cut

B CLOSE

Scrap Yard

Thames Wharf

FW

CF

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Notes

Key to symbols

Reference drawings

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Title

Silvertown Tunnel Crossing
Silvertown Worksite Layout Phase 1
Tunnel and Cut and Cover Works

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		
Scale at A1 NTS		Status		Rev	

Drawing Number

MMD-29348-C-DR-00-ZZ-1021

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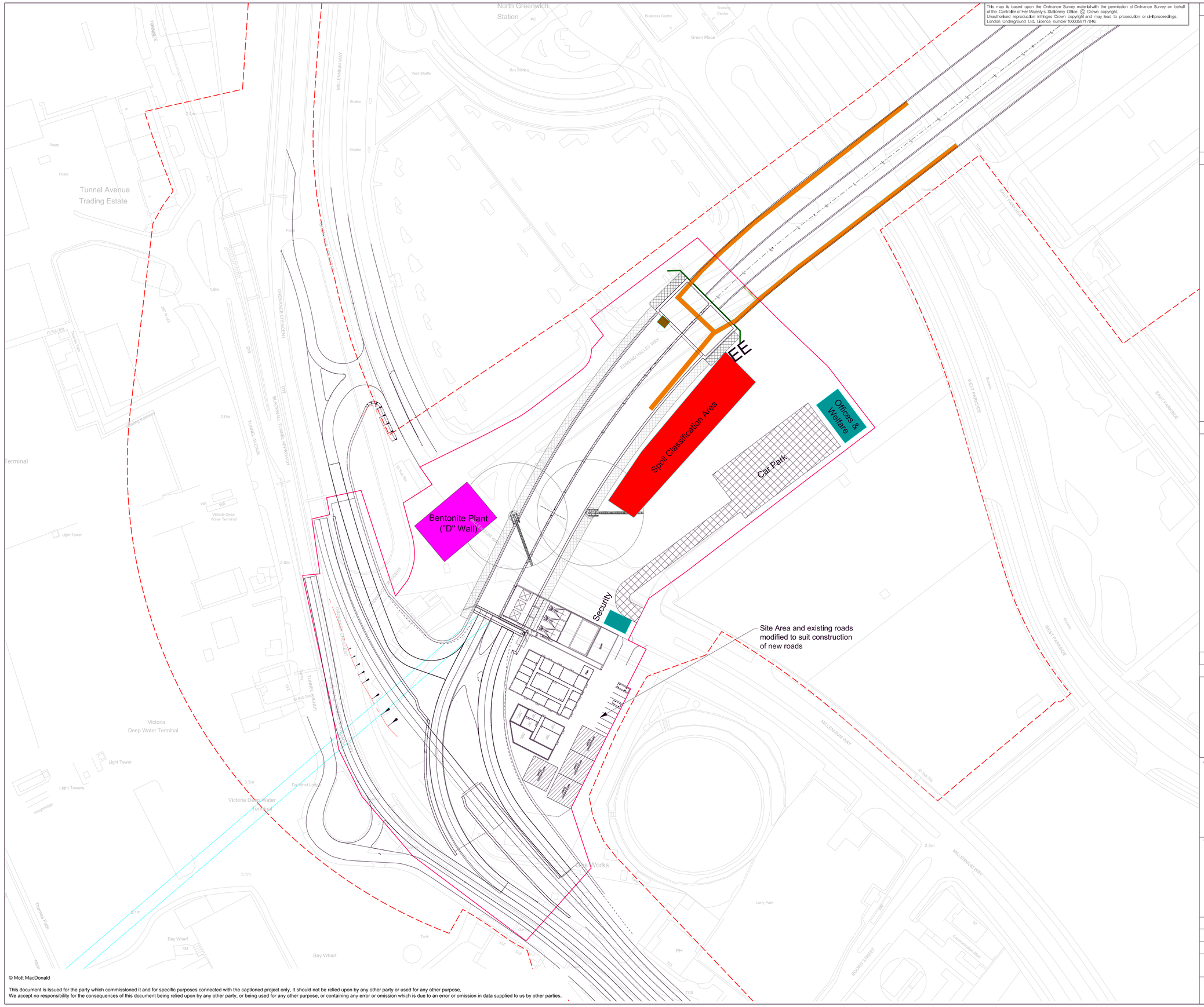

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Title

Silvertown Tunnel Crossing Greenwich Worksite Layout

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		
Scale at A1 NTS		Status		Rev	

Drawing Number MMD-29348-C-DR-00-ZZ-1023

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Site Area and existing roads modified to suit construction of new roads

Office (28m x 10m)

Security

Welfare (35m x 12m)

Car Park

Lime Dosing Plant

Spoil Classification Area 43m x 115m

Conveyor

Workshop Stores (27m x 10m)

Bentonite and Lime Storage Area

Bentonite Plant "D" Wall

Conveyor

Grout (10m x 7m)

Gantry Crane Operating Area

Segment- Storage - Double Stacked (85m x 27m)

TBM Erection Area

Ventilation

Crawler Crane Operating Area

Decompression Chamber

Water Treatment (3m x 6m)

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Title

Silvertown Tunnel Crossing
Silvertown Worksite Layout Phase 1
Tunnel and Cut and Cover Works

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		

Scale at A1	Status	Rev
NTS		

Drawing Number

MMD-29348-C-DR-00-ZZ-1024

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Site Area and existing roads modified to suit construction of new roads

Security

Office (28m x 10m)

Welfare (35m x 12m)

Car Park

Workshop Stores (27m x 10m)

Notes

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd

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Title

Silvertown Tunnel Crossing
Silvertown Worksite Layout Phase 2
Road Works & Fitout

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		
Scale at A1 NTS		Status		Rev	

Drawing Number MMD-29348-C-DR-00-ZZ-1025

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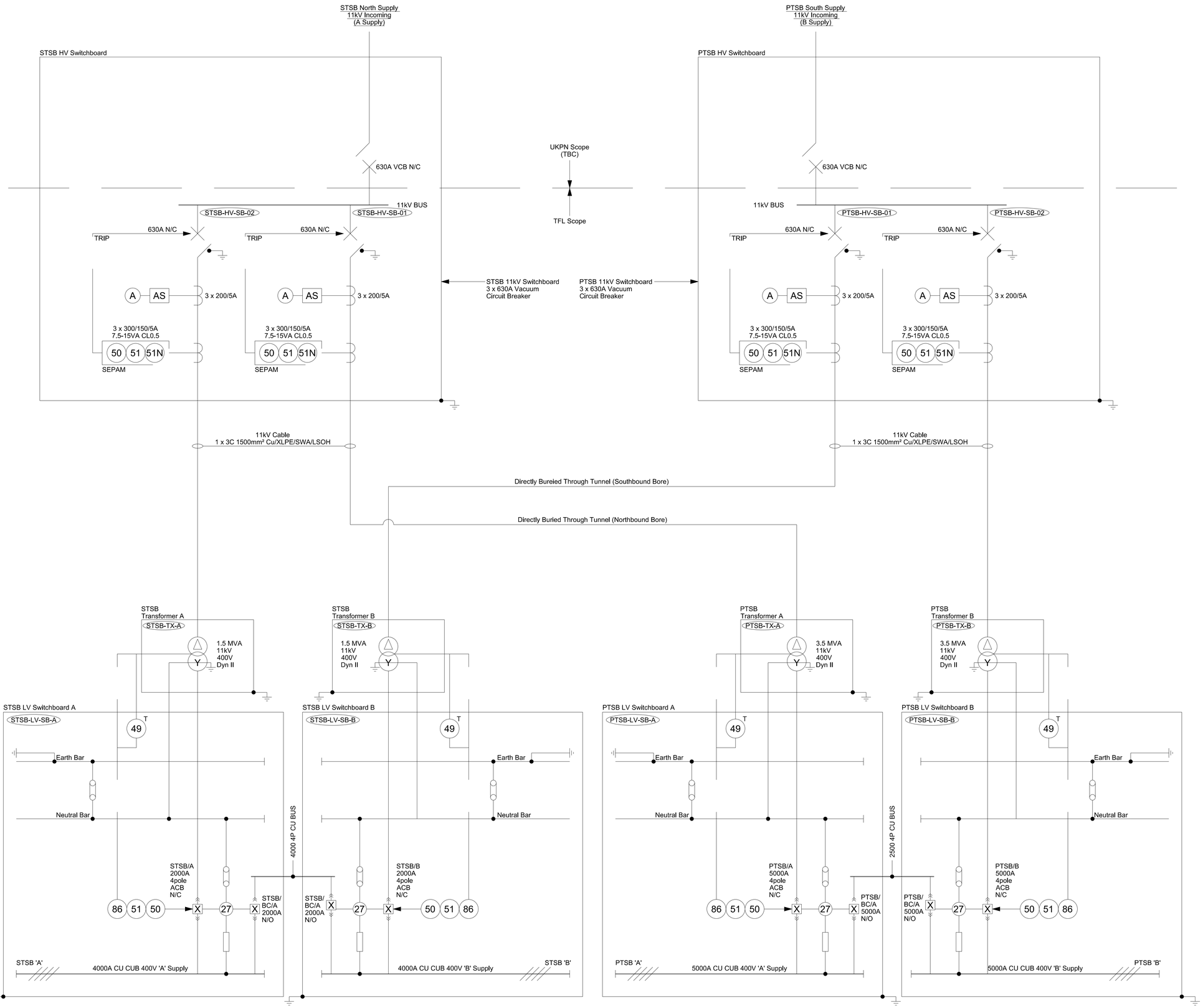

Notes

Key to symbols

A	Ammeter		11/0.40kV, 2000kVA, Dy n II
AS	Ammeter Selector Switch		
V	Voltmeter	X	Air Circuit Breaker (ACB) 4 Pole
VS	Voltmeter Selector Switch		
N/C	Normally Closed		
N/O	Normally Open		Current Transformer
STSB	Secondary Tunnel Services Building		
PTSB	Primary Tunnel Services Building		Link
MET	Main Earth Terminal		
M	REC Metering located remotely from swtichboard		Fuse
27	Undervoltage Relay		Voltage Transformer
49 T	Transformer Thermal Ray		
50	Instantaneous Overcurrent		Circuit Breaker
51N	IDMTL Overcurrent Relay		
51N	Earth Fault Relay IDMTL		Earth Switch
86	Locking-out Relay		

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
	25/03/13	ZZG	First Issue		

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Title

Silvertown River Crossing
Bored Tunnel Option
Electrical Systems
High Voltage Electrical Schematic
Single Line Diagram

Designed	Rakesh Oza	RO	Eng check		
Drawn	Zena Zuberi	ZZG	Coordination		
Dwg check			Approved		
Scale at A1 NTS		Status		Rev	

Drawing Number

MMD-298348-E-DR-00-ZZ-1001

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Notes

1. All dimensions in millimetres unless otherwise stated.
2. Do not scale off this drawing.
3. Indicative layouts for service buildings to be further developed in the next stage of design.
4. For approach roads and associated linkages with the road network please refer to the Atkins Highway design report.
5. Indicative ventilation provision based on air quality assessment to be further discussed and agreed with relevant stakeholders.
6. Location of Thames Water assesst from Atkins' collation of utility information in file "23952_Overview_Map_Issue_A.dwg".

Key to symbols

Reference drawings

MMD-298348-H-DR-00-ZZ-1005
Secondary Tunnel Services Building - Building Plan

MMD-298348-H-DR-00-ZZ-1007
Silvertown Ventilation Shaft - General Arrangement and Sections

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	16/04/2013	ZZG	PRELIMINARY ISSUE	MZ	RCH

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Title

Silvertown River Crossing
Bored Tunnel Option
Silvertown Approach
Secondary Tunnel Services Building
Compound Structures Plan

Designed	I. Siddy	IS	Eng check	M. Zbucki	MZ
Drawn	Z. Zuberi	ZZG	Coordination	S. Johnson	SJ
Dwg check	I. Siddy	IS	Approved	R. Hall	RCH
Scale at A1	1:200	Status	PRE	Rev	P1

Drawing Number

MMD-298348-H-DR-00-ZZ-1002

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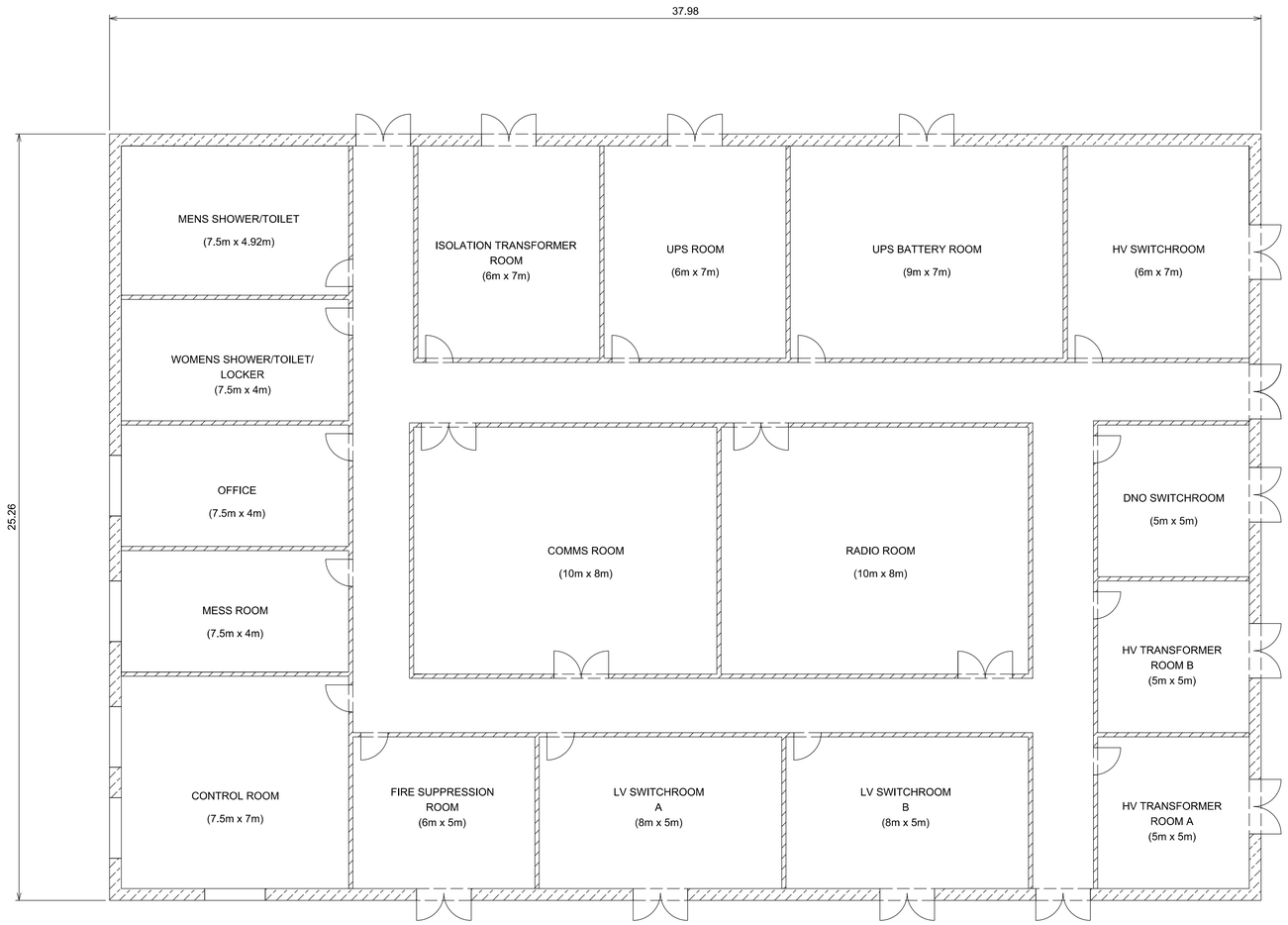

Notes

Key to symbols

Reference drawings

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Title

Silvertown River Crossing
Bored Tunnel Option
Principal Tunnel Services Building
Building Plan

Designed	I. Siddy	IS	Eng check	M. Zbucki	MZ
Drawn	Z. Zuberi	ZZG	Coordination	S. Johnson	SJ
Dwg check	I. Siddy	IS	Approved	R. Hall	RCH

Scale at A1	Status	Rev
1:100	PRE	P1

Drawing Number

MMD-298348-H-DR-00-ZZ-1003

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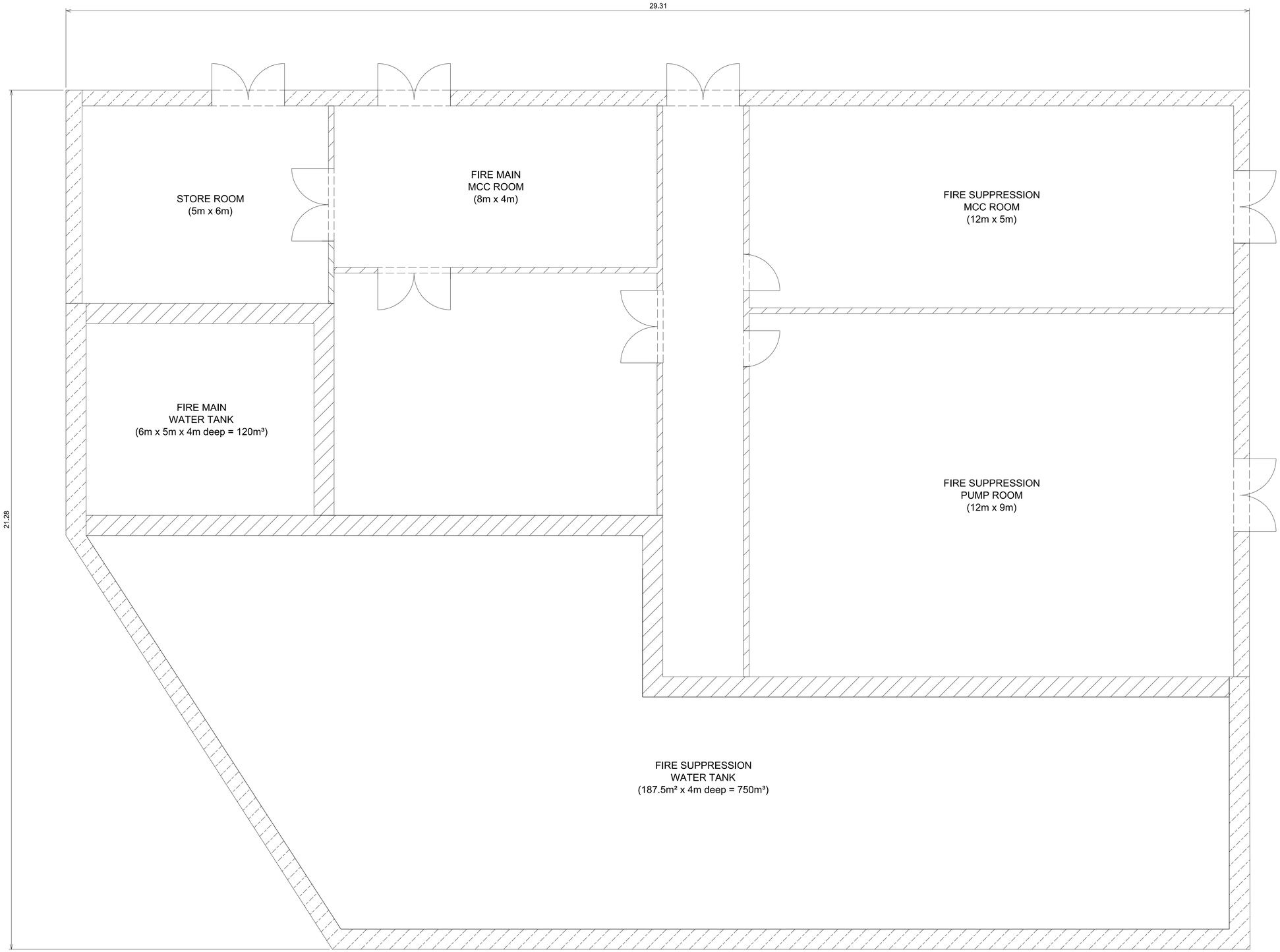

Notes

Key to symbols

Reference drawings

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Title

Silvertown River Crossing
Bored Tunnel Option
Fire Tanks and Pump Room Building
Building Plan

Designed	I. Siddy	IS	Eng check	M. Zbucki	MZ
Drawn	Z. Zuberi	ZZG	Coordination	S. Johnson	SJ
Dwg check	I. Siddy	IS	Approved	R. Hall	RCH

Scale at A1	Status	Rev
1:50	PRE	P1

Drawing Number

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Notes

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Title

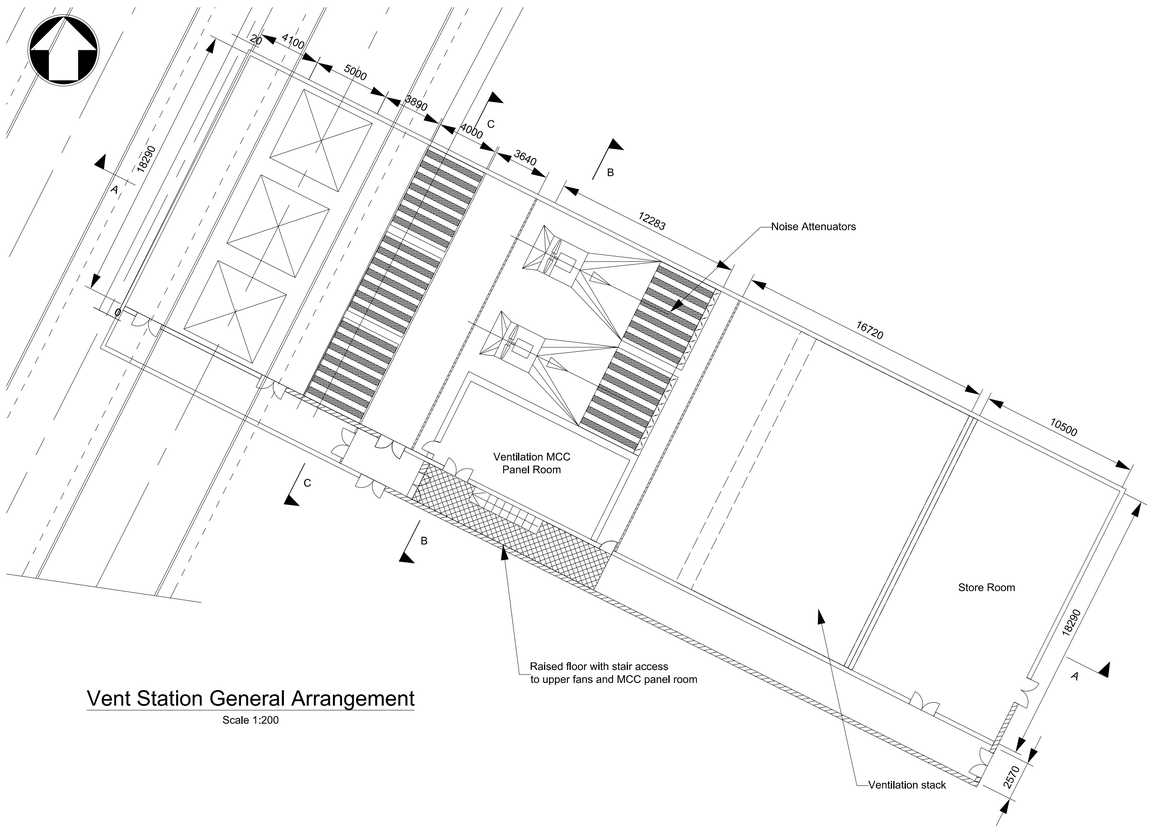
Silvertown River Crossing
Bored Tunnel Option
Secondary Tunnel Services Building
Building Plan

Designed	I. Siddy	IS	Eng check	M. Zbucki	MZ
Drawn	Z. Zuberi	ZZG	Coordination	S. Johnson	SJ
Dwg check	I. Siddy	IS	Approved	R. Hall	RCH

Scale at A1	Status	Rev
1:100	PRE	P1

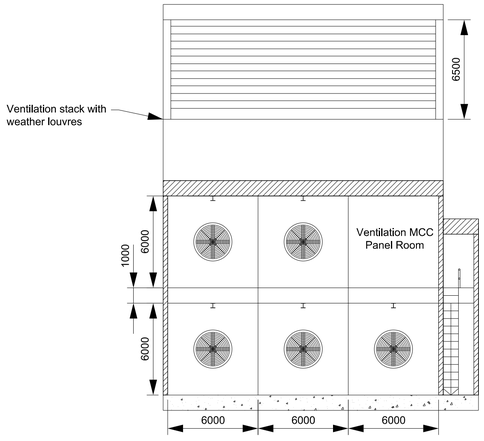
Drawing Number

MMD-298348-H-DR-00-ZZ-1005



Vent Station General Arrangement

Scale 1:200



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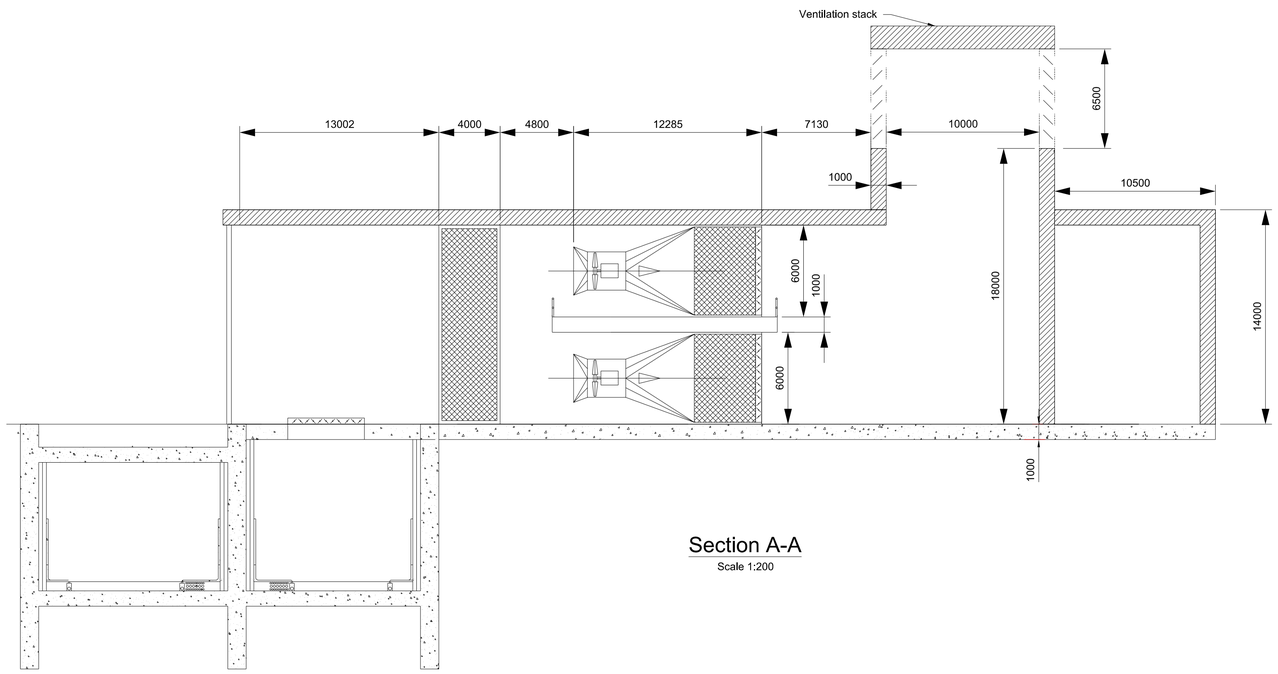

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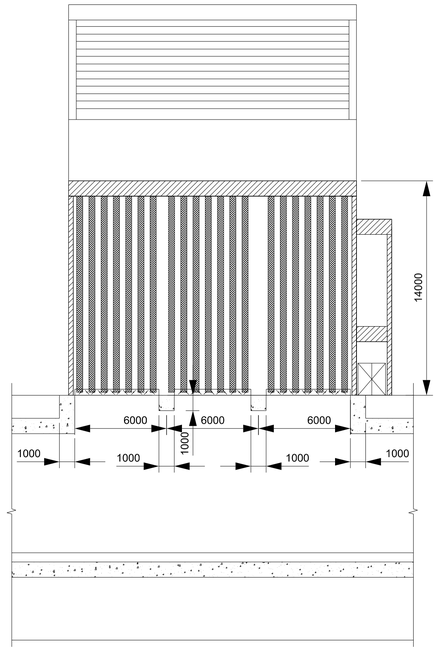

Section C-C

Scale 1:200

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Horizontal Scale 1:50 @ A1

0 10m 20m

Horizontal Scale 1:200 @ A1

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Notes

1. All dimensions are in millimetres
2. All levels are in metres above AOD
3. Do not scale if indoubt ask

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	16/04/2013	ZZG	PRELIMINARY ISSUE	MZ	RCH

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Client

Transport for London

Transport for London
50 Victoria Street
London
SW1H 0TL

Title

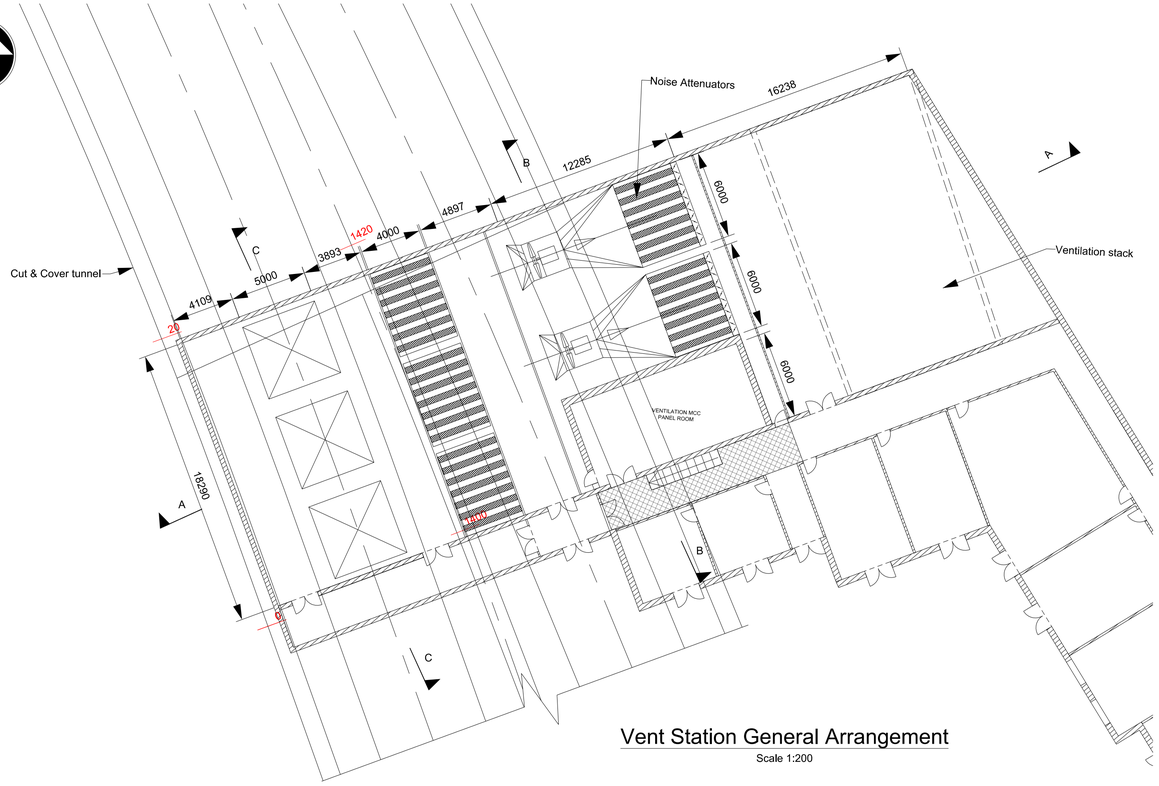
Silvertown River Crossing
Bored Tunnel Option
Greenwich Ventilation Shaft
General Arrangement and Sections

Designed	I. Siddy	IS	Eng check	M. Zbucki	MZ
Drawn	Z. Zuberi	ZZG	Coordination	S. Johnson	SJ
Dwg check	I. Siddy	IS	Approved	R. Hall	RCH

Scale at A1	Status	Rev
1:200	PRE	P1

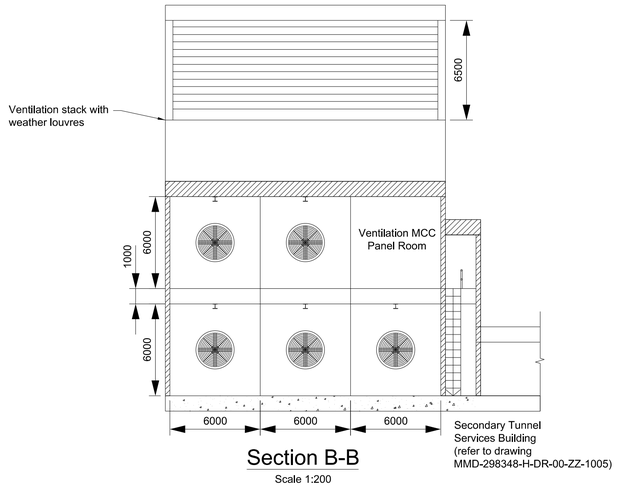
Drawing Number

MMD-298348-H-DR-00-ZZ-1006



Vent Station General Arrangement

Scale 1:200



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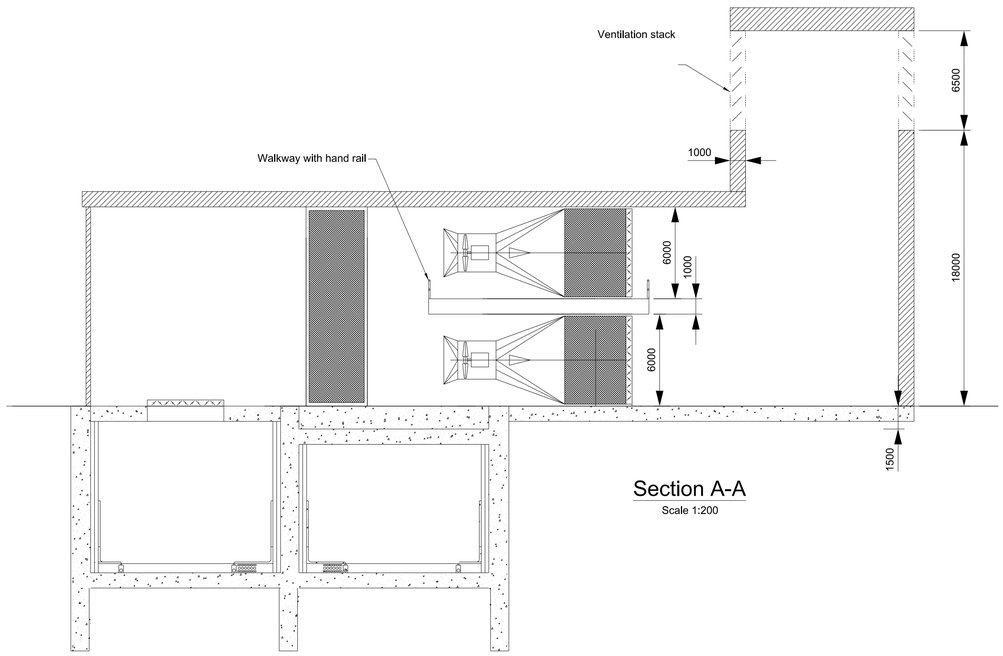

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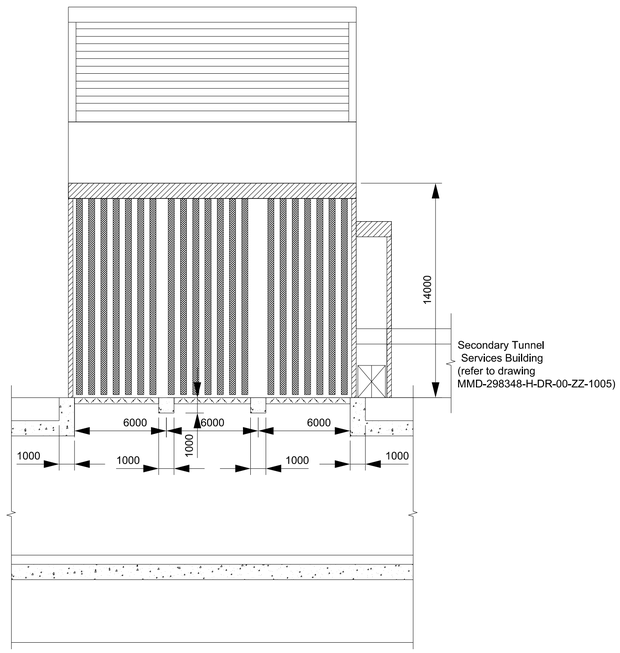
Scale 1:200



Section C-C

Scale 1:200

0 10m 20m

Horizontal Scale 1:200 @ A1

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Notes

Key to symbols

Reference drawings

MMD-298348-H-DR-00-ZZ-1005 - Secondary Tunnel Services Building - Building Plan

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Client

Transport for London

Transport for London
50 Victoria Street
London
SW1H 0TL

Title

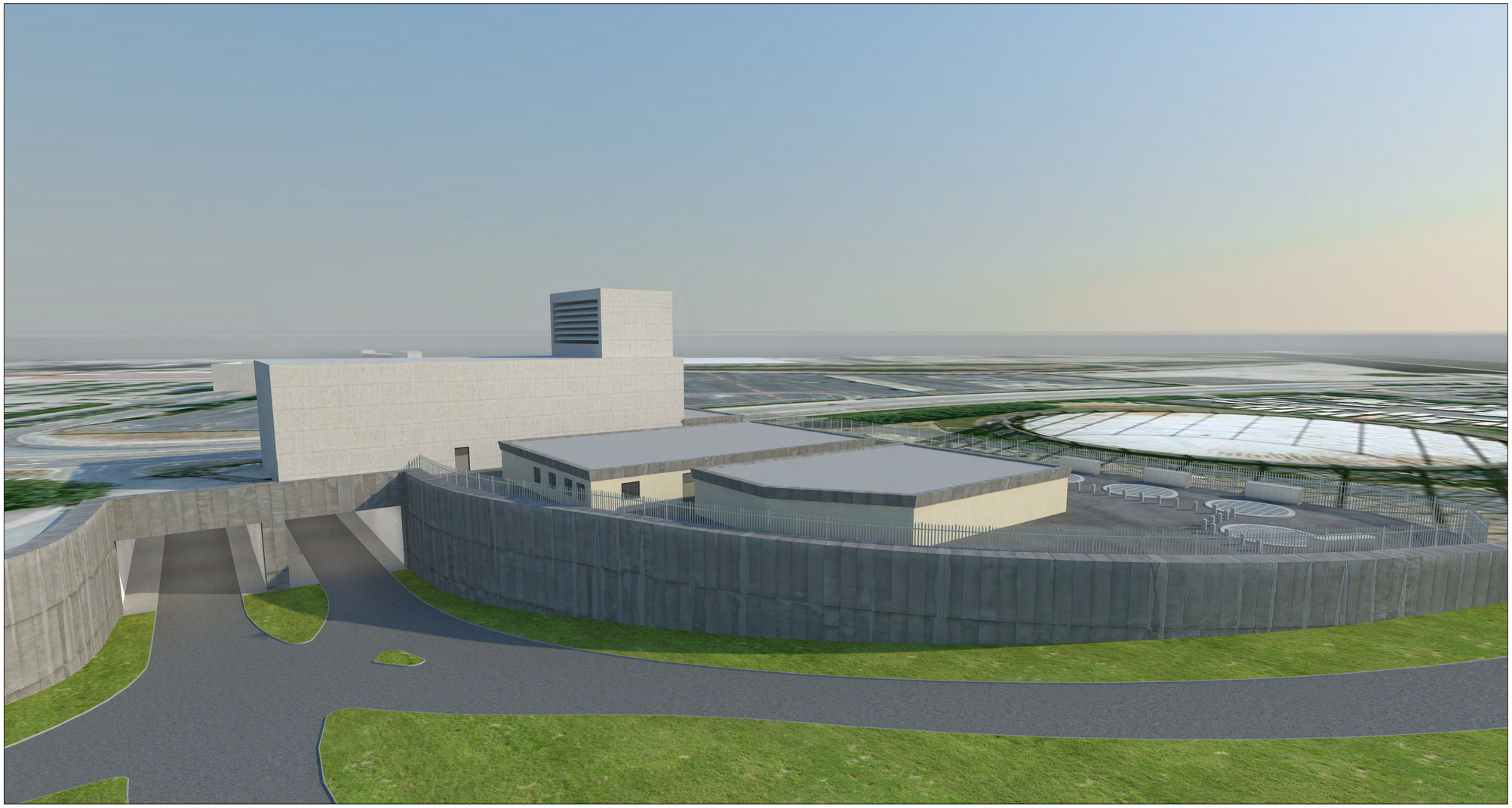
Silvertown River Crossing
Bored Tunnel Option
Silvertown Ventilation Shaft
General Arrangement and Sections

Designed	I. Siddy	IS	Eng check	M. Zbucki	MZ
Drawn	Z. Zuberi	ZZG	Coordination	S. Johnson	SJ
Dwg check	I. Siddy	IS	Approved	R. Hall	RCH

Scale at A1	Status	Rev
1:200	PRE	P1

Drawing Number

MMD-298348-H-DR-00-ZZ-1007



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Title

Silvertown River Crossing
Bored Tunnel Option
Greenwich Approach
Compound and Portal Visualisation

Designed	M. Kowalski	MK	Eng check	C. Njoteh	CN
Drawn	Z. Zuberi	ZZG	Coordination	S. Johnson	SJ
Dwg check	M. Kowalski	MK	Approved	R. Hall	RCH

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NTS	PRE	P1

Drawing Number

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Notes

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Reference drawings

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Title

Silvertown River Cross
Bored Tunnel Option
Silvertown Approach
Compound Visualisation

Designed	M. Kowalski	MK	Eng check	C. Njoteh	CN
Drawn	Z. Zuberi	ZZG	Coordination	S. Johnson	SJ
Dwg check	M. Kowalski	MK	Approved	R. Hall	RCH

Scale at A1	Status	Rev
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Drawing Number

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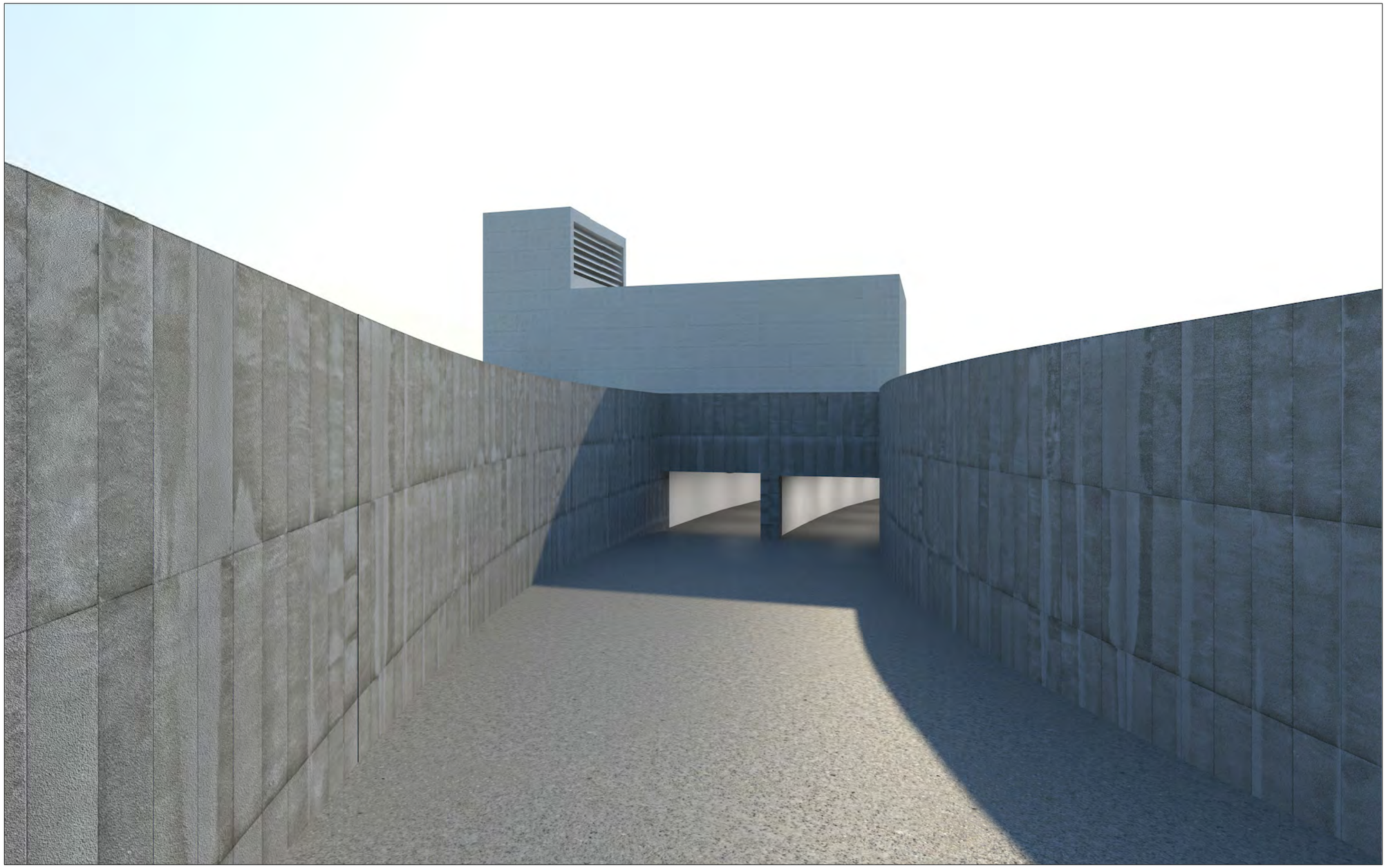

Notes

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	26/04/2013	ZZG	PRELIMINARY ISSUE	CN	RCH

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Client

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Title

Silvertown River Crossing
Bored Tunnel Option
Silvertown Approach
Portal Visualisation

Designed	M. Kowalski	MK	Eng check	C. Njoteh	CN
Drawn	Z. Zuberi	ZZG	Coordination	S. Johnson	SJ
Dwg check	M. Kowalski	MK	Approved	R. Hall	RCH

Scale at A1	Status	Rev
NTS	PRE	P1

Drawing Number

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A.2. Masterplan Reference Drawings

Drawing Title	Drawing Number
GREENWICH PENINSULA CABLE CAR AREA MASTERPLAN MAXIMUM & MINIMUM BUILDING HEIGHTS ABOVE ORDNANCE DATUM	DEW 7C PA_03_150 Rev P5
MAXIMUM BUILDING HEIGHTS ABOVE ORDNANCE DATUM GREENWICH PENINSULA – PLANNING APPLICATION DRAWING	DEW PA 03 025
ROAD JUNCTION OPTIONS GREENWICH PENINSULA – PLANNING APPLICATION DRAWING	DEW PA 03 217

Greenwich Peninsula

0 m 10 20 30 40 50 100

1:2000 @ A3

GREENWICH PENINSULA CABLE CAR AREA MASTERPLAN

MAXIMUM & MINIMUM BUILDING HEIGHTS ABOVE ORDNANCE DATUM

FARRELLS

LOCATION DWG NO: REV.
DEW 7C PA_03_150 P5
DATE 2010.11.25
SCALE 1:2000 @ A3

NOTES:

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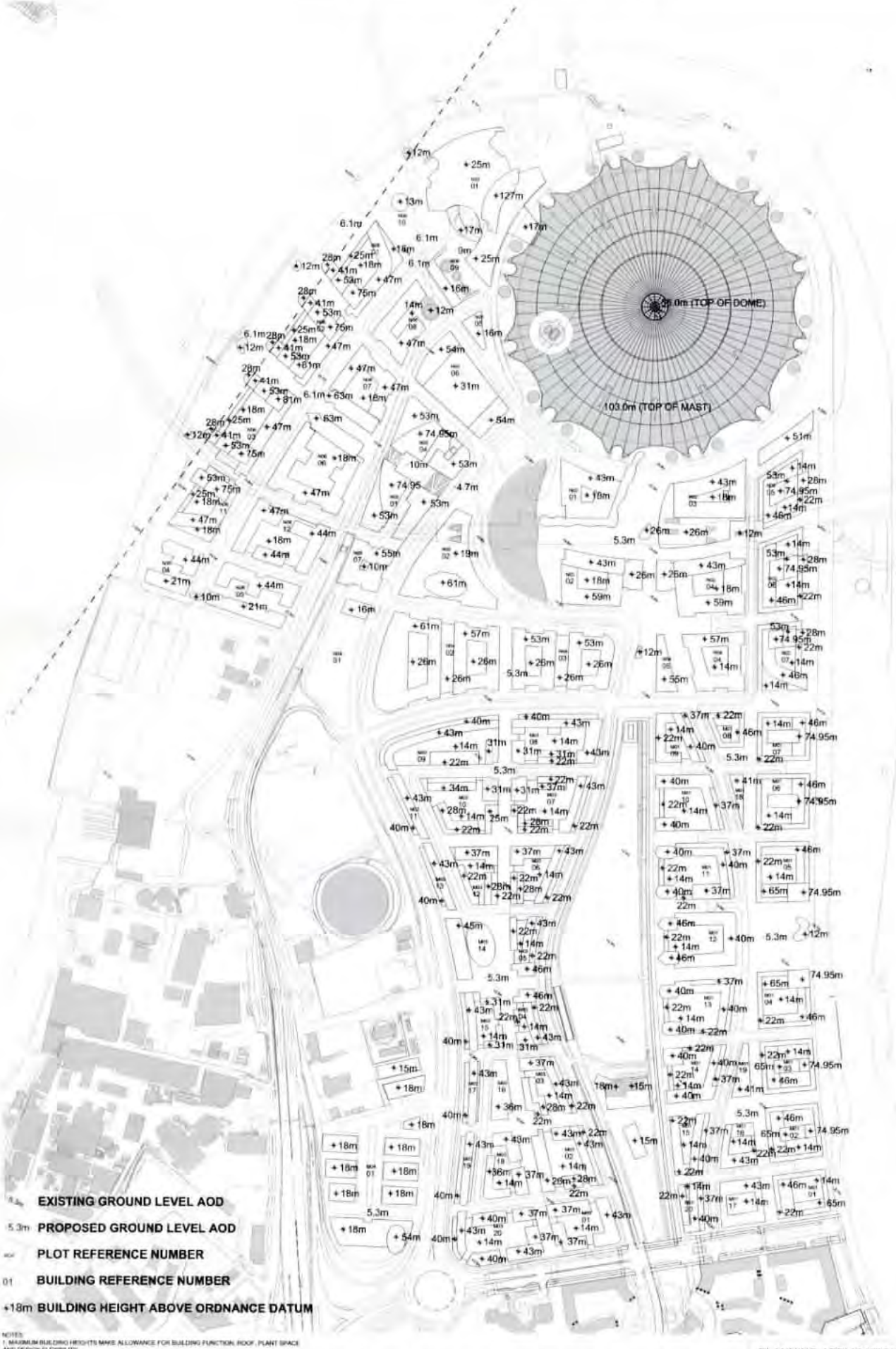

EXISTING GROUND LEVEL AOD

5.3m **PROPOSED GROUND LEVEL AOD**

PLOT REFERENCE NUMBER

01 **BUILDING REFERENCE NUMBER**

+18m **BUILDING HEIGHT ABOVE ORDNANCE DATUM**

NOTES:
1. MAXIMUM BUILDING HEIGHTS MAKE ALLOWANCE FOR BUILDING FUNCTION, ROOF, PLANT SPACE AND DESIGN FLEXIBILITY

SCALE 1:2000 @ A1

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MAXIMUM BUILDING HEIGHTS ABOVE ORDNANCE DATUM

GREENWICH PENINSULA

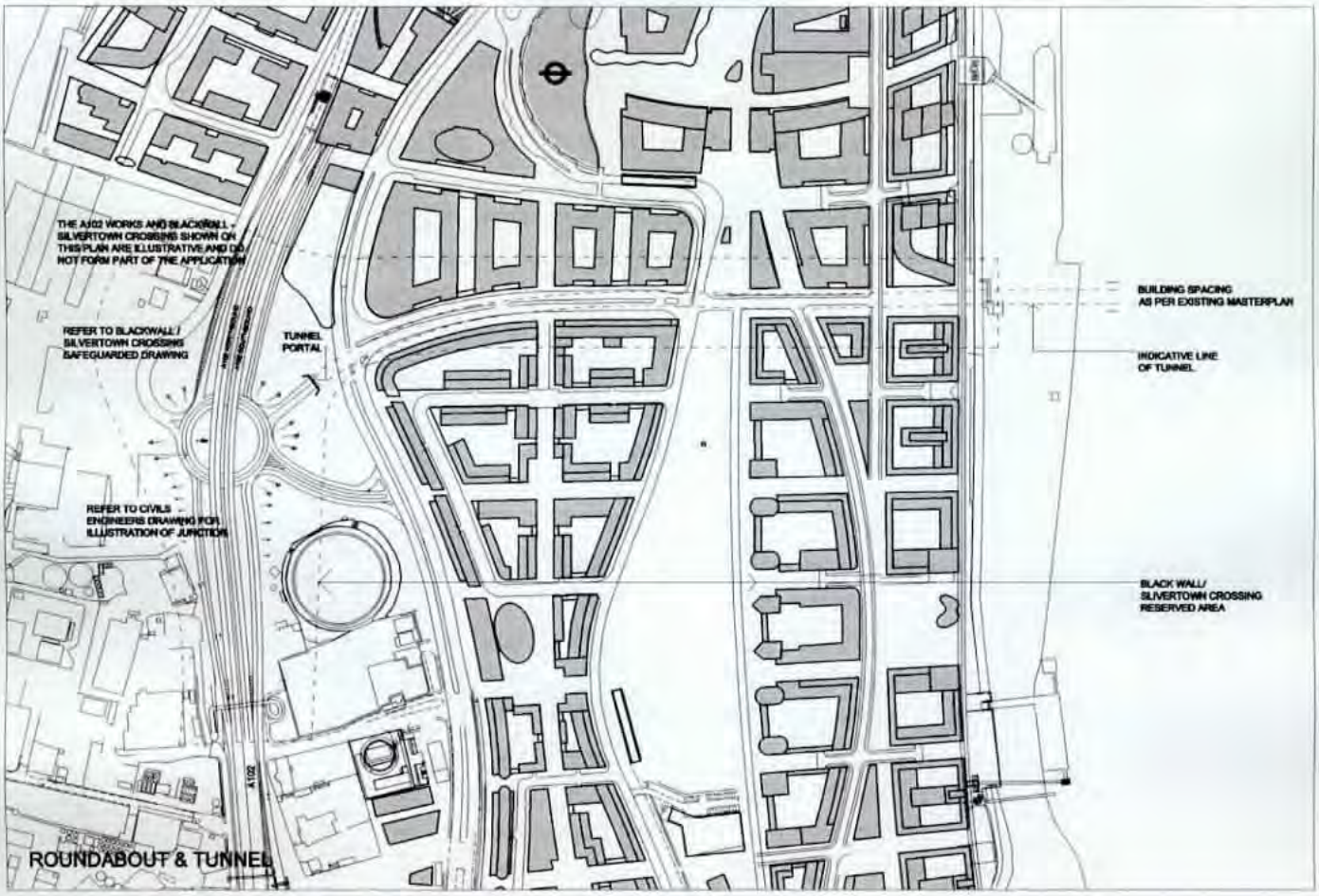
TERRY FARRELL & PARTNERS

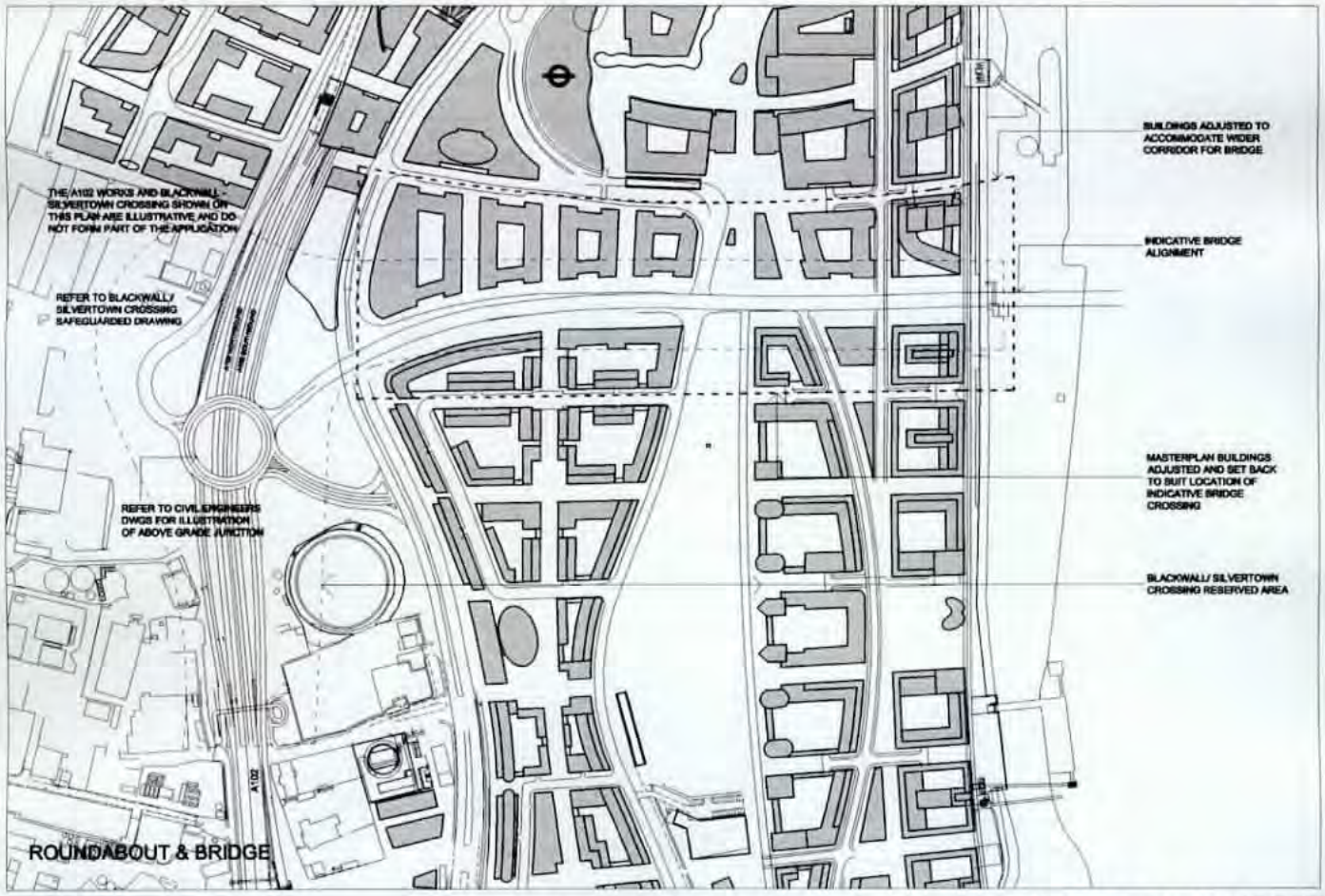
PLANNING APPLICATION DRAWING

DEW PA 03_025

18/12/02

GREENWICH PENINSULA





SCALE 1:2000 @ A1

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ROAD JUNCTION OPTIONS

GREENWICH PENINSULA

TERRY FARRELL PARTNERS

PLANNING APPLICATION DRAWING

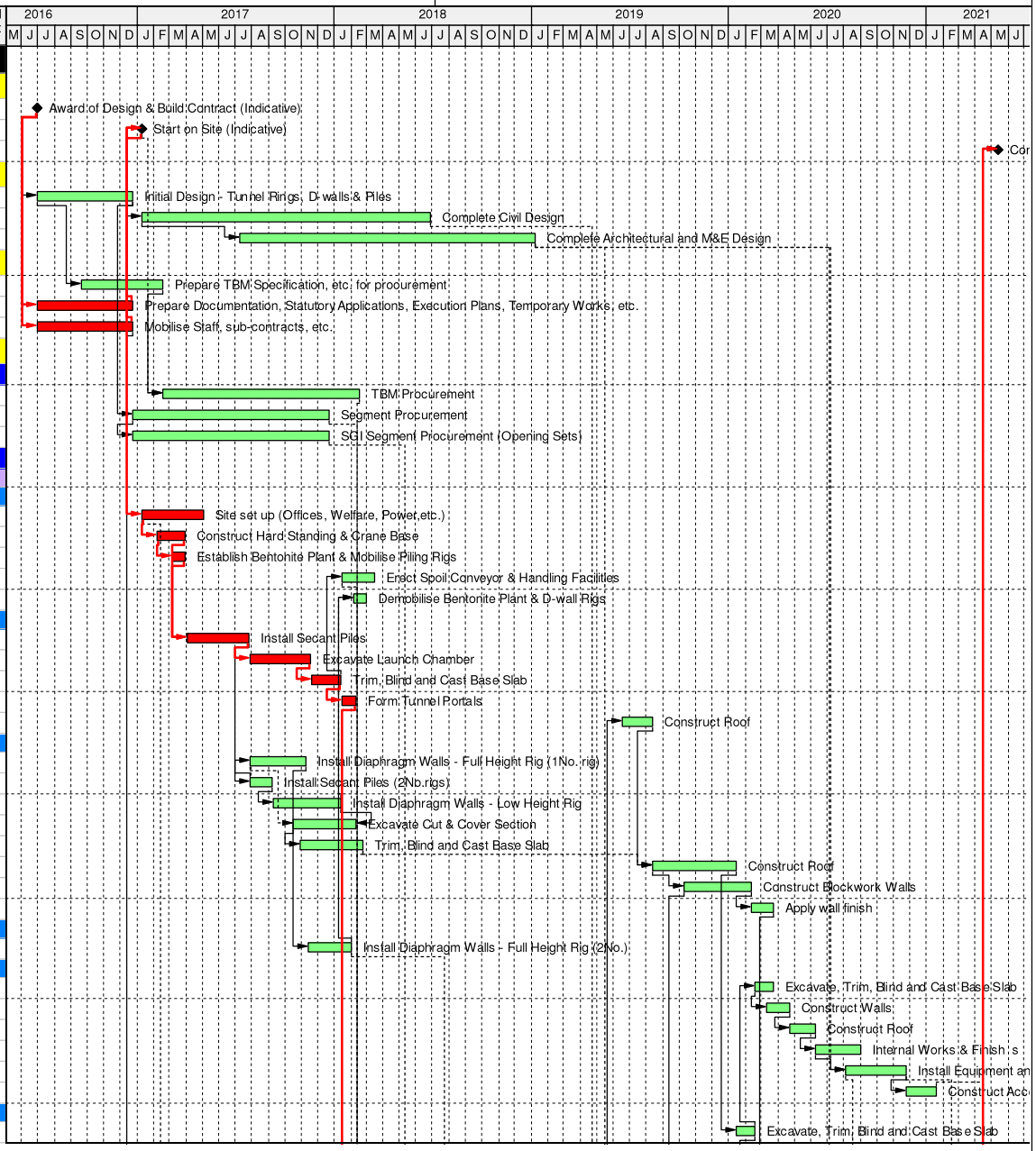
DEW PA 03_217

18/12/02

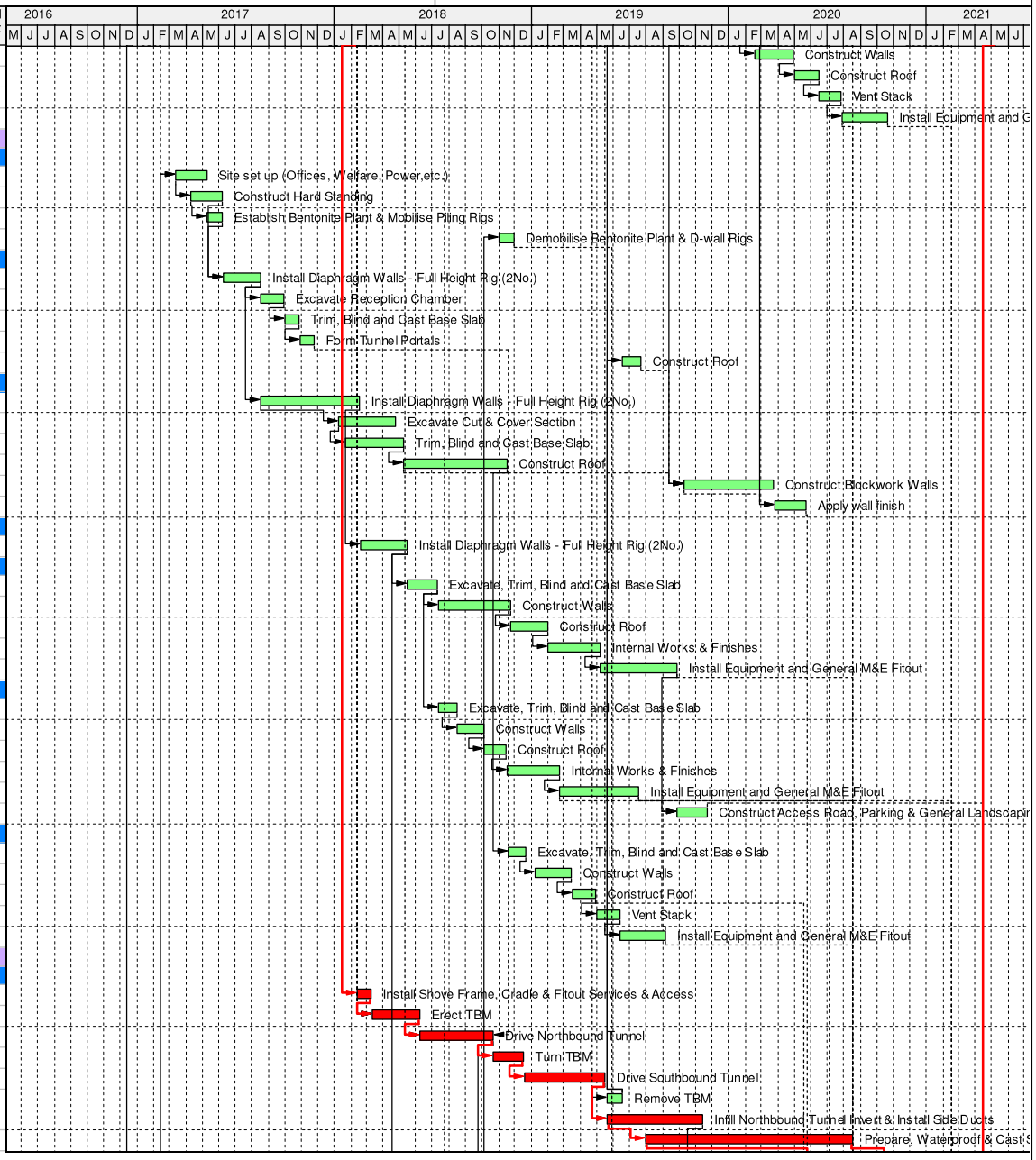
GREENWICH PENINSULA

Appendix B. Construction Programme

Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
Silvertown Crossing Study		1197	30-Jun-16	13-May-21	0
Key Dates		1197	30-Jun-16	13-May-21	0
KD.1000	Award of Design & Build Contract (Indicative)	0	30-Jun-16*		0
KD.1010	Start on Site (Indicative)	0	09-Jan-17*		0
KD.1020	Construction Completion & Handover	0		13-May-21	0
Design		617	30-Jun-16	07-Jan-19	360
A1000	Initial Design - Tunnel Rings, D-walls & Piles	126	30-Jun-16	23-Dec-16	15
A1010	Complete Civil Design	365	09-Jan-17	28-Jun-18	217
A1020	Complete Architectural and M&E Design	365	10-Jul-17	07-Jan-19	360
Preconstruction		156	30-Jun-16	17-Feb-17	15
PC1000	Prepare TBM Specification, etc. for procurement	100	19-Sep-16	17-Feb-17	15
PC1010	Prepare Documentation, Statutory Applications, Execution Plans, Te	126	30-Jun-16	23-Dec-16	0
PC1020	Mobilise Staff, sub-contracts, etc.	126	30-Jun-16	23-Dec-16	0
Tunnel Works		1007	24-Dec-16	09-Feb-21	64
Construction Procurement		421	24-Dec-16	17-Feb-18	110
PR.1000	TBM Procurement	365	18-Feb-17	17-Feb-18	22
PR.1010	Segment Procurement	365	24-Dec-16	23-Dec-17	78
PR.1020	SGI Segment Procurement (Opening Sets)	365	24-Dec-16	23-Dec-17	166
Construction		1007	09-Jan-17	09-Feb-21	64
Silvertown		992	09-Jan-17	19-Jan-21	79
Site Preparatory Works		295	09-Jan-17	16-Mar-18	776
ST.1050	Site set up (Offices, Welfare, Power,etc.)	80	09-Jan-17	03-May-17	0
ST.1060	Construct Hard Standing & Crane Base	40	06-Feb-17	31-Mar-17	0
ST.1070	Establish Bentonite Plant & Mobilise Piling Rigs	20	06-Mar-17	31-Mar-17	0
ST.1080	Erect Spoil Conveyor & Handling Facilities	45	15-Jan-18	16-Mar-18	20
ST.1090	Demobilise Bentonite Plant & D-wall Rigs	20	05-Feb-18	02-Mar-18	786
TBM Launch Chamber		582	03-Apr-17	12-Aug-19	9
ST.1100	Install Secant Piles	80	03-Apr-17	27-Jul-17	0
ST.1110	Excavate Launch Chamber	80	28-Jul-17	17-Nov-17	0
ST.1120	Trim, Blind and Cast Base Slab	30	20-Nov-17	12-Jan-18	0
ST.1130	Form Tunnel Portals	20	15-Jan-18	09-Feb-18	0
ST.1140	Construct Roof	40	18-Jun-19	12-Aug-19	9
Cut and Cover		652	28-Jul-17	24-Mar-20	20
ST.1150	Install Diaphragm Walls - Full Height Rig (1No. rig)	75	28-Jul-17	10-Nov-17	25
ST.1160	Install Secant Piles (2No.rigs)	30	28-Jul-17	08-Sep-17	10
ST.1170	Install Diaphragm Walls - Low Height Rig	80	11-Sep-17	12-Jan-18	10
ST.1180	Excavate Cut & Cover Section	75	16-Oct-17	09-Feb-18	10
ST.1190	Trim, Blind and Cast Base Slab	75	30-Oct-17	23-Feb-18	10
ST.1200	Construct Roof	100	13-Aug-19	14-Jan-20	9
ST.1210	Construct Blockwork Walls	80	09-Oct-19	11-Feb-20	20
ST.1220	Apply wall finish	30	12-Feb-20	24-Mar-20	20
Retained Cut		50	13-Nov-17	02-Feb-18	207
ST.1230	Install Diaphragm Walls - Full Height Rig (2No.)	50	13-Nov-17	02-Feb-18	207
Tunnel Services Building (STSB Building)		225	19-Feb-20	19-Jan-21	79
ST.1260	Excavate, Trim, Blind and Cast Base Slab	25	19-Feb-20	24-Mar-20	9
ST.1270	Construct Walls	30	11-Mar-20	23-Apr-20	9
ST.1280	Construct Roof	30	24-Apr-20	08-Jun-20	9
ST.1290	Internal Works & Finishes	60	09-Jun-20	01-Sep-20	9
ST.1300	Install Equipment and General M&E Fitout	80	04-Aug-20	24-Nov-20	9
ST.1310	Construct Access Road, Parking & General Landscaping	30	25-Nov-20	19-Jan-21	79
Vent Station		195	15-Jan-20	20-Oct-20	14
ST.1320	Excavate, Trim, Blind and Cast Base Slab	25	15-Jan-20	18-Feb-20	9



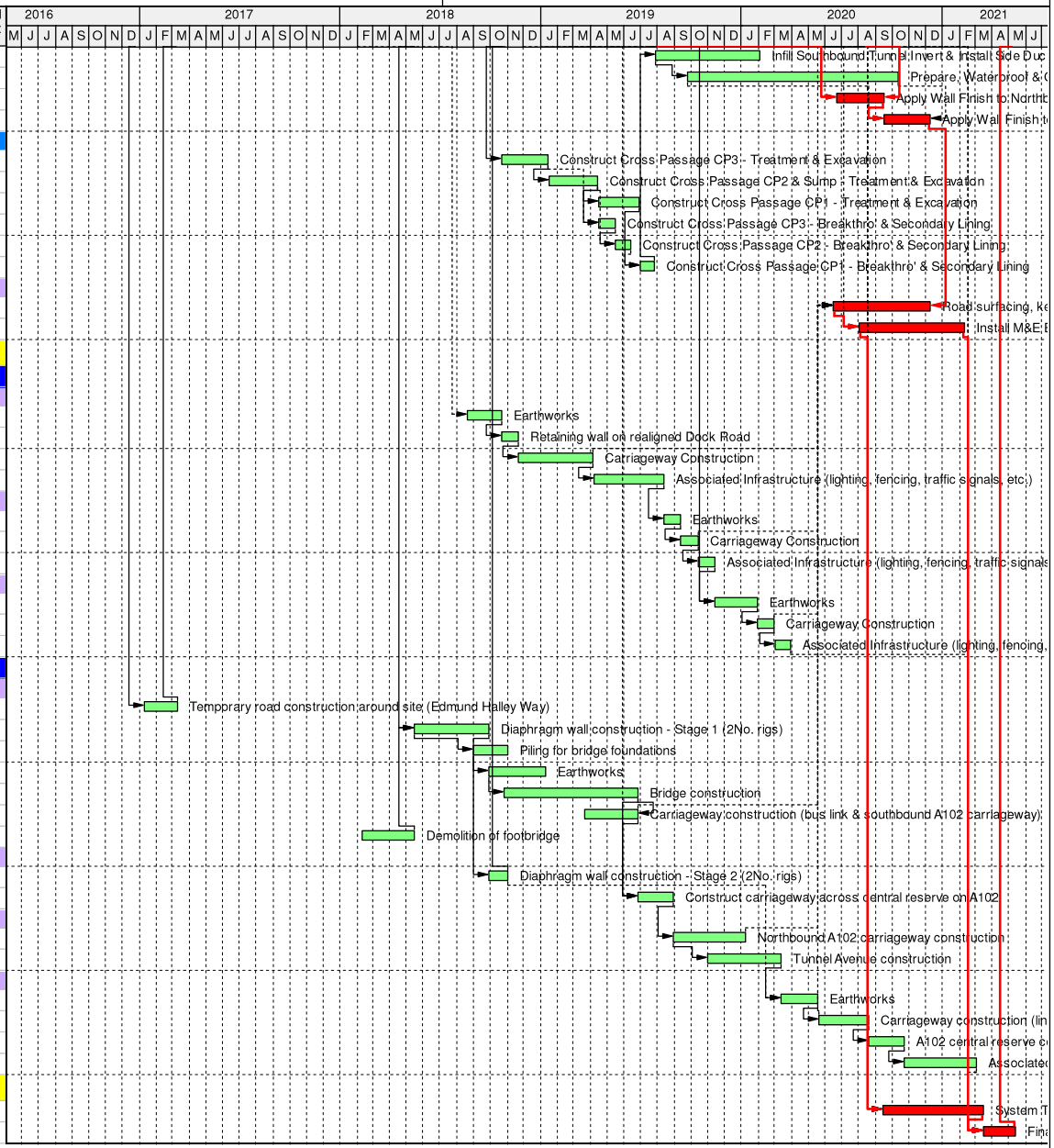
Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
ST.1330	Construct Walls	50	19-Feb-20	30-Apr-20	14
ST.1340	Construct Roof	30	01-May-20	15-Jun-20	14
ST.1350	Vent Stack	30	16-Jun-20	27-Jul-20	14
ST.1360	Install Equipment and General M&E Fitout	60	28-Jul-20	20-Oct-20	14
Greenwich		787	13-Mar-17	22-May-20	239
Site Preparatory Works		429	13-Mar-17	29-Nov-18	142
GR.1000	Site set up (Offices, Welfare, Power,etc.)	40	13-Mar-17	10-May-17	7
GR.1010	Construct Hard Standing	40	10-Apr-17	08-Jun-17	7
GR.1020	Establish Bentonite Plant & Mobilise Piling Rigs	20	11-May-17	08-Jun-17	7
GR.1030	Demobilise Bentonite Plant & D-wall Rigs	20	02-Nov-18	29-Nov-18	142
TBM Reception Chamber		522	09-Jun-17	22-Jul-19	105
GR.1040	Install Diaphragm Walls - Full Height Rig (2No.)	50	09-Jun-17	17-Aug-17	7
GR.1050	Excavate Reception Chamber	30	18-Aug-17	29-Sep-17	216
GR.1060	Trim, Blind and Cast Base Slab	20	02-Oct-17	27-Oct-17	216
GR.1070	Form Tunnel Portals	20	30-Oct-17	24-Nov-17	216
GR.1080	Construct Roof	25	18-Jun-19	22-Jul-19	105
Cut and Cover		677	18-Aug-17	22-May-20	20
GR.1100	Install Diaphragm Walls - Full Height Rig (2No.)	120	18-Aug-17	16-Feb-18	7
GR.1110	Excavate Cut & Cover Section	75	08-Jan-18	24-Apr-18	251
GR.1120	Trim, Blind and Cast Base Slab	75	22-Jan-18	09-May-18	251
GR.1130	Construct Roof	135	10-May-18	16-Nov-18	251
GR.1140	Construct Blockwork Walls	110	09-Oct-19	24-Mar-20	50
GR.1150	Apply wall finish	40	25-Mar-20	22-May-20	20
Retained Cut		59	19-Feb-18	15-May-18	7
GR.1160	Install Diaphragm Walls - Full Height Rig (2No.)	59	19-Feb-18	15-May-18	7
Tunnel Fire Tanks and Pump Rooms Building		340	16-May-18	26-Sep-19	237
GR.1310	Excavate, Trim, Blind and Cast Base Slab	40	16-May-18	11-Jul-18	237
GR.1320	Construct Walls	95	12-Jul-18	22-Nov-18	237
GR.1330	Construct Roof	40	23-Nov-18	31-Jan-19	237
GR.1340	Internal Works & Finishes	65	01-Feb-19	07-May-19	237
GR.1350	Install Equipment and General M&E Fitout	100	08-May-19	26-Sep-19	237
Tunnel Services Building (PTSB Building)		340	12-Jul-18	21-Nov-19	357
GR.1200	Excavate, Trim, Blind and Cast Base Slab	25	12-Jul-18	15-Aug-18	357
GR.1210	Construct Walls	35	16-Aug-18	04-Oct-18	357
GR.1220	Construct Roof	30	05-Oct-18	15-Nov-18	357
GR.1230	Internal Works & Finishes	60	16-Nov-18	21-Feb-19	357
GR.1240	Install Equipment and General M&E Fitout	100	22-Feb-19	17-Jul-19	357
GR.1250	Construct Access Road, Parking & General Landscaping	40	27-Sep-19	21-Nov-19	357
Vent Station		195	19-Nov-18	06-Sep-19	251
GR.1260	Excavate, Trim, Blind and Cast Base Slab	25	19-Nov-18	21-Dec-18	251
GR.1270	Construct Walls	50	07-Jan-19	15-Mar-19	251
GR.1280	Construct Roof	30	18-Mar-19	30-Apr-19	251
GR.1290	Vent Stack	30	01-May-19	13-Jun-19	251
GR.1300	Install Equipment and General M&E Fitout	60	14-Jun-19	06-Sep-19	251
Bored Tunnel		702	12-Feb-18	08-Dec-20	0
Tunnel Construction		702	12-Feb-18	08-Dec-20	0
BT.1000	Install Shove Frame, Cradle & Fitout Services & Access	20	12-Feb-18	09-Mar-18	0
BT.1010	Erect TBM	60	12-Mar-18	07-Jun-18	0
BT.1020	Drive Northbound Tunnel	96	08-Jun-18	22-Oct-18	0
BT.1030	Turn TBM	40	23-Oct-18	17-Dec-18	0
BT.1040	Drive Southbound Tunnel	96	18-Dec-18	17-May-19	0
BT.1050	Remove TBM	20	20-May-19	17-Jun-19	9
BT.1060	Infill Northbound Tunnel Invert & Install Side Ducts	126	20-May-19	13-Nov-19	0
BT.1070	Prepare, Waterproof & Cast Secondary Lining to Northbound Tunne	260	30-Jul-19	17-Aug-20	0



Silvertown Crossing Study

19-Apr-13

Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
BT.1080	Infill Southbound Tunnel Invert & Install Side Ducts	126	29-Jul-19	04-Feb-20	1
BT.1090	Prepare, Waterproof & Cast Secondary Lining to Southbound Tunne	260	24-Sep-19	12-Oct-20	1
BT.1100	Apply Wall Finish to Northbound Tunnel	60	23-Jun-20	15-Sep-20	0
BT.1110	Apply Wall Finish to Southbound Tunnel	60	16-Sep-20	08-Dec-20	0
Cross Passages		185	23-Oct-18	26-Jul-19	1
CP.1020	Construct Cross Passage CP3 - Treatment & Excavation	50	23-Oct-18	14-Jan-19	1
CP.1050	Construct Cross Passage CP2 & Sump - Treatment & Excavation	65	15-Jan-19	15-Apr-19	1
CP.1070	Construct Cross Passage CP1 - Treatment & Excavation	50	16-Apr-19	28-Jun-19	1
CP.1110	Construct Cross Passage CP3 - Breakthro' & Secondary Lining	20	16-Apr-19	16-May-19	11
CP.1160	Construct Cross Passage CP2 - Breakthro' & Secondary Lining	20	17-May-19	14-Jun-19	11
CP.1200	Construct Cross Passage CP1 - Breakthro' & Secondary Lining	20	01-Jul-19	26-Jul-19	1
General Works		161	15-Jun-20	09-Feb-21	0
GW.1000	Road surfacing, kerbs, footways, fire protection, etc.	126	15-Jun-20	08-Dec-20	0
GW.1010	Install M&E Equipment	126	03-Aug-20	09-Feb-21	0
Highway Infrastructure Works		1024	09-Jan-17	04-Mar-21	7
Silvertown Site		396	20-Aug-18	31-Mar-20	234
Phase 1		241	20-Aug-18	12-Aug-19	71
HWS.1000	Earthworks	45	20-Aug-18	22-Oct-18	71
HWS.1010	Retaining wall on realigned Dock Road	22	23-Oct-18	21-Nov-18	71
HWS.1020	Carriageway Construction	87	22-Nov-18	05-Apr-19	71
HWS.1030	Associated Infrastructure (lighting, fencing, traffic signals, etc.)	87	08-Apr-19	12-Aug-19	71
Phase 2		66	13-Aug-19	13-Nov-19	71
HWS.2000	Earthworks	22	13-Aug-19	12-Sep-19	71
HWS.2010	Carriageway Construction	22	13-Sep-19	14-Oct-19	71
HWS.2020	Associated Infrastructure (lighting, fencing, traffic signals, etc.)	22	15-Oct-19	13-Nov-19	71
Phase 3		89	14-Nov-19	31-Mar-20	234
HWS.3000	Earthworks	45	14-Nov-19	29-Jan-20	71
HWS.3010	Carriageway Construction	22	30-Jan-20	28-Feb-20	71
HWS.3020	Associated Infrastructure (lighting, fencing, traffic signals, etc.)	22	02-Mar-20	31-Mar-20	234
Greenwich Site		1024	09-Jan-17	04-Mar-21	7
Phase 1		609	09-Jan-17	26-Jun-19	7
HWG.1000	Temporary road construction around site (Edmund Halley Way)	45	09-Jan-17	10-Mar-17	7
HWG.1010	Diaphragm wall construction - Stage 1 (2No. rigs)	95	16-May-18	27-Sep-18	7
HWG.1020	Piling for bridge foundations	45	31-Aug-18	01-Nov-18	7
HWG.1030	Earthworks	65	28-Sep-18	10-Jan-19	7
HWG.1040	Bridge construction	160	26-Oct-18	26-Jun-19	7
HWG.1050	Carriageway construction (bus link & southbound A102 carriageway	65	22-Mar-19	26-Jun-19	7
HWG.1060	Demolition of footbridge	65	09-Feb-18	15-May-18	7
Phase 2		225	28-Sep-18	29-Aug-19	7
HWG.2000	Diaphragm wall construction - Stage 2 (2No. rigs)	25	28-Sep-18	01-Nov-18	142
HWG.2010	Construct carriageway across central reserve on A102	45	27-Jun-19	29-Aug-19	7
Phase 3		130	30-Aug-19	12-Mar-20	7
HWG.3000	Northbound A102 carriageway construction	85	30-Aug-19	09-Jan-20	7
HWG.3010	Tunnel Avenue construction	85	01-Nov-19	12-Mar-20	7
Phase 4		240	13-Mar-20	04-Mar-21	7
HWG.4010	Earthworks	45	13-Mar-20	19-May-20	7
HWG.4020	Carriageway construction (links from A102 to tunnel portal)	65	20-May-20	19-Aug-20	7
HWG.4030	A102 central reserve construction	45	20-Aug-20	22-Oct-20	7
HWG.4040	Associated infrastructure (lighting, fencing, traffic signals, etc)	85	23-Oct-20	04-Mar-21	7
Commissioning & Testing		160	15-Sep-20	13-May-21	0
CT.1000	System Testing & Commissioning	120	15-Sep-20	15-Mar-21	0
CT.1010	Final Integrated Testing, Commissioning and Handover	40	16-Mar-21	13-May-21	0



Appendix C. QRA Risk Register

001 – 065 are individual risk items

U1 – U30 are modelled estimating uncertainties

Category	Ref	Title	Description	Impact	Potential Risk Control Measures / Actions
Planning & Consent	001	Failure to obtain powers	TfL Failing to obtain the powers to carry out the works. - Difficulties in acquiring required residential or commercial land from private ownership - Objections from Pressure of User Groups	*Not modelled*	Engagement with all stakeholder parties High level or political influencing Design & Mitigation to reduce potential of objections
Planning & Consent	002	Conflicting development proposals along entire alignment	Conflicting development proposals along the alignment (changes to local land use) could lead to the need/pressure of changing the current alignment, that could lead to the need for additional links or changes to the configuration.	*Not modelled - assumed that safeguarding would be a sufficient mitigation. Any changes would be made if they were beneficial for the scheme.*	Early liaison with land owners (TfL and LDA) Utilising land ownership data, compiled during Cable Car negotiations, when developing land plans will help ensure effects on third parties are minimised and reduce risk from potential objectors.
Planning & Consent	003	Changes to the construction methodology / sequence	Risk that the construction methodology will be different that currently assumed (and costed) leading to changes in the cost and timescales of implementing the scheme. Reasons could be: - Constraints on working underneath the cable car (and the cable car exclusion zone constraint) - Unforeseen Ground Conditions leading to change in alignment and methodology to construct the scheme - e.g. old river walls (the old dock issue is resolved but needs to be taken into consideration)	*Ground condition risk assumed covered in costings and high level estimating uncertainties, with a residual risk for Cross Passages - allow a chance at 10% per cross passage "solutions" (3 No total) for ground treatment needing to be reworked causing an overall impact of about a month to resolve (20 working days at a cost of £25k per day - £0.5m).* *Additional protection measures for the cable car foundations are not modelled as a risk as the current design are based on the cable car as built information.*	Close liaison with Cable Car Team Mitigation through design and CC operation Advanced detailed investigations Re-align tunnel to avoid obstruction Alter construction technique used
Stakeholders/Interfaces	004	Access for other modes during construction	Compromise on location and layout of construction site. Risk of more onerous costs to facilitate necessary arrangements, including the maintenance of access (roads) and provision of additional facilities (e.g. temporary bridges)	*Allow additional impact of £0.5m to £1.5m for additional costs.*	Take access into account during detailed construction planning Further development of diversion schemes
Stakeholders/Interfaces	005	Mitigation measures required to avoid objections from the PLA	PLA may object to the scheme on the grounds of Environmental Impacts and/or the impact on River Navigation (during construction as well as operations), maintenance dredging, bringing in materials/spoil disposal and general river access.	*No additional risk modelled, current design solution assumed to have minimal impact of the river.* *Construction methodology assumes usage of the river for soil disposal with the residual risk of additional cost for upgrading the facilities.*	Early liaison with PLA

Category	Ref	Title	Description	Impact	Potential Risk Control Measures / Actions
Stakeholders/Interfaces	006	Overlapping construction period with other projects	Delay or advance of other projects impacting on tunnel - overlapping construction periods leading to Cumulative noise, vibration etc. Could have an impact due to the Interface with Master Plan North and South. Risk regarded as small.	*No major impacts assumed. Allow 25% chance of additional costs at £250k to £500k.*	Construction phasing plan in liaison with other developers/contractors on site EIA will consider cumulative effects as part of assessment
Stakeholders/Interfaces	007	Proximity to cable car foundations	The proximity to the cable car foundations could lead to the need to do changes to the current design	*Closed, foundations are known are considered in developing the scheme.*	To be considered as part of detailed design Verification of as built documentation
Closed – only risk for ITT	*008*	*South Station access (impact on) cable car*			
Stakeholders/Interfaces	009	Potential Thames Wharf DLR station in close proximity to north portal	Need to revise designs to take into account Thames Wharf DLR Station (approximately 100m east of the northern cut and cover approach). As there are currently no detailed plans for the station this could lead to changes to the current design.	*Risk retained. Allow a 5% chance of additional costs ranging from £0.5m to £1m.*	Close liaison with DLR throughout the project Safeguarding information to be reviewed Further development of highways design
Closed – only risk for ITT	*010*	*Interface / Impact London Cruises*			
Closed – not believed to be a risk to the Scheme	*011*	*Jubilee Line Safeguarding Impact*			
Stakeholders/Interfaces	012	Working in close proximity to DLR	Construction restrictions, the project may require temporary and/or permanent possession of DLR Land for Construction. (Failure to obtain consents from DLR can stop project)	*Not seen as a high risk, allow a 5% chance of an impact with a cost of £0.5m to £1m.*	Close liaison with DLR throughout the project (information available) Plan around constraints Further development of highways design
Stakeholders/ Interfaces	013	National Grid Gasholder	A single gas holder remains on the Greenwich side and the timeframe for decommissioning is uncertain. Decommissioning may present opportunities for works site if it is carried out ahead of the tunnel works. However, there may be specified works exclusion zones within the proximity of the gas holder.	*Assumed to be decommissioned before the works commences. Residual risk of interface with works assessed at 5% of an impact of £250k to £1000k.*	Monitor
Environment	014	Objections from EA	Objections and design changes resulting from consultation with the Environment Agency with regards to contamination and flood prevention. Note: Cross passages and works in river water will require consent from EA etc.	*Issue may emerge with regards to discharging water, Ground Treatments, Interventions, grouting and spoil treatment. Allow additional cost to mitigate issues of £0.5m to £2m at a 20% chance.* *In addition the scheme costs makes allowances for Environmental mitigation costs (including Flora and Fauna)*	Stakeholder engagement strategy

Category	Ref	Title	Description	Impact	Potential Risk Control Measures / Actions
Environment	015	Objections to the Scheme - Environmental Organisations	Various groups (not identified in separate risks), including: - Nature England - terrestrial - Marine Management Organisations - Green Organisations - Green Benefits / Traffic during constructions	*Additional allowances for reinstatement, screening and planting made in the estimate - allow a 50/50 at an additional cost of £100k to £500k for further mitigations being required.*	Further liaison with Organisations
Environment	016	Construction noise, vibration, light and dust	Objections and complaints (local authorities, residents and landowners)	*Sufficient mitigation measures for expected construction impact are assumed to be covered in construction costs and associated uncertainties. Small residual risk at 20% of £0.5m to £1m.*	Noise impact assessment and mitigation measures Engagement with residents and developers to align the scheme with current and emerging development
Environment	017	Traffic impact higher than forecasted	Traffic backing up in new tunnel (more actual traffic than designed for) compromising air quality and safety. The risk would be caused by insufficient capacity in the proposal due to traffic flow forecasting or modelling inaccuracies.	*Cost estimate to include allowance for Intelligent Traffic Systems and additional measures to manage traffic flows (suppression). This allowance may not be sufficient allow a 50/50 chance of costs increasing with up to £3m.*	Carry out traffic modelling and implement resulting recommended measures Tunnel and adjacent network designed to avoid congestion Allowance to be made in the estimate (but with residual risk)
Environment	018	Increase cost of disposing excavated material	Risk of increased cost of disposing excavated material, due to higher rates and/or lack of landfill void space.	*Covered in estimating uncertainties - not modelled as a separate risk.*	Identify local landfill sites, available void spaces, other larger projects to re-use material. Develop spoil removal/re-use strategy.
Environment	019	Contaminated Ground	During cut and cover construction and the approach works there is a risk of encountering contaminated ground that could increase costs and delay works.	*Extra over on spoil disposal cost allowed for in line with findings from studies carried out and this is subject to uncertainties identified. Spoil classification area on site to test spoil and arrange of disposal. Allow a 25% that overall costs are to high leading to savings of say £500k and 25% chance of additional costs of up to £2500k.*	Further site investigations
Environment	020	More onerous Traffic management during construction	There is a risk that the traffic management planned (and costed) could be more onerous during the construction or the impacts unacceptable due to increased local pollution (due to delays).	*Allow a 10% chance of additional traffic management cost with an impact of £0.5m to £1m.*	Further development of traffic management plan Obtain approval from Borough Highways Authorities for changes to the non-strategic network
Environment	021	Listed building on Blackwall approach	Negative visual impact	*See risk 022.*	Take building into account during design and construction planning
Environment	022	Overall visual impacts	Negative visual impact and objections Additional cost to provide acceptable solutions.	*Allow residual risk of further measures being required, 25% chance of £0.5m to £1m.*	Design so that visual impact is kept to a minimum Through appropriate design visual character can be enhanced

Category	Ref	Title	Description	Impact	Potential Risk Control Measures / Actions
Environment	023	Construction activity in the river (link to consents)	Impact on marine life whilst constructing To accommodate the soil disposal (by river) some additional works could be required to upgrade the Silvertown Wharf facilities. This could included dredging (contamination may be encountered leading to additional costs).	*Allowances made for additional works at Silvertown Wharf. Cost risk of additional cost assessed at 50/50 of cost increasing with up to £1.5m (but could also be less than allowed for, so minimum impact would be a £500k saving).* *In addition residual risk of finding contamination that would require further mitigation at a 10% chance and an impact of £1m to £1.5m.*	Assess as part of EIA process Study to review suitability of current arrangements to deal with the Soil Disposal Plan and wider impact
Environment	024	Archaeological impact	Archaeological findings may delay construction (Archaeological Priority Area)	*5% chance of impact ranging from £1m to £2m.*	Further studies Ensure archaeological works (if required) are allowed for during the early parts of the programme
Closed – see risk 020	*025*	*Impact on air quality from increased traffic*			
Environment	026	Thames River classified as Marine Conservation area	It is likely that the status of the River Thames may change in 2012 (to something like a Thames Estuary Marine Conservation Area) which would likely put more stringent controls on working in the Thames.	*Minor impact, not modelled as a cost risk.*	Review impacts
Environment	027	Flooding of Tunnel during construction/operation	Risk that the design does not accurately take into consideration current and future flood risk (climate change adaptation strategy - sustainability of assets) leading to flooding during construction or operation of the tunnel. (Note: Design to consider flood management - flooding in one tunnel not affecting the other, Environment Agency a key stakeholder for these considerations). Impact could be very severe, and comprise of: - Fatalities, if failing to evacuate effectively - Damage to the structure of the tunnel - Impact on Groundwater	*Construction costs assumed to cover cost of necessary measures being implemented. Temporary cofferdams will need to be constructed to maintain flood defence during the works* ***Floodgates are not included in estimates or cost risk.*** *Catastrophic risk of flooding during construction not modelled.*	Carry out flood-risk assessment and design for recommended strategy Flood risk requirements to be agreed with the Environment Agency Location of cofferdams will need to be agreed by Port of London Authority. Develop construction methods to take into account ground water / final design to accommodate too Design to climate change impacts
Land, Property and Legal	028	Compensation payment not properly understood/ allowed for	There is a risk that the actual compensation payments for the scheme is higher than allowed for in budgets leading to cost overruns.	*Not included as part of cost or risk assessment*	Include contingency in budget / early engagement with stakeholders in order to inform any potential compensation claims and include in budget at an early stage

Category	Ref	Title	Description	Impact	Potential Risk Control Measures / Actions
Land, Property and Legal	029	The current safeguarded area may be contested	Objections (from GPRL and other landowners) to the current use of space may lead to pressure to decrease the footprint at an early stage, leading to the risk of.... ...difficulties later if the detailed design indicate more land being required ...less efficient and more costly solution to implement the scheme (as land may not be available)	*See risk 002*	-
Land, Property and Legal	030	Objections to land acquisition especially British Gas/National Grid Site	Cannot use land (manageable)	*See risk 002*	Design around constraints / early engagement with potential objectors
Land, Property and Legal	031	Acquisition of and operation on construction sites	Potential CPO and delay to programme / cost	*See risk 002*	Design around constraints and liaise with land owners
Operations / Maintenance	032	Operations / Maintenance Facilities	Uncertainty in the need and scope of: - Adequate facilities - Access arrangements - Security/Anti-terrorism measures	*Facilities to be included as part of the base cost. Allow residual risk of £1-2m for the provision of additional facilities not covered for in the base costs, in addition residual risk of more onerous security measure needing to be implemented (this applies to Fire Tanks/ Pump Rooms, 2 No service buildings) at a 20% chance with an impact of £100k to £300k.*	Detailed review of end user requirements
Design and Approvals	033	Risk of Blowout	Risk of blowout. Need to mitigate - based on site investigations.	*Very limited use of compressed air. Risk is very small. However the TBM interventions may require the use of compressed air. If it is required there a small risk (less than 1%) of problem leading to additional costs (catastrophic risk) - £10m risk (insured risk and premium for insurance included in cost estimate). Not modelled with additional cost impact.*	Carry out SI and survey Minimise the tunnel design diameter Relax constraint on alignment gradient to greater than 4% Correct TBM specification Construction control
Design and Approvals	034	Failure to Challenge Standards and/or obtain Approval for the emergency escape and intervention plan	Failure to challenge Standards (especially HA Standard BD78/99 - Road Tunnels) leads to more costly solution. LFEPA (TDSCG - Tunnel Design Safety Consultation Group) do not approve emergency escape and intervention plan	*A maximum cross-passage spacing of 350m has been agreed with London Fire Brigade (LFB) and TfL.* *The current design allows for 3 SCL passages in the bored tunnel and one escape door in cut & cover tunnel (Greenwich). The risk of changes to this assumption are seen as small (5%) but would have a significant impact of 5 No. Cross passages at a cost of £1.9m each.*	Develop relevant cross section and cost Value engineering in detailed design stage. Ongoing peer review to challenge inputs Either comply with BD78/99 in all aspects, or design using a risk-based approach and write a robust analysis (ALARP on evacuation strategy) of the safety case & present it to Fire (LFB) and emergency services.

Category	Ref	Title	Description	Impact	Potential Risk Control Measures / Actions
Design and Approvals	035	Changes to Classification of tunnel (ADR Cat E)	Design assumption is a ADR Cat E tunnel (hazardous materials are banned from tunnel), but risk that this classification changes. This would lead to the need to make changes to the existing tunnel design associated with the drainage and tunnel ventilation solution. In addition it is assumed that an escorting regime would need to be implemented (subject to further assessment should the risk materialise).	*The impacts (in terms of additional costs) are as follows:* *(i) Drainage - installation of slot gutter drainage system would have an impact of £100k to £200k on top of current allowances for gullies.* *(ii) Tunnel Ventilation - increased number and more powerful jet fans (additional cost of £300k to £400k) as well cost associated with the provision of the extra power (larger transformers, LV Switchgear, supplies, floorspace at cost of £100k to £200k)* *(iii) Tunnel Escort System - would require marshalling land, escort vehicles and associated facilities. The capital cost is estimated at £0.5m to £1m.* *The risk assessment has allowed a 5% chance of the risk materialising (with the cost impacts stated above)* *Note that this impact does not include the land cost for the marshalling land and building. In addition there would be an operational cost assessed at £0.5m to £1m per annum to consider, again not included in these calculations.*	Review as part of wider traffic management strategy
Design and Approvals	036	Need to provide Fire Suppression System	There is a risk of needing to provide a Water Fire Suppression System to provide additional protection to the structure than the current design assumes.	*Allow a 50/50 chance of needing a more onerous system. Cost impact assessed at high level at £5m to £7m inclusive of Fire Tests.*	Space allowed for its potential inclusion in the TSB, compounds and sump Further review of cost benefits to be considered, including review of insurance charges
Design and Approvals	037	Unacceptable impact of Chimneys/ventilation stacks	Visual/smoke impact of chimneys/ventilation stacks if needed. Dependant on ventilation solution, air quality requirements, etc. Objections to planning (additional mitigation to deal with extraction - additional ducts etc) Failure to obtain powers - delay to project, cessation of project	*Modified ventilation design removes the need of the high chimneys identified during the last design iteration. No longer a risk.*	Design now modified
Design and Approvals	038	Sensitivity of cable car tower to differential pile cap vertical movement	Need to move cable car supports - additional impact on tunnel	*No longer a risk*	Careful design of raking piles a) sleeve piles, b) maximise clearance to tunnel
Design and Approvals	039	Deficient tunnel protection	Late information from physical model studies of ship impact protection show tunnel protection deficiency . Impact could lead to changes current to the current alignment and/or effect on cost and programme.	*(i) Anchor risk (mitigated by protection on top of the tunnel)* *(ii) Ship sinking on top to be mitigated by design* *(iii) Cable car protection/impact to be included in study* *Risk not modelled, unlikely*	Advance the ship impact analysis and model study and coordinate with tunnel design

Category	Ref	Title	Description	Impact	Potential Risk Control Measures / Actions
Design and Approvals	040	Cable Car southern tower/ Tunnel interaction modelling	No Cable Car southern tower/ Tunnel interaction modelling has as yet been carried out, to assess the potential likely ground displacement from the tower and its impact on the tunnel. In the worst case scenario, if work for the Cable Car is progressed to the degree that the southern tower location is fixed ahead of any interaction modelling taking place, then the current agreed alignment for the Silvertown tunnel may have to be altered	*No longer a risk*	Undertake interaction modelling at the earliest opportunity in conjunction with potential rationalisation of cable car foundation and tunnel design (i.e. to reduce risk of cable car foundation movement and overall size of tunnels etc)
Design and Approvals	041	Change in legal requirements and standards	Change in legal requirements and standards may require revisiting the design (CMD regulation, tunnel construction, alignment requirements, carriageway clearance for structures, or drainage attenuation) Delay in programme and increase in cost (could happen during or after design being finalised)	*Allow a 5% chance of additional costs of up to £1m.*	Monitoring of changes to legal requirements and standards
Design and Approvals	042	Connection to network need to consider Green Wave	Cannot achieve it, leading to the need for bigger geometry.	*No longer an issue with current design assumptions*	-
Design and Approvals	043	Traffic Congestion / Extraction System	Could lead to structural changes / bigger geometry	*Included in design and cost, management of congestion covered elsewhere.*	-
Design and Approvals	044	Requirements for processing of drainage water	Risk of additional costs for facilities to process/deal with drainage water (including land take)	*Included in design and cost*	-
Design and Approvals	045	Changes to key design Parameters	Changes arising from further ground investigations, boreholes etc.	*Covered in high level estimating uncertainties*	Risk workshops / Review
Ground Conditions	046	Additional works associated with gasworks site	Increased cost in disposing of spoil Contamination of other land or water	*The edge of one of the main historic Gas Works buildings was located above the proposed alignment with the possibility of foundations or items of infrastructure remaining underground. No records have been found detailing the demolition of these buildings. No records have been found detailing the surface remediation of the Greenwich Peninsula. Allowances to be made in the estimate for the removal of these foundations and infrastructure* *Allow additional remediation costs at a 50/50 chance with an impact of £250k to £1000k.*	Detailed advance site investigation focussing on likely hot spots and ensuring general coverage of excavated areas

Category	Ref	Title	Description	Impact	Potential Risk Control Measures / Actions
Ground Conditions	047	Hard layers (including flint bands) and inclusions in Lambeth Group soils	Interruption of construction	*Covered in costing approach and overall uncertainties..*	TBM needs to accommodate for this
Ground Conditions	048	Obstructions whilst piling (secant piles)	Hitting obstruction leading to overall delays of the works	*Covered in estimating uncertainties for the relevant works.*	Plan for interventions
Ground Conditions	049	Risk of collapse and settlement impact whilst doing the works	Risk of collapse to the tunnel whilst doing the works and also potential settlement impact on (weakening/collapse) the cable car foundations , rivers walls, tie back anchors and buildings.	*Catastrophic risk not modelled* *Allow a risk of needing to provide mitigation measures (e.g. DLR, Cable Car, River Walls, buildings). Allow a 20% of £50k to £2000k.*	Model effects and accommodate requirements in design or revise layout
Ground Conditions	050	PLA Maintenance Dredging of river	Risk that maintenance dredging will reduce the tunnel crown cover to less than acceptable levels.	*Risk regarded as low, and consultation needs to be held with PLA on regime. Not additional impact modelled.*	Liaison with PLA Dredging restrictions Ensure sufficient cover to start with
Ground Conditions	051	Vessel sinking on tunnel	Weakening of tunnel / damage to tunnel	*See above*	Risk assessment and accommodate likely loading in tunnel design
Enabling Works	052	Diversion of existing utilities	Uncertainty in the scope of utility diversions required and in addition risk of damage to utilities during construction, causing delay to programme (normal utilities but also drainage outfalls at Royal Docks and the Overhead Cables at the Northern Site)	*High level estimating uncertainty for main diversion works, allow residual risk at 20% of additional costs of up to £1m.* *In addition the risk assessment allows a high range of uncertainty to the individual utilities estimates (carried out by the project and others).*	Undertake investigations to locate utilities, engage with utilities providers, devise utilities management plan Ensure programme considers reasonable allowances for the diversion of utilities. Conduct further studies to obtain full understanding and design out major conflicts
Enabling Works	053	Unexploded Ordnance	Addition of cost (timescales) to the scheme in order to safely dispose of any explosive devices found in the area impacted by the tunnel construction	*Assumed covered in high level estimating uncertainties for the scheme.*	Undertake GI at the earliest opportunity, to reduce the risk of any implications on the project Detailed risk assessment in situ investigations prior to ground investigation and construction works
Construction	054	Terrorism and crime	Mitigation measures (increased cost of security) Drivers getting harmed in tunnel Damage to tunnel structure	*Adequate allowances made in estimate, residual risk of more measures assessed at 10% of costs of £250k to £1000k. In addition see Risk 032 for maintenance/operations facilities.*	Consulting with BT Police and other key stakeholders for safety input
Construction	055	Uncertainty in the cost estimates	Change in cost e.g. material and human resources, interest rates etc	*See separate exercise.*	Uncertainties in estimate considered as part of risk assessments Ongoing refinement of cost estimates
Closed	*056*	*TBM launch chamber on Silvertown side too shallow*			
Closed – only risk for ITT	*057*	*Requirements for River Closures*			

Category	Ref	Title	Description	Impact	Potential Risk Control Measures / Actions
Construction	058	Limited constricted road access for transport of TBM to launch site	Interruption of construction	*Not an issue with current assumptions*	Detailed checking of routes and initiation of improvements if deemed necessary
Construction	059	Blackwall tunnel not able to accommodate transport of large TBM components	Old Blackwall tunnel cannot accommodate transport of large TBM components for 2nd drive from Silvertown. Increased cost and delay on programme	*Not an issue with current assumptions, TBM will rotate for the second drive. The reason for this is the difficulty in transporting and disassembling the TBM.*	Construct TBM turn around chamber at O2 Transfer TBM by barge across river from temporary wharves Use QE2 bridge at Dartford, implement a closure and transport TBM northbound over the bridge.
Construction	060	Restrictions on Road and river traffic	Increased costs and limitations (storing on site) Compensation to LB (heavy vehicles) or restrictions	*See traffic management risk*	Construction traffic impact assessment and phasing plan
Construction	061	High Voltage Facilities	Needs to be upgraded.	*Adequate TBM site electricity assumed in the basic cost estimate and no additional risk modelled.*	To be addressed at detailed design stage
Construction	062	Fire/Toxic Spill during construction	-	*Adequate suppression systems will be included in the cost estimates.*	Review suppression systems at later design stage
Design and Approvals	063	Errors in preliminary Topographical Studies	Errors in preliminary Topographical Studies	*Assumed covered in high level estimating uncertainties.*	Conduct further Topographical surveys
Design and Approvals	064	Change to tunnel alignment	Changes to tunnel alignment (e.g. Vertical) resulting in additional constraints for highway tie-in	*Tunnel alignment unlikely to change from current assumptions. Allow a 5% residual risk with an impact on the highway tie-in at £500k to £1500k.*	Ongoing monitoring of any changes to alignment and conduct full impact analysis should changes occur
Stakeholders	065	Additional works to facilitate Peninsula Development Masterplan (South side)	There is a risk that further works than currently allowed for would be required to accommodate the Peninsula Development Masterplan (additional links or changes to the configuration). Full impact could be in the range of £5m to £10m to accommodate.	*Full impact not modelled as risk as this is believed to be subject to separate funding by developer if required. Risk model have allowed additional cost to improve bus facilities and minor tweaks to arrangements, on top of provisions made in the cost plan. Allow a high (50/50) chance of additional cost at £500k to £1500k for additional works.*	Ongoing liaison with stakeholder
Uncertainty in the Estimate	U1	Uncertainty in the Estimate - INSURANCES	Varies with the total base cost of the works, assumption is 4% for insurances and 1% for bonds.	Base cost in estimate assessed at £17.8M	Ongoing review of cost estimate
Uncertainty in the Estimate	U2	Uncertainty in the Estimate - SPECIFIED REQUIREMENTS	This includes for Client Facilities, Offices, Transport, Traffic Diversions and an allowances for ecological studies (£100k). Allow a range of -15% to +25% on the estimate.	*Base cost in estimate assessed at £1.5M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U3	Uncertainty in the Estimate - ALLOWANCE FOR STRUCTURAL SURVEYS	Limited amount of Structures to be surveyed, costs could increase with up to 20%.	*Base cost in estimate assessed at £0.1M*	Ongoing review of cost estimate

Category	Ref	Title	Description	Impact	Potential Risk Control Measures / Actions
Uncertainty in the Estimate	U4	Uncertainty in the Estimate - ALLOWANCE FOR INSTRUMENTATION INSTALLATION	Allow £750k to £1250k (+/- 25%), this would cover a reasonable amount of instrumentation being installed based on the structures and areas affected.	*Base cost in estimate assessed at £1.0M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U5	Uncertainty in the Estimate - SUPERVISION	Based on detailed estimate for the duration of the project, allow +/-5%.	*Base cost in estimate assessed at £28.0M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U6	Uncertainty in the Estimate - METHOD RELATED CHARGES	Allow to vary with total cost for Tunnel Works.	*Base cost in estimate assessed at £22.5M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U7	Uncertainty in the Estimate - DIVERTING DRAIN	Scope for the diversion of the 2 No. large rising mains, forming part of the Royal Victoria Dock drainage discharge into the Thames, is not yet clearly defined and the item carries considerable risk, costs could be under- as well as overestimated. Allow a range of £5m to £15m for the overall cost of the works. Works could be to divert the drains or to provide alternative drainage measures for the duration of the works.	*Base cost in estimate assessed at £10.0M*	Ongoing review of cost estimate Engage with the asset owner
Uncertainty in the Estimate	U8	Uncertainty in the Estimate - TBM SUPPLY,ERECT AND DISMANTLE	Estimate could be on the high side and overall could reduce with up to 5%, allow a -5% to ±0% range, with a most likely of 0% increased cost.	*Base cost in estimate assessed at £30.4M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U9	Uncertainty in the Estimate - TBM DRIVING COSTS	Cost uncertainty applied as follows: (a) PC Segments - £20m, cost uncertainty could increase with up to 10%. (b) Spoil disposal - £15m, could range -10% to +10%. (c) Cost of Interventions - £1m, could range from -10% to +40%. (d) residual cost, allow +/- 10%	*Base cost in estimate assessed at £51.6M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U10	Uncertainty in the Estimate - SECANT PILE LAUNCH CHAMBER	(a) Will be done with Secant Piles (forming the box) that constitutes about £4m of the total and costs could increase with up to 25% (Due to issues with the Victoria Dock as there may be both steel and, more likely, timber obstructions. (b) Spoil disposal also carries cost risk in line with previous assumptions and the £1.5m could increase with up to 25%, whilst the (c) residual cost is assumed to have a range of ±10%.	*Base cost in estimate assessed at £6.8M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U11	Uncertainty in the Estimate - CRANE MAT/HARDSTANDING FOR TBM ERECTION	-10% +10%	*Base cost in estimate assessed at £0.3M*	Ongoing review of cost estimate

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Uncertainty in the Estimate	U12	Uncertainty in the Estimate - TUNNEL PORTAL CONSTRUCTION	-10% +10%	*Base cost in estimate assessed at £1.5M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U13	Uncertainty in the Estimate - TUNNEL FILL AND CLADDING	The need for cladding will be reviewed at later stages of design development (with an opportunity of minimising the requirements as this have an impact on the maintenance costs). Allow an overall uncertainty on the Cladding element (£6.5m) at -10% to +25% depending on final specification, for the residual cost allow -5% to +10%.	*Base cost in estimate assessed at £12.8M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U14	Uncertainty in the Estimate - TUNNEL MECHANICAL AND ELECTRICAL WORKS	Allow -10% to +15% for the costs. Uncertainty lies in costs of SCADA and LED.	*Base cost in estimate assessed at £49.2M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U15	Uncertainty in the Estimate - CROSS PASSAGES	A total of 3 cross passages are to be included. For each crosspassage a separate ground treatment approach has been applied. Overall estimate seen as robust at a of ±10% uncertainty.	*Base cost in estimate assessed at £5.7M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U16	Uncertainty in the Estimate - TBM RECEPTION CHAMBER	Allow same overall uncertainty as for the "Launch Chamber Portal Construction".	*Base cost in estimate assessed at £7.3M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U17	Uncertainty in the Estimate - SUMP/ADDITIONAL GROUND TRTEATMENT	Allow an overall -10% to 30% on the estimate.	*Base cost in estimate assessed at £0.3M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U18	Uncertainty in the Estimate - SILVERTOWN CUT AND COVER	Relatively straightforward, allow +/-5% on the overall cost.	*Base cost in estimate assessed at £20.6M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U19	Uncertainty in the Estimate - SILVERTOWN RETAINED CUT.	Depending on methodology estimate could be on the high side, allow -10% to +10% on the overall cost.	*Base cost in estimate assessed at £11.3M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U20	Uncertainty in the Estimate - GREENWICH CUT AND COVER	Relatively straightforward, allow +/-5% on the overall cost.	*Base cost in estimate assessed at £28.0M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U21	Uncertainty in the Estimate - GREENWICH RETAINED CUT.	Depending on methodology estimate could be on the high side, allow -10% to +10% on the overall cost.	*Base cost in estimate assessed at £10.0M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U22	Uncertainty in the Estimate - SUB STATIONS AND VENT BUILDINGS	Additional considerations to be given for maintenance/ operational facilities. Allow costs could range between -5% to +10%.	*Base cost in estimate assessed at £19.4M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U23	Uncertainty in the Estimate - Indicative saving for secondary lining in lieu of VE cladding	No risk modelled	*Base cost in estimate assessed at -£1.3M*	Ongoing review of cost estimate

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Uncertainty in the Estimate	U24	Uncertainty in the Estimate - Approaches Road Works - General	The majority of costs relates to earthworks, overall uncertainty assessed at -20% to +20%. For the works package	*Base cost in estimate assessed at £13.2M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U25	Uncertainty in the Estimate - Approaches Road Works - Main Carriageways	High level of uncertainty in drainage for which outfalls have not yet been identified. This would lead to additional works being required. Uncertainty in the estimate for this element (£1674k) assessed with the possibility of increasing with up to 50% (-20% to +50%). For the remainder of the works (Pavements, kerbs and Footpaths at a cost of £3989k) and uncertainty of -20% to +20% was applied.	*Base cost in estimate assessed at £5.7M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U26	Uncertainty in the Estimate - Approaches Substructure - End Supports	Estimating uncertainties applied as follows: (i) Two-lane overbridge (cost of structures relatively stable uncertainty in the amount of earthworks) - allow -10% to 25%. (ii) Pedestrian Footbridge (allowance based on a recently built similar 6 lane bridge), £2500k costs could range between -20% and +25% (iii) Gantries - £1766k allow -20% to +30%	*Base cost in estimate assessed at £6.3M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U27	Uncertainty in the Estimate - Approaches Other Works - including Utilities, Retaining Walls and Prelims	The main element is the utility diversions that could be considerably higher than allowed for due to lack of current survey information. Estimating uncertainties applied as follows: (i) Traffic Signs and Road Markings - £350k allow -20% to +50% (ii) Street Lighting - £184k allow -20% to +25% (iii) Landscaping - £90k allow -20% to +50% (iv) Utility Diversions - £9018k costs could in worst case be 3 times as high (allow 0% to +300%, with a ml at +75%) (v) Accommodation and facilitation works - £885k allow -20% to +50% (vi) Prelims - £2221k allow -0% to +100% (TM May increase in scope, may need to do more temporary works) (vi) Retaining Walls - £755k allow -20% to 50%.	*Base cost in estimate assessed at £13.5M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U28	Uncertainty in the Estimate - Contractor's OH and P	Base assumption at 10% allow range of 8..12.5% in the risk model.	*Base cost in estimate assessed at £37.3M*	Ongoing review of cost estimate
Uncertainty in the Estimate	U29	Escalation	No risk calculation	-	-

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Uncertainty in the Estimate	U30	Uncertainty in the Estimate - Contractor Risk Allowance	Base Assumption at 10% allow range of 7..13% in the risk model. This represents the risk allowance made by the contractor for specific construction risks not covered by the scope of the high level risk assessment of these works. This would relate to specific programme related risks, resources, productivity shortfall/acceleration, quality issues, management of interfaces etc.	*Base cost in estimate assessed at £41.1M*	Ongoing review of cost estimate