



### C305 - Eastern Running Tunnels

## I&M Close out report for Cross Passage 13 (including Blackwall Tunnel and DLR Blackwall Station). Drive Y

CRL Document Number: C305-DSJ-C2-RGN-CRG03-50374

Supplier Document Number:

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#### 2a. Stakeholder Review Required? YES NO

Stakeholder submission required: LU  NR  DLR  RfI  LO  Other

Purpose of submission: For no objection  For information

This document has been reviewed by the following individual for coordination, compliance, integration and acceptance and is acceptable for transmission to the above stakeholder for the above stated purpose.

Sign: [Redacted] Role: [Redacted] Name: [Redacted] Date: 11/07/16

Sign: \_\_\_\_\_ Role: \_\_\_\_\_ Name: \_\_\_\_\_ Date: \_\_\_\_\_

#### 2b. Review by Stakeholder (if required):

Stakeholder Organisation	Job Title	Name	Signature	Date	Acceptance
					<input type="checkbox"/>

#### 3. Acceptance by Crossrail:

Crossrail Review and Acceptance Decal	
This decal is to be used for submitted documents requiring acceptance by Crossrail.	
<input checked="" type="checkbox"/>	Code 1 Accepted. Work May Proceed
<input type="checkbox"/>	Code 2 Not Accepted. Revise and resubmit. Work may proceed subject to incorporation of changes indicated
<input type="checkbox"/>	Code 3 Not Accepted. Revise and resubmit. Work may not proceed
<input type="checkbox"/>	Code 4 Received for information only. Receipt is confirmed
Reviewed/Accepted by (signature)	Print Name: [Redacted] Position: [Redacted] Date: 11/07/16

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**GEOCISA UK**

**C305-CLOUT-A4-20160315**

**I&M Close out report for Cross Passage 13 (including Blackwall Tunnel and DLR Blackwall Station). Drive Y - C305-DSJ-C2-RGN-CRG03-50374**

**C305 Crossrail Eastern Running Tunnels**

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**Current Version of the Documents & Signatures :**

Revision:	Date:	Prepared by:	Checked by:	Engineering Approved by:
2.0	04/07/2016	[Redacted]	[Redacted]	[Redacted]
		[Redacted]	[Redacted]	[Redacted]
		[Redacted]	[Redacted]	[Redacted]

**Document History :**

Revision:	Date:	Prepared by:	Checked by:	Engineering Approved by:
1.0	04/05/2016	[Redacted]	[Redacted]	[Redacted]

## 1. CLOSE OUT REPORT PURPOSE

As stated in the specification: C122-OVE-Z4-RSP-CR001-00007 Rev 7.0, the purpose of this close-out report is to summarise the data from the instrumentation included in this document and to relate the recorded ground movements to the construction activities which produce any observed changes. The construction activities include excavation of the C305 twin bored tunnels and construction of Cross-Passage 13 (including excavation and depressurization); impacts from other CRL contracts are not included in this report.

The long term readings have been used to demonstrate that the subsequent movement has reached an acceptably stable rate within the accuracy of the system in order to decommission and/or that C305 works are no longer impacting the area concerned.

The specification defines a settlement rate of 2 mm/year (yr). Where this is not achieved this report seeks agreement from all parties that the rate is acceptably low enough to cease monitoring and decommission.

## 2. LOCATION OF THE WORKS

The instrumentation included in this report is located in Area 4, Limmo Shaft to Canary Wharf Station, between project chainages 83550 and 84130.

See Appendix A for instrument location.

## 3. DOCUMENTATION SUMMARY

CROSSRAIL NUMBER	DOCUMENT NAME	DOCUMENT
C305-DSJ-C2-GMS-CRG03-50020	I&M Installation Report for Levelling Points from East India to Canary Wharf (Drive Y)	Installation Report
C305-DSJ-C2-RGN-CRG03-50074	IR for I&M installed as per "I&M Blackwall Tunnels 84000-83700"	Installation Report
C305-DSJ-C2-RGN-CRG03-50396	I&M Installation Report for DLR Blackwall Station (CP13) and East India Station & Viaduct (CP14)	Installation Report
C305-DSJ-C2-RGN-CRG03-50205	Installation Report for I&M MS "Sockets & 3D Prisms (83900-83500)	Installation Report
C305-DSJ-C2-RGN-CRG03-50376	I&M Installation Report for Cross Passages 13 and 14	Installation Report
C305-DSJ-C2-RGN-CRG03-50203	I & M Installation Report for Blackwall Way Boreholes Rod Extensometers Drive Y	Installation Report
C305-DSJ-C2-RGN-CRG03-50017	C305: Eastern Running Tunnels Baseline Monitoring Report – DLR East India Station and Viaduct	Baseline report

#### 4. SUMMARY OF INSTALLED INSTRUMENTATION ON SITE

The list of instrumentation included in the Close Out Report is as follows:

##### BLACKWALL TUNNEL

- BLACKWALL TUNNEL
  - 33 Electrolevel beams: S C305-EL040201 to S C305- EL040233
  - 27 Levelling points: C305-LP043101 to C305-LP043127
  - 5 Levelling points: C305-LP043301 to C305-LP043305
- VENTILATION SHAFT
  - 5 Sockets: C305-LB044101 to C305-LB044105
  - 5 3D Prisms: C305-RP044101 to C305- RP044105

##### CROSS PASSAGE 13

- IBIS HOTEL
  - 9 Sockets: C305-LB040601 to C305-LB040609
  - 4 3D Prisms: C305-RP042101 to C305- RP042104
- STREAMLIGHT TOWER
  - 4 Sockets: C305-LB040610 to C305-LB040613
  - 3 Retro targets: C305-RP042101 to C305- RP042103
- SHALLOW DATUM: C305-SD043501
- VIBRATING WIRE PIEZOMETER:
  - C305-PV04134
  - C305-PV04135
  - C305-PV04136
  - C305-PV04090
  - C305-PV04091
  - C305-PV04070
  - C305-PV04071
- TRANSECT 4I
  - 34 Levelling points: C305-LP040701 to C305-LP040734
  - 15 Levelling points: C305-LP047101 to C305-LP047115
- BLACKWALL WAY
  - 65 Levelling points: C305-LP040501 to C305- LP040565
- TRANSECT 4K
  - 35 Levelling points: C305-LP041101 to C305- LP041135
- POPLAR DOCK
  - 22 Levelling points: C305-LP041217 to C305- LP041239

##### DLR BLACKWALL STATION

- 25 Sockets: C305-LB047010 to C305-LB047115

Detailed information of the installed instrumentation is reported in Appendix B.

The average commissioning readings included in Appendix B have been used to calculate the relative movements provided in the graphs of this report. In some of them, new values were determined as a

baseline according to the requirement of the client in CTC meeting. The dates of the new baselines are as follows:

- C305-LB040601 to C305-LB040609: 15<sup>th</sup> April 2013
- C305-LB040610 to C305-LB040613: 15<sup>th</sup> April 2013
- C305-LP040501 to C305-LP040565: 4<sup>th</sup> April 2013
- C305-LP040701 to C305-LP040734: 7<sup>th</sup> March 2013

## 5. CONSTRUCTION ACTIVITY

### Tunnel Boring Machine (TBM) PASSAGE

DRIVE Y	RINGS	PROJECT CHAINAGE	DATES
Eastbound (EB)	459 – 817	84130 - 83550	11/04/2013 to 03/05/2013
Westbound (WB)	449 – 814	84130 - 83550	26/04/2013 to 27/05/2013

Stoppage period

Eastbound Drive-Y                      No stoppage

Westbound Drive-Y                      No stoppage

The ring number stated above relates the nearest constructed tunnel ring location to each period of TBM passage and any stoppages recorded.

### DEWATERING

Cross passage 13:                      Dewatering and depressurization: 26<sup>th</sup> November 2013 to 3<sup>rd</sup> August 2015

## 6. METHODOLOGY

To determine the settlement rate the following methodology has been used. A Linear Regression has been applied for a defined period using long term readings after TBM construction. This uses the following formula.

$$b = \frac{\sum_{i=1}^n (X_i - \bar{X}_i) \cdot (Y_i - \bar{Y}_i)}{\sum_{i=1}^n (X_i - \bar{X}_i)^2}$$

Where:

B =gradient or slope

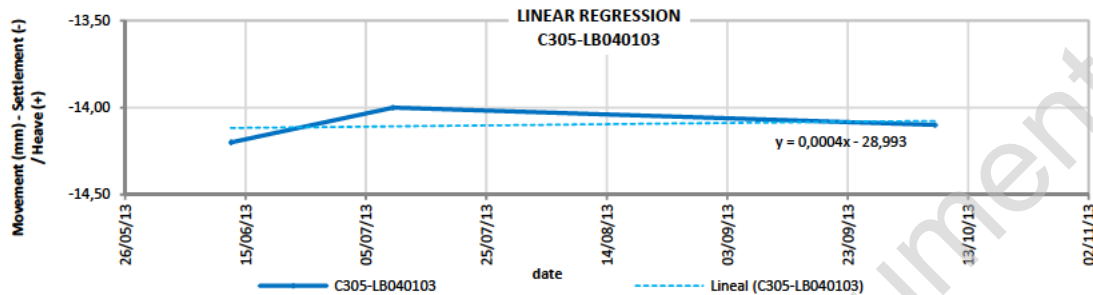
X (independent variable) = date

Y (dependent variable) = vertical movement

From this, the settlement rate per day can be calculated and rate per year determined (negative value is for settlement, positive is for heave). For these values, the percentage at or below 2 mm/yr will be used to determine the trend of the section/area being considered. Also for comparison, values at or below 3mm/year are presented to highlight that the rate is close to achieving the 2 mm/yr. Note the percentages of settlement rate presented in the sections below refer to values rounded to the nearest integer.

One example of this calculation can be seen below for one socket and its projection.

	Registered movement (mm)			RATE mm/year
	12/06/2013	09/07/2013	07/10/2013	
C305-LB040103	-14.20	-14.00	-14.10	0.146



**CALCULATION - C305-LB040103**

$X_i$	$Y_i$	$X_i - \bar{X}_i$	$Y_i - \bar{Y}_i$	$(X_i - \bar{X}_i)^2$	$(X_i - \bar{X}_i) \cdot (Y_i - \bar{Y}_i)$
12/06/2013	-14.2	-47.94	-0.10	2298.67	4.794
09/07/2013	-14	-21.03	0.10	442.17	-2.103
07/10/2013	-14.1	68.97	0.00	4757.17	0.000

$\bar{X}_i$	41485.53	
$\bar{Y}_i$	-14.10	
$\sum_{i=1}^n (X_i - \bar{X}_i)^2$	7498.00	(2)
$\sum_{i=1}^n (X_i - \bar{X}_i) \cdot (Y_i - \bar{Y}_i)$	2.692	(1)
m (SLOPE)	(1)/(2)	0.0004
Rate (mm/year)	m * 365	0.146

**7. SUMMARY OF THE DATA**

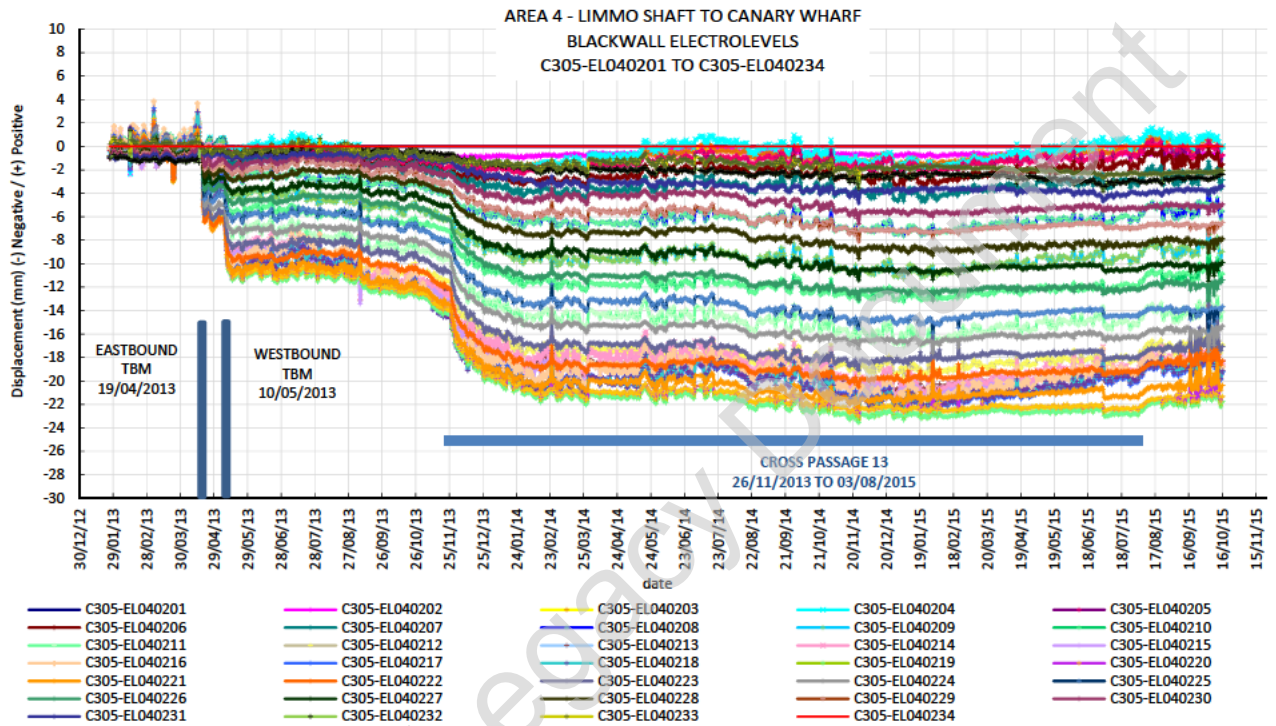
Note: For the following data plots #N/A refers to instances where readings were not taken for that sensor (e.g. damaged sensor, no access, etc)

As described in the C122 I&M Plan (C122-OVE-C2-RGN-CRG01-50070), for levelling points situated in the vicinity of 3<sup>rd</sup> party utility assets, deflection ratio values are provided in appendix D.

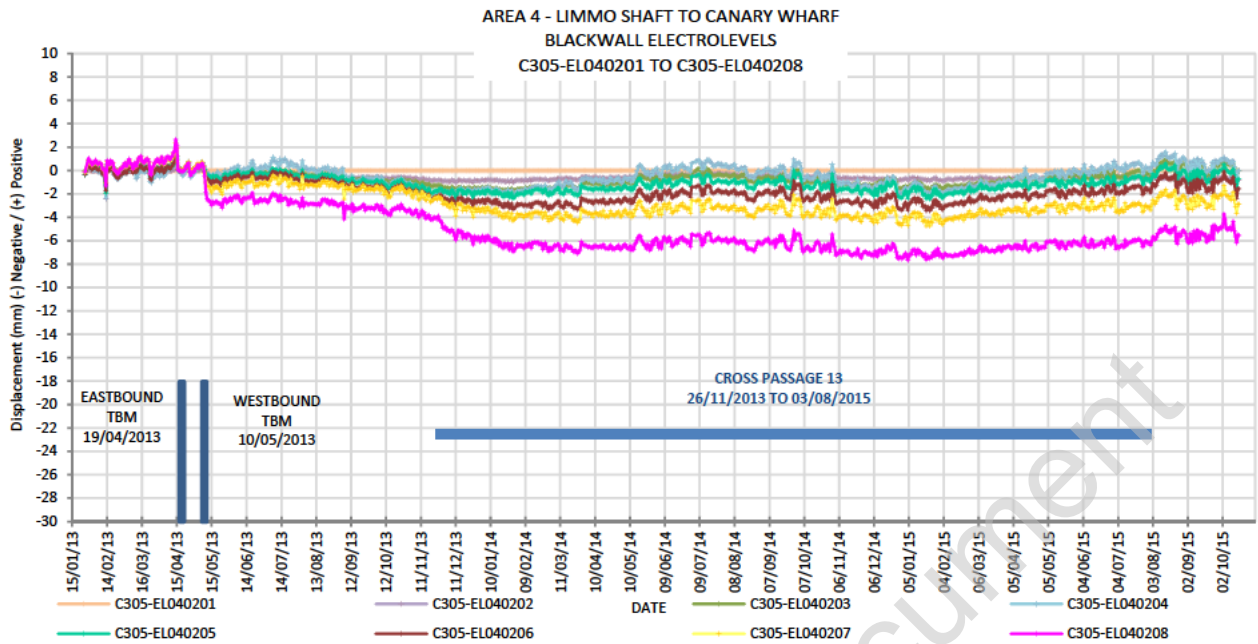
**7.1 BLACKWALL TUNNEL AND VENTILATION SHAFT**

**ELECTROLEVELS C305-EL040201 - C305-EL040234**

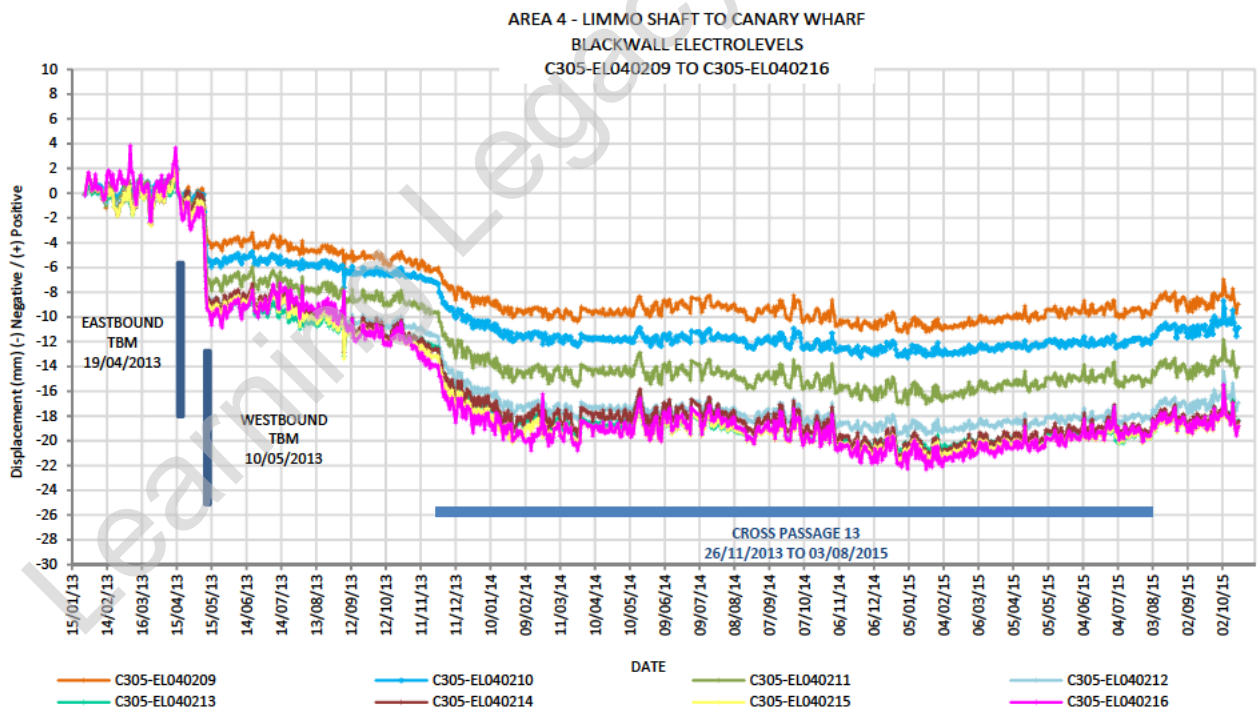
The graph below shows a maximum negative movement of -7mm after the eastbound TBM transit and -11mm after the westbound TBM transit. Dewatering in Cross passage 13 shows a maximum negative settlement of -23mm.



The following graphs presented below are from different sections of the electrolevel line installed within the Blackwall southbound tunnel.

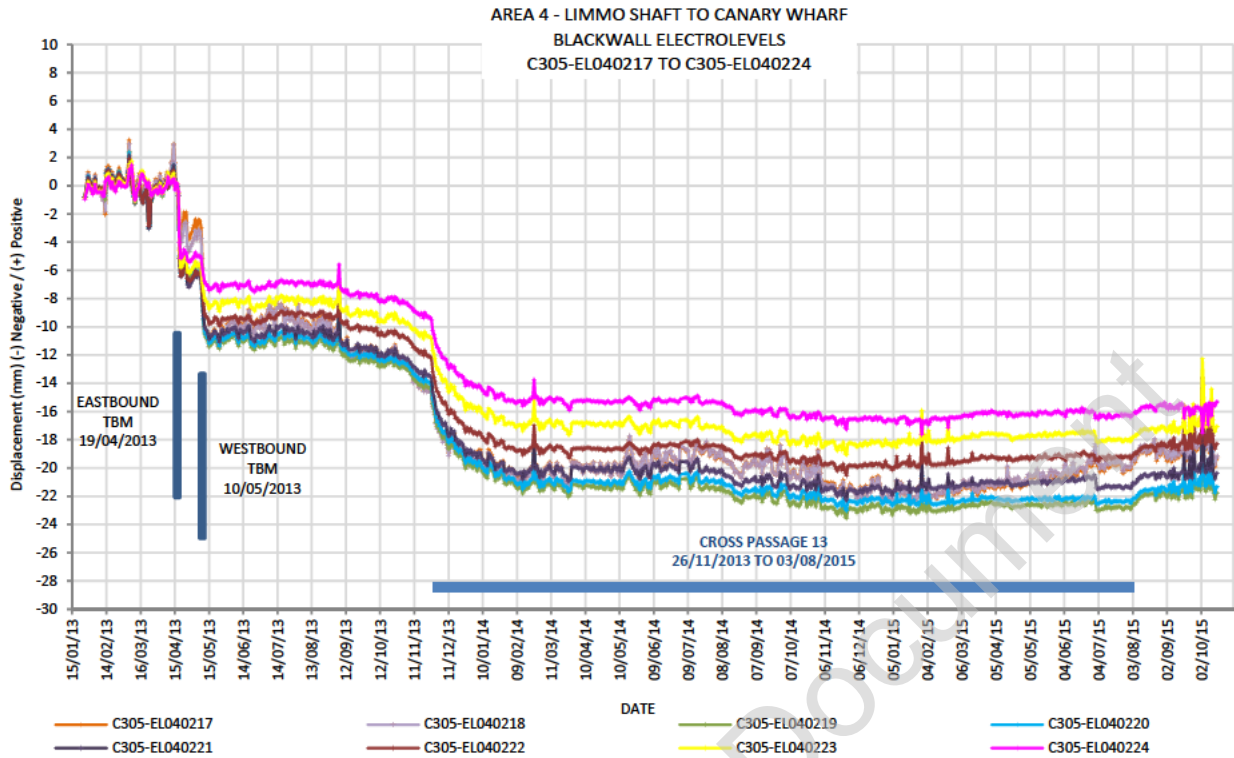


The graph above shows data recorded from the electrolevels located in the south part of the electrolevel line; there was no significant movement after the eastbound TBM transit and a maximum settlement of -3mm after the westbound TBM transit. The dewatering of CP13 shows a maximum settlement of -8mm.

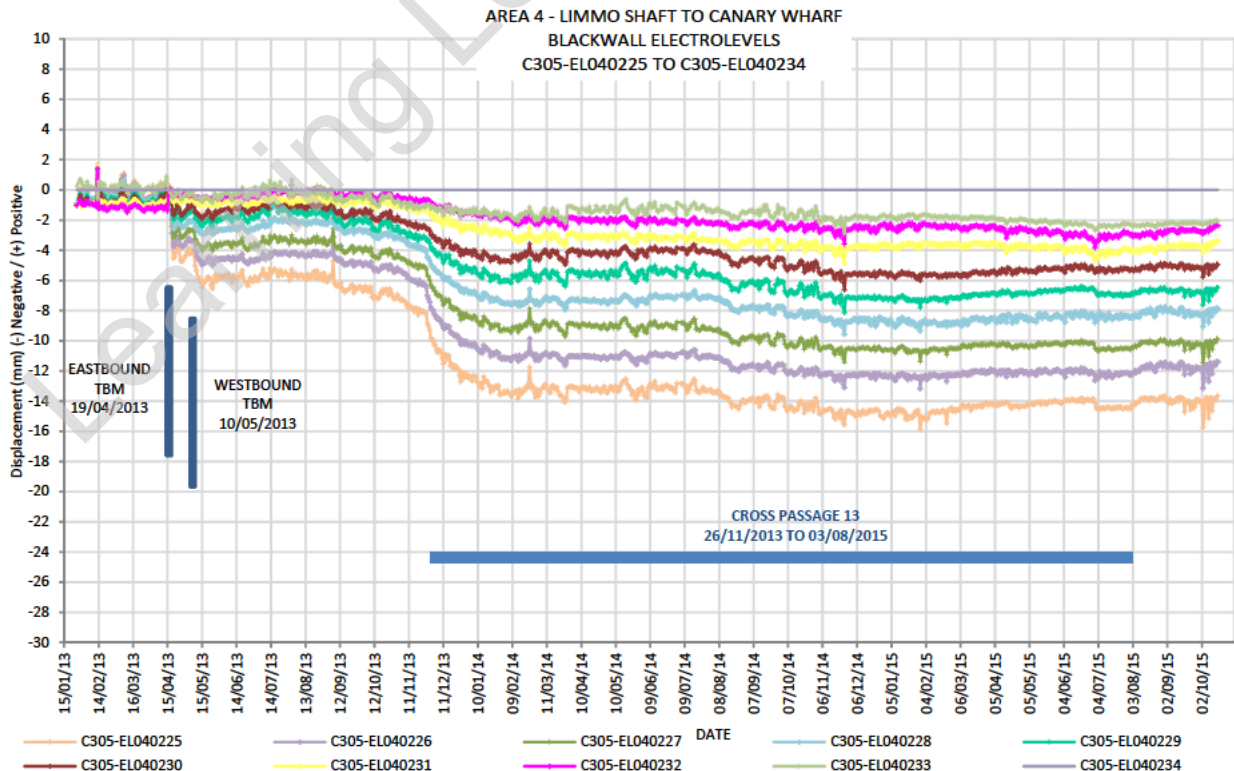


The graph above shows data recorded from electrolevels located above the westbound tunnel alignment. There was -2.9mm settlement after the eastbound TBM transit and a total maximum settlement of -11mm after the westbound TBM transit. The dewatering of CP13 shows a total maximum settlement of -22mm.





The graph above shows data recorded from electrolevels located above the eastbound tunnel. There was -6.7mm settlement after the eastbound TBM transit and a total maximum settlement of -11mm after the westbound TBM transit. The dewatering of CP13 shows a total maximum settlement of -23mm.



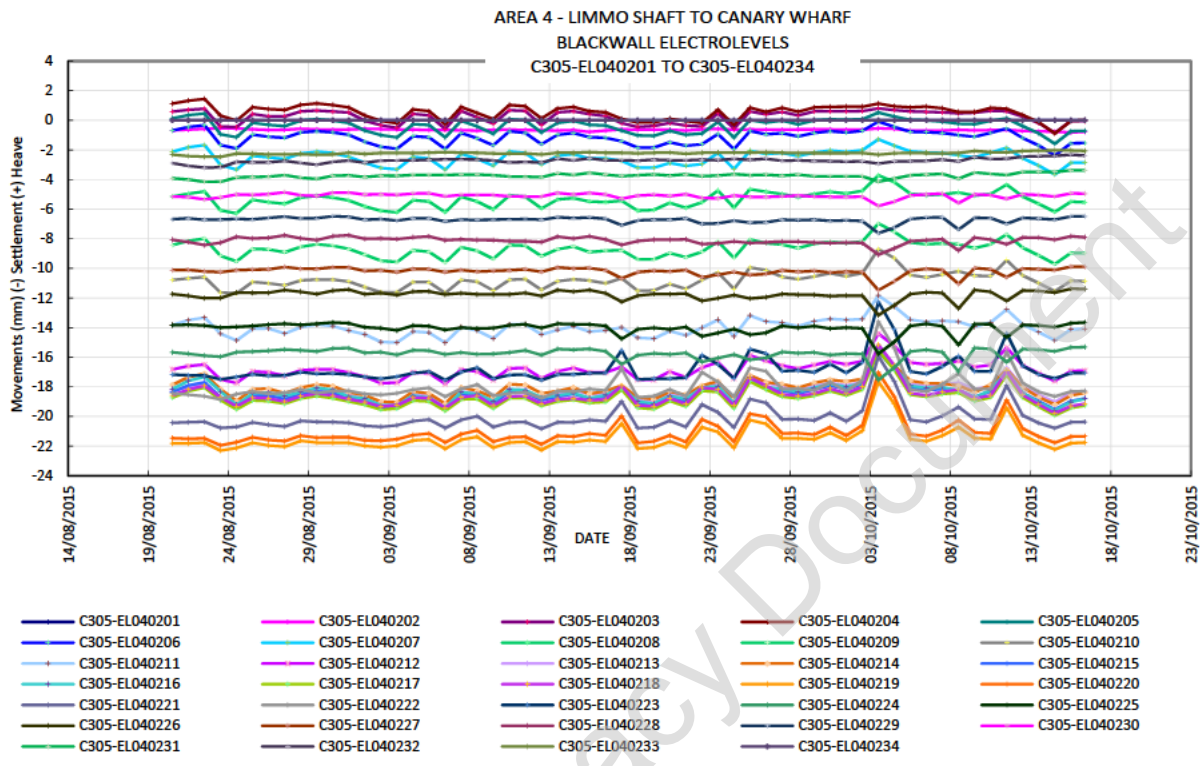
The graph above shows data recorded from electrolevels located along the north section of the line. There was -4.7mm settlement after the eastbound TBM transit and a total maximum settlement of -6mm after the westbound TBM transit. The dewatering of CP13 shows a total maximum settlement of -15mm.

Readings taken from August 2015 (after the dewatering in Cross Passage) to October 2015 were used to calculate the annual projection for the electrolevels monitoring points in this array.

	Registered Movement (mm)		Rate (mm/year)
C305-EL040201			0.000
C305-EL040202			-0.574
C305-EL040203			0.281
C305-EL040204			-2.334
C305-EL040205			-0.056
C305-EL040206			0.008
C305-EL040207			0.734
C305-EL040208			3.917
C305-EL040209			2.591
C305-EL040210			5.507
C305-EL040211			4.567
C305-EL040212			5.834
C305-EL040213			6.149
C305-EL040214			2.811
C305-EL040215			3.691
C305-EL040216			2.338
C305-EL040217			3.370
C305-EL040218			3.447
C305-EL040219			6.959
C305-EL040220			7.464
C305-EL040221			6.888
C305-EL040222			7.410
C305-EL040223			7.506
C305-EL040224			-1.447
C305-EL040225			-2.194
C305-EL040226			-1.049
C305-EL040227			-1.494
C305-EL040228			-1.405
C305-EL040229			-1.099
C305-EL040230			-0.794
C305-EL040231			1.896
C305-EL040232			2.362
C305-EL040233			1.300
C305-EL040234			0.000
	Rate less than -2.5 mm/year		% less 2 mm/ year
	Rate greater than -3.5		% less 3 mm/ year

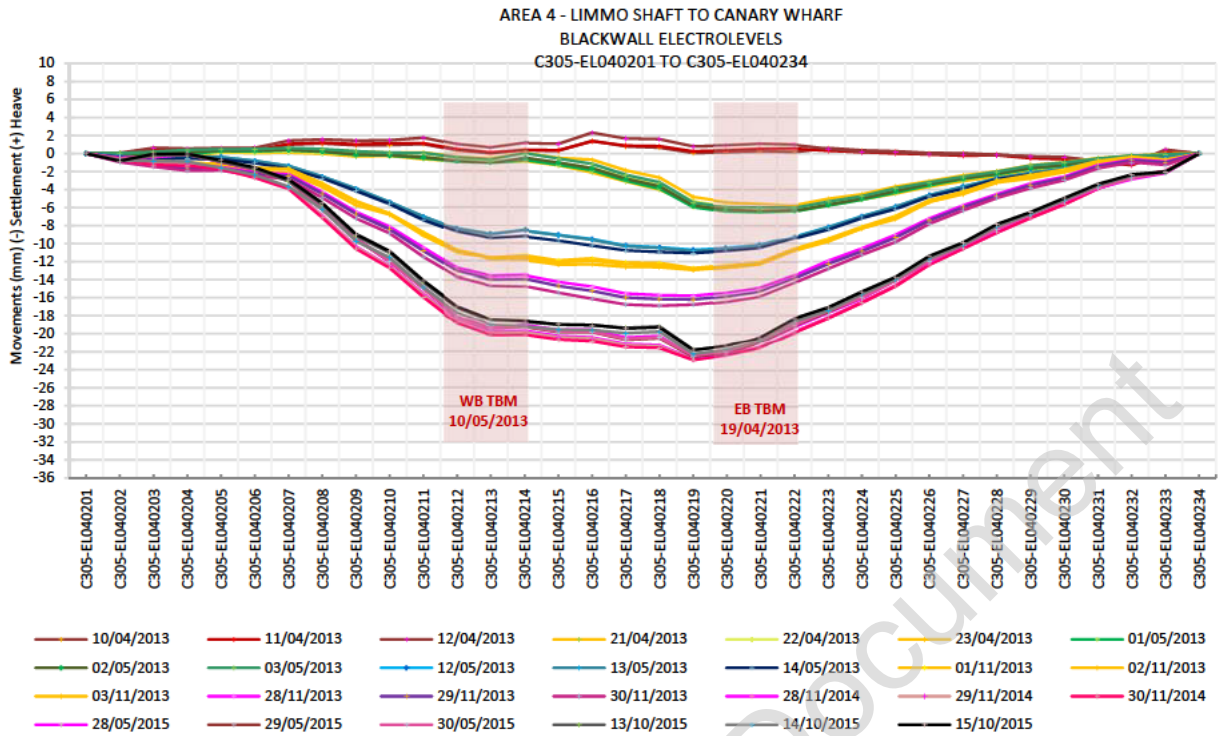
The percentage of electrolevels monitoring points with a settlement rate less than 2 mm/year is 100%.

The graph below shows the trend line adjustment for the electrolevels monitoring points in this array.



The graph below shows the data in a longitudinal profile. Selected dates were chosen in order to clearly show the effects of the different activities. These selected dates are listed in the table below:

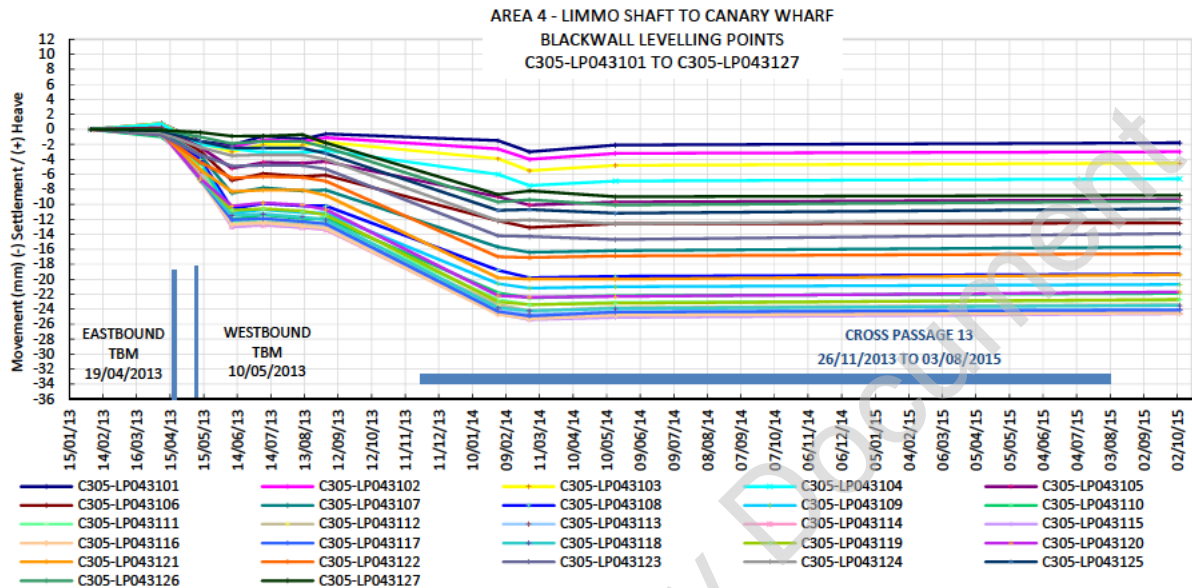
ACTIVITIES	DATES IN THE GRAPH		
Before eastbound TBM transit	10/04/2013	11/04/2013	12/04/2013
After eastbound TBM transit	21/04/2013	22/04/2013	23/04/2013
Before westbound TBM transit	01/05/2013	02/05/2013	03/05/2013
After westbound TBM transit	12/05/2013	13/05/2013	14/05/2013
Before dewatering in CP13	01/11/2013	02/11/2013	03/11/2013
During dewatering in CP13	28/11/2013	29/11/2013	30/11/2013
	28/11/2014	29/11/2014	30/11/2014
	28/05/2015	29/05/2015	30/05/2015
After dewatering in CP13	13/10/2015	14/10/2015	15/10/2015



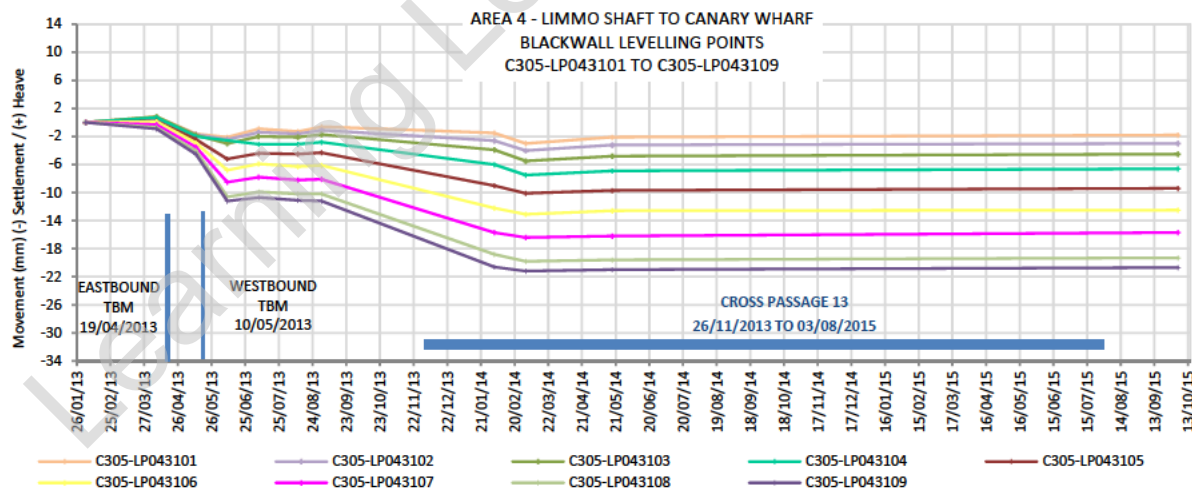
The graph above shows a settlement of -6mm after the eastbound TBM transit (for electrolevels: C305-EL040220 to C305-EL040222). After the westbound TBM transit, the total maximum settlement was -10mm (for the electrolevels: C305-EL040212 to C305-EL040214). The dewatering period for Cross Passage 13 shows a total maximum settlement of -23mm.

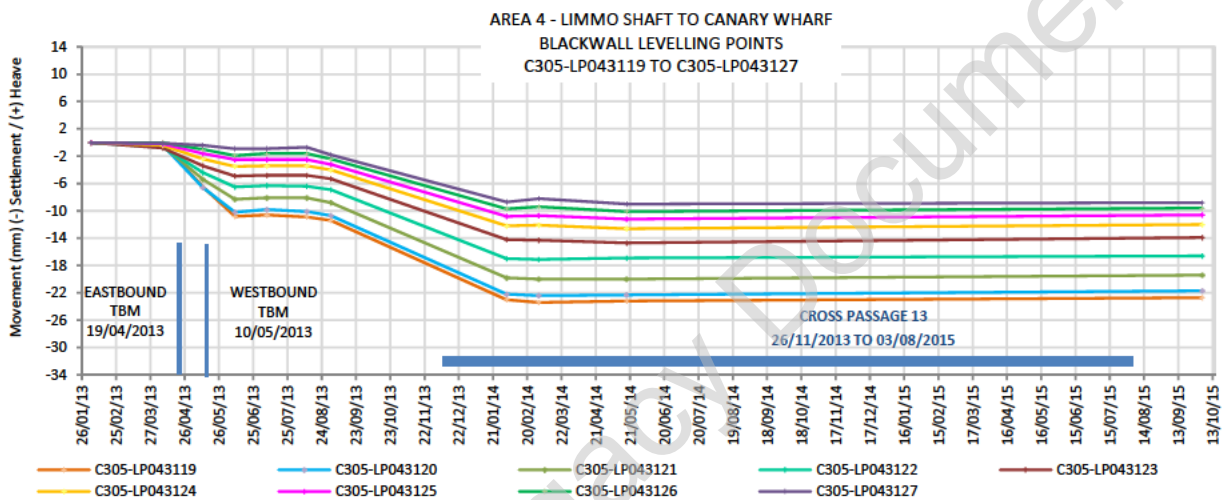
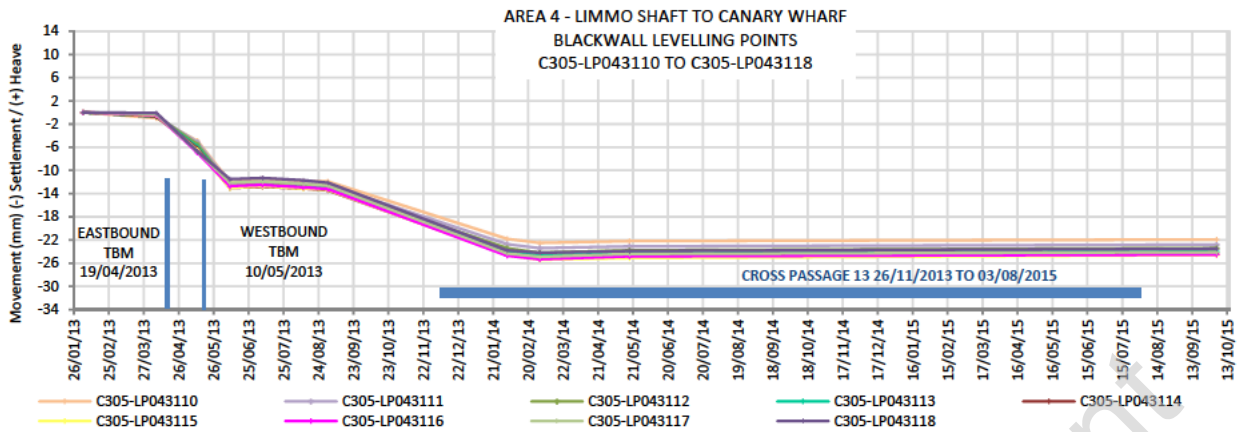
**LEVELLING POINTS C305-LP043101 - C305-LP043127**

The following graph shows data for the leveling points installed in the north section of the Blackwall Tunnel. There was a maximum settlement of -7mm after the eastbound TBM transit and a total maximum settlement of -13mm after the westbound TBM transit. During the dewatering period for CP13 the total maximum settlement recorded was -25mm.



The following graphs presented below are from different sections of the leveling points array installed within the Blackwall northbound tunnel.





In order to determine if the rate of change in the data has reached an acceptably small rate, the last two readings (this includes one reading after the dewatering period) were used to calculate the annual projection.

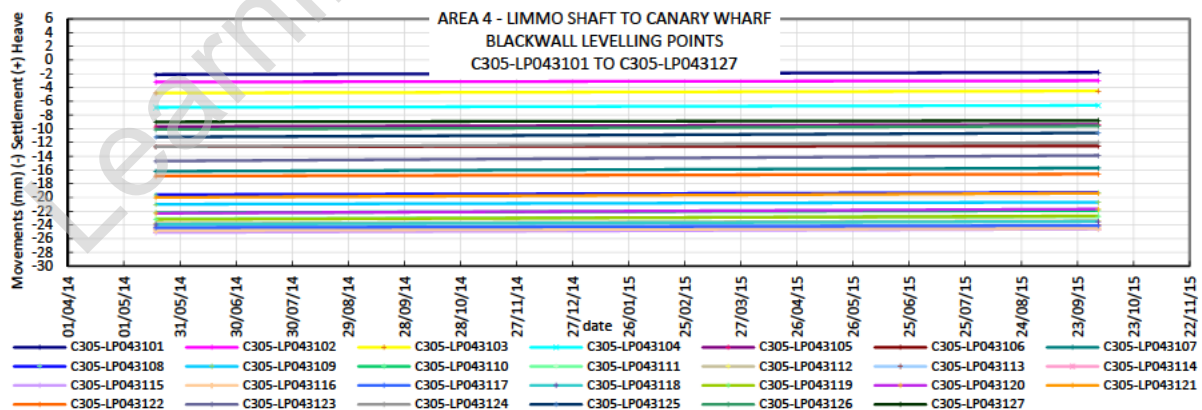
The table below shows the annual settlement rates for the levelling points in this array.

	Registered movement (mm)		Rate (mm/year)
	18/05/2014	04/10/2015	
C305-LP043101	-2.10	-1.80	0.217
C305-LP043102	-3.20	-3.00	0.145
C305-LP043103	-4.80	-4.50	0.217
C305-LP043104	-6.90	-6.60	0.217
C305-LP043105	-9.70	-9.40	0.217
C305-LP043106	-12.60	-12.50	0.072
C305-LP043107	-16.20	-15.70	0.362
C305-LP043108	-19.60	-19.30	0.217
C305-LP043109	-21.00	-20.70	0.217
C305-LP043110	-22.20	-21.90	0.217
C305-LP043111	-23.10	-22.80	0.217
C305-LP043112	-23.80	-23.40	0.290
C305-LP043113	-24.30	-24.00	0.217
C305-LP043114	-24.80	-24.40	0.290
C305-LP043115	-25.10	-24.60	0.362
C305-LP043116	-24.80	-24.50	0.217
C305-LP043117	-24.40	-24.10	0.217
C305-LP043118	-23.90	-23.50	0.290
C305-LP043119	-23.20	-22.70	0.362
C305-LP043120	-22.30	-21.70	0.435
C305-LP043121	-20.00	-19.40	0.435
C305-LP043122	-16.90	-16.60	0.217
C305-LP043123	-14.70	-13.90	0.579
C305-LP043124	-12.60	-12.00	0.435
C305-LP043125	-11.20	-10.60	0.435
C305-LP043126	-10.10	-9.60	0.362
C305-LP043127	-9.00	-8.80	0.145
	Rate less than -2.5 mm/year	% less 2 mm/ year	100%
	Rate greater than -3.5 mm/year	% less 3 mm/ year	100%

Note: All the movements are in mm. (-) Settlement / (+) Heave

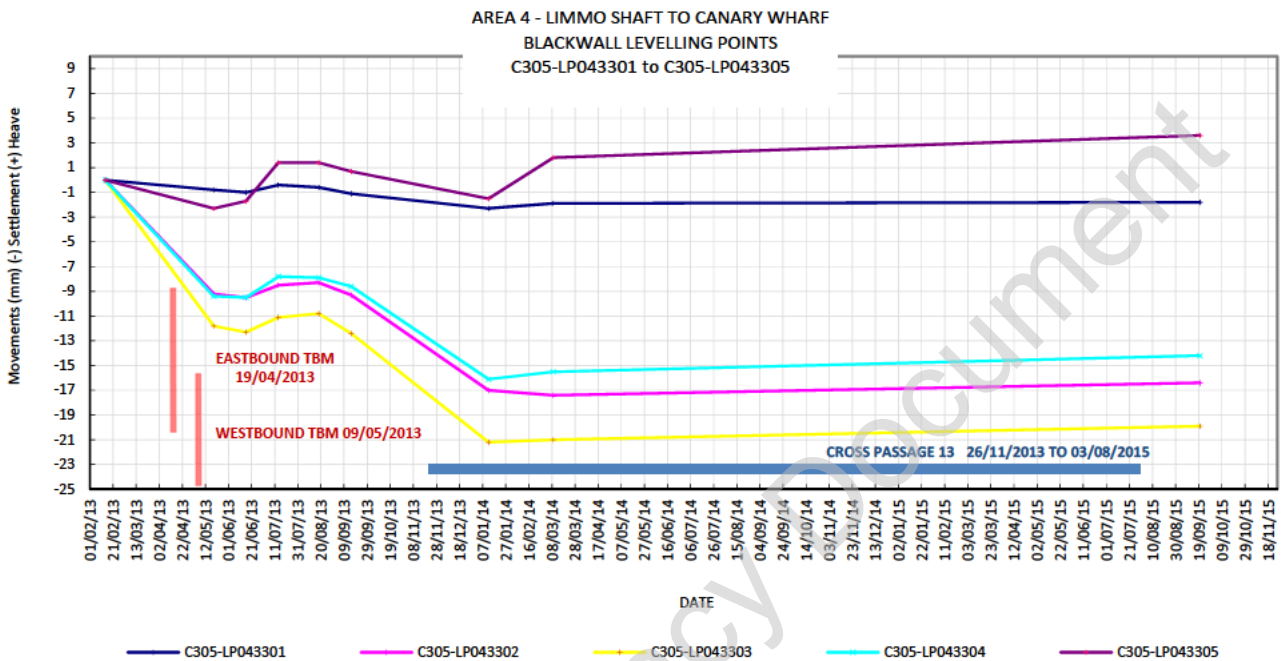
The percentage of levelling points with a settlement rate less than 2 mm/year is 100%.

The graph below shows the trend line adjustment for the levelling points in this array.



**LEVELLING POINTS C305-LP043301 - C305-LP043305**

The following graph shows data for the levelling points installed in Blackwall Tunnel southbound. There was a maximum settlement of -7mm after the eastbound TBM transit and a total maximum settlement of -11mm after the westbound TBM transit. During the dewatering period for CP13 the total maximum settlement recorded was -21mm.



The table below shows the annual settlement rates for the levelling points in this array.

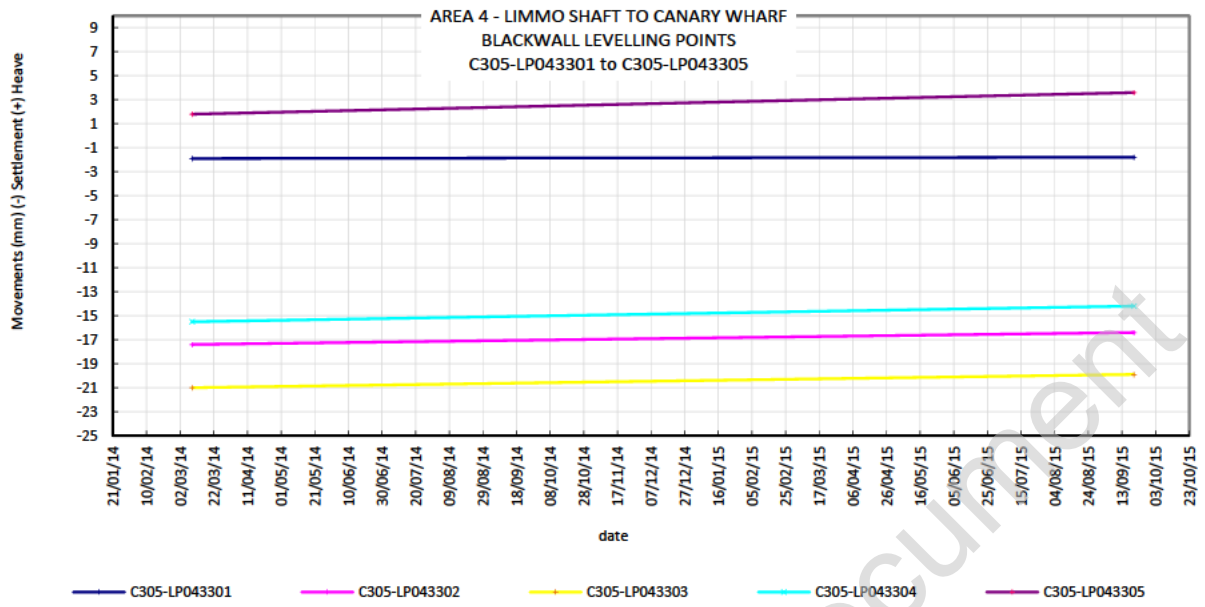
			mm/year
	09/03/2014	20/09/2015	
C305-LP043301	-1.90	-1.80	0.065
C305-LP043302	-17.40	-16.40	0.652
C305-LP043303	-21.00	-19.90	0.717
C305-LP043304	-15.50	-14.20	0.847
C305-LP043305	1.80	3.60	1.173
	Rate less than -2.5 mm/year	% less 2 mm/ year	100%
	Rate greater than -3.5 mm/year	% less 3 mm/ year	100%

Note: All the movements are in mm. (-) Settlement / (+) Heave

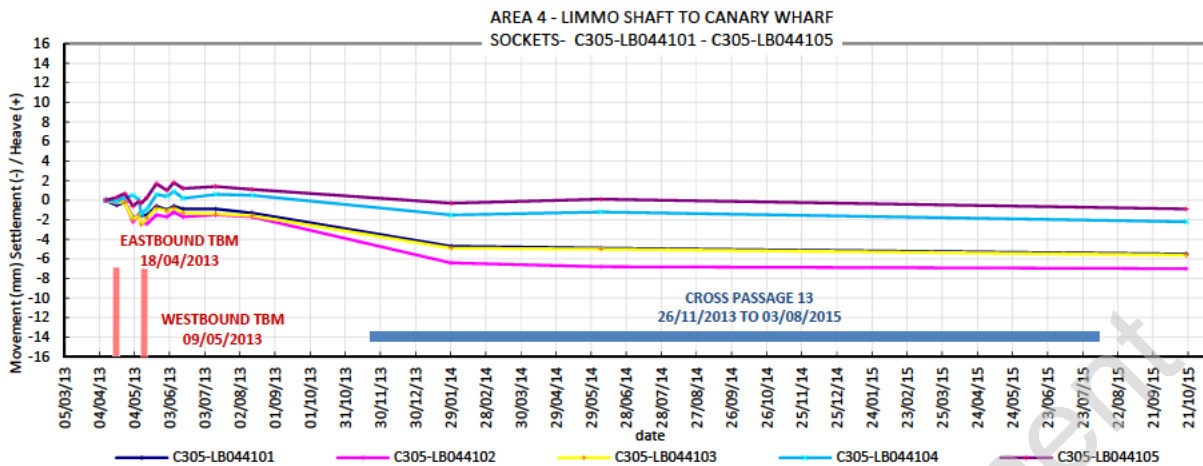
The percentage of levelling points with a settlement rate less than 2 mm/year is 100%.



The graph below shows the trend line adjustment for the levelling points in this array.



**SOCKETS VENTILATION SHAFT C305-LB044101 - C305-LB044105**



The graph above shows a maximum settlement of -2mm after the westbound TBM transit, and a total maximum settlement of -7mm during the dewatering period of Cross Passage 13.

In order to determine if the rate of change in the data has reached an acceptably small rate, the last two readings (this includes one reading after the dewatering period) were used to calculate the annual projection.

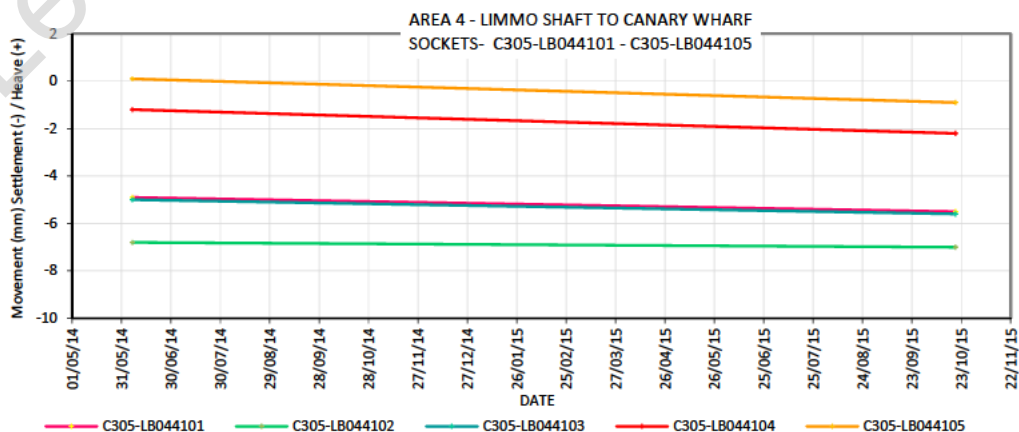
The table below shows the annual settlement rates for the sockets in this array.

	Registered movement (mm)		Rate (mm/year)
	06/06/2014	19/10/2015	
C305-LB044101	-4.90	-5.50	-0.438
C305-LB044102	-6.80	-7.00	-0.146
C305-LB044103	-5.00	-5.60	-0.438
C305-LB044104	-1.20	-2.20	-0.730
C305-LB044105	0.10	-0.90	-0.730
	Rate less than -2.5 mm/year	% less 2 mm/ year	100.00%
	Rate greater than -3.5 mm/year	% less 3 mm/ year	100.00%

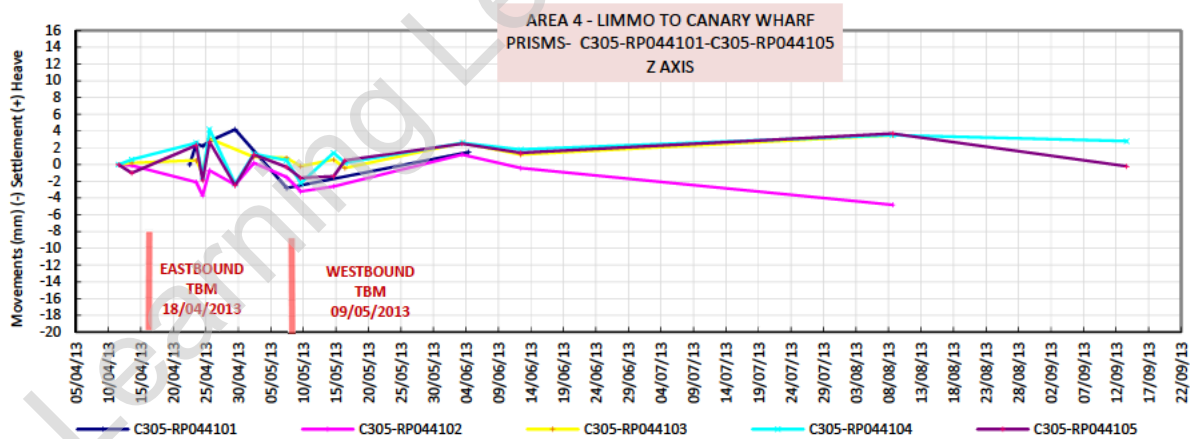
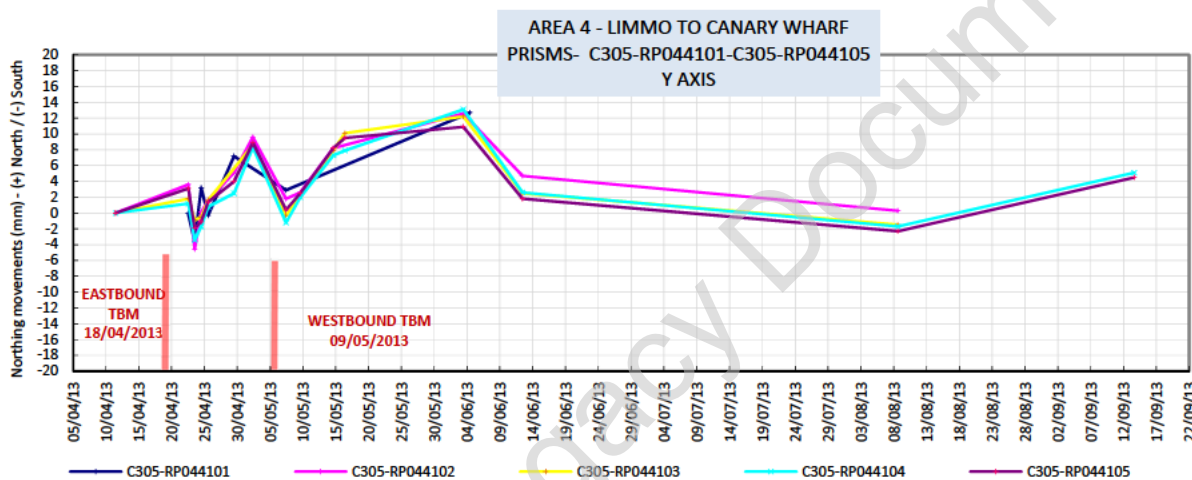
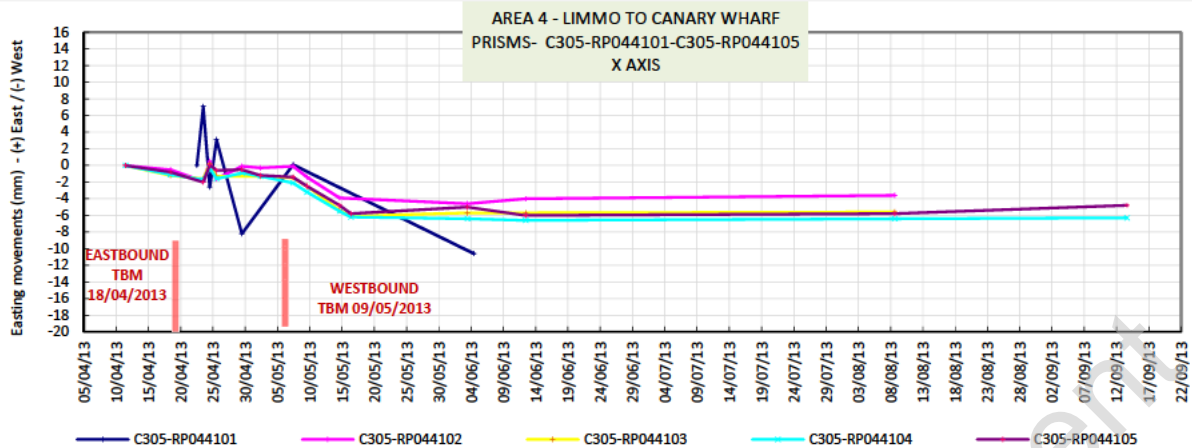
Note: All the movements are in mm. (-) Settlement / (+) Heave

The percentage of the sockets with a settlement rate less than 2 mm/year is 100%.

The graph below shows the trend line adjustment for the sockets in this array.



**PRISMS VENTILATION SHAFT C305-RP044101 - C305-RP044105**



Readings in X direction show a negative movement of -2mm after the eastbound TBM transit and -6mm after the westbound TBM transit. The data from prism C305-RP044101 shows spiky readings. The Y axis shows a positive movement of +4mm after the eastbound TBM transit and +8mm after the westbound TBM transit.

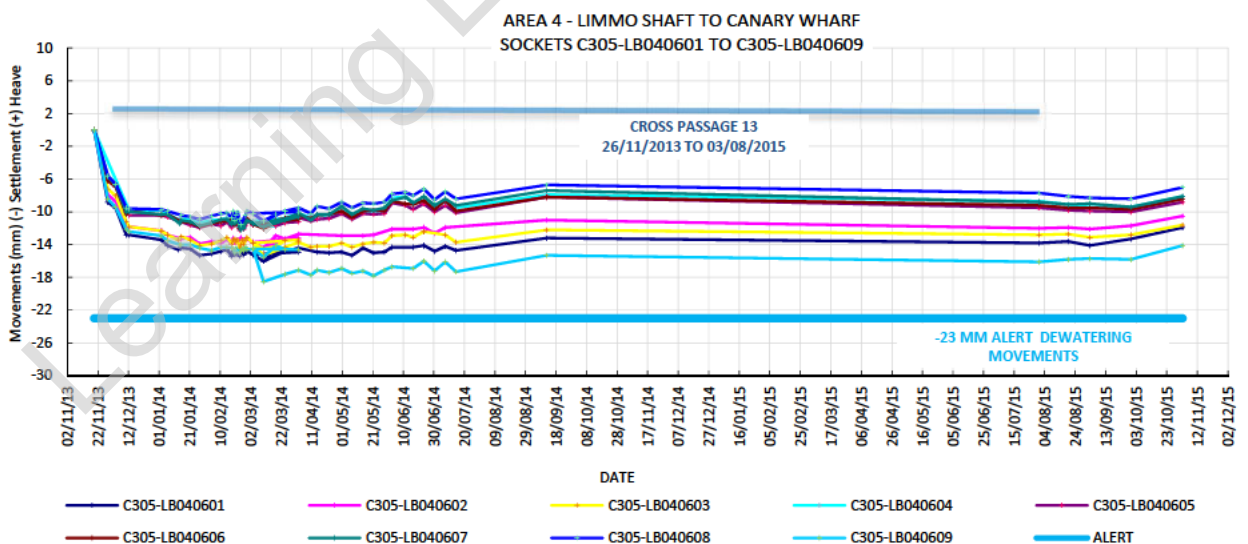
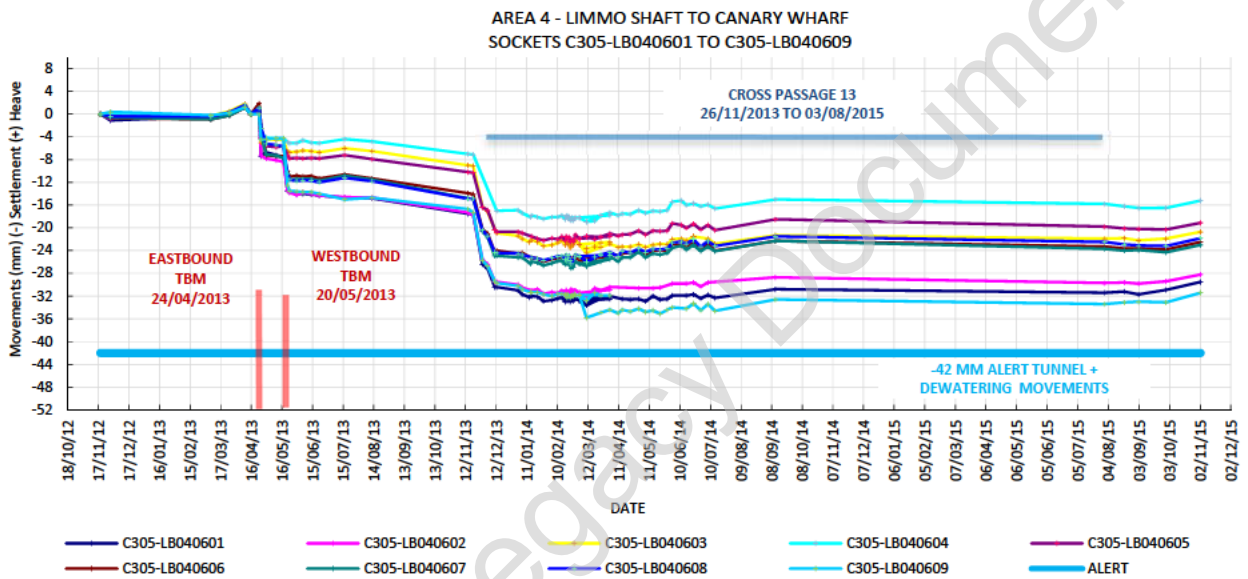
In the Z axis direction; a settlement of -2mm was observed for the prism C305-RP044102 and a heave of +2mm for prism C305-RP044104 after the eastbound TBM transit. There was a settlement of -3mm after the westbound TBM transit.

**7.2 CROSS PASSAGE 13**

**SOCKETS IBIS HOTEL C305-LB040601 - C305- LB040609**

The first graph presented below shows the monitoring data from the date of installation. There was a maximum settlement of -7mm after the eastbound TBM transit and a total maximum settlement of -15mm after the westbound TBM transit. A total maximum settlement of -36mm was recorded during the dewatering period of Cross Passage 13.

The second graph presented below shows the effect of the dewatering in Cross Passage 13 with a total maximum settlement of -18.5mm.



To check whether the rate of change of settlement in the data has reached an acceptably small rate, the last four readings were used to calculate the annual projection.

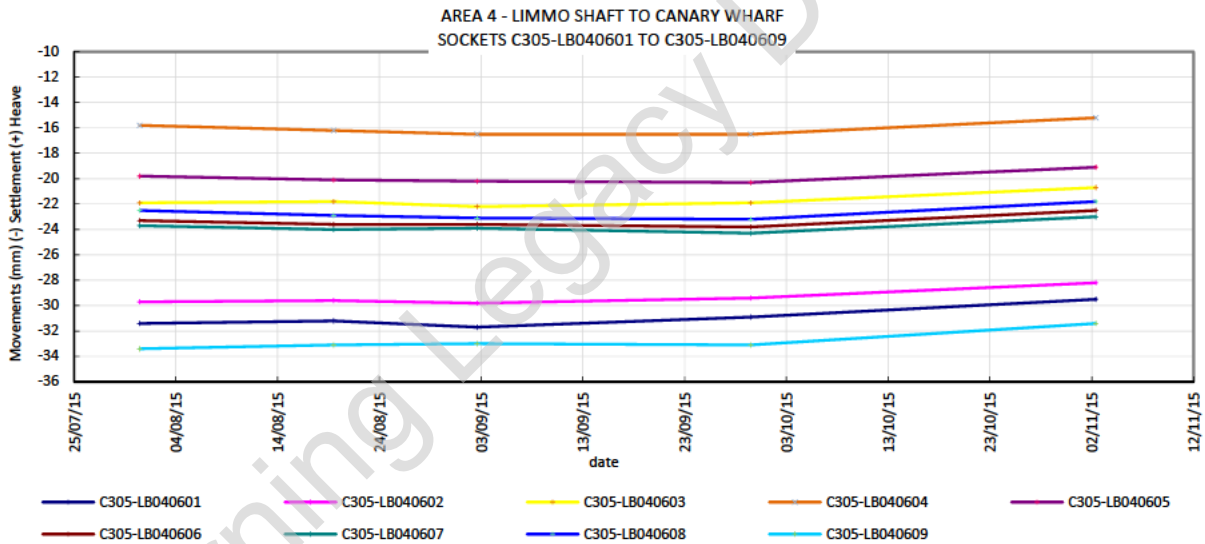
The table below shows the annual rate for the sockets in this array.

	Registered movement (mm)					Rate (mm/year)
	31/07/2015	19/08/2015	02/09/2015	29/09/2015	02/11/2015	
C305-LB040601	-31.40	-31.20	-31.70	-30.90	-29.50	7.282
C305-LB040602	-29.70	-29.60	-29.80	-29.40	-28.20	5.640
C305-LB040603	-21.90	-21.80	-22.20	-21.90	-20.70	4.297
C305-LB040604	-15.80	-16.20	-16.50	-16.50	-15.20	2.234
C305-LB040605	-19.80	-20.10	-20.20	-20.30	-19.10	2.531
C305-LB040606	-23.30	-23.60	-23.60	-23.80	-22.50	2.834
C305-LB040607	-23.70	-24.00	-23.90	-24.30	-23.00	2.295
C305-LB040608	-22.50	-22.90	-23.10	-23.20	-21.80	2.536
C305-LB040609	-33.40	-33.10	-33.00	-33.10	-31.40	6.851
	Rate less than -2.5 mm/year			% less 2 mm/ year		100%
	Rate greater than -3.5 mm/year			% less 3 mm/ year		100%

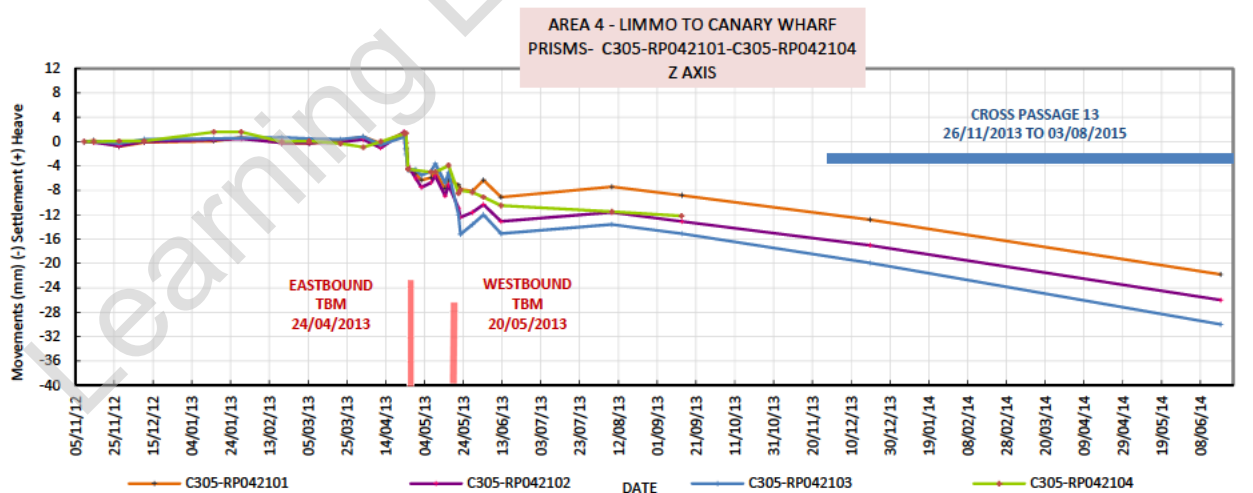
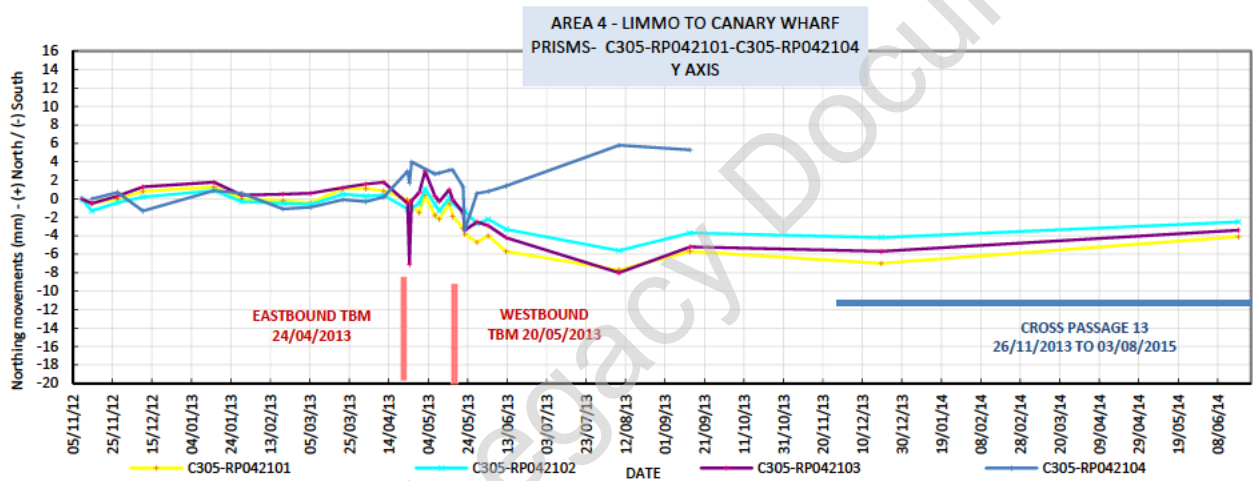
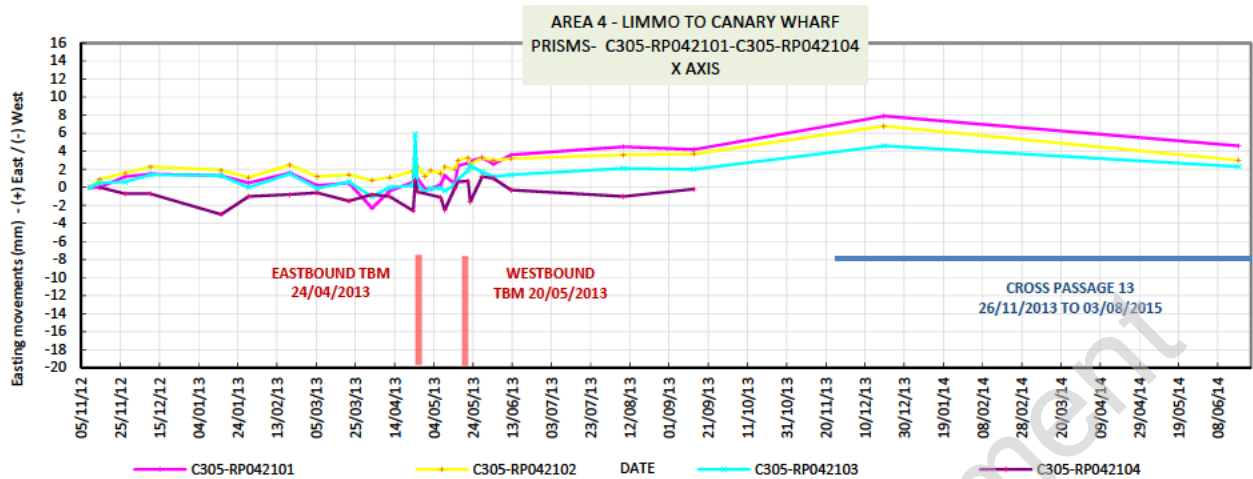
Note: All the movements are in mm. (-) Settlement / (+) Heave

The percentage of the sockets with a settlement rate less than 2 mm/year is 100%.

The graph below shows the trend line adjustment for the sockets in this array.



**3D PRISMS IBIS HOTEL - C305-RP042101 - C305-RP042104**



Readings in X direction show a positive spike of +6mm during the eastbound TBM transit and +2mm after the westbound TBM transit for prism C305-RP042103.

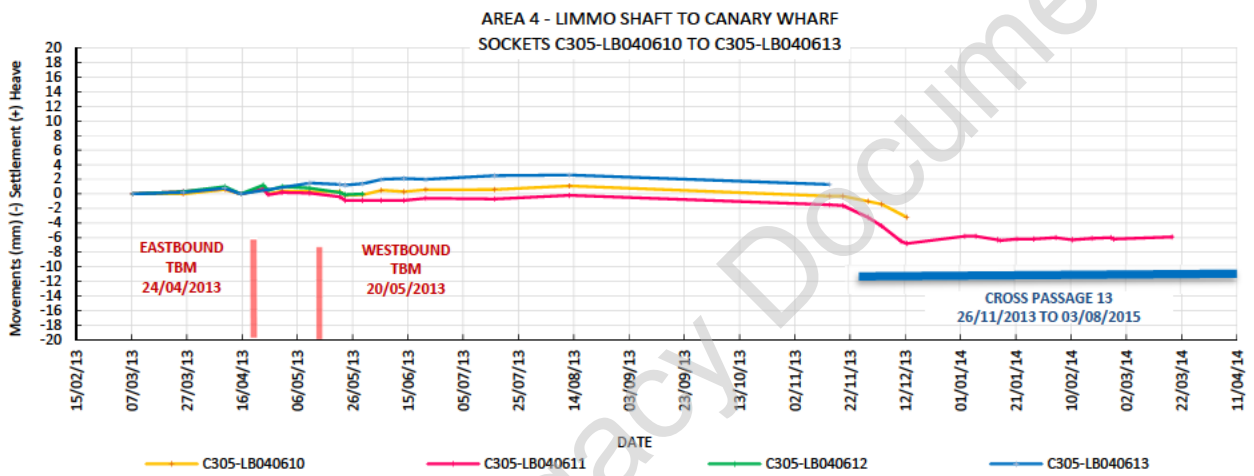
The Y axis shows a negative spike of -7mm during the eastbound TBM transit and -3mm after the westbound TBM transit for prism C305-RP042103.

In the Z axis direction a settlement of -8mm was observed after the eastbound TBM transit and a maximum settlement of -16mm after the westbound TBM transit.

NOTE: This section was not included in Specific Action Plan (SAP) for Cross Passage 13 and readings were not required.

**SOCKETS STREAMLIGHT TOWER - C305-LB040610 - C305-LB040613**

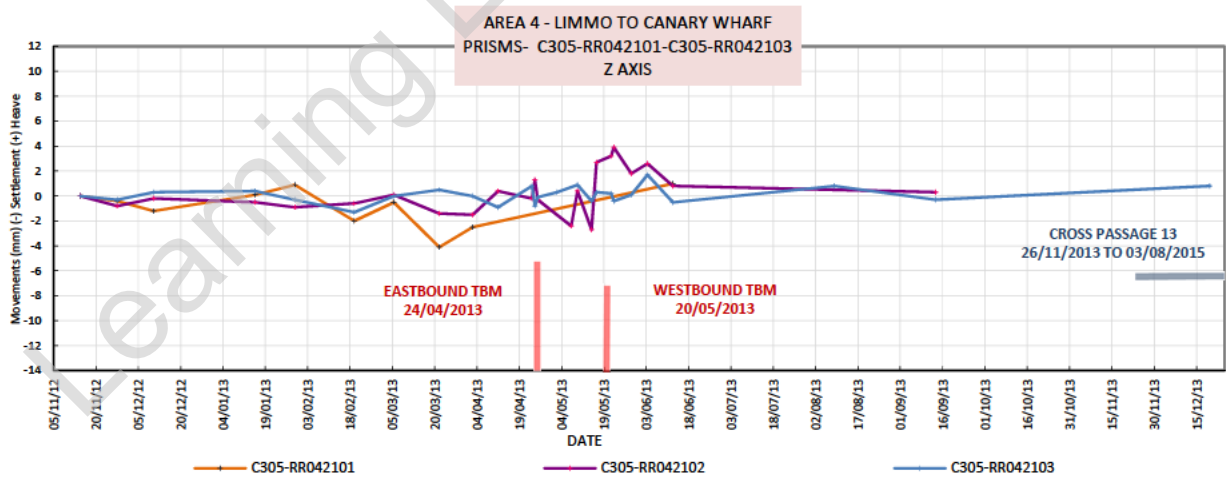
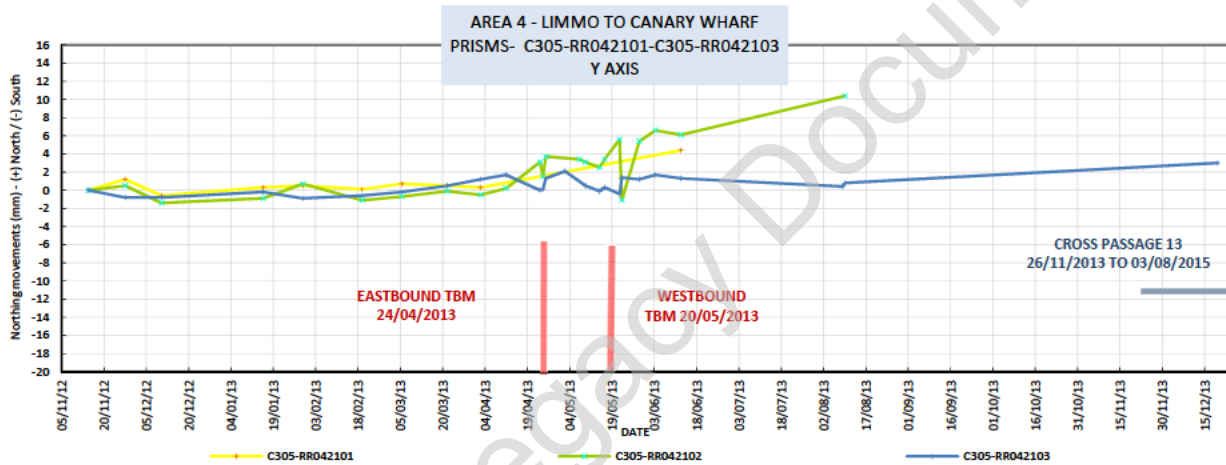
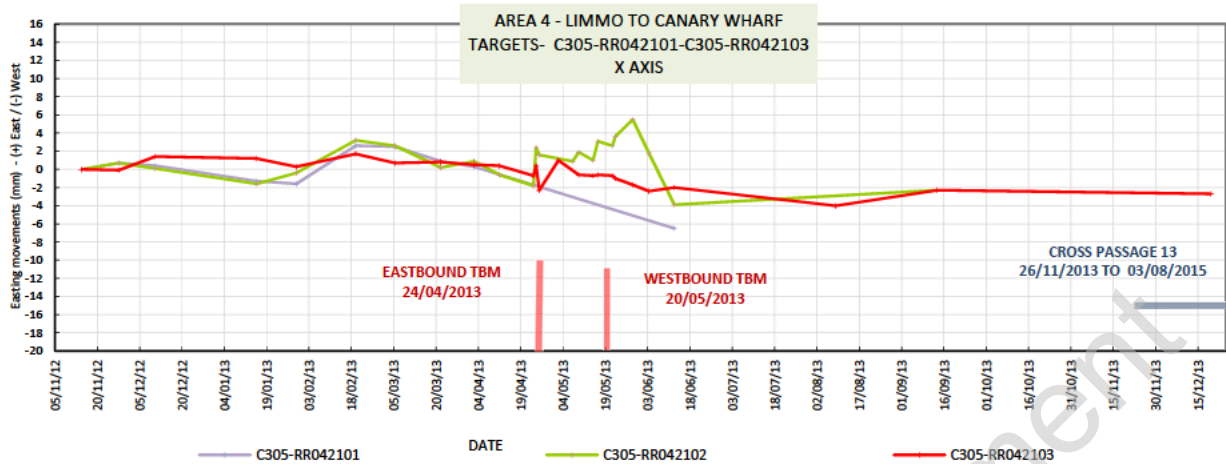
The graph below shows there was a maximum settlement of -1mm after the westbound TBM transit. A maximum settlement of -8mm was recorded during the dewatering of CP13.



No projection has been calculated for this array because some of the sockets were damaged/destroyed and no further readings were taken after the dewatering of Cross Passage 13.

NOTE: This section was not included in SAP for Cross Passage 13 and readings were not required.

**RETRO TARGETS STREAMLIGHT TOWER - C305-RR042101 - C305-RR042103**



Readings in the X direction show a settlement of -2mm during the eastbound TBM transit and +2mm after the westbound TBM transit.

The Y axis shows a positive movement of +4mm during the eastbound TBM transit and +6mm during the westbound TBM transit.



In the Z axis a settlement of -3mm was observed for target C305-RP044102 during the eastbound TBM passage and a maximum heave of +4mm was observed for the same target after the westbound TBM transit.

NOTE: This section was not included in SAP for Cross Passage 13 and readings not required.

Learning Legacy Document

**LEVELLING POINTS TRANSECT 4I - C305-LP040701 – C305-LP040734 & C305-LP047101 – C305-LP047115**

Summary history of the levelling points section at Transect 4I:

- **C305-LP040701 – C305-LP040734**

Section installed to control TBMs passage on the 23<sup>rd</sup> of October 2012.

Levelling points C305-LP040701 to C305-LP040721 were damaged by another contractor during construction works on the 19<sup>th</sup> of November 2013.

- **C305-LP047101 – C305-LP047115**

Section installed to control CP13 works on the 20<sup>th</sup> of November 2013, after section C305-LP040701 – C305-LP040734 was partially destroyed.

- **C305-LP047107 – C305-LP047115 AND C305-LP040723 – C305-LP040734**

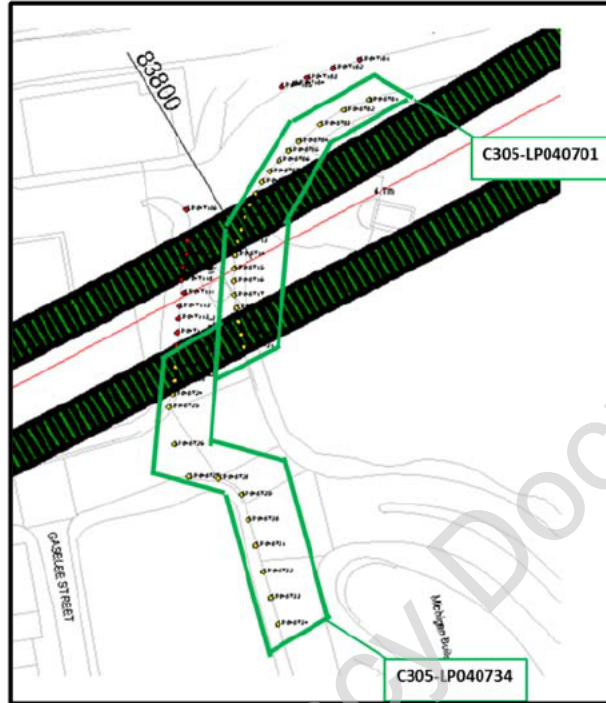
A new section was nominated from the combination of the two sections above to control TBMs passage and CP13 works, after section C305-LP040701 – C305-LP040734 was partially destroyed. For accurate and reliable readings, levelling points C305-LP040713 – C305-LP040721 historical settlement movements have been applied as an offset to C305-LP047107 – C305-LP047115.

The plot below shows monitoring history of the levelling points installed at Transect 4I.

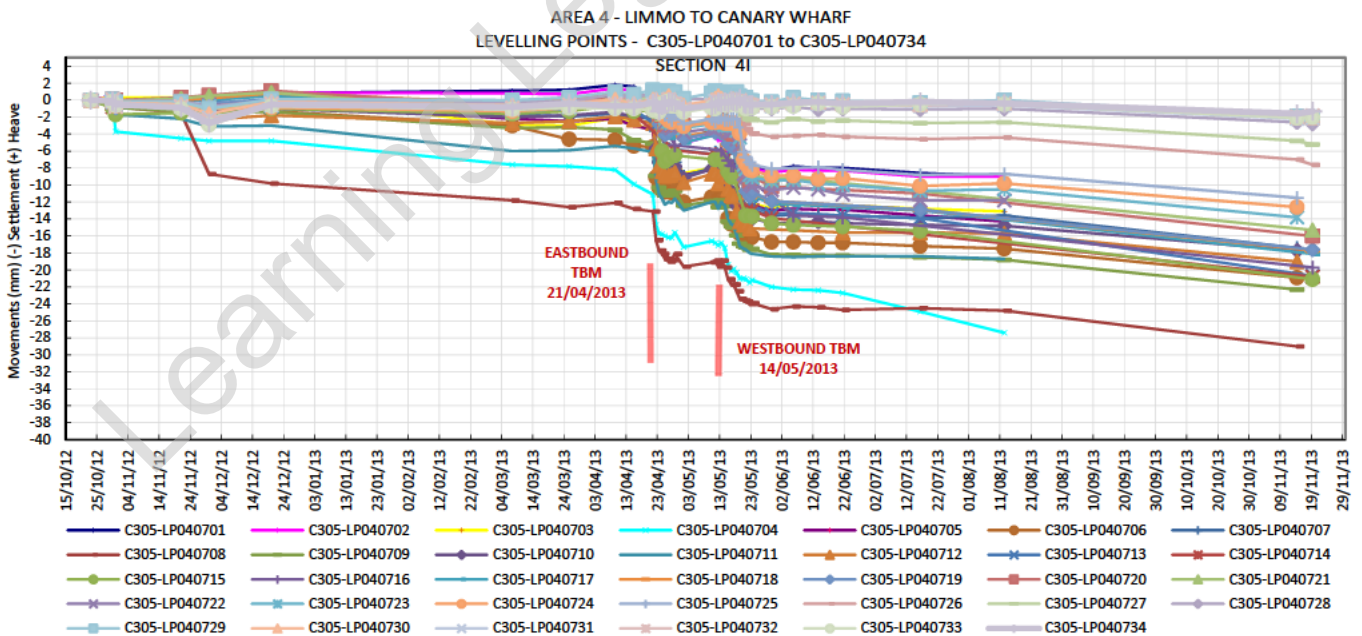
SECTION	Monitoring	First Readings	Last Readings	Comments
C305-LP040701 – C305-LP040734	TBMs	23-10-12	19-11-13	C305-LP040701 – C305-LP040721 were destroyed by another contractor during construction works on November 2013
C305-LP047101 – C305-LP047115	CP13	20-11-13	02-11-15	C305-LP047101 – C305-LP047115 were installed to monitor CP13 works from late November 2013 to November 2015
C305-LP047107 – C305-LP047115 AND C305-LP040723 – C305-LP040734	TBMs and CP13	23-10-12 (C305-LP040723 – C305-LP040734) 20-11-13 (C305-LP047107 – C305-LP047115)	02-11-15	C305-LP040713 – C305-LP040721 historical settlement movements have been applied as an offset to C305-LP047107 – C305-LP047115 to monitor CP13 works from late November 2013 onwards

### C305-LP040701 – C305-LP040734

The plot below shows the location of the levelling points section at Transect 4I installed on the 23<sup>rd</sup> of October 2012.



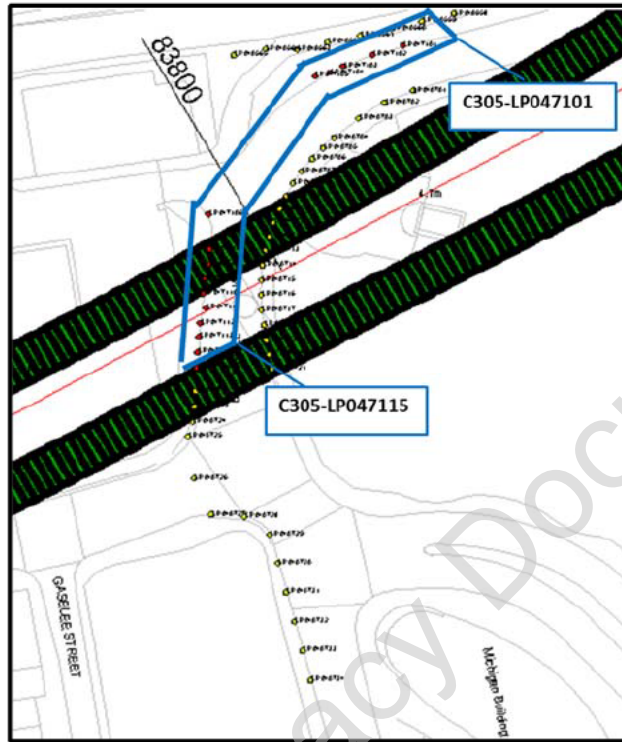
The following graph show data for the levelling points installed in Transect 4I.



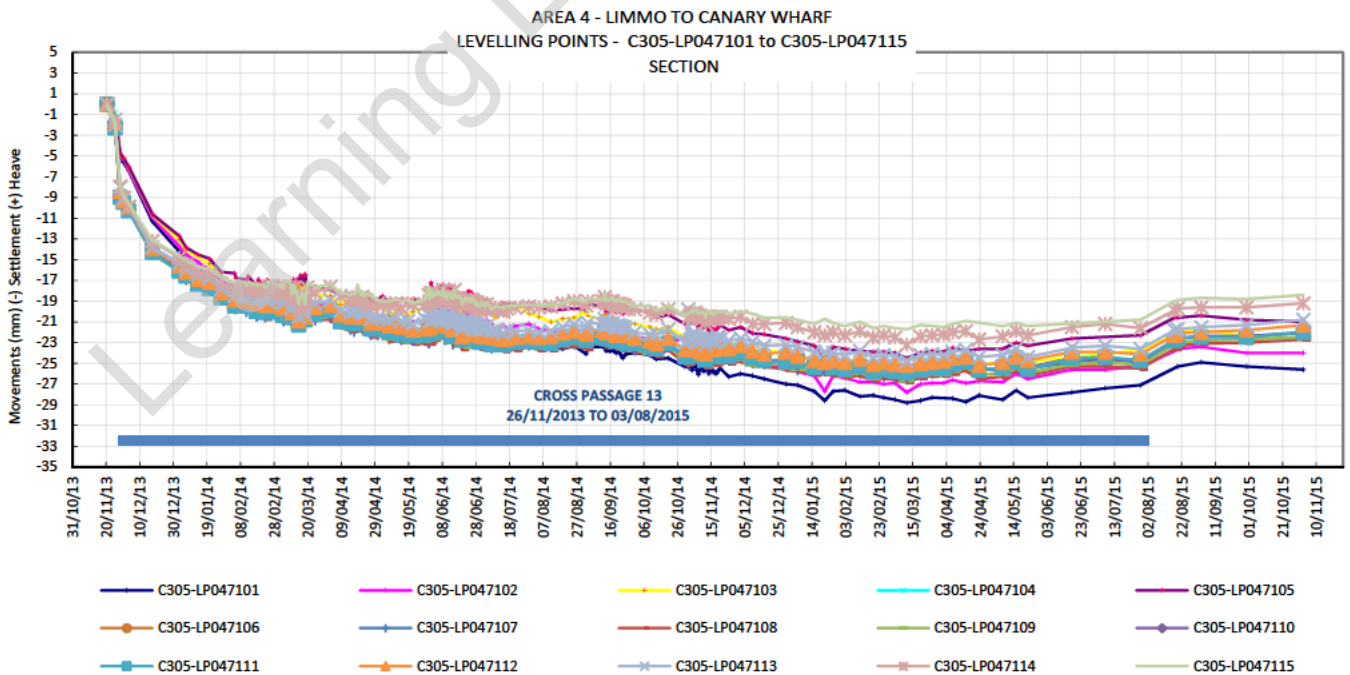
The graph above shows a maximum settlement of -20mm after the eastbound TBM transit and -29mm settlement after the westbound TBM transit.

**C305-LP047101 – C305-LP047115**

The plot below shows the location of the levelling points section at Transect 4I installed on the 20<sup>th</sup> of November 2013.



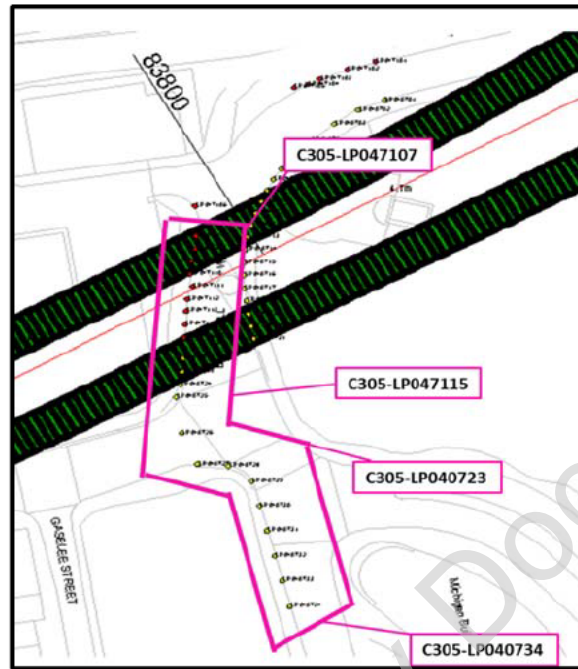
The following graph show data for the levelling points installed in Transect 4I.



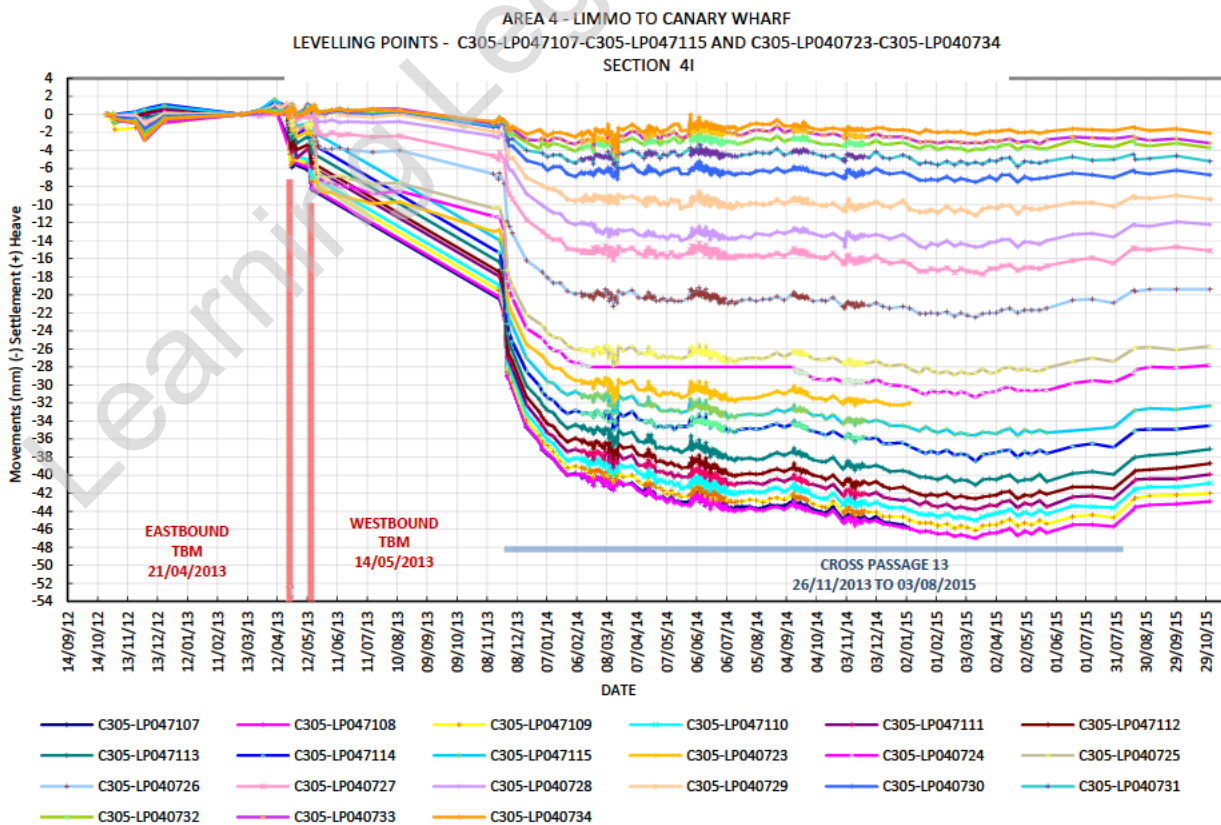
The graph above shows a maximum settlement of -29mm due to dewatering in Cross Passage 13.

**C305-LP047107 – C305-LP047115 AND C305-LP040723 – C305-LP040734**

The plot below shows the location of the levelling points combined section at Transect 4I.



The following graph show data for the levelling points installed in Transect 4I.



The graph above shows a maximum settlement of -6mm after the eastbound TBM transit and -8mm settlement after the westbound TBM transit. The maximum settlement due to dewatering in Cross Passage 13 is -47mm.

To check whether the settlement rate of change in the data has reached an acceptably small rate, the readings after dewatering were used to calculate the annual projection.

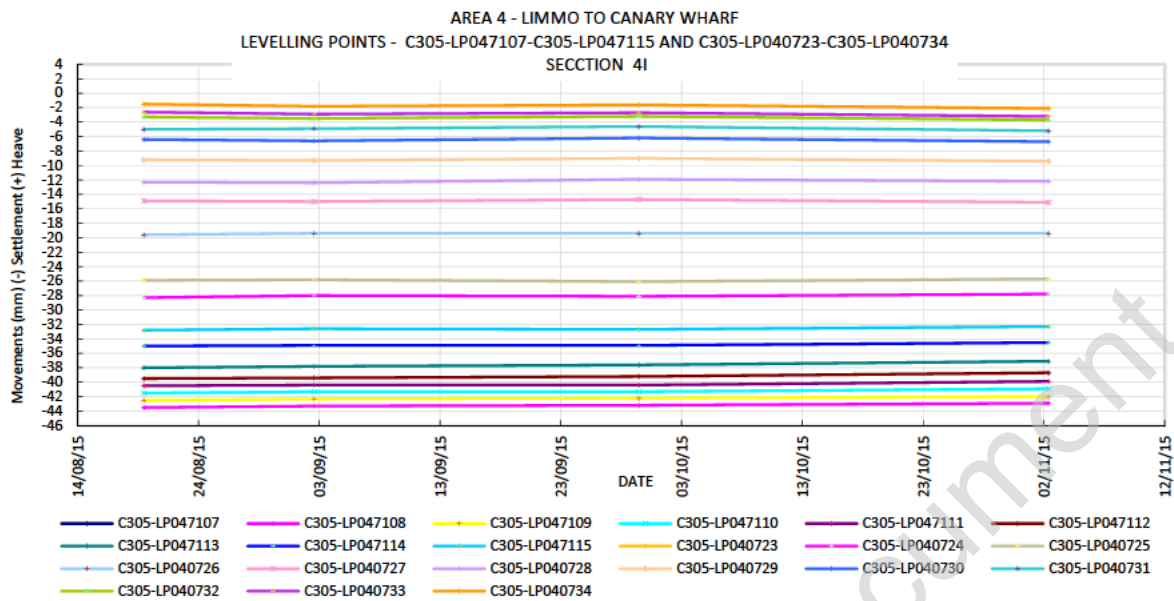
The table below shows the annual rate for the levelling points in this array.

	Registered movement (mm)				Rate mm/Year
	19/08/2015	02/09/2015	29/09/2015	02/11/2015	
C305-LP047107	#N/A	#N/A	#N/A	#N/A	-
C305-LP047108	-43.50	-43.30	-43.20	-42.90	2.7
C305-LP047109	-42.50	-42.30	-42.20	-42.00	2.2
C305-LP047110	-41.50	-41.30	-41.30	-40.90	2.6
C305-LP047111	-40.50	-40.40	-40.40	-39.90	2.7
C305-LP047112	-39.50	-39.40	-39.20	-38.70	3.9
C305-LP047113	-38.00	-37.80	-37.60	-37.10	4.2
C305-LP047114	-35.00	-34.90	-34.90	-34.50	2.3
C305-LP047115	-32.80	-32.60	-32.70	-32.30	2.1
C305-LP040723	#N/A	#N/A	#N/A	#N/A	-
C305-LP040724	-28.30	-28.00	-28.10	-27.80	1.9
C305-LP040725	-25.90	-25.80	-26.10	-25.70	0.6
C305-LP040726	-19.60	-19.40	-19.40	-19.40	0.7
C305-LP040727	-14.90	-15.00	-14.70	-15.10	-0.6
C305-LP040728	-12.30	-12.40	-11.90	-12.20	1.1
C305-LP040729	-9.20	-9.30	-9.00	-9.40	-0.6
C305-LP040730	-6.40	-6.60	-6.20	-6.70	-0.8
C305-LP040731	-5.00	-4.90	-4.60	-5.20	-0.8
C305-LP040732	-3.30	-3.50	-3.20	-3.70	-1.4
C305-LP040733	-2.60	-2.90	-2.70	-3.20	-2.3
C305-LP040734	-1.50	-1.80	-1.60	-2.10	-2.3
	Rate less than -2.5 mm/year		% less 2 mm/ year		100.00%
	Rate greater than -3.5 mm/year		% less 3 mm/ year		100.00%

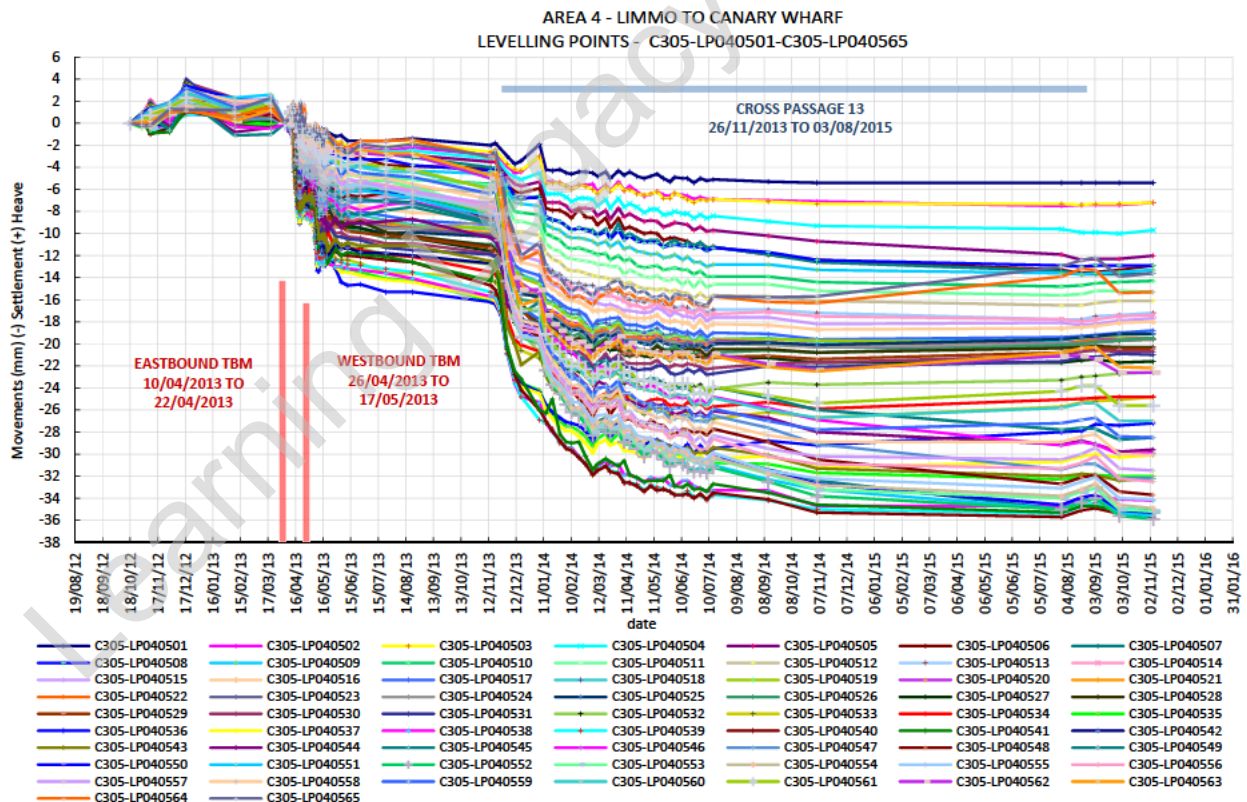
Note: All the movements are in mm. (-) Settlement / (+) Heave

The percentage of levelling points with a settlement rate less than 2 mm/year is 100%.

The graph below shows the trend line adjustment for the levelling points in this array.



**LEVELLING POINTS BLACKWALL WAY - C305-LP040501 – C305-LP040565**



The graph above shows a maximum settlement of -9mm after the eastbound TBM transit and a total maximum settlement of -15mm after the westbound TBM transit. The total maximum settlement due to dewatering in Cross Passage 13 is -36mm.

To check whether the settlement rate of change in the data has reached an acceptably small rate, the last two readings after dewatering were used to calculate the annual projection.

The table below shows the annual rate for the levelling points in this array.

	Registered movement (mm)		Rate (mm/year)
	29/09/2015	05/11/2015	
C305-LP040501	-5.40	-5.40	0.000
C305-LP040502	-7.40	-7.20	1.969
C305-LP040503	-7.30	-7.20	0.984
C305-LP040504	-10.00	-9.70	2.953
C305-LP040505	-12.30	-12.00	2.953
C305-LP040506	-13.30	-12.90	3.938
C305-LP040507	-13.70	-13.60	0.984
C305-LP040508	-12.90	-12.90	0.000
C305-LP040509	-13.50	-13.30	1.969
C305-LP040510	-14.40	-14.30	0.984
C305-LP040511	-15.20	-15.30	-0.984
C305-LP040512	-16.10	-16.10	0.000
C305-LP040513	-17.40	-17.20	1.969
C305-LP040514	-17.50	-17.40	0.984
C305-LP040515	-17.90	-17.70	1.969
C305-LP040516	-18.10	-18.00	0.984
C305-LP040517	-19.00	-18.80	1.969
C305-LP040518	-19.20	-19.10	0.984
C305-LP040519	-19.40	-19.50	-0.984
C305-LP040520	-19.60	-19.50	0.984
C305-LP040521	-19.70	-19.60	0.984
C305-LP040522	-19.70	-19.50	1.969
C305-LP040523	-19.70	-19.60	0.984
C305-LP040524	-19.70	-19.50	1.969
C305-LP040525	-19.10	-19.10	0.000
C305-LP040526	-19.70	-19.50	1.969
C305-LP040527	-21.70	-21.60	0.984
C305-LP040528	-20.30	-20.30	0.000
C305-LP040529	-20.50	-20.50	0.000
C305-LP040530	-20.70	-20.70	0.000
C305-LP040531	-20.90	-21.00	-0.984
C305-LP040532	-22.70	-22.60	0.984
C305-LP040533	-25.10	-24.80	2.953
C305-LP040534	-24.80	-24.80	0.000
C305-LP040535	-32.00	-32.00	0.000
C305-LP040536	-27.40	-27.20	1.969
C305-LP040537	-30.30	-30.10	1.969
C305-LP040538	-34.10	-34.20	-0.984
C305-LP040539	-34.90	-35.10	-1.969
C305-LP040540	-35.40	-35.70	-2.953
C305-LP040541	-35.10	-35.20	-0.984
C305-LP040542	#N/A	#N/A	-
C305-LP040543	-32.40	-32.20	1.969
C305-LP040544	-29.80	-29.60	1.969
C305-LP040545	-28.70	-28.50	1.969
C305-LP040546	-30.00	-29.90	0.984
C305-LP040547	-32.20	-32.20	0.000
C305-LP040548	-33.40	-33.70	-2.953
C305-LP040549	-35.40	-35.50	-0.984

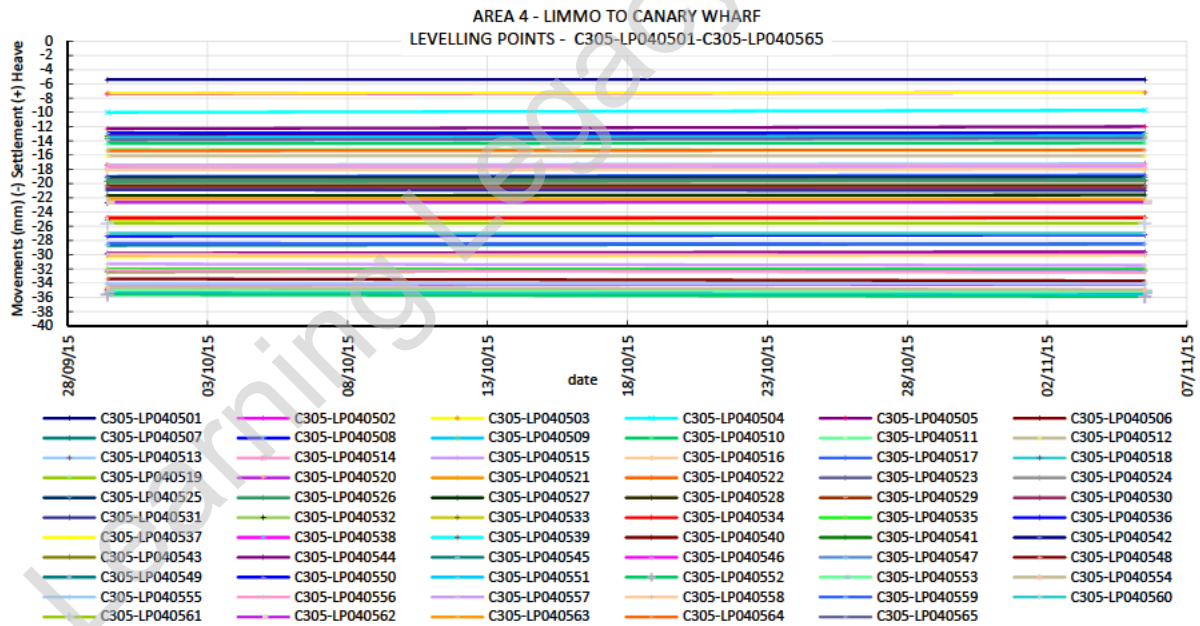


	Registered movement (mm)		Rate (mm/year)
	29/09/2015	05/11/2015	
C305-LP040550	-35.10	-35.30	-1.969
C305-LP040551	-35.40	-35.60	-1.969
C305-LP040552	-35.60	-35.90	-2.953
C305-LP040553	-35.00	-35.20	-1.969
C305-LP040554	-34.60	-34.90	-2.953
C305-LP040555	-34.00	-34.10	-0.984
C305-LP040556	-32.20	-32.50	-2.953
C305-LP040557	-31.30	-31.50	-1.969
C305-LP040558	-30.00	-30.10	-0.984
C305-LP040559	-28.40	-28.50	-0.984
C305-LP040560	-27.00	-27.00	0.000
C305-LP040561	-25.60	-25.60	0.000
C305-LP040562	-22.60	-22.60	0.000
C305-LP040563	-22.10	-22.20	-0.984
C305-LP040564	-15.40	-15.30	0.984
C305-LP040565	-13.90	-13.60	2.953
	Rate less than -2.5 mm/year	% less 2 mm/ year	92%
	Rate greater than -3.5 mm/year	% less 3 mm/ year	100%

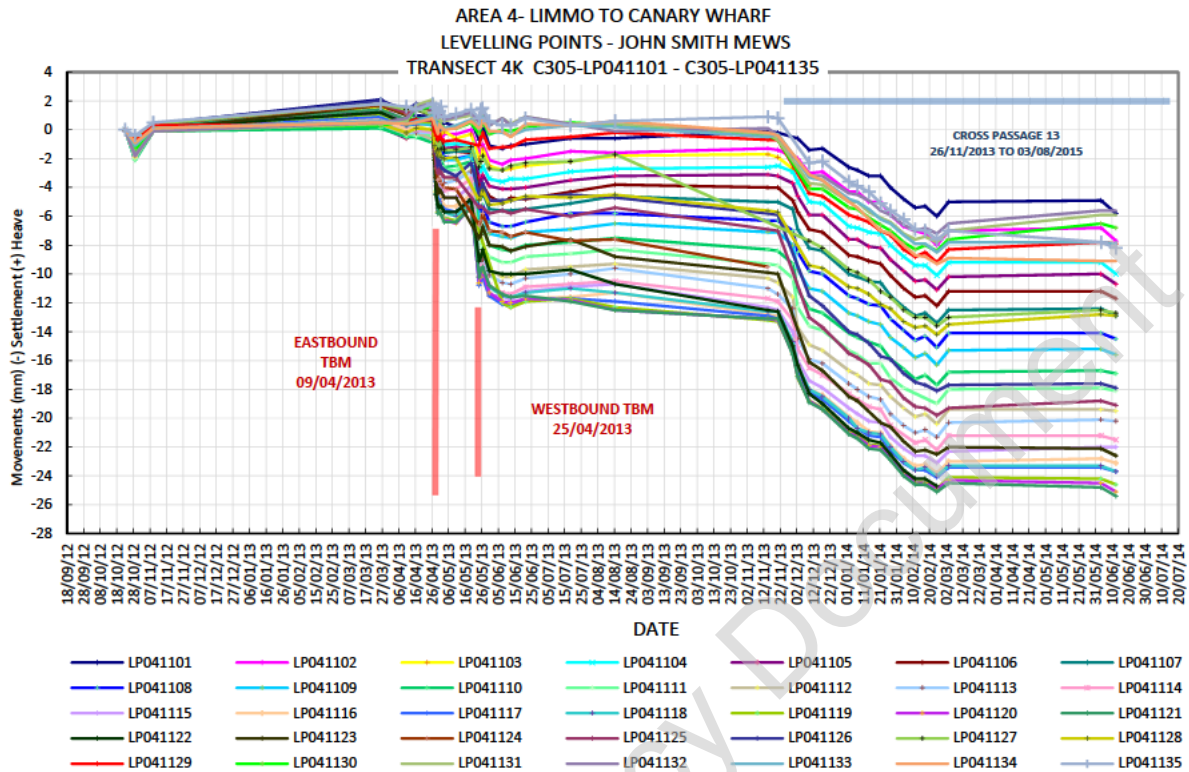
Note: All the movements are in mm. (-) Settlement / (+) Heave

The percentage of levelling points with a settlement rate less than 2 mm/year is 92%, and 100% are less than 3 mm/year.

The graph below shows the trend line adjustment for the levelling points in this array.



**LEVELLING POINTS TRANSECT 4K - C305-LP041101 – C305-LP041135**



The graph above shows a maximum settlement of -6.4 mm after the eastbound TBM transit and a total maximum settlement of -12.3 mm after the westbound TBM transit. The total maximum settlement due to dewatering in Cross Passage 13 is -25.4 mm.

The table below shows the annual rate for the levelling points in this array.

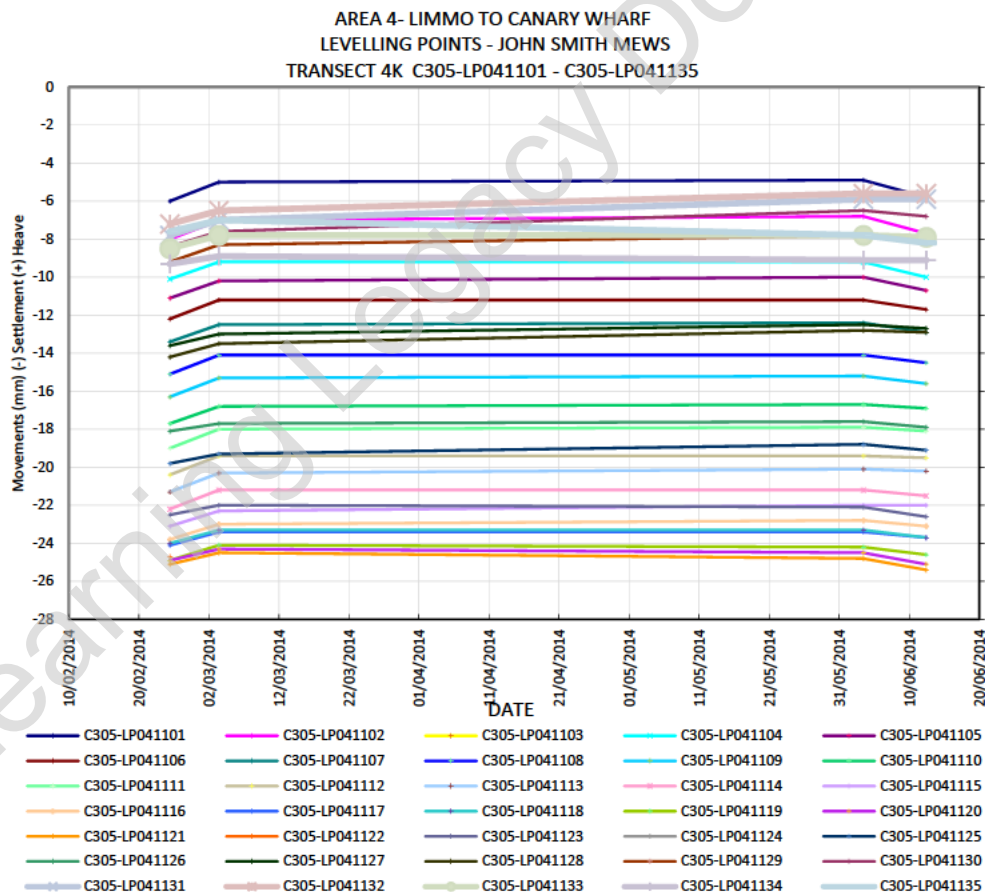
	Registered Movement (mm)				Rate (mm/year)
	24/02/2014	03/03/2014	03/06/2014	12/06/2014	
C305-LP041101	-6.0000	-5.0000	-4.9000	-5.8000	0.524
C305-LP041102	-8.0000	-7.0000	-6.8000	-7.7000	0.887
C305-LP041103	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP041104	-10.1000	-9.2000	-9.2000	-10.0000	0.165
C305-LP041105	-11.1000	-10.2000	-10.0000	-10.7000	1.088
C305-LP041106	-12.2000	-11.2000	-11.2000	-11.7000	0.952
C305-LP041107	-13.4000	-12.5000	-12.4000	-12.9000	1.121
C305-LP041108	-15.1000	-14.1000	-14.1000	-14.5000	1.150
C305-LP041109	-16.3000	-15.3000	-15.2000	-15.6000	1.513
C305-LP041110	-17.7000	-16.8000	-16.7000	-16.9000	1.714
C305-LP041111	-19.0000	-18.0000	-17.9000	-18.1000	1.908
C305-LP041112	-20.4000	-19.4000	-19.4000	-19.5000	1.743
C305-LP041113	-21.3000	-20.3000	-20.1000	-20.2000	2.468
C305-LP041114	-22.2000	-21.2000	-21.2000	-21.5000	1.347
C305-LP041115	-23.1000	-22.3000	-22.0000	-22.0000	2.640
C305-LP041116	-23.8000	-23.0000	-22.8000	-23.1000	1.685
C305-LP041117	-24.1000	-23.4000	-23.4000	-23.7000	0.765
C305-LP041118	-24.0000	-23.3000	-23.3000	-23.7000	0.568
C305-LP041119	-24.9000	-24.1000	-24.2000	-24.6000	0.399
C305-LP041120	-24.9000	-24.3000	-24.5000	-25.1000	-0.747
C305-LP041121	-25.1000	-24.5000	-24.8000	-25.4000	-1.110
C305-LP041122	-24.7000	#N/A	#N/A	#N/A	#N/A
C305-LP041123	-22.5000	-22.0000	-22.1000	-22.6000	-0.381
C305-LP041124	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP041125	-19.8000	-19.3000	-18.8000	-19.1000	2.191
C305-LP041126	-18.1000	-17.7000	-17.6000	-17.9000	0.546
C305-LP041127	-13.6000	-13.0000	-12.5000	-12.7000	2.582

	Registered Movement (mm)				Rate (mm/year)
	24/02/2014	03/03/2014	03/06/2014	12/06/2014	
C305-LP041128	-14.2000	-13.5000	-12.8000	-12.9000	3.699
C305-LP041129	-9.2000	-8.3000	-7.8000	-7.9000	3.362
C305-LP041130	-8.4000	-7.6000	-6.5000	-6.8000	4.949
C305-LP041131	-7.8000	-7.0000	-5.9000	-5.9000	5.542
C305-LP041132	-7.2000	-6.5000	-5.6000	-5.6000	4.622
C305-LP041133	-8.5000	-7.8000	-7.8000	-7.9000	1.161
C305-LP041134	-9.3000	-8.9000	-9.1000	-9.1000	0.051
C305-LP041135	-7.6000	-7.0000	-7.8000	-8.2000	-2.528
	Rate less than -2.5 mm/year			% less 2 mm/ year	96.88%
	Rate greater than -3.5 mm/year			% less 3 mm/ year	100.00%

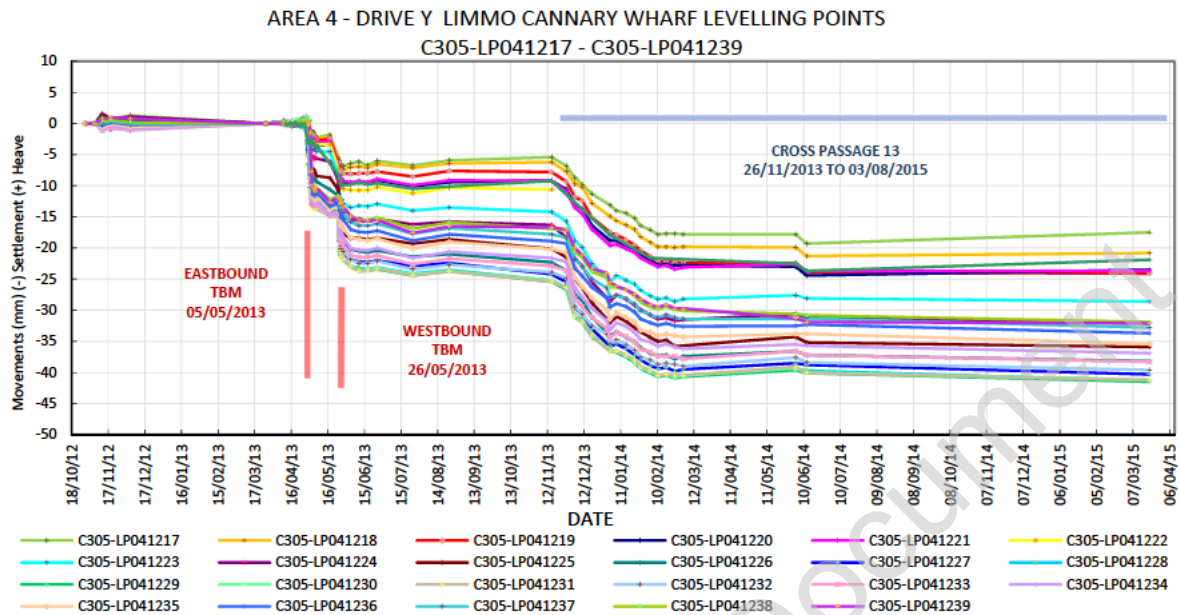
Note: All the movements are in mm. (-) Settlement / (+) Heave

The percentage of levelling points with a settlement rate less than 2 mm/year is 96%, and 100% are less than 3 mm/year.

The graph below shows the trend line adjustment for the levelling points in this array.



**LEVELLING POINTS POPLAR DOCK - C305-LP041217 – C305-LP041239**



The graph above shows a maximum settlement of -12.3 mm after the eastbound TBM transit and a total maximum settlement of -21.5 mm after the westbound TBM transit. The total maximum settlement due to dewatering in Cross Passage 13 is -41.2 mm.

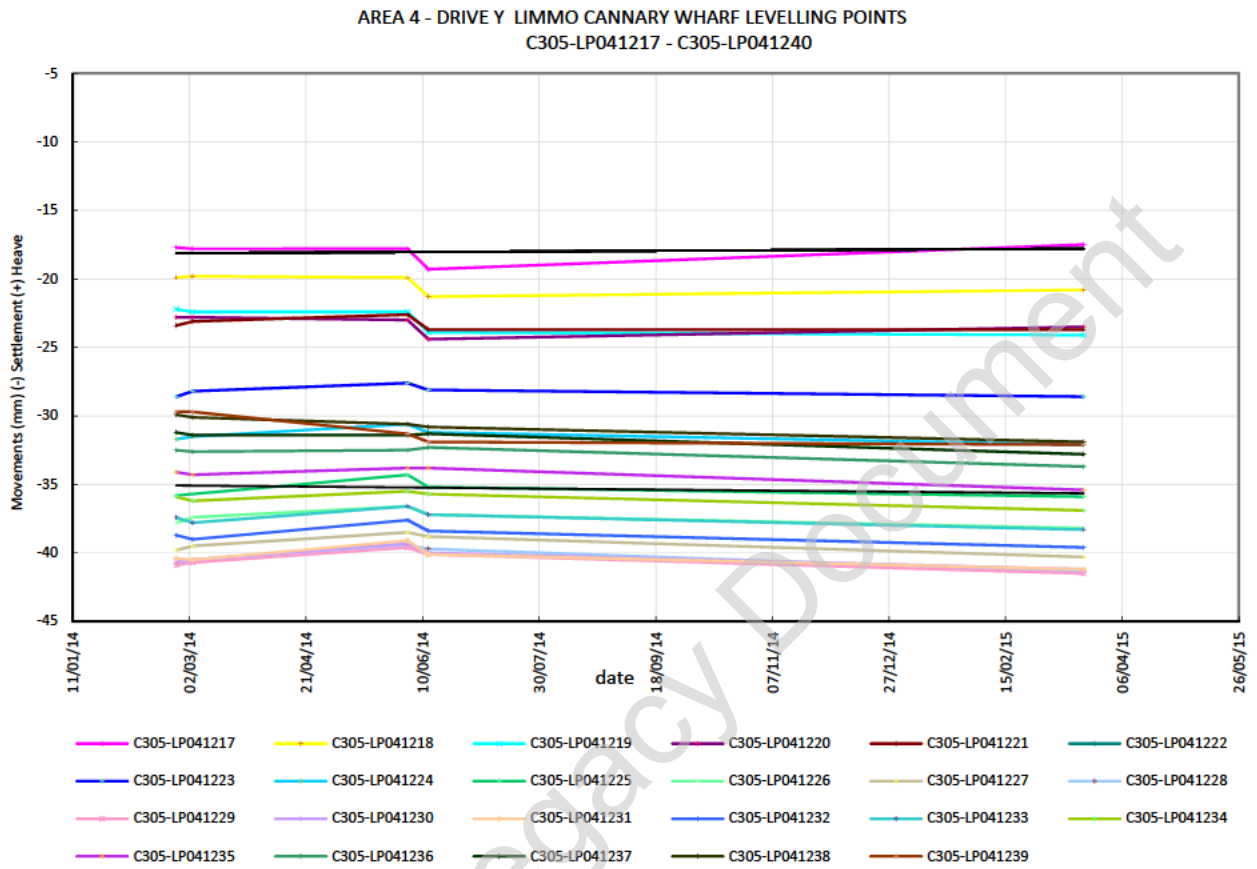
The table below shows the annual rate for the levelling points in this array.

	24/02/2014	03/03/2014	03/06/2014	12/06/2014	20/03/2015	Rate (mm/year)
C305-LP041217	-17.7000	-17.8000	-17.8000	-19.3000	-17.5000	0.329
C305-LP041218	-19.9000	-19.8000	-19.9000	-21.3000	-20.8000	-0.840
C305-LP041219	-22.2000	-22.4000	-22.4000	-23.9000	-24.1000	-1.679
C305-LP041220	-22.8000	-22.8000	-23.0000	-24.4000	-23.5000	-0.584
C305-LP041221	-23.4000	-23.1000	-22.6000	-23.7000	-23.7000	-0.475
C305-LP041222	#N/A	#N/A	#N/A	#N/A	#N/A	-
C305-LP041223	-28.6000	-28.2000	-27.6000	-28.1000	-28.6000	-0.256
C305-LP041224	-31.7000	-31.5000	-30.6000	-31.2000	-32.1000	-0.584
C305-LP041225	-35.8000	#N/A	-34.3000	-35.2000	-35.9000	-0.548
C305-LP041226	-37.8000	-37.4000	-36.6000	-37.2000	-38.2000	-0.694
C305-LP041227	-39.8000	-39.5000	-38.5000	-38.8000	-40.3000	-0.767
C305-LP041228	-40.8000	-40.5000	-39.4000	-39.7000	-41.4000	-0.876
C305-LP041229	-40.9000	-40.7000	-39.6000	-40.1000	-41.5000	-0.803
C305-LP041230	-40.6000	-40.5000	-39.3000	-40.0000	-41.2000	-0.767
C305-LP041231	-40.4000	-40.5000	-39.1000	-40.1000	-41.2000	-0.840
C305-LP041232	-38.7000	-39.0000	-37.6000	-38.4000	-39.6000	-0.840
C305-LP041233	-37.4000	-37.8000	-36.6000	-37.2000	-38.3000	-0.803
C305-LP041234	-35.9000	-36.2000	-35.5000	-35.7000	-36.9000	-0.913
C305-LP041235	-34.1000	-34.3000	-33.8000	-33.8000	-35.4000	-1.241
C305-LP041236	-32.5000	-32.6000	-32.5000	-32.3000	-33.7000	-1.132
C305-LP041237	-31.2000	-31.4000	-31.4000	-31.3000	-32.8000	-1.460
C305-LP041238	-29.9000	-30.1000	-30.6000	-30.8000	-31.9000	-1.789
C305-LP041239	-29.7000	-29.7000	-31.3000	-31.9000	-32.1000	-2.117
	Rate less than -2.5 mm/year				% less 2 mm/ year	100.00%
	Rate greater than -3.5 mm/year				% less 3 mm/ year	100.00%

Note: All the movements are in mm. (-) Settlement / (+) Heave

The percentage of levelling points with a settlement rate less than 2 mm/year is 100%.

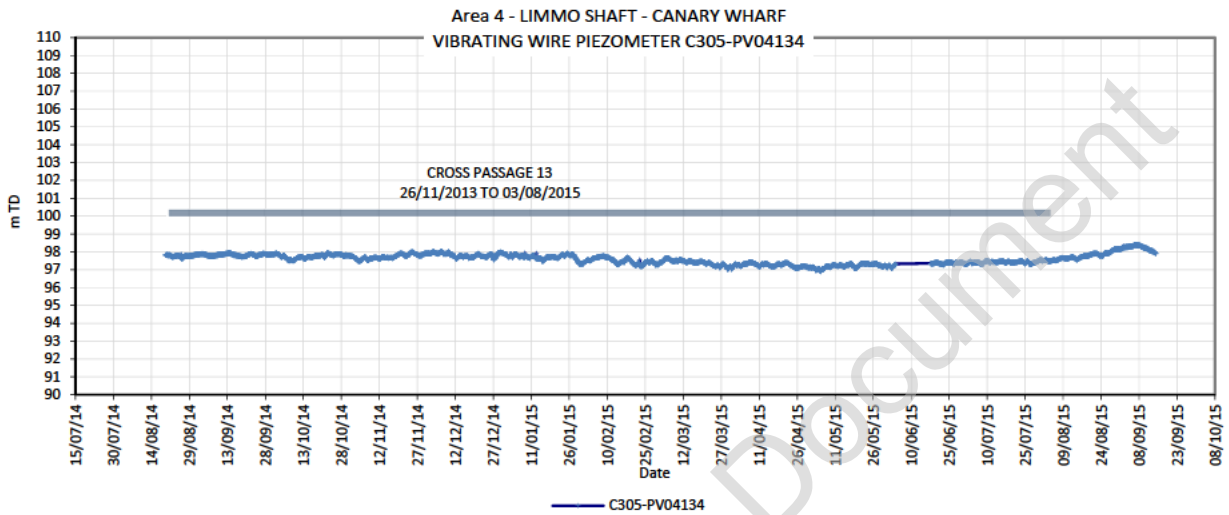
The graph below shows the trend line adjustment for the levelling points in this array.



**VIBRATING WIRE PIEZOMETER C305-PV04134**

This vibrating wire piezometer was installed in August 2014, after the TBMs transit, in order to check the effect of the dewatering in the upper aquifer.

There was a 1m rise in the water level after the dewatering of Cross Passage 13.

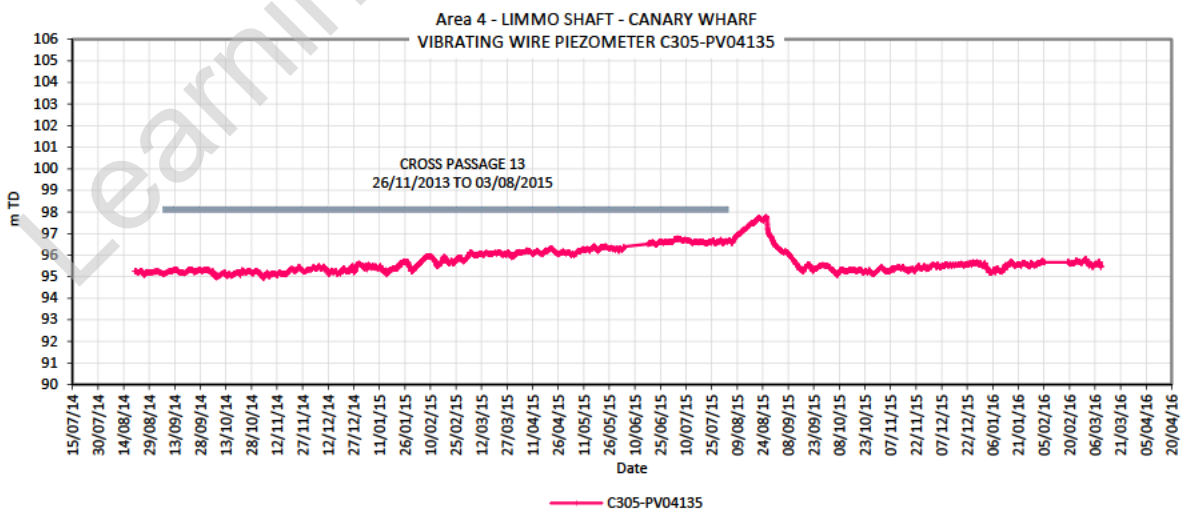


Note: The depth of the response zone of C305-PV04134 is located in London Clay at 14.4 m .

**VIBRATING WIRE PIEZOMETER C305-PV04135**

This vibrating wire piezometer was installed in August 2014, after the TBMs transit, in order to check the effect of the dewatering in the upper aquifer.

There was a progressive rise in the water level (+3m) during the dewatering of Cross Passage 13, with a drop of -3m after the switch off.

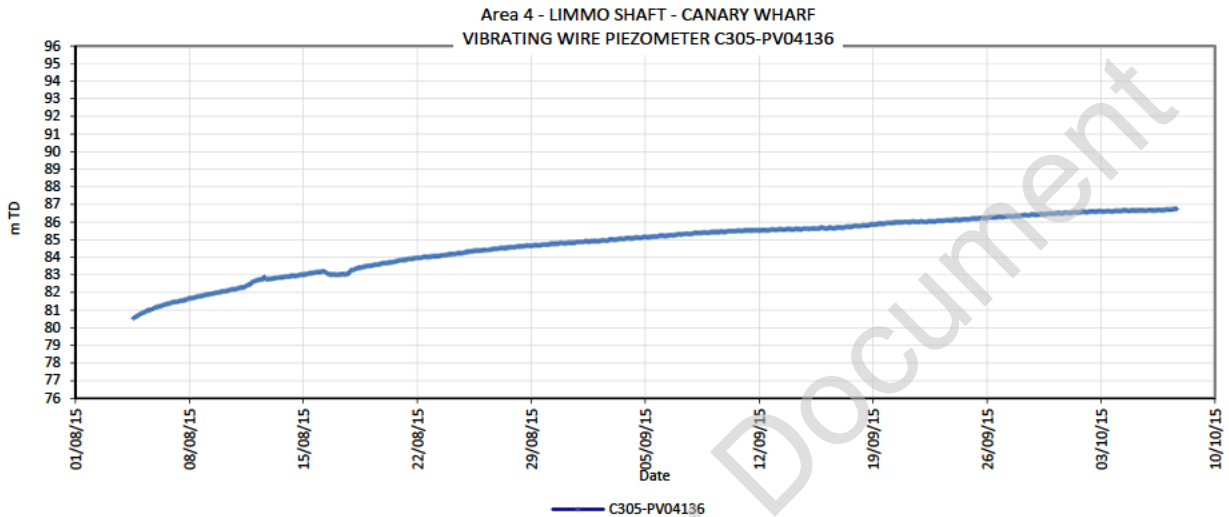


Note: The depth of the response zone of C305-PV04135 is located in London Clay at 17 m .

**VIBRATING WIRE PIEZOMETER C305-PV04136**

This vibrating wire piezometer was installed in August 2015, after the TBMs transit and dewatering in Cross Passage 13.

There was a progressive rise in the water level (+6m) between August and October 2015.

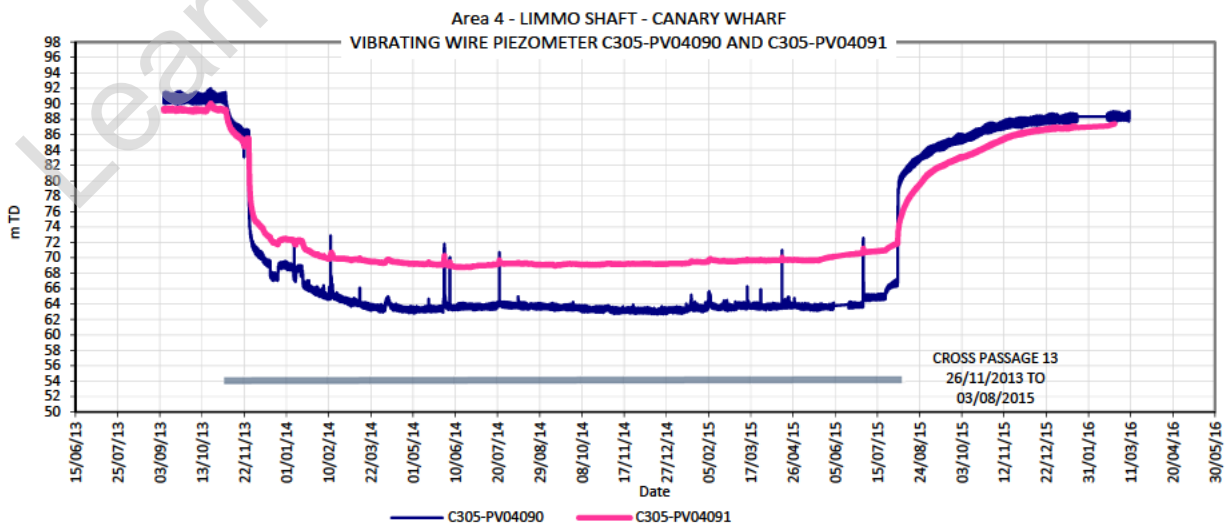


Note: The depth of the response zone of C305-PV04136 is located in Chalk at 42.5 m of.

**VIBRATING WIRE PIEZOMETER C305-PV04090 AND C305-PV04091**

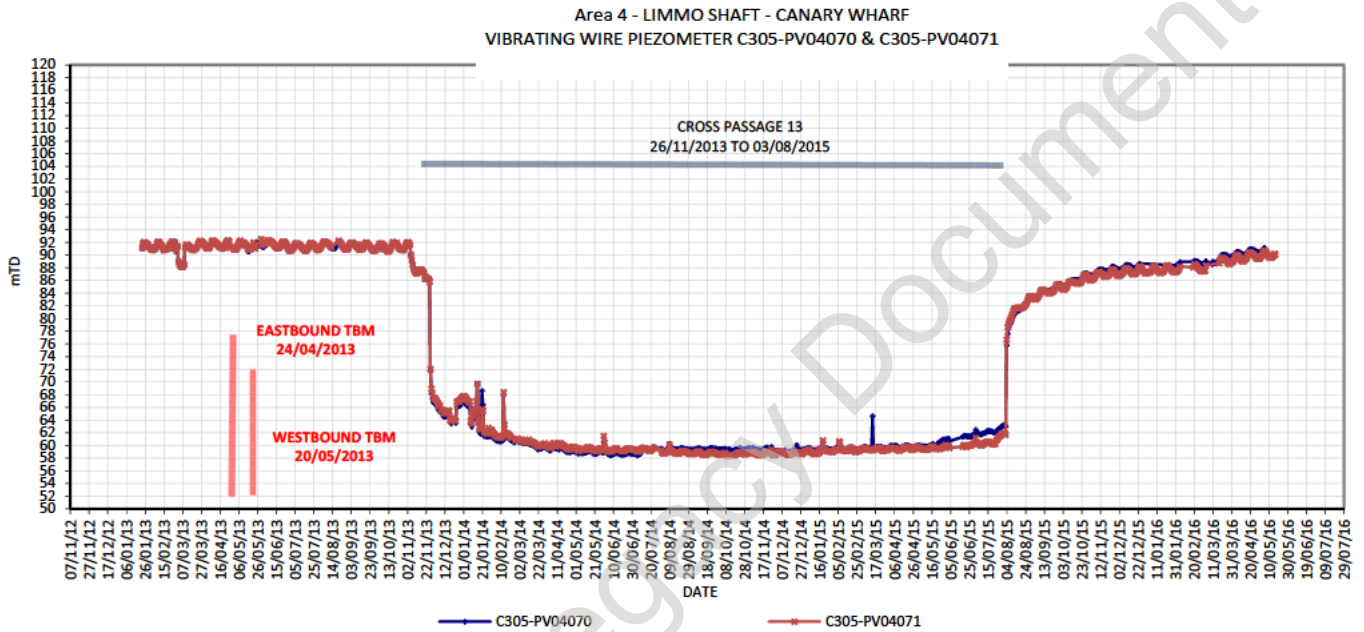
Both these vibrating wire piezometers were installed in September 2013, after the TBMs transit.

There was a drop in the water level for both piezometers when the dewatering in Cross Passage 13 started; -17m for C305-PV04091 and -24m for C305-PV04090 respectively. After dewatering; the water levels recovered to 87.39m and 88.23m respectively.



Note: The depth of the response zone of C305-PV04090 is located in Chalk at 59.5 m and C305-PV04091 is located in Sand at 47.5 m.

**VIBRATING WIRE PIEZOMETER C305-PV04070 AND C305-PV04071**



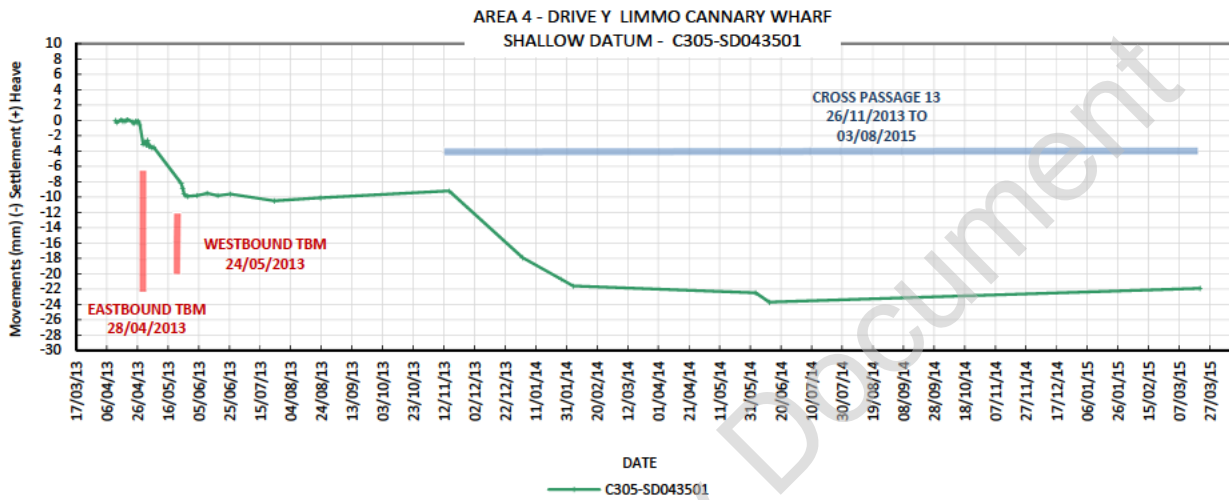
The graph above shows a drop in the water level for both piezometers of -32m when the dewatering in Cross Passage 13 started. After dewatering; the water levels for both piezometers recovered to 90.1m.

Note: The depth of the response zone of C305-PV04070 is located in Chalk at 49 m and C305-PV04071 is located in Chalk at 57 m.



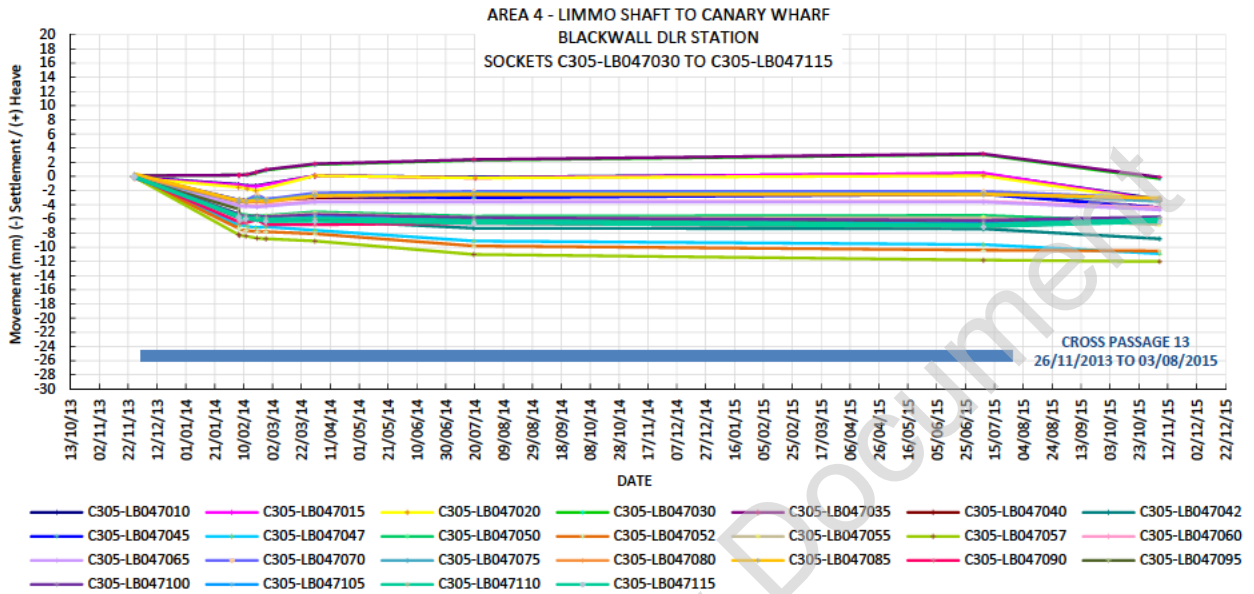
**SHALLOW DATUM C305-SD043501**

The graph below shows a maximum settlement of -3mm after the eastbound TBM transit and a total maximum settlement of -1.50mm after the westbound TBM transit. The total maximum settlement during dewatering of Cross Passage 13 is -23.7mm.



### 7.3 Docklands Light Railway (DLR) SOCKETS

The sockets in this array were installed in November 2013, after the transit of both TBMs. The effect of the dewatering shows a maximum settlement of -12mm.

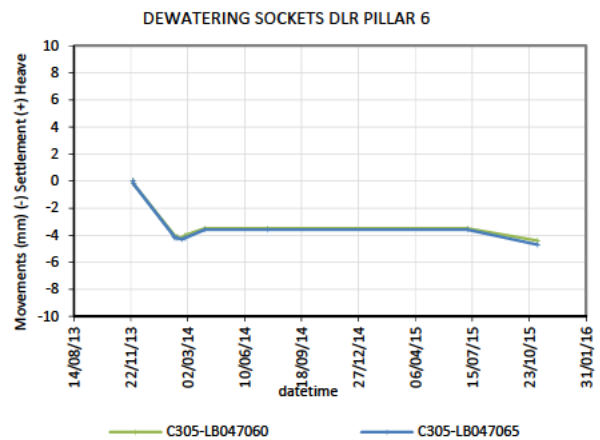
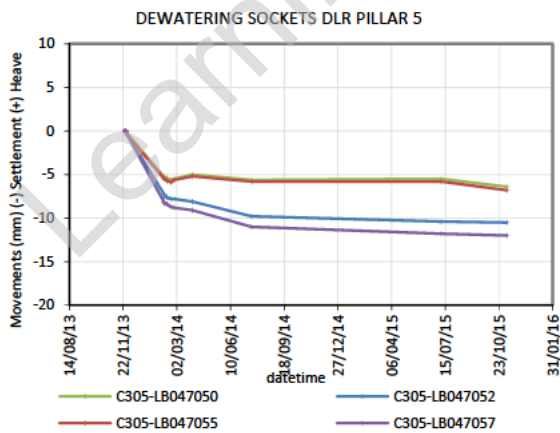
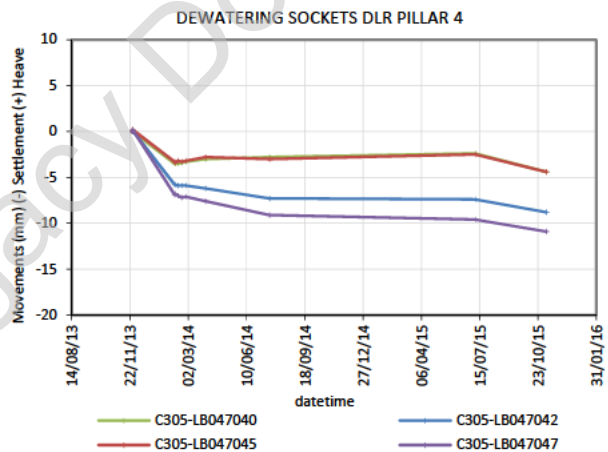
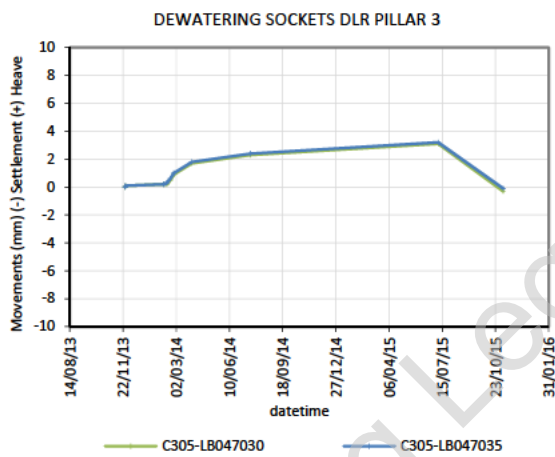
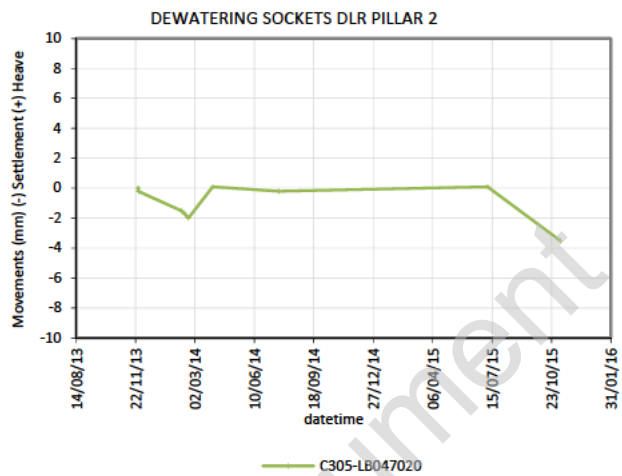
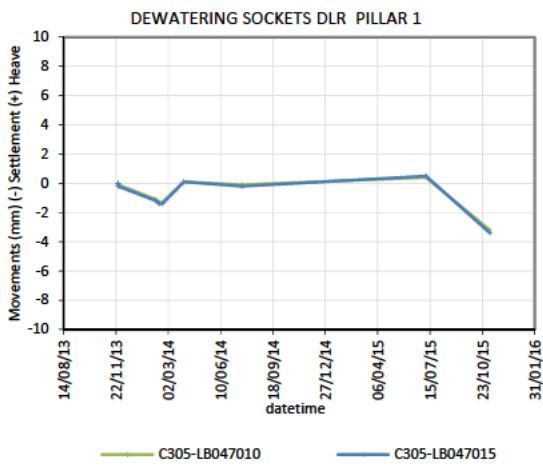


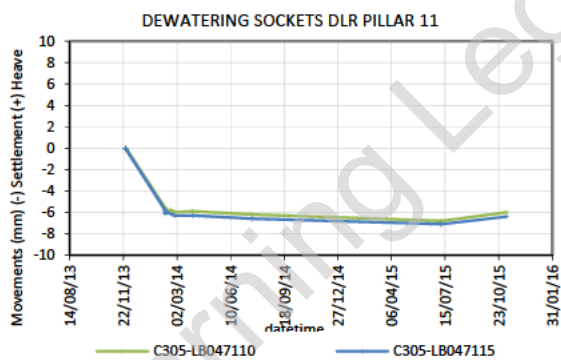
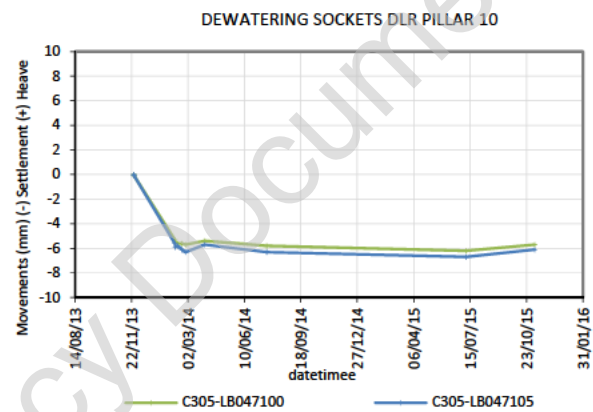
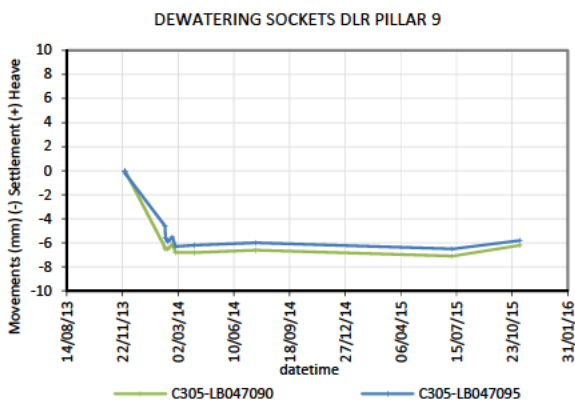
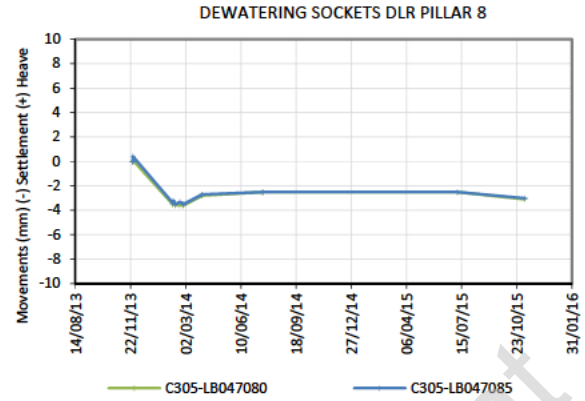
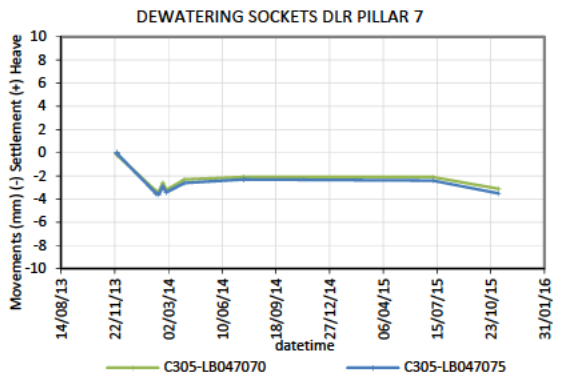
Monitoring was only carried out over specific dates which were determined in CTC meetings. After the last reading it was agreed not to continue monitoring because the last rate of movement was acceptably low.

The sketch below shows the location of the piers (P1 to P11) on which instrumentation was installed on the DLR structure.



The graphs below show settlement for the piers during the dewatering period. Socket C305 LB47057, located on pier 5, recorded the most settlement: -12mm.





## 8. SUMMARY STATEMENT

It has been agreed in the monitoring close out review meeting between the Project Manager, the Designer, the Contractor and the Sub-Contractor that the instrumentation covered within this close out report; for monitoring ground movement effects of Crossrail works, including long term effects, can now be decommissioned as trends of the monitoring points are approaching or have achieved the specified 2 mm/year settlement rate.

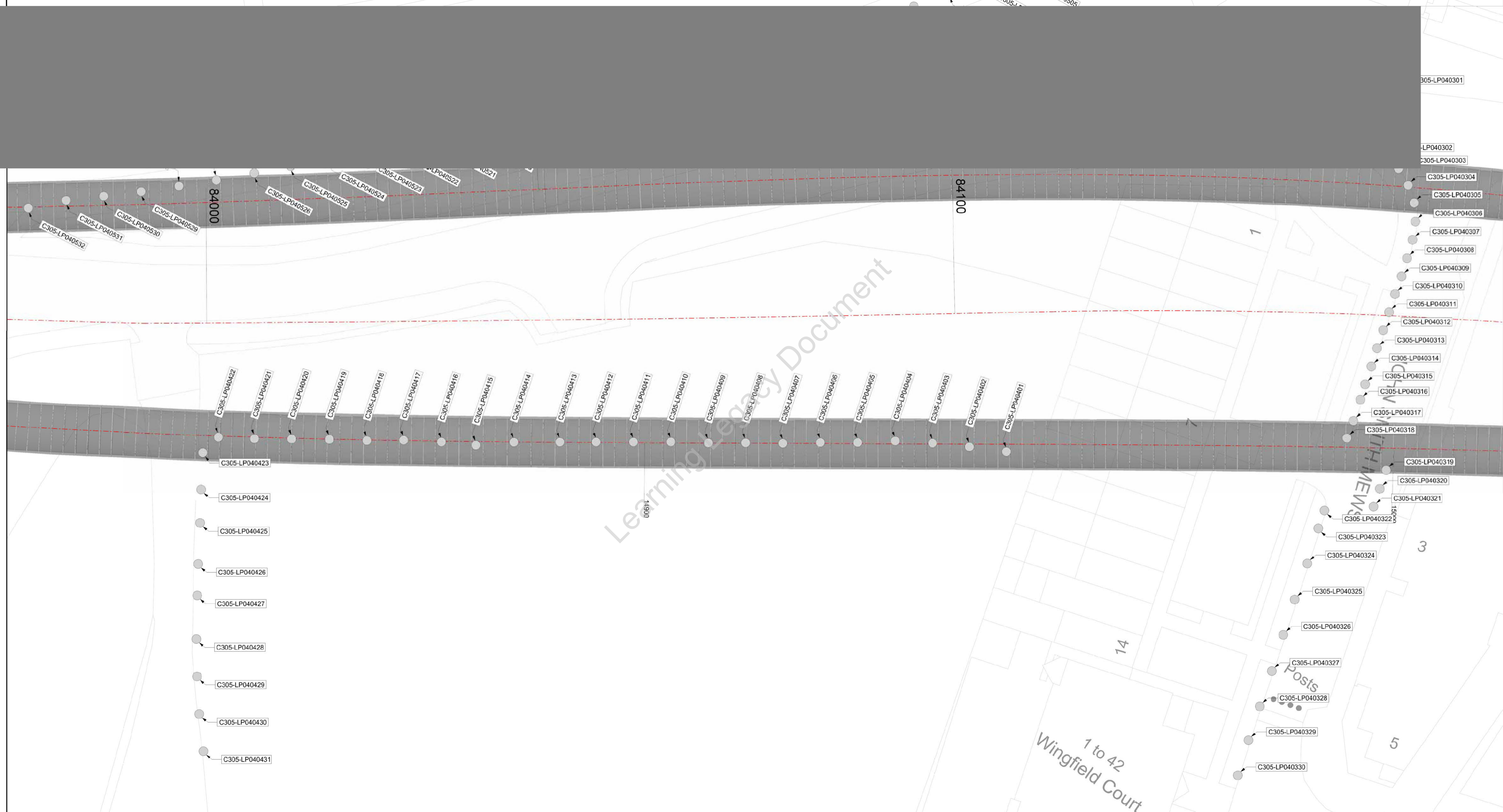
The minutes of the monitoring close out review meeting are included in appendix C.

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**APPENDIX A: INSTRUMENT LOCATION**



Gantry

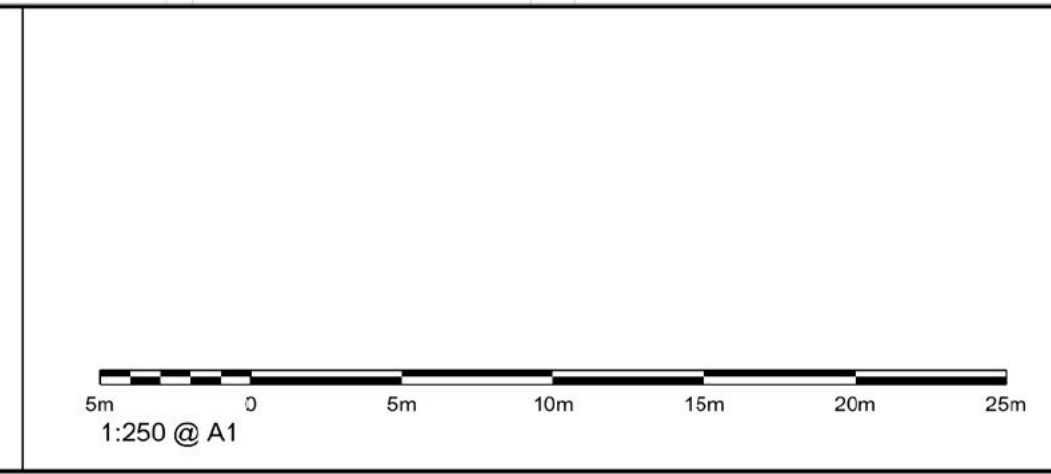


Rev.	Date	Description	By	Chkd	App	Auth
P01	23/04/2015	First Issue	MD	RC	RC	-
P02	25/08/2015	---	MD	RC	RC	-
P03	14/01/2016	---	MD	MD	MD	-

Notes

- Levelling Point

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Contract: Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G  
 Originator: Dragados Sisk Joint Venture  
 Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)

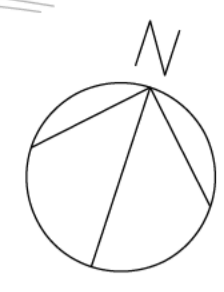
**Crossrail**  
 Crossrail Limited  
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 Canary Wharf  
 London  
 E14 5LQ

Title: Instrumentation & Monitoring  
 Installation Report for I&M Studs Installation  
 East India to Canary Wharf (84400-84350)  
 C305-DSJ-C-GMS-CR143-50011

By: M.DAVIS  
 CRK: M.DAVIS  
 App: M.DAVIS  
 Auth: ...

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 Drawing and CAD file No.: C305-DSJ-C2-DDA-CRT00\_ST006\_1-08138  
 Rev: P03  
 Suitability: S4  
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Retail Site

ASPEN WAY

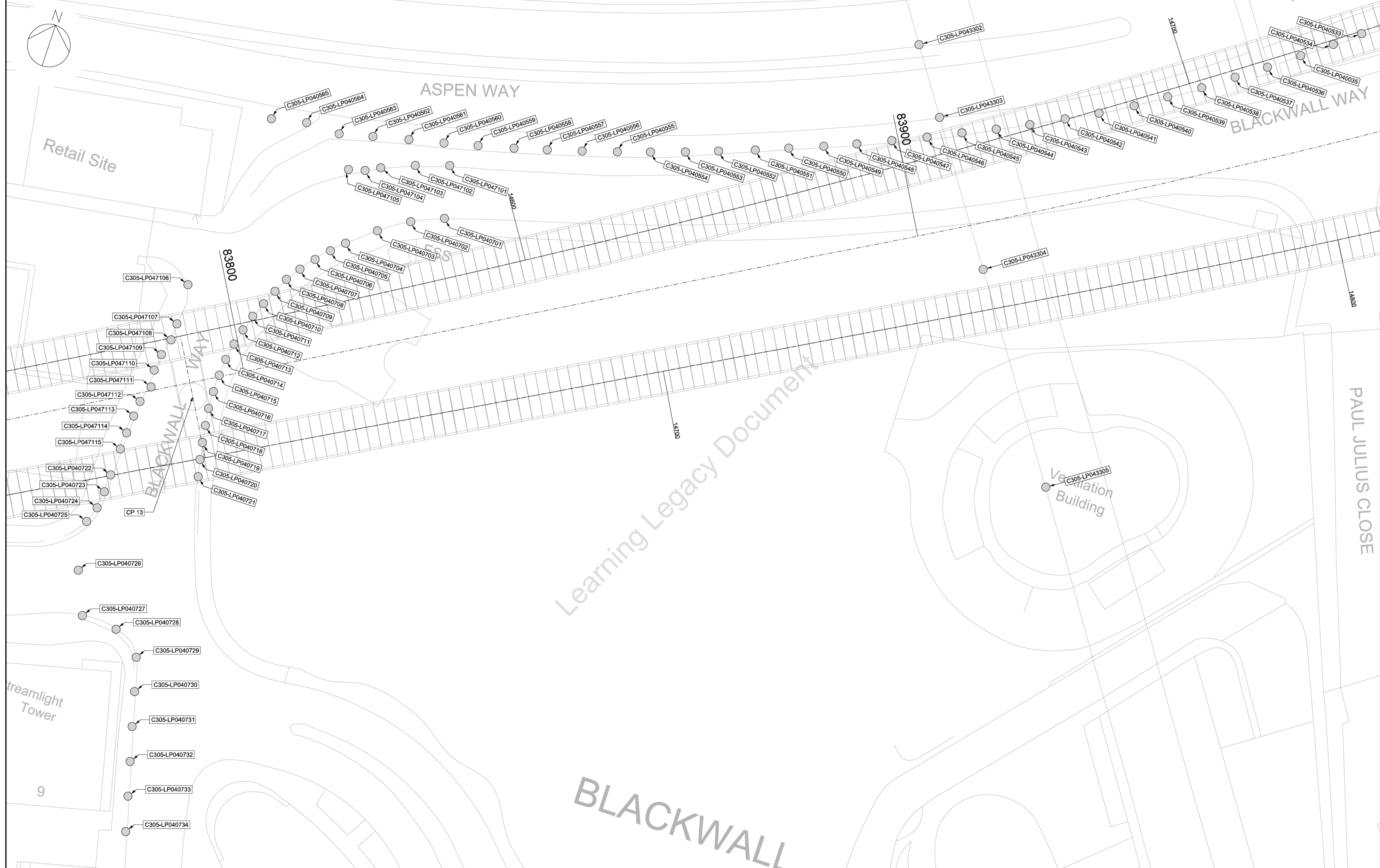
BLACKWALL WAY

PAUL JULIUS CLOSE

Learning Legacy Document

BLACKWALL

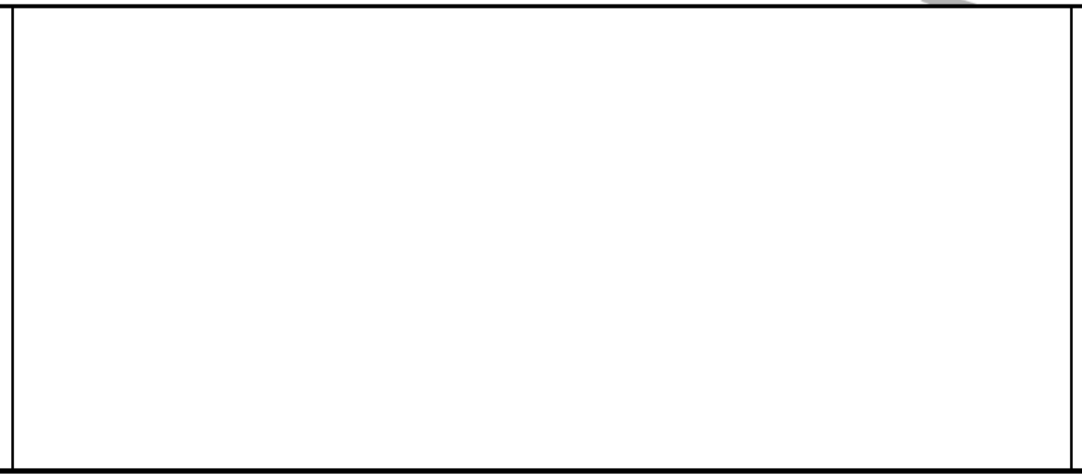
Ventilation Building



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P01	23/04/2015	First Issue				
P02	25/08/2015		MD	RC	RC	-
P03	14/01/2016		MD	MD	MD	-
P04	29/06/2016		MD	MD	MD	-

Notes

● Levelling Point



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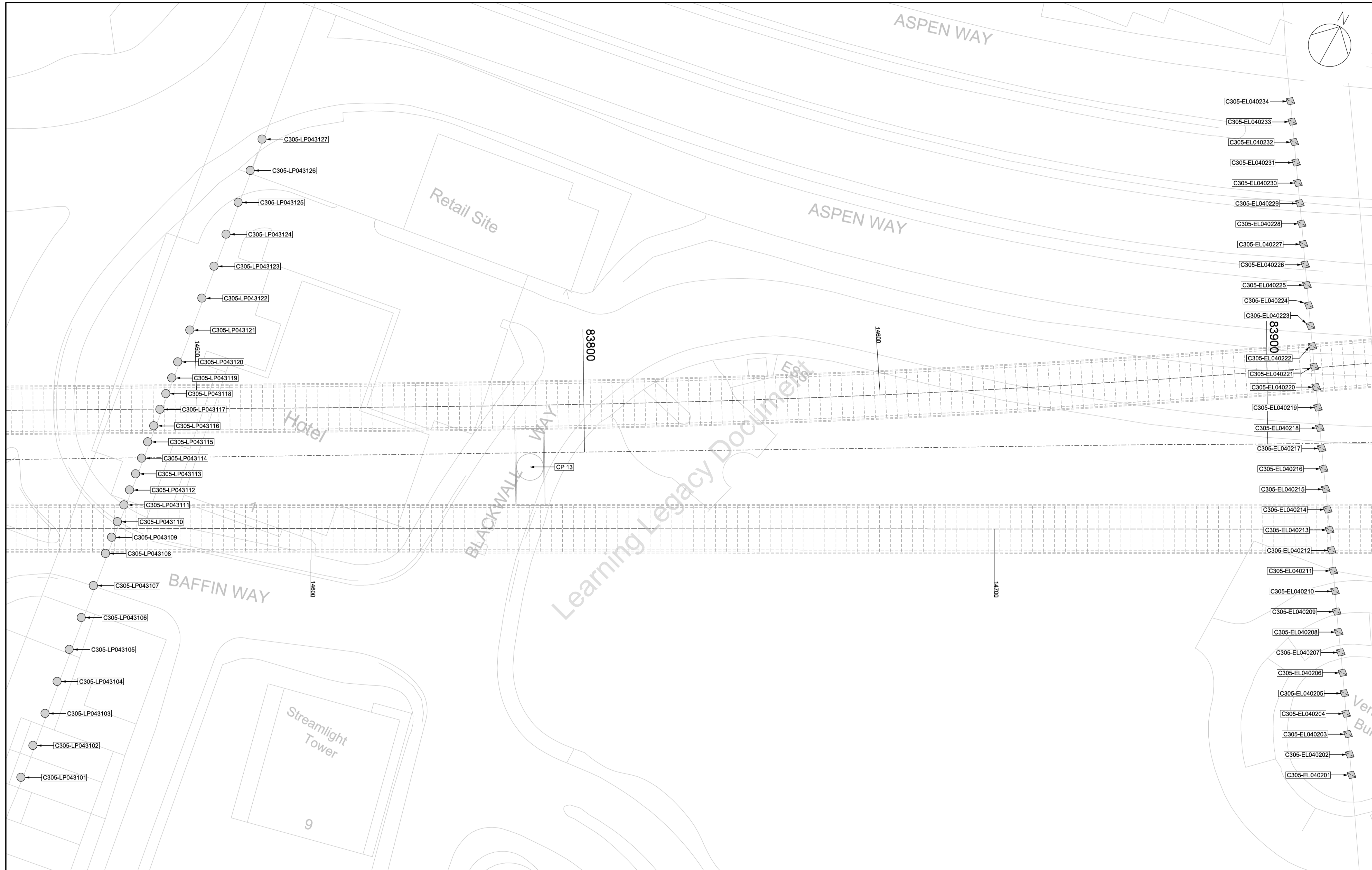
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 Originator: Dragados Sisk Joint Venture  
 Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)

Title: Instrumentation & Monitoring Installation Report for I&M Studs Installation  
 East India to Canary Wharf (84400-84350)  
 C305-DSJ-C-GMS-CR143-50011

By: M.DAVIS  
 Chk: M.DAVIS  
 App: M.DAVIS  
 Auth: -

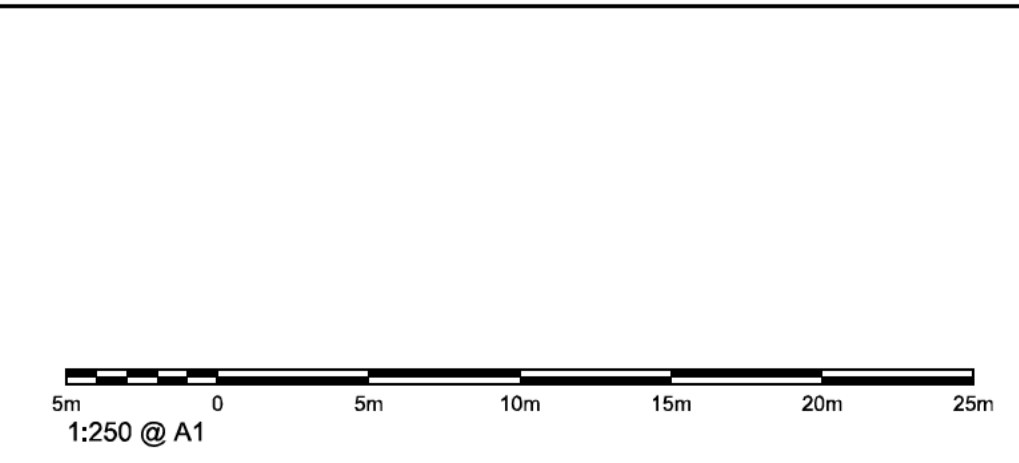
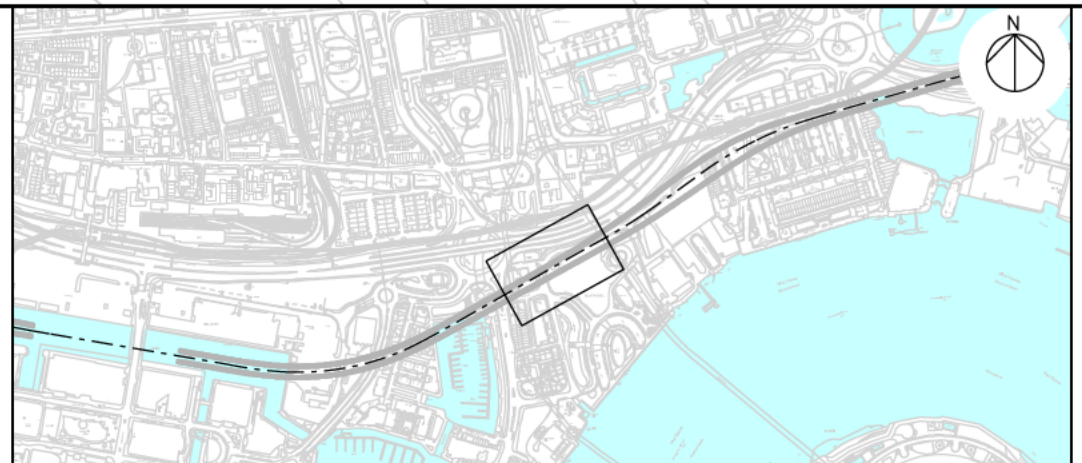
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 Rev: P04  
 Suitability: S4

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P01	11/03/2016	First Issue	MD	MD	MD	-

- Notes**
- Levelling Points
  - ◆ Electrolevel Beams



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	<p>Title: Instrumentation &amp; Monitoring Installation Report for I&amp;M at Blackwall Tunnel (Drive Y)</p> <p>C305-DSJ-C2-RGN-CRG03-50074</p>	<p>Scale: 1:250 @ A1</p>	<p>Rev: P01</p>
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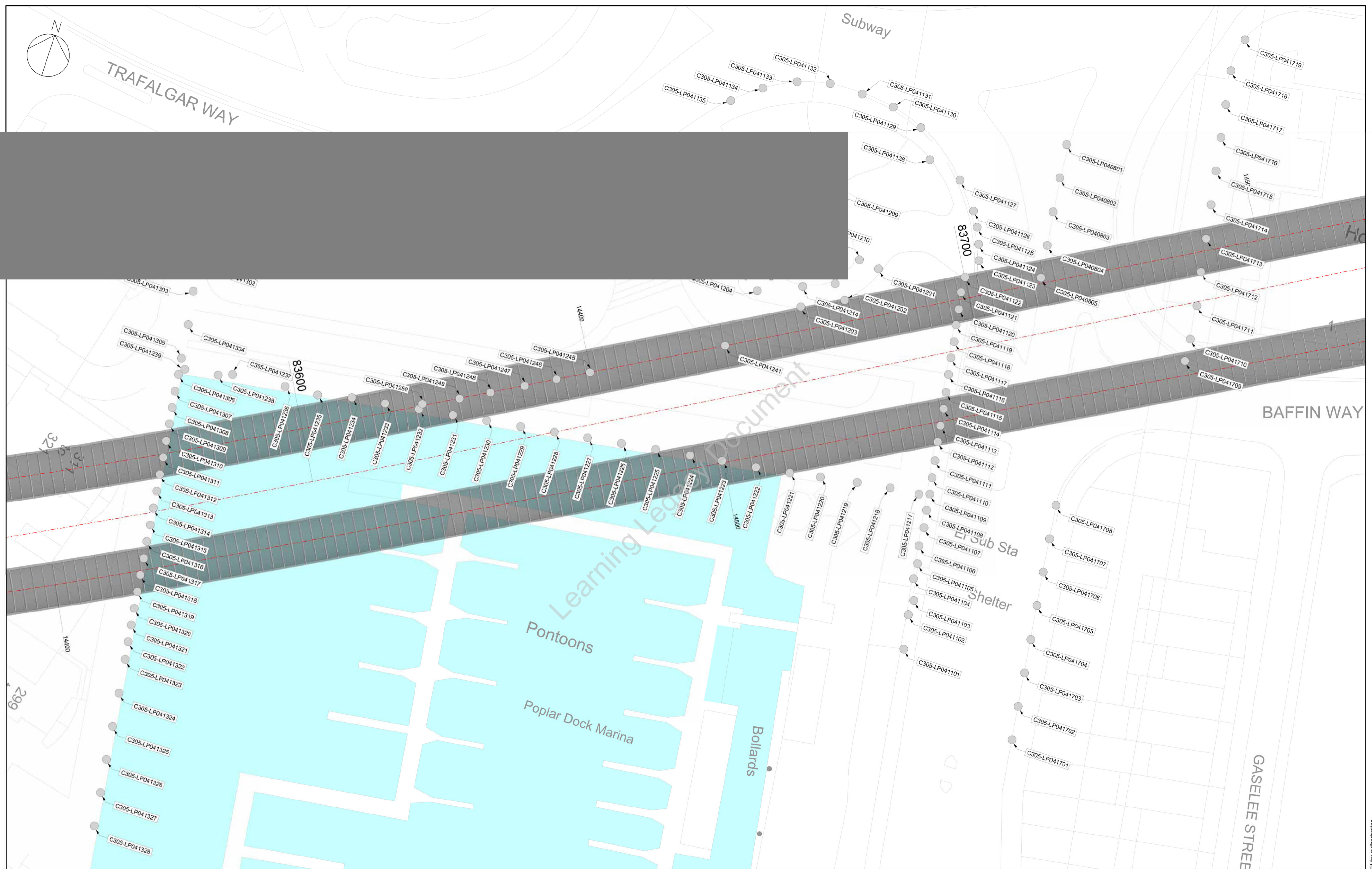


TRAFALGAR WAY

Subway

BAFFIN WAY

GASELEE STREET

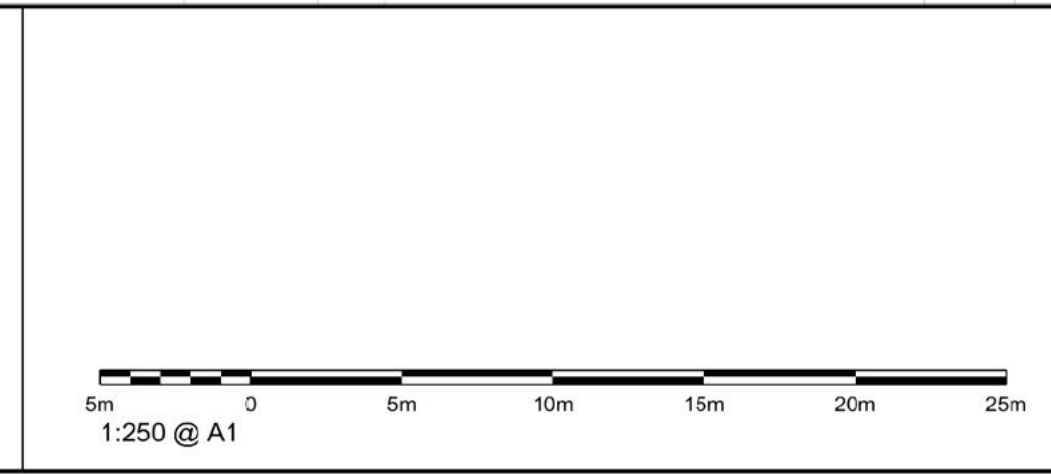


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P01	23/04/2015	First Issue	MD	RC	RC	-
P02	25/08/2015	---	MD	RC	RC	-
P03	14/01/2016	---	MD	MD	MD	-

Notes

- Levelling Point

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 Originator: Dragados Sisk Joint Venture  
 Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)

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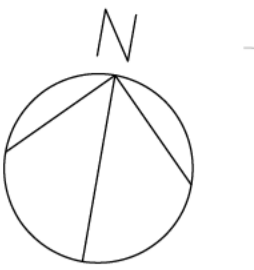
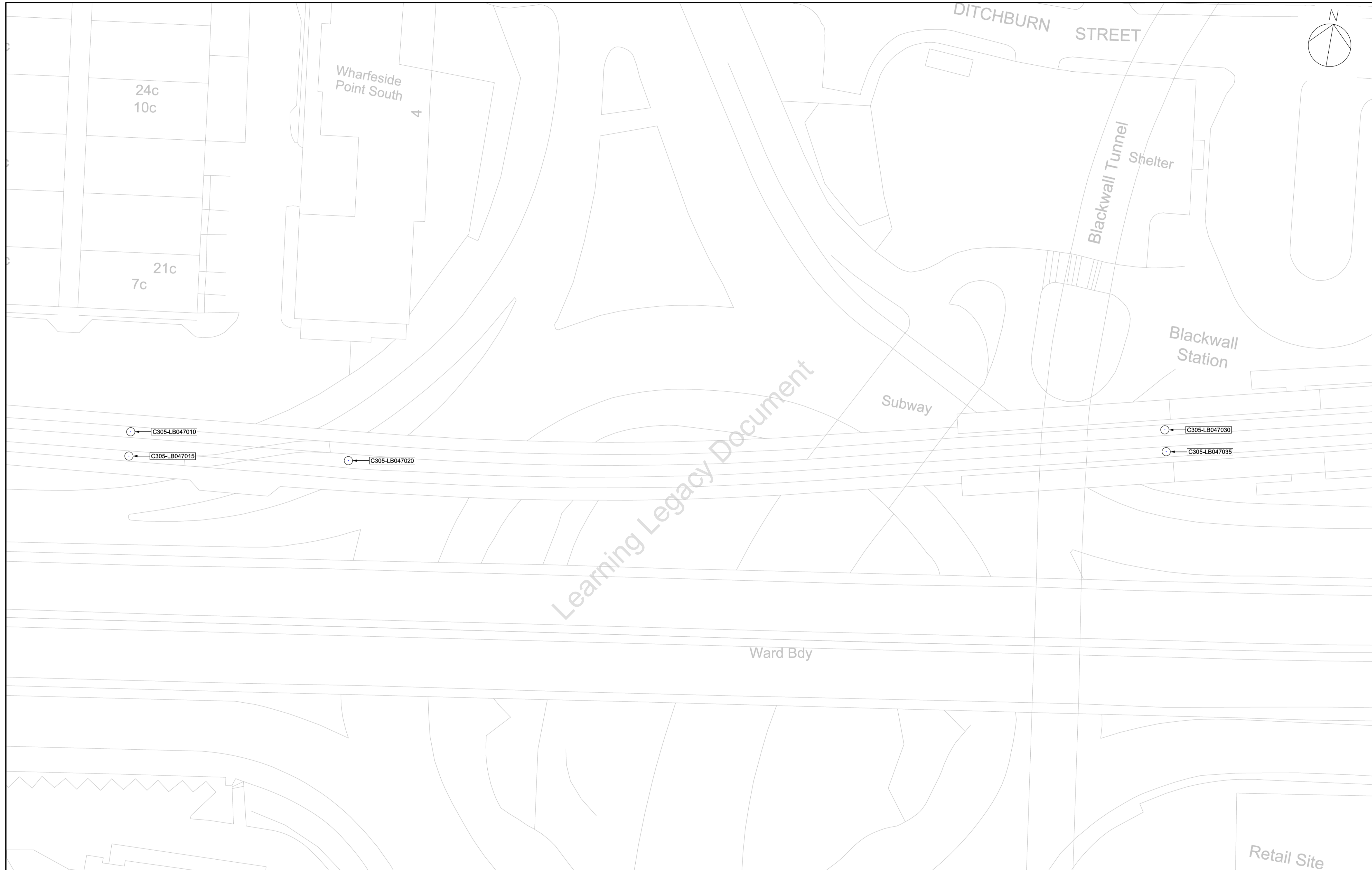
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 East India to Canary Wharf (84400-84350)  
 C305-DSJ-C-GMS-CR143-50011

By: M.DAVIS  
 Chk: M.DAVIS  
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 Rev: P03  
 Suitability: S4

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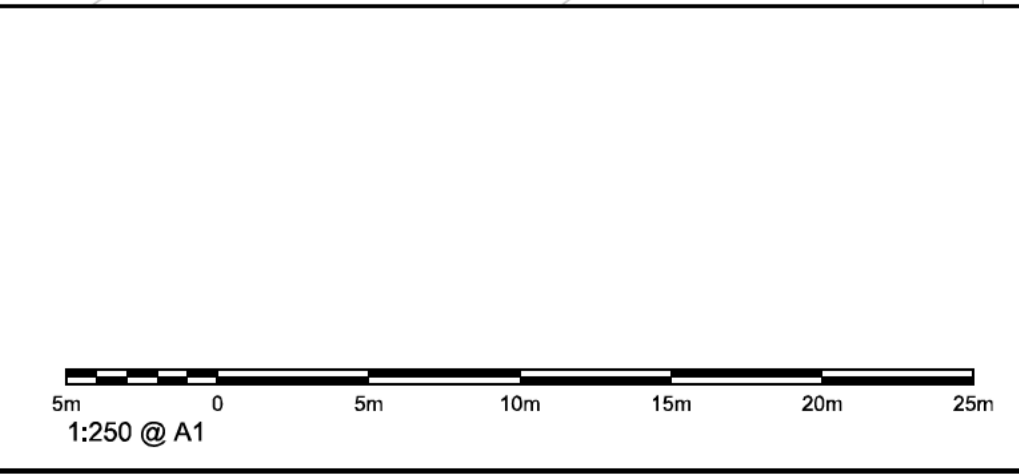
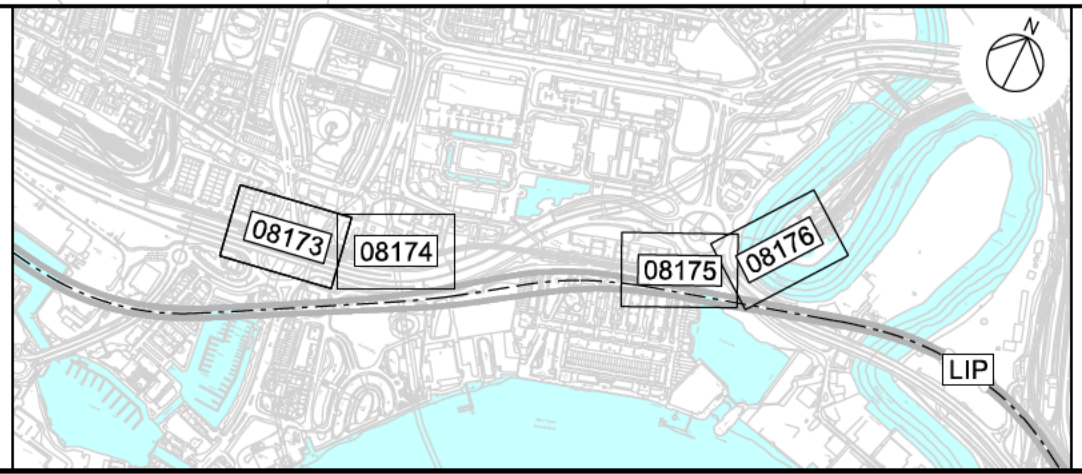
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P01	19/02/2016	First Issue	MD	MD	MD	-

- Notes**
- Sockets
  - 3D Prisms
  - ⊗ Tiltmeters



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	<p>Title: <b>Instrumentation &amp; Monitoring Installation Report for I&amp;M at DLR Blackwall Station, East India Station &amp; Viaduct (CP14)</b></p> <p><b>C305-DSJ-C2-RGN-CRG03-50396</b></p>	<p>Rev: P01</p> <p>Suitability: S4</p>
	<p>Scale: <b>1:250 @ A1</b></p>	<p>Drawing and CAD No: <b>C305-DSJ-C2-DDA-CRT00_ST006_1-08173</b></p>
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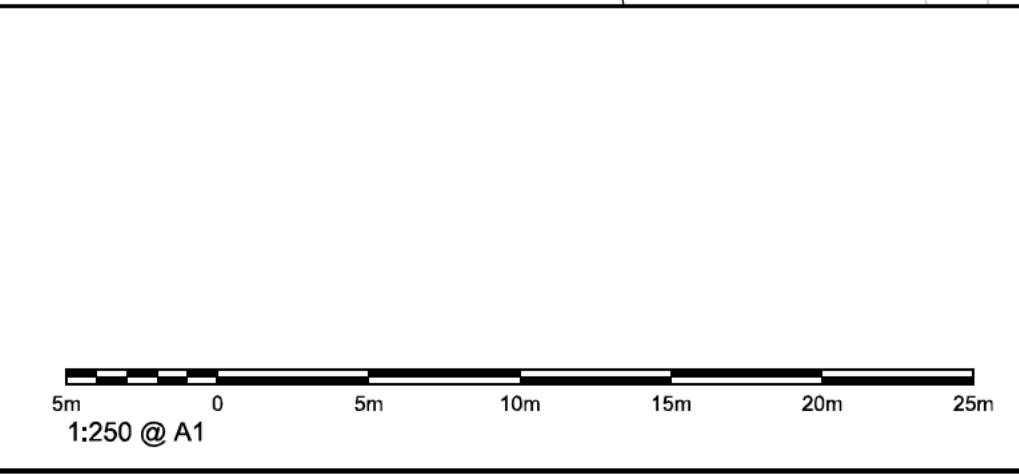
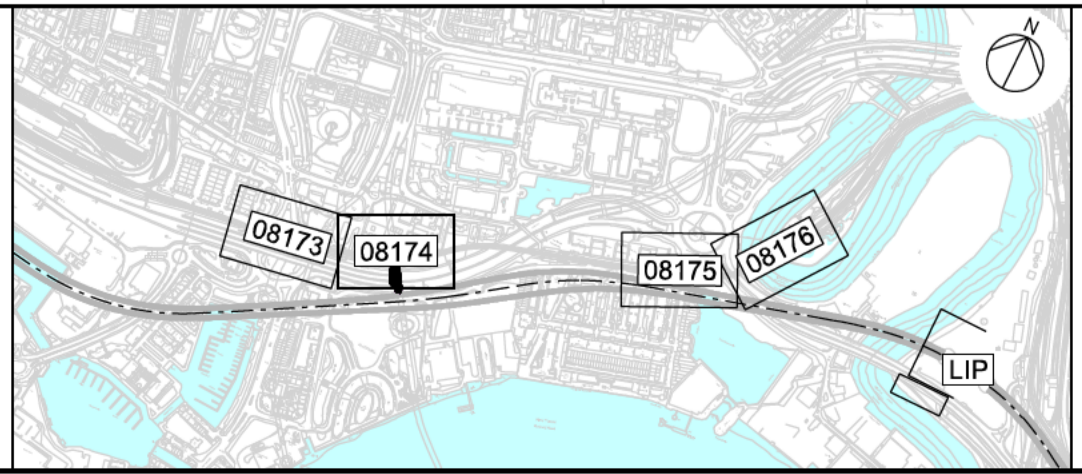
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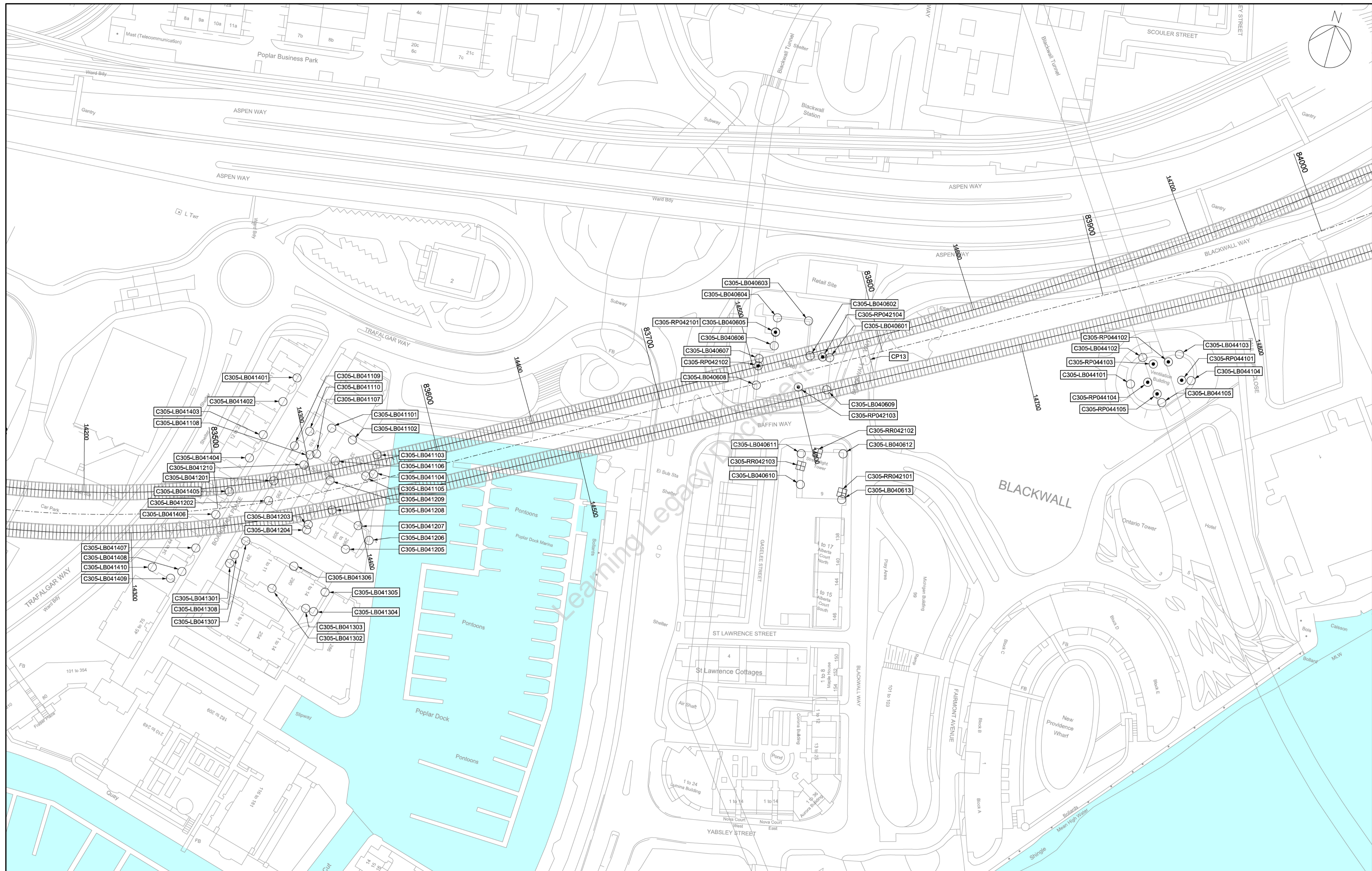
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P02	29/06/2016	-	MD	MD	MD	-

- Notes**
- Sockets
  - 3D Prisms
  - ⊗ Tiltmeters
  - Levelling Points



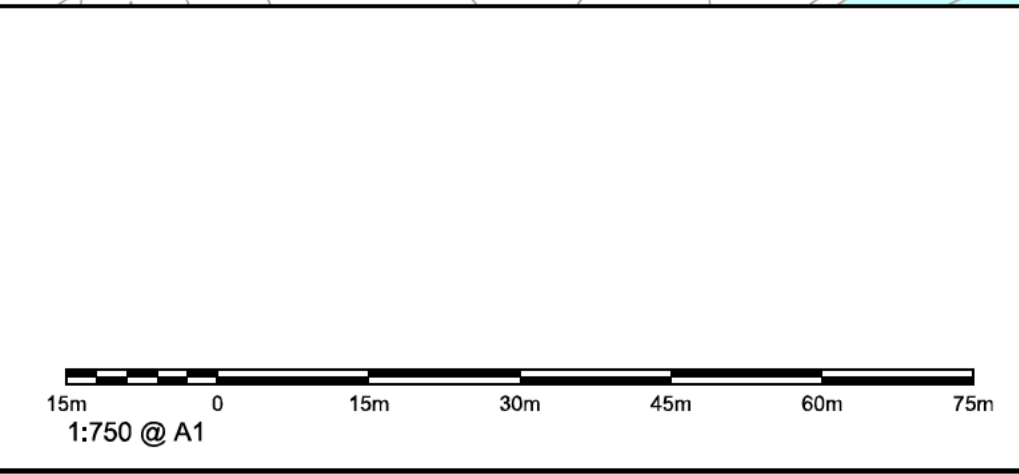
<p>Crossrail Limited 25 Canada Square London E14 6LQ</p> <p>© Crossrail www.crossrail.co.uk</p>	<p>Contract: Tunnels East - Drive Y LIM to FAR &amp; Drive Z SGJ to PML &amp; Drive G</p> <p>Originator: Dragados Sisk Joint Venture</p> <p>Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)</p>	<p>By: M.DAVIS</p> <p>CHK: M.DAVIS</p> <p>APP: M.DAVIS</p> <p>Auth: -</p>
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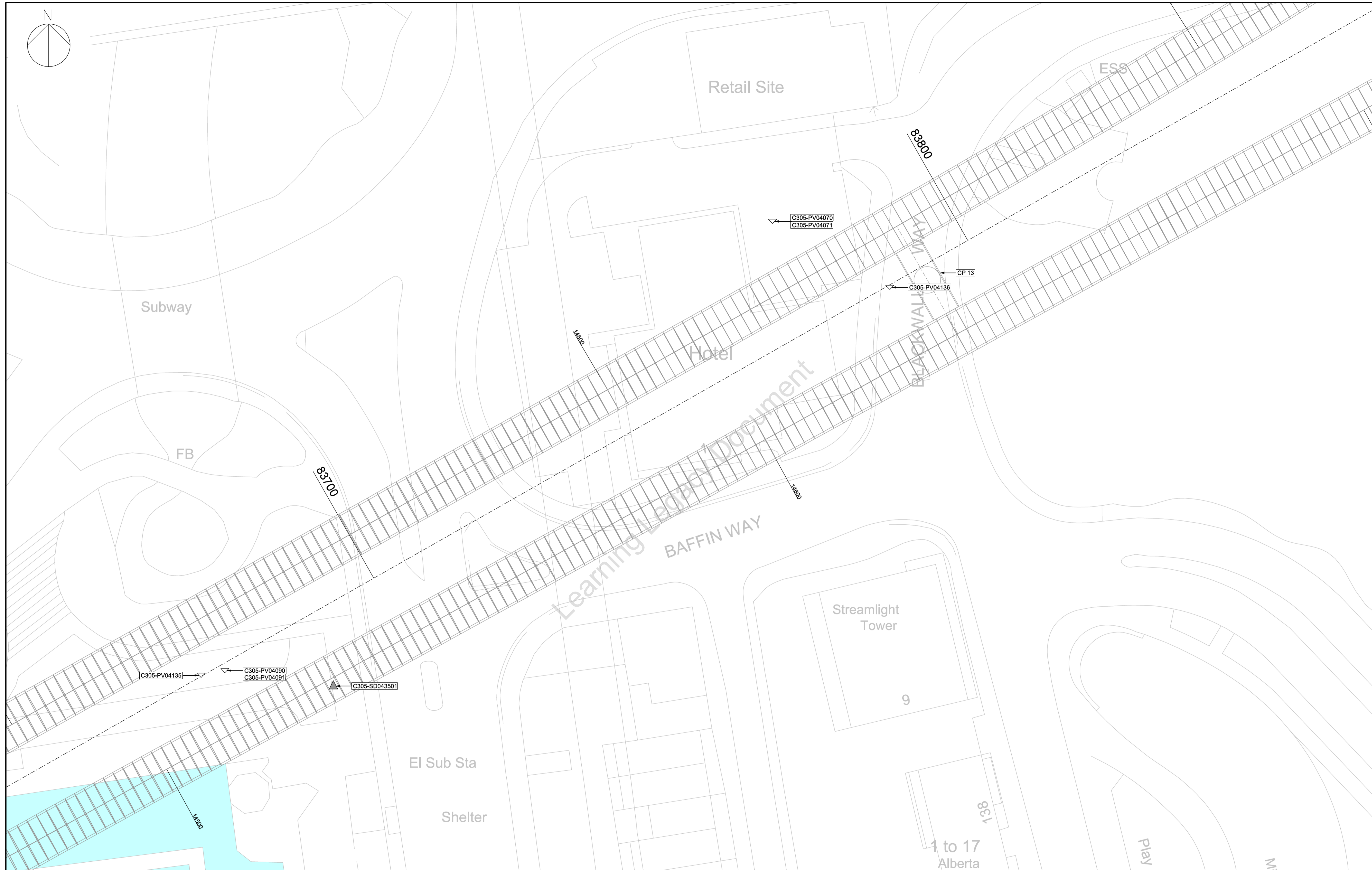
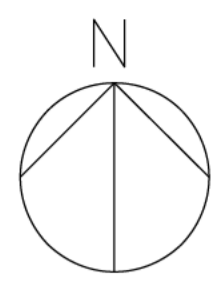
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P03	18/03/2015		MD	AH	RC	-
P04	04/08/2015		MD	RC	RC	-
P05	09/11/2015		MD	MD	MD	-
P06	11/03/2016		MD	MD	MD	-

- Notes**
- Levelling Sockets
  - 3D Prisms
  - ⊠ Retro Reflective Targets



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	<p>Title: Instrumentation &amp; Monitoring Installation Report for I&amp;M MS Sockets and 3D Prisms (83900-83500) C305-DSJ-C2-GMS-CRG03-50020</p>	<p>Scale: 1:750 @ A1</p> <p>Drawing and CAD No: C305-DSJ-C2-DDA-CRT00_ST006_Z-08099</p> <p>Rev: P06</p> <p>Suitability: S4</p>

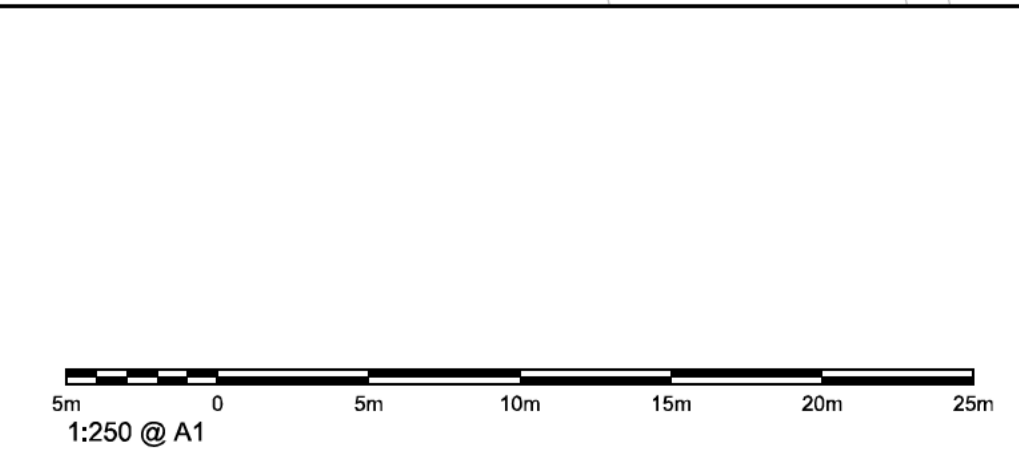
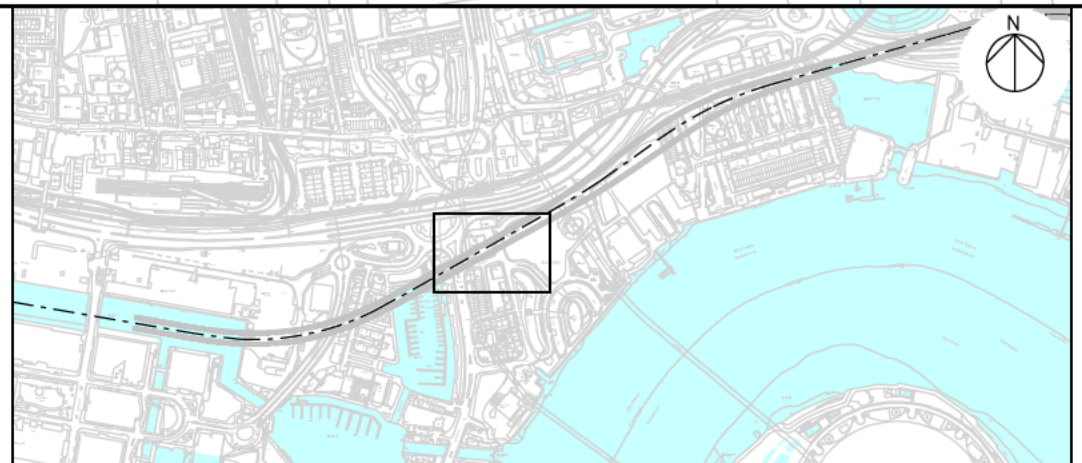
RESTRICTED



Rev.	Date	Description	By	Chkd	App	Auth
P01	18/04/2016	First Issue	MD	MD	MD	-
P02	29/06/2016	-	MD	MD	MD	-

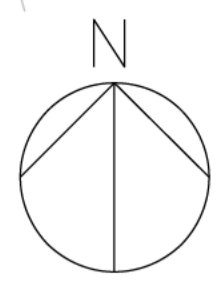
**Notes**

- ▽ Vibrating Wire Piezometer
- ▲ Shallow Datum



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	<p>Title: Instrumentation &amp; Monitoring I&amp;M Installation Report for CP13, CP14 &amp; CP5 Piezometers (Drive Y)</p> <p>Drawing and CAD No: C305-DSJ-C2-RGN-CRG03-50407</p>	<p>Scale: 1:250 @ A1</p>	<p>Rev: P02</p>
	<p>Subsidiary: S4</p>	<p>Contract No: C305-DSJ-C2-DDA-CRT00_ST006_1-08283</p>	<p>Date: 29/06/2016</p>
	<p>Project No: C305-DSJ-C2-DDA-CRT00_ST006_1-08283</p>		

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Romney House

1 to 126 Explorers Court

JOHN SMITH MEWS

1 to 42 Wingfield Court

Gantry

Posts

84+100

14800

14800

14800

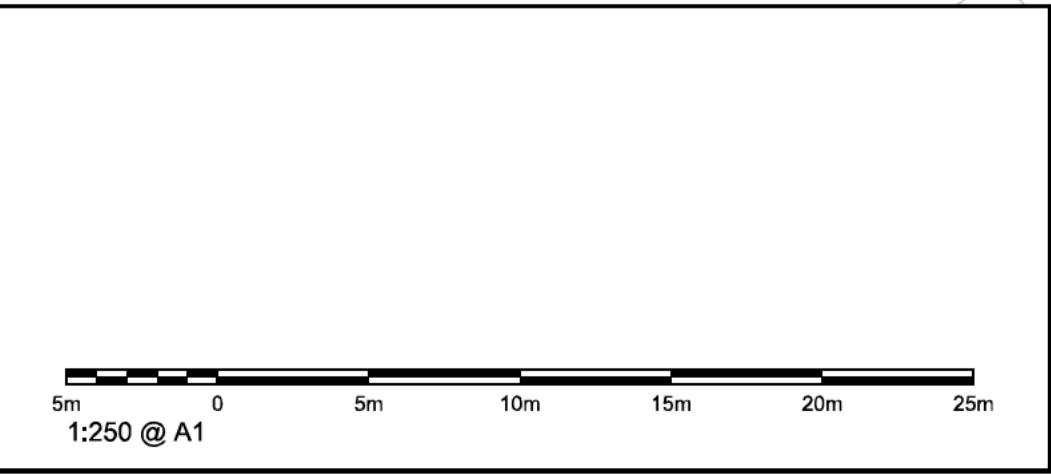
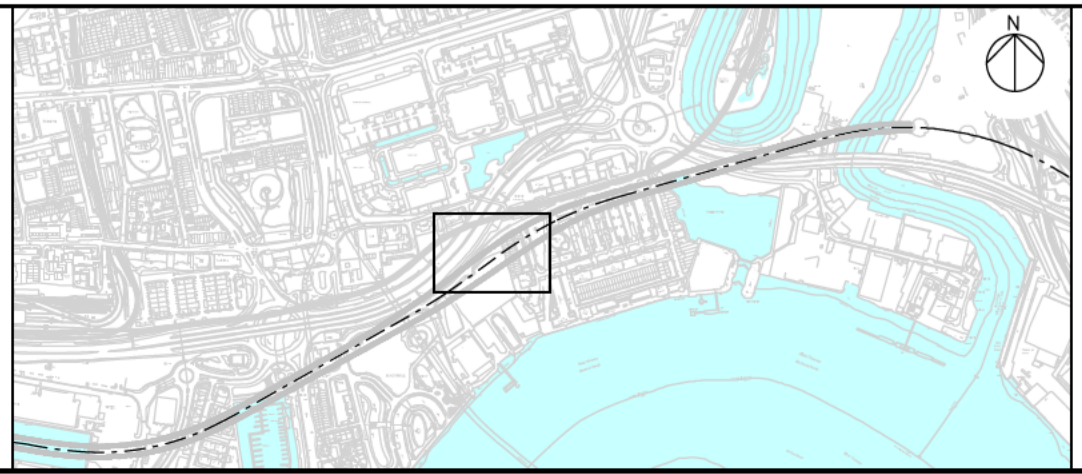
C305-PV04134

Learning Legacy Document

Rev.	Date	Description	By	Chkd	App	Auth
P01	13/04/2016	First Issue	MD	MD	MD	-

Notes

- ▽ Vibrating Wire Piezometer



**Crossrail**

Crossrail Limited  
25 Canada Square  
London  
E14 6LQ

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Contract: Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G  
Originator: Dragados Sisk Joint Venture  
Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)

Title: Instrumentation & Monitoring  
I&M Installation Report for CP13,  
CP14 & CP5 Piezometers (Drive Y)  
C305-DSJ-C2-RGN-CRG03-50407

By: M.DAVIS  
CHK: M.DAVIS  
APP: M.DAVIS  
Auth: -

Scale: 1:250 @ A1  
Drawing and CAD No: C305-DSJ-C2-DDA-CRT00\_ST006\_1-08284  
Rev: P01  
Suitability: S4

FT for authorisation  
RESTRICTED

**APPENDIX B: SUMMARY OF INSTRUMENTATION INSTALLED ON SITE**

Learning Legacy Document

IRS Installation Record Sheets – Levelling points

Sensor Type	Sensor ID	Sub-Area	Installation Date	Status	Location SENSOR (m)			Commissioning Readings (mATD))			
					Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Average	18/10/2012	18/10/2012	18/10/2012
Levelling Point	C305-LP040501	Blackwall Way	10/09/2012	Installed	89011.454	35348.826	105.916	105.8728	105.8727	105.8733	105.8724
Levelling Point	C305-LP040502	Blackwall Way	10/09/2012	Installed	89008.719	35344.663	105.969	105.914	105.9146	105.9134	105.914
Levelling Point	C305-LP040503	Blackwall Way	10/09/2012	Installed	89005.927	35340.369	106.032	105.9672	105.9669	105.9675	105.9672
Levelling Point	C305-LP040504	Blackwall Way	10/09/2012	Installed	89003.119	35336.123	106.032	105.9752	105.9753	105.9748	105.9755
Levelling Point	C305-LP040505	Blackwall Way	10/09/2012	Installed	89000.341	35331.994	106.04	105.9829	105.983	105.9826	105.9831
Levelling Point	C305-LP040506	Blackwall Way	10/09/2012	Installed	88997.499	35327.819	106.055	106.0007	106.0004	106.0012	106.0005
Levelling Point	C305-LP040507	Blackwall Way	10/09/2012	Installed	88994.556	35323.585	106.052	106.0003	106.0006	106	106.0003
Levelling Point	C305-LP040508	Blackwall Way	10/09/2012	Installed	88991.648	35319.479	106.074	106.0217	106.0215	106.0218	106.0218
Levelling Point	C305-LP040509	Blackwall Way	10/09/2012	Installed	88988.692	35315.345	106.088	106.0328	106.0325	106.0332	106.0327
Levelling Point	C305-LP040510	Blackwall Way	10/09/2012	Installed	88985.692	35311.249	106.084	106.0282	106.0286	106.0277	106.0283
Levelling Point	C305-LP040511	Blackwall Way	10/09/2012	Installed	88982.71	35307.177	106.051	105.9926	105.9922	105.993	105.9926
Levelling Point	C305-LP040512	Blackwall Way	10/09/2012	Installed	88979.605	35303.132	106.021	105.9588	105.9582	105.9593	105.9589
Levelling Point	C305-LP040513	Blackwall Way	10/09/2012	Installed	88976.419	35299.088	106.001	105.938	105.9386	105.9379	105.9375
Levelling Point	C305-LP040514	Blackwall Way	10/09/2012	Installed	88973.209	35295.185	105.97	105.9082	105.9087	105.9078	105.9081
Levelling Point	C305-LP040515	Blackwall Way	10/09/2012	Installed	88969.959	35291.33	105.942	105.88	105.8805	105.8798	105.8797
Levelling Point	C305-LP040516	Blackwall Way	10/09/2012	Installed	88966.606	35287.456	105.898	105.8421	105.8418	105.8422	105.8423
Levelling Point	C305-LP040517	Blackwall Way	10/09/2012	Installed	88963.222	35283.684	105.867	105.8098	105.8101	105.8097	105.8096
Levelling Point	C305-LP040518	Blackwall Way	10/09/2012	Installed	88959.799	35279.95	105.841	105.7774	105.7772	105.7776	105.7774
Levelling Point	C305-LP040519	Blackwall Way	10/09/2012	Installed	88956.336	35276.264	105.822	105.7593	105.7588	105.7594	105.7597
Levelling Point	C305-LP040520	Blackwall Way	10/09/2012	Installed	88952.803	35272.604	105.786	105.7231	105.723	105.7237	105.7226
Levelling Point	C305-LP040521	Blackwall Way	10/09/2012	Installed	88949.321	35269.022	105.759	105.6969	105.697	105.6963	105.6974
Levelling Point	C305-LP040522	Blackwall Way	10/09/2012	Installed	88945.79	35265.408	105.734	105.6653	105.6647	105.6656	105.6656
Levelling Point	C305-LP040523	Blackwall Way	10/09/2012	Installed	88942.273	35261.782	105.71	105.647	105.6474	105.6467	105.6469
Levelling Point	C305-LP040524	Blackwall Way	10/09/2012	Installed	88938.755	35258.161	105.699	105.6303	105.6304	105.6302	105.6303
Levelling Point	C305-LP040525	Blackwall Way	10/09/2012	Installed	88935.237	35254.547	105.675	105.6096	105.61	105.6092	105.6096



Sensor Type	Sensor ID	Sub-Area	Installation Date	Status	Location SENSOR (m)			Commissioning Readings (mATD))			
					Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Average	18/10/2012	18/10/2012	18/10/2012
Levelling Point	C305-LP040526	Blackwall Way	10/09/2012	Installed	88931.751	35250.973	105.627	105.5621	105.562	105.5624	105.5619
Levelling Point	C305-LP040527	Blackwall Way	10/09/2012	Installed	88928.113	35247.338	105.566	105.4988	105.4991	105.4982	105.4991
Levelling Point	C305-LP040528	Blackwall Way	10/09/2012	Installed	88924.466	35243.863	105.59	105.5233	105.5231	105.5235	105.5233
Levelling Point	C305-LP040529	Blackwall Way	10/09/2012	Installed	88920.733	35240.392	105.591	105.5237	105.5242	105.5232	105.5237
Levelling Point	C305-LP040530	Blackwall Way	10/09/2012	Installed	88916.941	35237.009	105.578	105.5131	105.5126	105.5132	105.5135
Levelling Point	C305-LP040531	Blackwall Way	10/09/2012	Installed	88913.139	35233.713	105.543	105.4784	105.4785	105.478	105.4787
Levelling Point	C305-LP040532	Blackwall Way	10/09/2012	Installed	88909.584	35230.017	105.526	105.4583	105.4582	105.4585	105.4582
Levelling Point	C305-LP040533	Blackwall Way	10/09/2012	Installed	88905.074	35226.497	105.49	105.4351	105.4355	105.4346	105.4352
Levelling Point	C305-LP040534	Blackwall Way	10/09/2012	Installed	88901.62	35223.722	105.441	105.3885	105.3888	105.3884	105.3883
Levelling Point	C305-LP040535	Blackwall Way	10/09/2012	Installed	88897.643	35220.684	105.385	105.3403	105.3406	105.3397	105.3406
Levelling Point	C305-LP040536	Blackwall Way	10/09/2012	Installed	88893.56	35217.586	105.404	105.3982	105.3988	105.398	105.3978
Levelling Point	C305-LP040537	Blackwall Way	10/09/2012	Installed	88889.541	35214.721	105.413	105.3556	105.3559	105.3552	105.3557
Levelling Point	C305-LP040538	Blackwall Way	10/09/2012	Installed	88885.395	35211.772	105.401	105.3492	105.3491	105.3494	105.3491
Levelling Point	C305-LP040539	Blackwall Way	10/09/2012	Installed	88881.102	35208.968	105.389	105.3502	105.3505	105.3497	105.3504
Levelling Point	C305-LP040540	Blackwall Way	10/09/2012	Installed	88876.873	35206.194	105.403	105.3574	105.3578	105.3571	105.3573
Levelling Point	C305-LP040541	Blackwall Way	10/09/2012	Installed	88872.363	35203.598	105.435	105.3823	105.382	105.3825	105.3824
Levelling Point	C305-LP040542	Blackwall Way	10/09/2012	Installed	88867.938	35201.269	105.485	105.4492	105.4495	105.4486	105.4495
Levelling Point	C305-LP040543	Blackwall Way	10/09/2012	Installed	88863.316	35198.871	105.524	105.464	105.4637	105.4644	105.4639
Levelling Point	C305-LP040544	Blackwall Way	10/09/2012	Installed	88858.884	35196.716	105.528	105.474	105.4743	105.4737	105.474
Levelling Point	C305-LP040545	Blackwall Way	10/09/2012	Installed	88854.31	35194.66	105.508	105.4601	105.4597	105.4606	105.46
Levelling Point	C305-LP040546	Blackwall Way	10/09/2012	Installed	88849.678	35192.477	105.477	105.4308	105.4306	105.4312	105.4306
Levelling Point	C305-LP040547	Blackwall Way	10/09/2012	Installed	88844.96	35190.404	105.396	105.3547	105.355	105.3546	105.3545
Levelling Point	C305-LP040548	Blackwall Way	10/09/2012	Installed	88840.27	35188.362	105.32	105.2848	105.2843	105.2853	105.2848
Levelling Point	C305-LP040549	Blackwall Way	10/09/2012	Installed	88835.8	35186.537	105.258	105.2184	105.2178	105.2187	105.2187
Levelling Point	C305-LP040550	Blackwall Way	10/09/2012	Installed	88831.042	35184.685	105.189	105.1419	105.1425	105.1416	105.1416
Levelling Point	C305-LP040551	Blackwall Way	10/09/2012	Installed	88826.506	35182.908	105.091	105.0517	105.0511	105.0523	105.0517
Levelling Point	C305-LP040552	Blackwall Way	10/09/2012	Installed	88821.478	35181.106	105.009	104.9578	104.9584	104.9576	104.9574
Levelling Point	C305-LP040553	Blackwall Way	10/09/2012	Installed	88816.928	35179.482	104.895	104.8467	104.8472	104.8466	104.8463

Sensor Type	Sensor ID	Sub-Area	Installation Date	Status	Location SENSOR (m)			Commissioning Readings (mATD))			
					Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Average	18/10/2012	18/10/2012	18/10/2012
Levelling Point	C305-LP040554	Blackwall Way	10/09/2012	Installed	88812.112	35177.881	104.771	104.7191	104.7195	104.7187	104.7191
Levelling Point	C305-LP040555	Blackwall Way	10/09/2012	Installed	88807.514	35176.413	104.644	104.5957	104.5955	104.5959	104.5957
Levelling Point	C305-LP040556	Blackwall Way	10/09/2012	Installed	88802.61	35174.916	104.511	104.4622	104.462	104.4627	104.4619
Levelling Point	C305-LP040557	Blackwall Way	10/09/2012	Installed	88797.731	35173.502	104.368	104.3198	104.3202	104.3196	104.3196
Levelling Point	C305-LP040558	Blackwall Way	10/09/2012	Installed	88793.06	35172.218	104.199	104.1546	104.1541	104.1552	104.1545
Levelling Point	C305-LP040559	Blackwall Way	10/09/2012	Installed	88787.98	35170.942	104.031	103.9679	103.9673	103.9683	103.9681
Levelling Point	C305-LP040560	Blackwall Way	10/09/2012	Installed	88783.155	35169.768	103.884	103.8252	103.825	103.8256	103.825
Levelling Point	C305-LP040561	Blackwall Way	10/09/2012	Installed	88778.149	35168.638	103.738	103.6876	103.6871	103.6882	103.6875
Levelling Point	C305-LP040562	Blackwall Way	10/09/2012	Installed	88773.027	35167.442	103.646	103.5976	103.597	103.5978	103.598
Levelling Point	C305-LP040563	Blackwall Way	10/09/2012	Installed	88768.234	35166.281	103.55	103.5014	103.5019	103.5011	103.5012
Levelling Point	C305-LP040564	Blackwall Way	10/09/2012	Installed	88763.229	35166.342	103.623	103.5716	103.5721	103.5712	103.5715
Levelling Point	C305-LP040565	Blackwall Way	10/09/2012	Installed	88758.195	35165.281	103.7	103.6464	103.6466	103.6459	103.6467
								Average	23/10/2012	23/10/2012	23/10/2012
Levelling Point	C305-LP040701	Blackwall Sect. 1	05/09/2012	Installed	88786.634	35159.365	103.86	103.842	103.8421	103.8415	103.8424
Levelling Point	C305-LP040702	Blackwall Sect. 1	05/09/2012	Installed	88782.102	35157.376	104.013	103.9988	103.9982	103.999	103.9992
Levelling Point	C305-LP040703	Blackwall Sect. 1	05/09/2012	Installed	88777.918	35154.617	104.155	104.1254	104.1256	104.1248	104.1258
Levelling Point	C305-LP040704	Blackwall Sect. 1	05/09/2012	Installed	88774.071	35151.446	104.163	104.1352	104.1354	104.1348	104.1354
Levelling Point	C305-LP040705	Blackwall Sect. 1	05/09/2012	Installed	88772.329	35149.722	104.178	104.1543	104.1537	104.1544	104.1548
Levelling Point	C305-LP040706	Blackwall Sect. 1	05/09/2012	Installed	88770.596	35147.824	104.18	104.1477	104.1472	104.148	104.1479
Levelling Point	C305-LP040707	Blackwall Sect. 1	05/09/2012	Installed	88768.948	35145.797	104.192	104.1719	104.1725	104.1716	104.1716
Levelling Point	C305-LP040708	Blackwall Sect. 1	05/09/2012	Installed	88767.541	35143.768	104.205	104.1834	104.1833	104.1836	104.1833
Levelling Point	C305-LP040709	Blackwall Sect. 1	05/09/2012	Installed	88766.503	35141.603	104.219	104.1967	104.1973	104.1966	104.1962
Levelling Point	C305-LP040710	Blackwall Sect. 1	05/09/2012	Installed	88765.481	35139.378	104.187	104.1613	104.1612	104.1615	104.1612
Levelling Point	C305-LP040711	Blackwall Sect. 1	05/09/2012	Installed	88764.56	35137.151	104.162	104.1311	104.1312	104.1306	104.1315
Levelling Point	C305-LP040712	Blackwall Sect. 1	05/09/2012	Installed	88763.822	35134.812	104.248	104.2144	104.2147	104.2142	104.2143
Levelling Point	C305-LP040713	Blackwall Sect. 1	05/09/2012	Installed	88763.219	35132.449	104.198	104.169	104.1685	104.1694	104.1691
Levelling Point	C305-LP040714	Blackwall Sect. 1	05/09/2012	Installed	88762.78	35129.958	104.115	104.0881	104.0878	104.0886	104.0879
Levelling Point	C305-LP040715	Blackwall Sect. 1	05/09/2012	Installed	88762.604	35127.466	104.018	103.9946	103.9943	103.9947	103.9948

Sensor Type	Sensor ID	Sub-Area	Installation Date	Status	Location SENSOR (m)			Commissioning Readings (mATD))			
					Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Average	18/10/2012	18/10/2012	18/10/2012
Levelling Point	C305-LP040716	Blackwall Sect. 1	05/09/2012	Installed	88762.525	35124.956	103.911	103.8907	103.8902	103.8911	103.8908
Levelling Point	C305-LP040717	Blackwall Sect. 1	06/09/2012	Installed	88762.623	35122.405	103.785	103.7665	103.7661	103.7666	103.7668
Levelling Point	C305-LP040718	Blackwall Sect. 1	05/09/2012	Installed	88762.95	35119.9	103.645	103.6257	103.6258	103.6252	103.6261
Levelling Point	C305-LP040719	Blackwall Sect. 1	05/09/2012	Installed	88763.312	35117.415	103.55	103.5307	103.531	103.5302	103.5309
Levelling Point	C305-LP040720	Blackwall Sect. 1	05/09/2012	Installed	88763.75	35114.95	103.458	103.4429	103.4425	103.443	103.4432
Levelling Point	C305-LP040721	Blackwall Sect. 1	05/09/2012	Installed	88764.284	35112.499	103.249	103.2311	103.2315	103.2306	103.2312
Levelling Point	C305-LP040722	Blackwall Sect. 1	05/09/2012	Installed	88752.085	35108.773	102.883	102.8772	102.8776	102.8766	102.8774
Levelling Point	C305-LP040723	Blackwall Sect. 1	05/09/2012	Installed	88752	35106.159	102.829	102.8434	102.8437	102.8433	102.8432
Levelling Point	C305-LP040724	Blackwall Sect. 1	05/09/2012	Installed	88751.722	35103.617	102.745	102.7269	102.7268	102.7275	102.7264
Levelling Point	C305-LP040725	Blackwall Sect. 1	05/09/2012	Installed	88750.893	35101.239	102.661	102.5999	102.6	102.5999	102.5998
Levelling Point	C305-LP040726	Blackwall Sect. 1	05/09/2012	Installed	88751.944	35094.132	102.775	102.7165	102.7161	102.7171	102.7163
Levelling Point	C305-LP040727	Blackwall Sect. 1	05/09/2012	Installed	88754.578	35088.046	102.696	102.6302	102.6305	102.6301	102.63
Levelling Point	C305-LP040728	Blackwall Sect. 1	05/09/2012	Installed	88759.852	35087.689	102.816	102.7262	102.726	102.7266	102.726
Levelling Point	C305-LP040729	Blackwall Sect. 1	05/09/2012	Installed	88763.903	35084.719	102.783	102.7343	102.7337	102.7345	102.7347
Levelling Point	C305-LP040730	Blackwall Sect. 1	05/09/2012	Installed	88765.231	35079.908	102.724	102.7129	102.7134	102.7124	102.7129
Levelling Point	C305-LP040731	Blackwall Sect. 1	05/09/2012	Installed	88766.477	35074.971	102.719	102.7075	102.708	102.7074	102.7071
Levelling Point	C305-LP040732	Blackwall Sect. 1	05/09/2012	Installed	88767.783	35070.04	102.735	102.7233	102.7228	102.7239	102.7232
Levelling Point	C305-LP040733	Blackwall Sect. 1	05/09/2012	Installed	88769.061	35065.152	102.764	102.7524	102.753	102.7523	102.7519
Levelling Point	C305-LP040734	Blackwall Sect. 1	05/09/2012	Installed	88770.342	35060.161	102.81	102.7978	102.7983	102.7974	102.7977
								Average	20/11/2013	20/11/2013	20/11/2013
Levelling Point	C305-LP047101	Blackwall Sect. 2	20/11/2013	Installed	88784.963	35166.904	103.977	103.9765	103.9769	103.9761	103.9765
Levelling Point	C305-LP047102	Blackwall Sect. 2	20/11/2013	Installed	88780.189	35165.366	104.142	104.1422	104.1418	104.1427	104.1421
Levelling Point	C305-LP047103	Blackwall Sect. 2	20/11/2013	Installed	88775.517	35163.473	104.286	104.2858	104.2856	104.2862	104.2856
Levelling Point	C305-LP047104	Blackwall Sect. 2	20/11/2013	Installed	88773.471	35162.386	104.338	104.3381	104.3376	104.3383	104.3384
Levelling Point	C305-LP047105	Blackwall Sect. 2	20/11/2013	Installed	88771.137	35161.78	104.406	104.4062	104.406	104.4068	104.4058
Levelling Point	C305-LP047106	Blackwall Sect. 2	20/11/2013	Installed	88754.167	35138.57	104.149	104.1486	104.148	104.1488	104.149
Levelling Point	C305-LP047107	Blackwall Sect. 2	20/11/2013	Installed	88754.415	35132.662	104.046	104.0455	104.0457	104.0451	104.0457
Levelling Point	C305-LP047108	Blackwall Sect. 2	20/11/2013	Installed	88754.34	35130.179	103.944	103.9444	103.9442	103.9449	103.9441

Sensor Type	Sensor ID	Sub-Area	Installation Date	Status	Location SENSOR (m)			Commissioning Readings (mATD))			
					Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Average	18/10/2012	18/10/2012	18/10/2012
Levelling Point	C305-LP047109	Blackwall Sect. 2	20/11/2013	Installed	88753.662	35127.717	103.813	103.8129	103.8124	103.8131	103.8132
Levelling Point	C305-LP047110	Blackwall Sect. 2	20/11/2013	Installed	88753.363	35125.231	103.684	103.6842	103.6838	103.6847	103.6841
Levelling Point	C305-LP047111	Blackwall Sect. 2	20/11/2013	Installed	88753.7	35122.772	103.549	103.5492	103.5493	103.5486	103.5497
Levelling Point	C305-LP047112	Blackwall Sect. 2	20/11/2013	Installed	88752.828	35120.26	103.419	103.4187	103.4192	103.4181	103.4188
Levelling Point	C305-LP047113	Blackwall Sect. 2	20/11/2013	Installed	88752.612	35117.955	103.274	103.2737	103.2743	103.2735	103.2733
Levelling Point	C305-LP047114	Blackwall Sect. 2	20/11/2013	Installed	88752.401	35115.316	103.141	103.1411	103.1408	103.1413	103.1412
Levelling Point	C305-LP047115	Blackwall Sect. 2	20/11/2013	Installed	88752.272	35112.807	102.862	102.8621	102.8622	102.8616	102.8625
								AVERAGE	03/02/2013	03/02/2013	03/02/2013
Levelling Point	C305-LP043101	Blackwall Tunnel Northbound	03/02/2013	Installed	88716.618	35047.522	88.194	88.1949	88.1952	88.1947	88.1948
Levelling Point	C305-LP043102	Blackwall Tunnel Northbound	03/02/2013	Installed	88715.9142	35052.472	88.345	88.3456	88.3461	88.345	88.3457
Levelling Point	C305-LP043103	Blackwall Tunnel Northbound	03/02/2013	Installed	88715.194	35057.428	88.496	88.4961	88.4963	88.4957	88.4963
Levelling Point	C305-LP043104	Blackwall Tunnel Northbound	03/02/2013	Installed	88714.486	35062.38	88.642	88.6429	88.6428	88.6435	88.6424
Levelling Point	C305-LP043105	Blackwall Tunnel Northbound	03/02/2013	Installed	88713.771	35067.332	88.791	88.7918	88.7922	88.7912	88.792
Levelling Point	C305-LP043106	Blackwall Tunnel Northbound	03/02/2013	Installed	88713.063	35072.275	88.943	88.9432	88.9429	88.9434	88.9433
Levelling Point	C305-LP043107	Blackwall Tunnel Northbound	03/02/2013	Installed	88712.357	35077.229	89.096	89.0965	89.0968	89.0961	89.0966
Levelling Point	C305-LP043108	Blackwall Tunnel Northbound	03/02/2013	Installed	88711.638	35082.195	89.297	89.2477	89.2479	89.2476	89.2476
Levelling Point	C305-LP043109	Blackwall Tunnel Northbound	03/02/2013	Installed	88711.279	35084.704	89.319	89.3195	89.3194	89.3201	89.319
Levelling Point	C305-LP043110	Blackwall Tunnel Northbound	03/02/2013	Installed	88710.929	35087.11	89.388	89.3889	89.3886	89.3895	89.3886
Levelling Point	C305-LP043111	Blackwall Tunnel Northbound	03/02/2013	Installed	88710.563	35089.724	89.467	89.4678	89.4679	89.4674	89.4681
Levelling Point	C305-LP043112	Blackwall Tunnel Northbound	03/02/2013	Installed	88710.23	35092.039	89.538	89.538	89.5386	89.5377	89.5377
Levelling Point	C305-LP043113	Blackwall Tunnel Northbound	03/02/2013	Installed	88709.871	35094.529	89.611	89.6113	89.6114	89.6107	89.6118
Levelling Point	C305-LP043114	Blackwall Tunnel Northbound	03/02/2013	Installed	88709.525	35096.956	89.684	89.6841	89.6844	89.6838	89.6841
Levelling Point	C305-LP043115	Blackwall Tunnel	03/02/2013	Installed	88709.157	35099.481	89.766	89.7661	89.766	89.7665	89.7658

Sensor Type	Sensor ID	Sub-Area	Installation Date	Status	Location SENSOR (m)			Commissioning Readings (mATD))			
					Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Average	18/10/2012	18/10/2012	18/10/2012
		Northbound									
Levelling Point	C305-LP043116	Blackwall Tunnel Northbound	03/02/2013	Installed	88708.797	35101.971	89.844	89.8441	89.8446	89.8437	89.844
Levelling Point	C305-LP043117	Blackwall Tunnel Northbound	03/02/2013	Installed	88708.423	35104.514	89.922	89.9228	89.923	89.9222	89.9232
Levelling Point	C305-LP043118	Blackwall Tunnel Northbound	03/02/2013	Installed	88708.076	35106.937	89.993	89.9937	89.9933	89.9939	89.9939
Levelling Point	C305-LP043119	Blackwall Tunnel Northbound	03/02/2013	Installed	88707.719	35109.374	90.064	90.064	90.0634	90.0643	90.0643
Levelling Point	C305-LP043120	Blackwall Tunnel Northbound	03/02/2013	Installed	88707.36	35111.852	90.135	90.1354	90.1359	90.1348	90.1355
Levelling Point	C305-LP043121	Blackwall Tunnel Northbound	03/02/2013	Installed	88706.655	35116.786	90.286	90.2865	90.2865	90.2862	90.2868
Levelling Point	C305-LP043122	Blackwall Tunnel Northbound	03/02/2013	Installed	88705.946	35121.726	90.436	90.4366	90.4362	90.4367	90.4369
Levelling Point	C305-LP043123	Blackwall Tunnel Northbound	03/02/2013	Installed	88705.242	35126.669	90.584	90.5849	90.5852	90.5849	90.5846
Levelling Point	C305-LP043124	Blackwall Tunnel Northbound	03/02/2013	Installed	88704.531	35131.629	90.721	90.721	90.7208	90.7213	90.7209
Levelling Point	C305-LP043125	Blackwall Tunnel Northbound	03/02/2013	Installed	88703.818	35136.567	90.871	90.8714	90.8718	90.8711	90.8713
Levelling Point	C305-LP043126	Blackwall Tunnel Northbound	03/02/2013	Installed	88703.121	35141.509	91.02	91.0206	91.0207	91.02	91.0211
Levelling Point	C305-LP043127	Blackwall Tunnel Northbound	03/02/2013	Installed	88702.427	35146.357	91.167	91.1677	91.1681	91.1673	91.1677

Sensor Type	Sensor ID	Sub-Area	Installation Date	Status	Location SENSOR (m)			Commissioning Readings (mATD))			
					Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Average	14/02/2013	14/02/2013	14/02/2013
Levelling Point	C305-LP043301	Blackwall Tunnel Northbound	14/02/2013	Installed	88825.95	35232.29	99.503	99.5025	99.5021	99.5029	99.5025
Levelling Point	C305-LP043302	Blackwall Tunnel Northbound	14/02/2013	Installed	88844.37	35204.9	98.221	98.2209	98.2207	98.2210	98.2210
Levelling Point	C305-LP043303	Blackwall Tunnel Northbound	14/02/2013	Installed	88850.51	35195.78	97.776	97.7762	97.7759	97.7762	97.7765
Levelling Point	C305-LP043304	Blackwall Tunnel Northbound	14/02/2013	Installed	88863.42	35176.74	96.846	96.8463	96.8460	96.8465	96.8464
Levelling Point	C305-LP043305	Blackwall Tunnel Northbound	14/02/2013	Installed	88881.96	35149.48	95.546	95.5462	95.5464	95.5458	95.5464

Learning Legacy Document

IRS Installation Record Sheets – Sockets

Sensor Type	Sensor ID	Date Installation	Sub-area	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
					Eastings X	Northings Y	Elevation Z (mATD)	AVERAGE	19/11/2012	19/11/2012	19/11/2012
								AVERAGE	19/11/2012	19/11/2012	19/11/2012
Socket	C305-LB040601	18/11/2012	IBIS Hotel	Installed	88744.356	35120.292	103.97	103.9695	103.9696	103.9698	103.9691
Socket	C305-LB040602	18/11/2012	IBIS Hotel	Installed	88735.818	35118.839	103.958	103.9582	103.9586	103.9581	103.958
Socket	C305-LB040603	18/11/2012	IBIS Hotel	Installed	88731.197	35133.461	103.965	103.9654	103.9649	103.9656	103.9657
Socket	C305-LB040604	18/11/2012	IBIS Hotel	Installed	88717.63	35131.174	103.975	103.9748	103.9749	103.9751	103.9744
Socket	C305-LB040605	18/11/2012	IBIS Hotel	Installed	88718.495	35124.962	104.627	104.038	104.0383	104.0377	104.0379
Socket	C305-LB040606	18/11/2012	IBIS Hotel	Installed	88719.512	35118.972	104.626	104.0373	104.0374	104.0369	104.0375
Socket	C305-LB040607	18/11/2012	IBIS Hotel	Installed	88714.561	35111.765	104.638	104.0436	104.0435	104.0439	104.0434
Socket	C305-LB040608	18/11/2012	IBIS Hotel	Installed	88716.514	35100.207	104.634	104.0411	104.0406	104.0409	104.0418
Socket	C305-LB040609	18/11/2012	IBIS Hotel	Installed	88746.72	35106.367	104.339	103.7475	103.7479	103.7475	103.7472
								AVERAGE	06/03/2013	06/03/2013	07/03/2013
Socket	C305-LB040610	18/11/2012	Streamlight Tower	Installed	88746.634	35063.201	103.445	103.4447	103.4451	103.4443	103.4448
Socket	C305-LB040611	18/11/2012	Streamlight Tower	Installed	88743.406	35076.384	103.432	103.4315	103.4313	103.4319	103.4312
Socket	C305-LB040612	18/11/2012	Streamlight Tower	Installed	88761.17	35081.132	103.906	103.9064	103.9063	103.9062	103.9067
Socket	C305-LB040613	18/11/2012	Streamlight Tower	Installed	88765.874	35061.607	103.939	103.9387	103.9384	103.9388	103.9388
								AVERAGE	08/04/2013	08/04/2013	09/04/2013
Socket	C305-LB044101	27/03/2013	Blackwall Ventilation	Installed	88874.835	35143.958	104.968	104.9676	104.9678	104.9674	104.9675
Socket	C305-LB044102	27/03/2013	Blackwall Ventilation	Installed	88876.975	35156.609	104.903	104.9034	104.9036	104.9033	104.9032
Socket	C305-LB044103	27/03/2013	Blackwall Ventilation	Installed	88892.143	35162.182	104.919	104.9186	104.9188	104.9187	104.9182
Socket	C305-LB044104	27/03/2013	Blackwall Ventilation	Installed	88900.087	35152.409	104.931	104.9311	104.9311	104.9312	104.931
Socket	C305-LB044105	27/03/2013	Blackwall Ventilation	Installed	88890.213	35139.735	104.885	104.8854	104.8855	104.8859	104.8849
								AVERAGE	25/11/2013	25/11/2013	25/11/2013
Socket	C305-LB047010	25/11/2013	Blackwall DLR	Installed	88555.982	35183.477	104.992	104.9915	104.9909	104.9921	104.9915
Socket	C305-LB047015	25/11/2013	Blackwall DLR	Installed	88556.335	35179.929	104.930	104.9295	104.9294	104.9298	104.9293

Sensor Type	Sensor ID	Date Installation	Sub-area	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
					Eastings X	Northings Y	Elevation Z (mATD)				
Socket	C305-LB047020	25/11/2013	Blackwall DLR	Installed	88588.087	35184.849	105.094	105.0944	105.0948	105.0941	105.0943
Socket	C305-LB047030	25/11/2013	Blackwall DLR	Installed	88704.980	35210.045	104.684	104.6836	104.6839	104.6832	104.6837
Socket	C305-LB047035	25/11/2013	Blackwall DLR	Installed	88705.739	35206.931	104.738	104.7377	104.7381	104.7372	104.7378
Socket	C305-LB047040	25/11/2013	Blackwall DLR	Installed	88741.650	35218.934	104.828	104.8277	104.8276	104.8280	104.8275
Socket	C305-LB047042	25/11/2013	Blackwall DLR	Installed	88741.243	35220.639	104.833	104.8326	104.8332	104.8321	104.8325
Socket	C305-LB047045	25/11/2013	Blackwall DLR	Installed	88742.400	35215.879	104.839	104.8385	104.8379	104.8390	104.8386
Socket	C305-LB047047	25/11/2013	Blackwall DLR	Installed	88742.790	35214.260	104.859	104.8588	104.8589	104.8586	104.8589
Socket	C305-LB047050	25/11/2013	Blackwall DLR	Installed	88761.236	35223.893	105.893	105.8926	105.8930	105.8921	105.8927
Socket	C305-LB047052	25/11/2013	Blackwall DLR	Installed	88758.384	35224.944	105.806	105.8059	105.8060	105.8054	105.8063
Socket	C305-LB047055	25/11/2013	Blackwall DLR	Installed	88762.009	35220.722	105.908	105.9082	105.9079	105.9086	105.9081
Socket	C305-LB047057	25/11/2013	Blackwall DLR	Installed	88759.965	35218.509	105.803	105.8033	105.8029	105.8034	105.8036
Socket	C305-LB047060	25/11/2013	Blackwall DLR	Installed	88780.429	35228.790	105.766	105.7662	105.7662	105.7658	105.7666
Socket	C305-LB047065	25/11/2013	Blackwall DLR	Installed	88781.269	35225.593	105.754	105.7544	105.7548	105.7543	105.7541
Socket	C305-LB047070	25/11/2013	Blackwall DLR	Installed	88806.463	35237.561	105.111	105.1106	105.1100	105.1108	105.1110
Socket	C305-LB047075	25/11/2013	Blackwall DLR	Installed	88807.680	35234.462	105.306	105.3063	105.3069	105.3061	105.3059
Socket	C305-LB047080	25/11/2013	Blackwall DLR	Installed	88835.048	35251.523	104.581	104.5808	104.5811	104.5802	104.5811
Socket	C305-LB047085	25/11/2013	Blackwall DLR	Installed	88836.759	35248.718	104.651	104.6513	104.6509	104.6514	104.6516
Socket	C305-LB047090	25/11/2013	Blackwall DLR	Installed	88858.107	35267.212	104.261	104.2605	104.2599	104.2610	104.2606
Socket	C305-LB047095	25/11/2013	Blackwall DLR	Installed	88860.222	35264.549	104.262	104.2616	104.2618	104.2615	104.2615
Socket	C305-LB047100	25/11/2013	Blackwall DLR	Installed	88873.380	35279.484	104.100	104.1004	104.1002	104.1008	104.1002
Socket	C305-LB047105	25/11/2013	Blackwall DLR	Installed	88875.603	35277.128	104.115	104.1154	104.1148	104.1159	104.1155
Socket	C305-LB047110	25/11/2013	Blackwall DLR	Installed	88889.030	35292.750	104.147	104.1469	104.1472	104.1463	104.1472
Socket	C305-LB047115	25/11/2013	Blackwall DLR	Installed	88891.150	35290.346	104.210	104.2102	104.2098	104.2106	104.2102



IRS Installation Record Sheets – 3D Prisms

Sensor ID	Date Installation	Sub-area	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
				Eastings X	Northings Y	Elevation Z (mATD)		Eastings X	Northings Y	Elevation Z
C305-RP042101	13/09/2012	IBIS Hotel	Installed	88718.47	35124.832	111.32				
							AVERAGE	88718.4697	35124.8315	111.3195
							09/11/2012	88718.4693	35124.8317	111.3199
							09/11/2012	88718.4698	35124.8313	111.3194
							09/11/2012	88718.4701	35124.8315	111.3191
C305-RP042102	13/09/2012	IBIS Hotel	Installed	88715.056	35108.596	106.781				
							AVERAGE	88715.0556	35108.5956	106.7807
							09/11/2012	88715.0556	35108.5958	106.7807
							09/11/2012	88715.0554	35108.5951	106.7807
							09/11/2012	88715.0559	35108.5959	106.7806
C305-RP042103	13/09/2012	IBIS Hotel	Installed	88734.517	35104.265	108.646				
							AVERAGE	88734.5173	35104.2649	108.6455
							09/11/2012	88734.5175	35104.2651	108.6454
							09/11/2012	88734.5171	35104.2646	108.6456
							09/11/2012	88734.5172	35104.2649	108.6454
C305-RP042104	13/09/2012	IBIS Hotel	Installed	88741.327	35119.811	109.954				
							AVERAGE	88741.328	35119.8098	109.9516
							14/11/2012	88741.3281	35119.8095	109.9514
							14/11/2012	88741.328	35119.8099	109.9516
							14/11/2012	88741.3279	35119.8101	109.9517
C305-RP044101	09/04/2013	Blackwall Ventilation	Installed	88896.08	35151.473	119.968				
							AVERAGE	88896.0796	35151.4734	119.9676
							15/01/2013	88896.0799	35151.4735	119.9672
							15/01/2013	88896.0798	35151.4736	119.9677
							15/01/2013	88896.0791	35151.473	119.9678
C305-RP044102	09/04/2013	Blackwall Ventilation	Installed	88888.307	35157.722	119.965				
							AVERAGE	88888.3069	35157.7217	119.9653
							11/04/2013	88888.3075	35157.7212	119.965
							11/04/2013	88888.3069	35157.7217	119.9654
							11/04/2013	88888.3062	35157.7221	119.9656
C305-RP044103	09/04/2013	Blackwall Ventilation	Installed	88882.171	35155.081	132.227	AVERAGE	88882.1708	35155.0813	132.2274

Sensor ID	Date Installation	Sub-area	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
				Eastings X	Northings Y	Elevation Z (mATD)				
							11/04/2013	88882.1705	35155.081	132.2272
							11/04/2013	88882.1707	35155.0811	132.2273
							11/04/2013	88882.1713	35155.0819	132.2277
C305-RP044104	09/04/2013	Blackwall Ventilation	Installed	88881.921	35146.713	132.214	AVERAGE	88881.9207	35146.7127	132.2135
							11/04/2013	88881.921	35146.7123	132.214
							11/04/2013	88881.9204	35146.7131	132.2135
							11/04/2013	88881.9207	35146.7126	132.2131
C305-RP044105	09/04/2013	Blackwall Ventilation	Installed	88887.271	35142.859	132.235	AVERAGE	88887.2712	35142.8588	132.2355
							11/04/2013	88887.2716	35142.8592	132.2351
							11/04/2013	88887.2709	35142.8583	132.2357
							11/04/2013	88887.2711	35142.8588	132.2356
C305-RR042101	13/09/2012	Streamlight Tower	Installed	88765.142	35064.456	105.014	AVERAGE	88765.1419	35064.4555	105.0138
							14/11/2012	88765.1419	35064.4557	105.0137
							14/11/2012	88765.1416	35064.4556	105.0137
							14/11/2012	88765.1421	35064.4552	105.0139
C305-RR042102	13/09/2012	Streamlight Tower	Installed	88750.245	35078.537	104.978	AVERAGE	88750.245	35078.537	104.9778
							14/11/2012	88750.2449	35078.5368	104.9777
							14/11/2012	88750.2448	35078.5369	104.9776
							14/11/2012	88750.2454	35078.5372	104.978
C305-RR042103	13/09/2012	Streamlight Tower	Installed	88744.653	35071.153	104.405	AVERAGE	88744.6527	35071.1526	104.4052
							14/11/2012	88744.6531	35071.1528	104.4051
							14/11/2012	88744.6527	35071.1526	104.4052
							14/11/2012	88744.6523	35071.1524	104.4054



Sensor Type	Sensor ID	Sensor Serial Number	Date Installation	Status	Monitoring ID	Location MONR	Location MONR	Location MONR	Comm. Readings (mm)	Comm. Readings (mm)	Comm. Readings (mm)
						Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	26/01/2013 02:00	26/01/2013 03:00	26/01/2013 05:00
Electrolevel Beam	S C305-EL040213	1606	26/01/2013	INSTALLED							
					C305-EL040214	88865.17	35174.198	-	-0.25933	-0.41505	-0.35967
Electrolevel Beam	S C305-EL040214	3471	26/01/2013	INSTALLED							
					C305-EL040215	88863.47	35176.67	-	-0.24910	-0.37180	-0.34094
Electrolevel Beam	S C305-EL040215	4502	26/01/2013	INSTALLED							
					C305-EL040216	88861.77	35179.141	-	-0.37072	-0.46770	-0.41742
Electrolevel Beam	S C305-EL040216	4748	26/01/2013	INSTALLED							
					C305-EL040217	88860.076	35181.617	-	-0.87319	-1.00012	-0.97731
Electrolevel Beam	S C305-EL040217	3399	26/01/2013	INSTALLED							
					C305-EL040218	88858.392	35184.1	-	-0.93621	-1.06673	-1.03182
Electrolevel Beam	S C305-EL040218	2540	26/01/2013	INSTALLED							
					C305-EL040219	88856.712	35186.586	-	-0.85133	-0.94514	-0.93902
Electrolevel Beam	S C305-EL040219	3489	26/01/2013	INSTALLED							
					C305-EL040220	88855.036	35189.074	-	-0.83525	-0.96048	-0.93934
Electrolevel Beam	S C305-EL040220	3891	26/01/2013	INSTALLED							
					C305-EL040221	88853.356	35191.559	-	-0.80745	-0.89671	-0.87813
Electrolevel Beam	S C305-EL040221	3453	26/01/2013	INSTALLED							
					C305-EL040222	88851.675	35194.044	-	-0.84263	-0.86224	-0.88869
Electrolevel Beam	S C305-EL040222	3535	26/01/2013	INSTALLED							
					C305-EL040223	88849.997	35196.531	-	-0.86757	-0.92885	-0.93588
Electrolevel Beam	S C305-EL040223	3293	26/01/2013	INSTALLED							
					C305-EL040224	88848.322	35199.02	-	-0.97307	-1.04819	-1.03288
Electrolevel Beam	S C305-EL040224	3297	26/01/2013	INSTALLED							
					C305-EL040225	88846.647	35201.509	-	-0.98628	-1.10307	-1.06542
Electrolevel Beam	S C305-EL040225	3464	26/01/2013	INSTALLED							
					C305-EL040226	88844.974	35203.998	-	-0.88231	-0.98218	-0.98956
Electrolevel	S C305-EL040226	3462	26/01/2013	INSTALLED							

Sensor Type	Sensor ID	Sensor Serial Number	Date Installation	Status	Monitoring ID	Location MONR	Location MONR	Location MONR	Comm. Readings (mm)	Comm. Readings (mm)	Comm. Readings (mm)
						Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	26/01/2013 02:00	26/01/2013 03:00	26/01/2013 05:00
Beam											
Electrolevel Beam	S C305-EL040227	5373	26/01/2013	INSTALLED	C305-EL040227	88843.308	35206.493	-	-0.88088	-0.96382	-0.97962
Electrolevel Beam	S C305-EL040228	3459	26/01/2013	INSTALLED	C305-EL040228	88841.64	35208.987	-	-0.91680	-0.99600	-1.00557
Electrolevel Beam	S C305-EL040229	3552	26/01/2013	INSTALLED	C305-EL040229	88839.961	35211.473	-	-0.99081	-1.11168	-1.11062
Electrolevel Beam	S C305-EL040230	4471	26/01/2013	INSTALLED	C305-EL040230	88838.279	35213.957	-	-0.96154	-1.08160	-1.07724
Electrolevel Beam	S C305-EL040231	4509	26/01/2013	INSTALLED	C305-EL040231	88836.596	35216.44	-	-0.89859	-0.96767	-0.94755
Electrolevel Beam	S C305-EL040232	4753	26/01/2013	INSTALLED	C305-EL040232	88834.913	35218.924	-	-0.95135	-1.06210	-1.03575
Electrolevel Beam	S C305-EL040233	3640	26/01/2013	INSTALLED	C305-EL040233	88833.225	35221.404	-	0.11649	0.11787	0.15192
					C305-EL040234	88831.537	35223.884	-	0.00000	0.00000	0.00000

IRS Installation Record Sheets – Vibrating Wire Piezometer

Sensor Type	Date Installation	Monitoring ID	Status	Location Sensor – GPS readings (m)			Borehole Depth
				Eastings X	Northings Y	Elevation Z (m ATD)	(m bgl)
Vibrating Wire Piezometer	30/05/2013	C305-PV04090	Installed	88657.126	35066.306	105.501	60.55
Vibrating Wire Piezometer	30/05/2013	C305-PV04091	Installed	88657.126	35066.306	105.501	60.55
Vibrating Wire Piezometer	19/08/2014	C305-PV04134	Installed	89005.9871	35287.275	105.52	15.42
Vibrating Wire Piezometer	20/08/2014	C305-PV04135	Installed	88653.638	35065.609	105.61	17.48
Vibrating Wire Piezometer	04/08/2015	C305-PV04136	Installed	88754.438	35122.387	103.943	43.37
Vibrating Wire Piezometer	22/01/2013	C305-PV04070	Installed	88737.278	35132.046	102.666	49.00
Vibrating Wire Piezometer	21/01/2013	C305-PV04071	Installed	88737.278	35132.046	102.666	57.00

Sensor Type	Sensor ID	Sensor Depth (m bgl)	Date Installation	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
					Eastings X	Northings Y	Elevation Z (mATD)	AVERAGE	06/09/2013 15:00	06/09/2013 16:00	06/09/2013 17:00
Vibrating Wire Piezometer	C305-PV04090	60.0	30/05/2013	Installed	88657.126	35066.306	105.501	91.204	91.450	91.267	90.894
								AVERAGE	06/09/2013 15:00	06/09/2013 16:00	06/09/2013 17:00
Vibrating Wire Piezometer	C305-PV04091	47.0	30/05/2013	Installed	88657.126	35066.306	105.501	89.334	89.302	89.346	89.353
								AVERAGE	19/08/2014 15:00	19/08/2014 16:00	19/08/2014 17:00
Vibrating Wire Piezometer	C305-PV04134	14.4	19/08/2014	Installed	89005.9871	35287.275	105.52	97.829	97.839	97.827	97.822
								AVERAGE	20/08/2014 15:05	20/08/2014 16:00	20/08/2014 17:00
Vibrating Wire Piezometer	C305-PV04135	17.0	20/08/2014	Installed	88653.638	35065.609	105.61	95.265	95.269	95.262	95.264
								AVERAGE	04/08/2015 13:34	04/08/2015 14:00	04/08/2015 15:00
Vibrating Wire Piezometer	C305-PV04136	42.5	04/08/2015	Installed	88754.438	35122.387	103.943	80.565	80.551	80.548	80.595
								AVERAGE	22/01/2013 14:00	22/01/2013 15:00	22/01/2013 16:00

Vibrating Wire Piezometer	C305-PV04070	48.6	22/01/2013	Installed	88737.278	35132.046	102.666	91.05	91.07	91.02	91.06
								AVERAGE	22/01/2013 14:15	22/01/2013 14:16	22/01/2013 14:16
Vibrating Wire Piezometer	C305-PV04071	55.5	21/01/2013	Installed	88737.278	35132.046	102.666	90.97	90.98	90.97	90.97

**IRS Installation Record Sheets – Shallow Datum**

Sensor Type	Sensor ID	Sensor Depth (m bgl)	Date Installation	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
					Eastings X	Northings Y	Elevation Z (mATD)	AVERAGE	11/04/2013	11/04/2013	11/04/2013
Shallow Datum	C305-SD043501	12.0	14/03/2013	Installed	88673.02	35064.039	105.032	105.500	105.501	105.501	105.500

**Notes:**

- \* The difference between the Elevation Z reading and Commissioning reading results from the use of a GPS staff and a manual level respectively.
- \* All elevations or levels presented in this document are metres above tunnel datum (mATD).

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**APPENDIX C: MINUTES CLOSE OUT MEETING AREA 4**





# I&M Close Out Meeting

Date & Time		15/07/2015 09:00		
Meeting No.		1		
The purpose of this document is to record agreement to cease monitoring long term monitoring and decommission based on review of the data against the requirements. Agreement from this meeting is then considered acceptance from all parties that the Close Out Report can then be produced based on the data shown and this will be acceptable to the Project Manager.				
Attendees:				
[Redacted]				
Data Reviewed				
Monitoring References	Location	Settlement rate	Cease Monitoring?	Decommission/ prepare report?
Levelling Points Area 4 Limmo to Canary Wharf Station				
LP045100-LP045147	Area 4 - River Lea River West Bank Wall (4A)	74% at 2mm/year 80% at 3mm/year	Yes	Yes
LP040101-LP040124	Area 4 - Bridge Court	0% at 2mm/year 0% at 3mm/year	Yes - CP13/14	Yes
LP040201-LP040226	Area 4 - Keel Court	40% at 2mm/year 68% at 3mm/year	Yes - CP13/14	Yes
LP040301-LP040330	Area 4 - John Smith Mews	73% at 2mm/year 83% at 3mm/year	Yes - CP13/14	Yes
LP040422-LP040431	Area 4 - Reuters Car Park	90% at 2mm/year 90% at 3mm/year		
LP041301-LP041328	Area 4 - Poplar Dock	68% at 2mm/year 82% at 3mm/year		
LP041401-LP041425	Area 4 - Boardwalk Place	100% at 2mm/year 100% at 3mm/year		
LP041501-LP041536	Area 4 - Trafalgar Way	36% at 2mm/year 44% at 3mm/year		
LP042301-LP042327	Area 4 - Billingsgate Market	96% at 2mm/year 100% at 3mm/year		
LP04472-LP04477	Area 4 - Lower Lea Crossing	50% at 2mm/year 83% at 3mm/year	Yes - CP14	Yes
LP04301-LP04310	Area 4 - Bow Creek River Wall	90% at 2mm/year 100% at 3mm/year	Yes - CP14	Yes
LP043201-LP043210	Area 4 - Orchard Place	20% at 2mm/year 20% at 3mm/year	Yes - temporary studs due to stoppage	Yes.
LP042050-LP042078	Area 4 - East India Dock	79% at 2mm/year 90% at 3mm/year	Yes - CP13/14	Yes
LP040801-LP040805	Area 4 - Prestons Road	100% at 2mm/year 100% at 3mm/year		
LP040201-LP040216	Area 4 - Aspen Way Underpass	100% at 2mm/year 100% at 3mm/year		
LP041701-LP041719	Area 4 - Prestons Road	95% at 2mm/year 95% at 3mm/year		
LP042001-LP042007	Area 4 - East India Dock	100% at 2mm/year 100% at 3mm/year	Yes - CP13/14	Yes
LP042201-LP042211	Area 4 - Billingsgate Market	64% at 2mm/year 82% at 3mm/year		
LP042401-LP042440	Area 4 - Billingsgate Market	67% at 2mm/year 78% at 3mm/year		
LP43201-LP43227	Area 4 - Blackwall Tunnel NB	89% at 2mm/year 100% at 3mm/year		
LP04478-LP04483	Area 4 - Lower Lea Crossing	??% at 2mm/year ??% at 3mm/year		
LP045301-LP045321	Area 4 - Orchard Place	52% at 2mm/year		
LP045201-LP045212	Area 4 - Orchard Place (4B)	59% at 3mm/year	Yes	Yes

LPO41241-LPO41249	Area 4 - Poplar Dock	67% at 2mm/year 100% at 3mm/year		
<b>Sockets Area 4 Limmo to Canary Wharf Station</b>				
LB04301-LB04312	Area 4 - Orchard Place	83% at 2mm/year 92% at 3mm/year	Yes	Yes
LB040101-LB040110	Area 4 - Sail Court	100% at 2mm/year 100% at 3mm/year	Yes - CP13/CP14	Yes
LB040201-LB040211	Area 4 - Bridge/Keel Court	100% at 2mm/year 100% at 3mm/year	Yes - CP13/CP14	Yes
LB040301-LB040304	Area 4 - Sexton Court	75% at 2mm/year 100% at 3mm/year	Yes - CP13/14	Yes
LB040401-LB040412	Area 4 - John Smith Mews	80% at 2mm/year 90% at 3mm/year	Yes - CP13/14	Yes
LB040501-LB040506	Area 4 - Proton/Neutron Towers	100% at 2mm/year 100% at 3mm/year	Yes - CP13/14	Yes
LB040701-LB040706	Area 4 - Billingsgate Market	100% at 2mm/year 100% at 3mm/year		
LB041101-LB041110	Area 4 - Boardwalk Place	20% at 2mm/year 50% at 3mm/year		
LB041201-LB041210	Area 4 - Boardwalk Place	20% at 2mm/year 60% at 3mm/year		
LB041301-LB041308	Area 4 - Boardwalk Place	100% at 2mm/year 100% at 3mm/year		
LB041401-LB041410	Area 4 - Boardwalk Place	90% at 2mm/year 100% at 3mm/year		
LB044101-LB044105	Area 4 - Blackwall Tunnel Ventilation Tower (SB)	80% at 2mm/year 100% at 3mm/year		
<b>Notes</b>				
<p>-Cells in yellow indicate data review needs amending. <i>to included for rounding.</i></p> <p>-Limmo dewatering switch on 04/11/13, CP13 dewatering switch on 26/11/13.</p> <p>* -include CP13/CP14 data to demonstrate area is stable after last TBIM readings in close out reports affected by dewatering works. Next meeting tomorrow after CTC.</p>				
<b>Sign off</b>				
DSJV	Geocisa	Crossrail	C122	

I&M Close Out Template - 13th July 2015

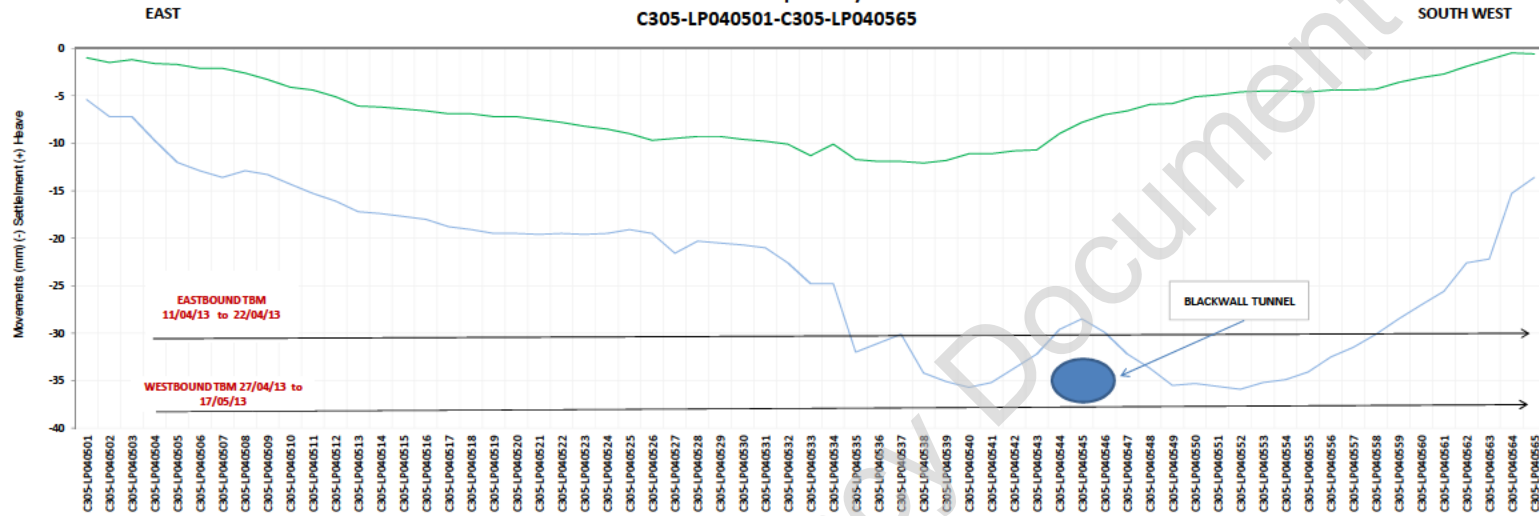
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**APPENDIX D: DEFLECTION RATIO**

**CONTRACT C305**

**AREA 4 Aspen Way**

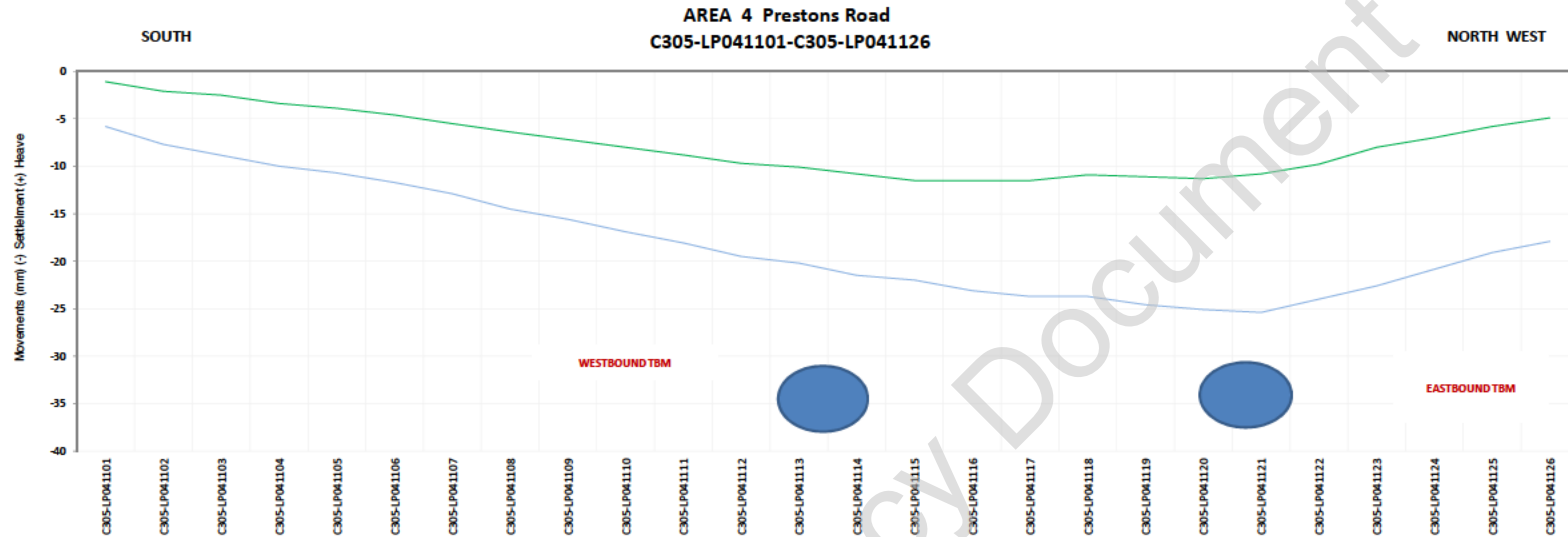
**C305-LP040501-C305-LP040565**



NOTE: x axis is of monitoring points and is not a scaled distance

TRANSECT	ALERT VALUE	AMBER TRIGGER VALUE	MAX DEFLECTION RATIO	
			TBMs Passage	After CP13
Aspen Way	1/2600 1/3300	-	1/23336	1/9289

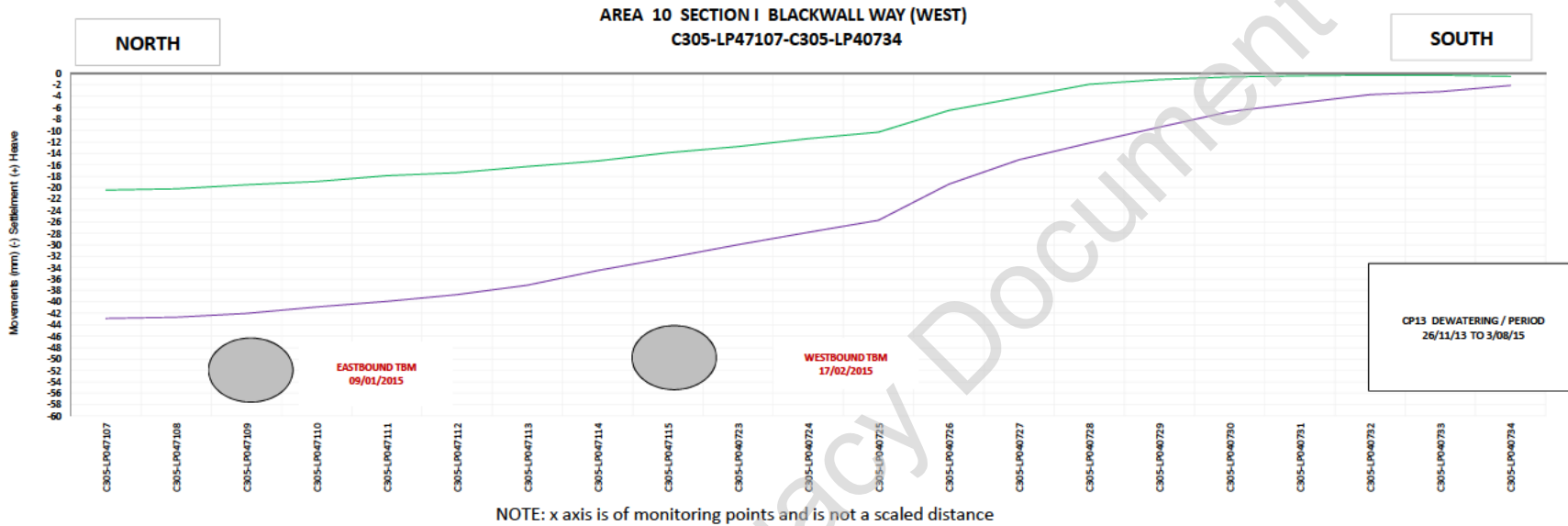
— 19/05/2013      AFTER TBMs TRANSIT  
— 05/11/2015      AFTER CP13 DEWATERING



TRANSECT	ALERT VALUE	AMBER TRIGGER VALUE	MAX DEFLECTION RATIO	
			TBMs Passage	After CP13
Preston Rd	1/2600 1/2700 1/4400 1/5800	-	1/19296	1/22502

— 30/05/13 AFTER TBMs TRANSIT  
— 12/06/14 AFTER CP13 DEWATERING

**NOTE:**  
 RFI 266-1 refer to section C305-LP041101-C305-LP041135.  
 However, instead the deflection shown adobe presents data for the section C305-LP041101-C305-LP041126  
 This points were used to monitored for CP13 works, following Action plan instructions and presented in daily CTC/SRG meetings.



TRANSECT	ALERT VALUE	MAX DEFLECTION RATIO	
		TBMs Passage	After CP13
BLACKWALL WAY (WEST)	1/2000	1/6382	1/7317

— 20/11/13 AFTER TBMs TRANSIT  
— 02/11/15 AFTER CP 13 DEWATERING

**NOTE:**

RFI 266-1 refer to section C305-LP040701-C305-LP040734.  
 However the C305-LP040701-C305-LP040721 were damaged, instead the deflection shown above presents data for the section C305-LP47107-C305-LP47115 & C305-LP040723-C305-LP040734.  
 This section was used to monitored for CP13 works and presented in daily CTC/SRG meetings.

**DEFLECTION RATIO NO REQUESTED**

Loc.	Sub-location	SAI Area	Road	Maximum Recorded movement (+/-mm)	Relevant I&M		Water Mains	Sewers	Comment
					Levelling Points	Shallow Datums	Spec Deflection Ratio; 1 in X	Spec Deflection Ratio; 1 in X	
Y	LIM-CWS	4	Prestons Road	-30	LP041719 – 041701	-	2700	4400	Agreed in Area 3 monitoring review meeting, 02/03/16, to use LP041101 series to check deflection ratios for Preston Road.

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