



C305 – Eastern Running Tunnels

I&M Close Out Report for instrumentation from Liverpool Street to Farringdon (including Barbican Centre) – (Drive Y)

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Stakeholder submission required: LU NR DLR R/L LO Other: _____ Purpose of submission: For no objection For information

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Sign: _____ Role: _____ Name: _____ Date: _____
 Sign: _____ Role: _____ Name: _____ Date: _____

2b. Review by Stakeholder (if required):

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

3. Acceptance by Crossrail:

Crossrail Review and Acceptance Decal	
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<input type="checkbox"/>	Code 3. Not Accepted. Revise and resubmit. Work may not proceed
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Reviewed/Accepted by: (signature)	Print Name: _____ Position: _____ Date: <u>20/5/16</u>
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I&M Close Out Report for instrumentation from Liverpool Street to Farringdon (including Barbican Centre) – (Drive Y)				
<i>C305 Crossrail Eastern Running Tunnels</i>				
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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 summarize the data from the instrumentation included in this document and to relate the any recorded ground movements to the construction activities and dewatering of cross passage 5a (CP5a). The construction activities include excavation of the C305 twin bored tunnels and construction of Cross-Passage 5a (including excavation and depressurization); impacts from other CRL contracts are not included in this report.

Apart from post-dewatering and Cross passage monitoring for CP5a, the long term readings included in this report do not cover the specified full monitoring period of 12 months as the contractor was instructed to stop all long term monitoring post TBM transit and Crossrail has informed DSJV that the long term monitoring will be undertaken by satellite radar interferometry (see PMI C305_PMI_1087).

2. LOCATION OF THE WORKS

The instrumentation included in this report is located within Area 12, Liverpool Street Station to Farringdon Station, between project chainage 77350 and 76590.

See Appendix A for the instrument location.

3. DOCUMENTATION SUMMARY

CROSSRAIL NUMBER	DOCUMENT NAME	REASON FOR ISSUE
C305-DSJ-C2-RGN-CRG03-50176	I&M Installation Report for Liverpool Street to Farringdon (including Barbican Centre) - Drive Y	Installation report
C305-DSJ-C2-RGN-CRG03-50407	I & M Installation Report for CP13 CP14 & CP5 Piezometers (Drive Y)	Installation report

4. SUMMARY OF INSTALLED INSTRUMENTATION ON SITE

The total number of instruments installed was:

- 215 – Levelling points
- 096 – Sockets
- 017 – 3D Prisms
- 003 – Piezometers

See Appendix B for further information of the installed instrumentation.

The average commissioning readings included in Appendix B have been used to calculate the relative movements provided in the graphs of this report.

5. CONSTRUCTION ACTIVITY

TBM PASSAGE

DRIVE Y	RINGS	PROJECT CHAINAGE	DATES
Eastbound	3911 – 4369	76590 – 77330	07/04/2015 to 11/05/2015
Westbound	4013 – 4477	76590 – 77350	13/04/2015 to 26/05/2015

Stoppage period

Westbound Drive-Y	Ring 4017 (Project chainage 77320)	14/04/2015 to 16/04/2015
	Ring 4020 (Project chainage 77320)	16/04/2015 to 18/04/2015
	Ring 4475 (Project chainage 76600)	23/05/2015 to 25/05/2015

The periods of TBM passage and stoppage are related to the rings located close to the instrumentation included in this close out report.

CP5a DEPRESSURISATION

From 1st September 2015 to 3rd December 2015

CP5a CONSTRUCTION

From 5th October 2015 to 11th November 2015

CP5a SUMP CONSTRUCTION

From 15th November 2015 to 30th November 2015

6. METHODOLOGY

To determine the settlement rate following methodology has been used. A Linear Regression has been applied for a defined period using. 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

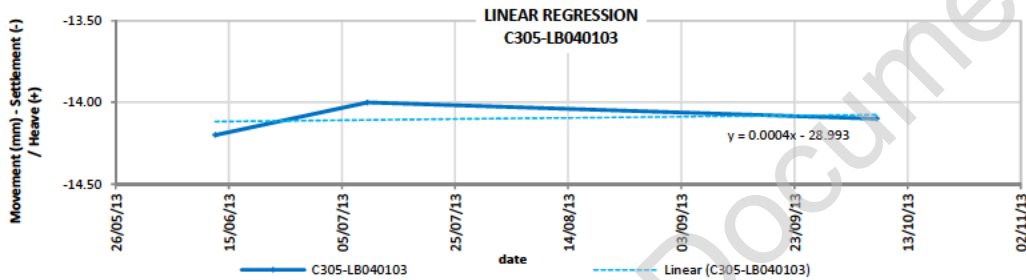
Y (dependent variable) = vertical movement

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/year will be used to determine the trend of the section/area being considered. Also for comparison, values at or below 3 mm/year are presented to highlight that the rate is close to achieving the 2 mm/year. 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

The methodology described for sockets in section 6 also applies for leveling points close to crosspassage CP5a area.

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).

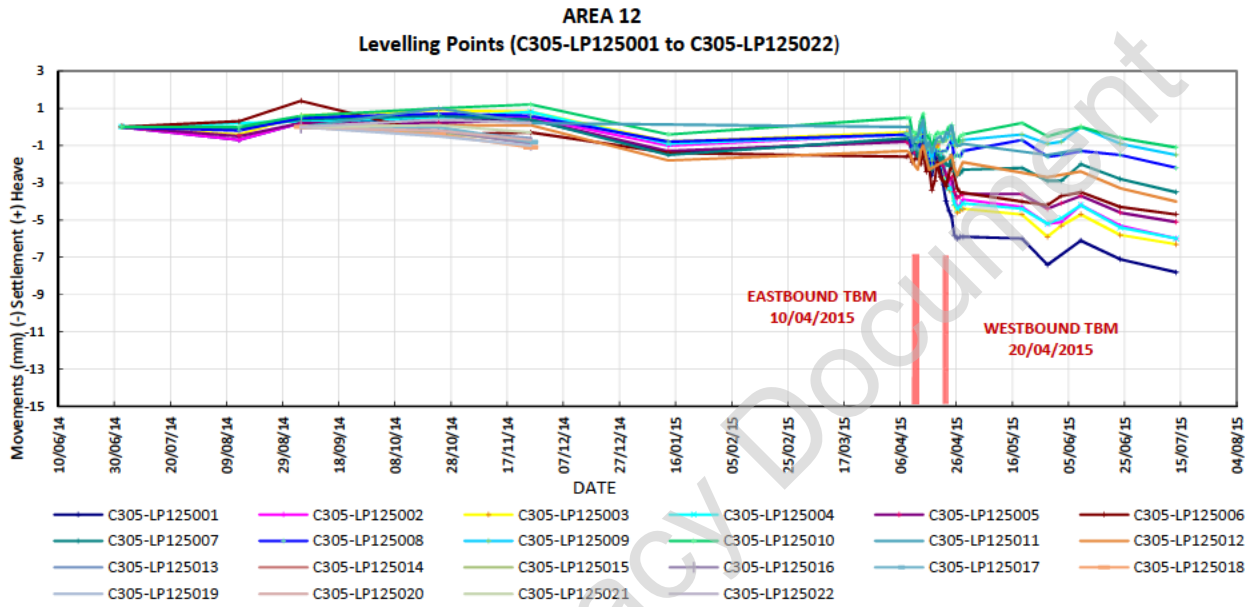
As described in the C122 I&M Plan (C122-OVE-C2-RGN-CRG01-50070), for levelling points situated in the vicinity of 3rd party utility assets, deflection ratio values are provided in appendix #.

Learning Legacy Document

LEVELLING POINTS

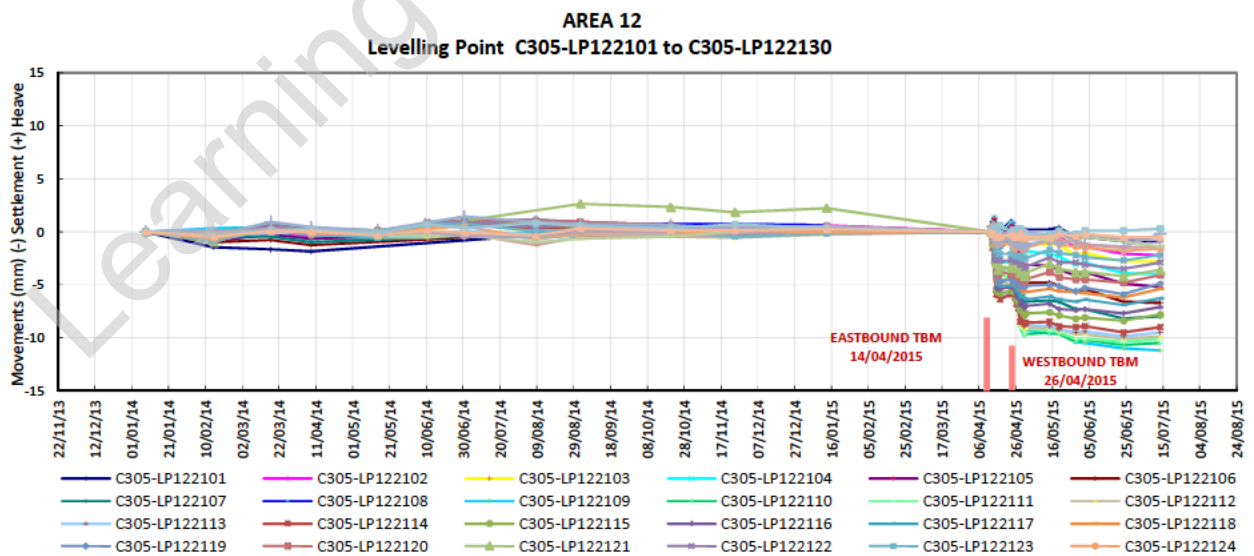
C305-LP125001 to C305-LP125022

The graph below presents the levelling point readings from this array and shows a settlement of -3.8 mm after the eastbound TBM transit and a total maximum settlement of -7.8 mm after westbound TBM transit.

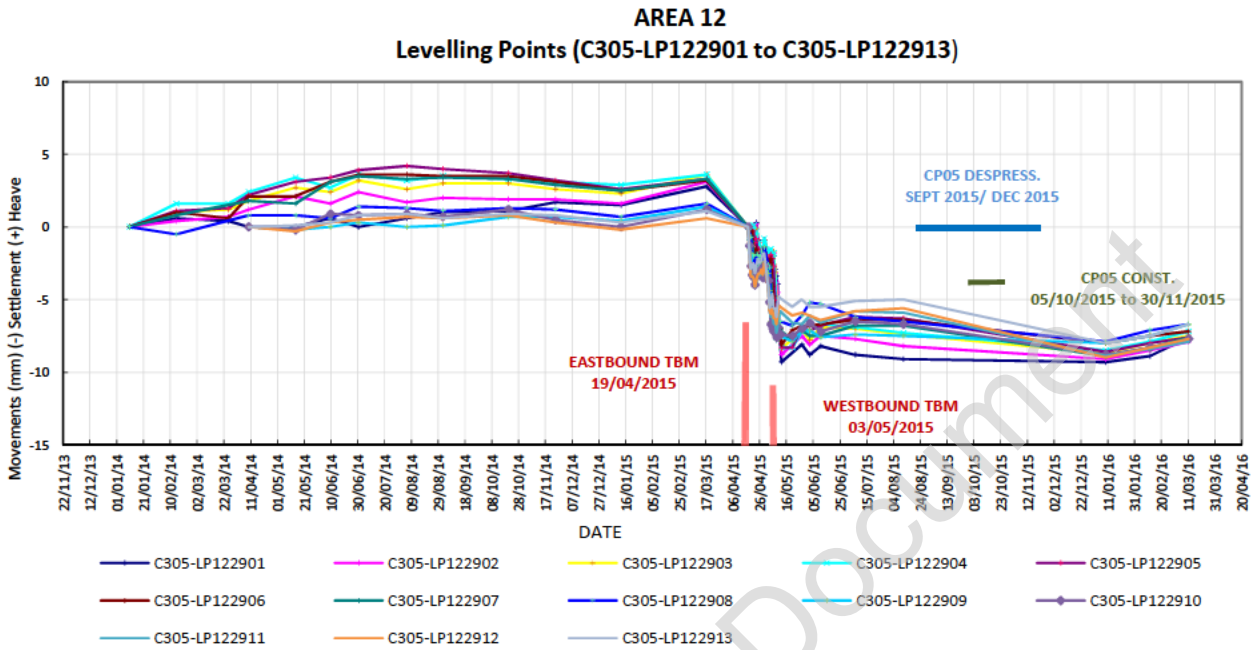


C305-LP122101 to C305-LP122130

The graph below presents the levelling point readings from this array and shows a settlement of -6.4 mm after the eastbound TBM transit and a total maximum settlement of -7.8 mm after westbound TBM transit.

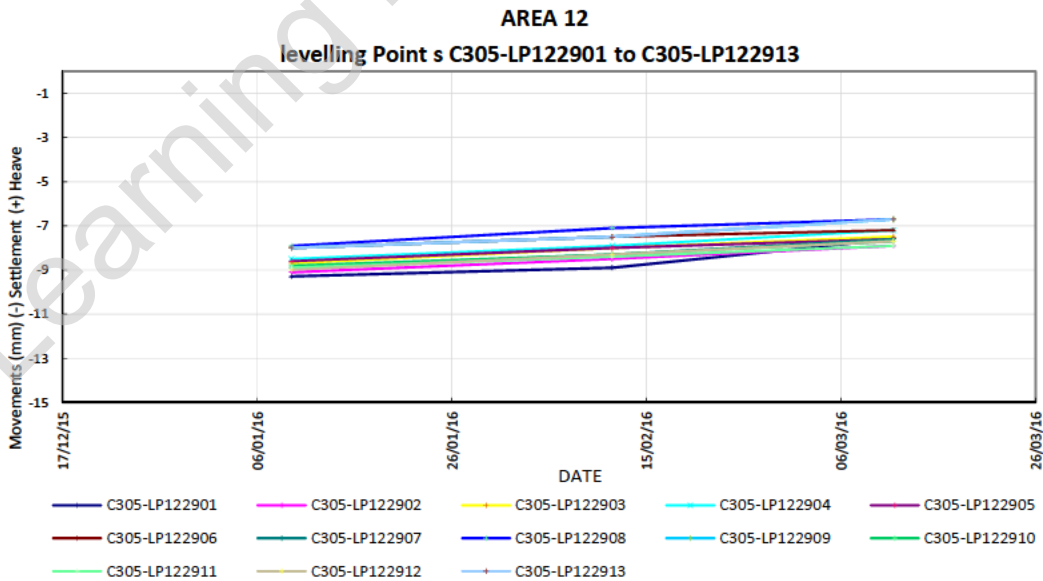


C305-LP122901 to C305-LP122913



The graph above presents the levelling point readings from this array and shows a settlement of -4.1 mm after the eastbound TBM transit and a maximum settlement of -9.3 mm after westbound TBM transit.

This instrument array includes the monitoring period for CP5a, and the plot below shows the trend line adjustment for each levelling point:



The table below lists the annual settlement rate for each levelling of the points:

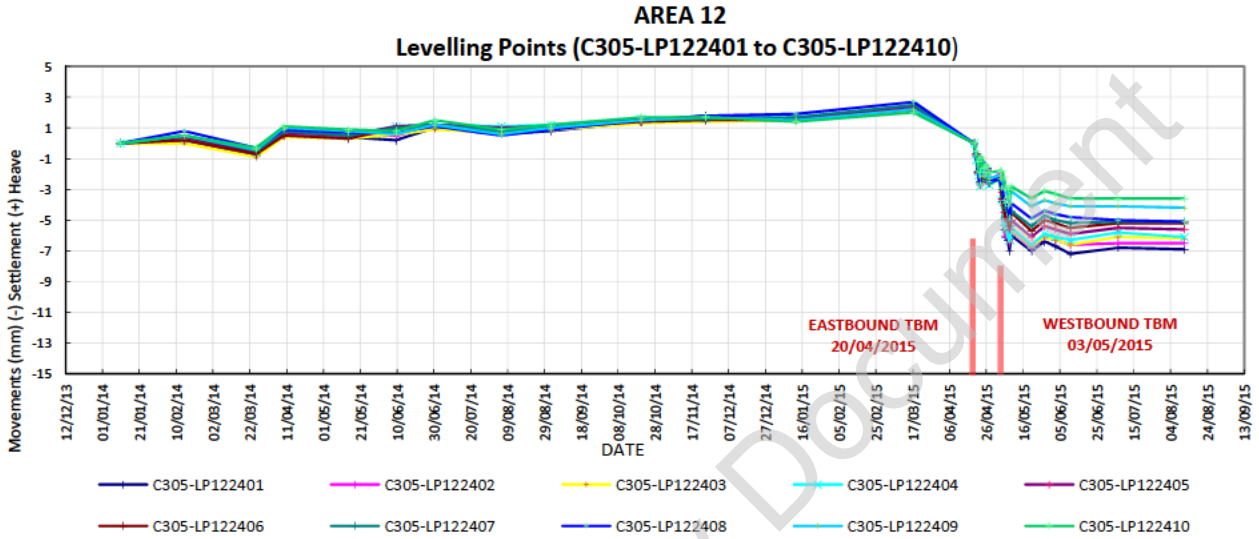
	Registered movement (mm)			mm/year
	09/01/2016	11/02/2016	11/03/2016	
C305-LP122901	-9.30	-8.90	-7.60	9.891
C305-LP122902	-9.10	-8.50	-7.90	7.064
C305-LP122903	-8.70	-8.00	-7.50	7.090
C305-LP122904	-8.50	-7.90	-7.20	7.639
C305-LP122905	-8.60	-8.00	-7.60	5.912
C305-LP122906	-8.00	-7.50	-7.20	4.735
C305-LP122907	-8.90	-8.30	-7.60	7.639
C305-LP122908	-7.90	-7.10	-6.70	7.116
C305-LP122909	-8.00	-7.50	-6.70	7.614
C305-LP122910	-8.80	-8.30	-7.70	6.462
C305-LP122911	-8.90	-8.40	-7.90	5.886
C305-LP122912	-9.00	-8.30	-7.70	7.665
C305-LP122913	-8.00	-7.50	-6.70	7.614
	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
 #N/A: No readings

The table above shows that all levelling points are showing heave (+values) and the percentage of levelling points with a settlement rate less than 2 mm/year is 100%.

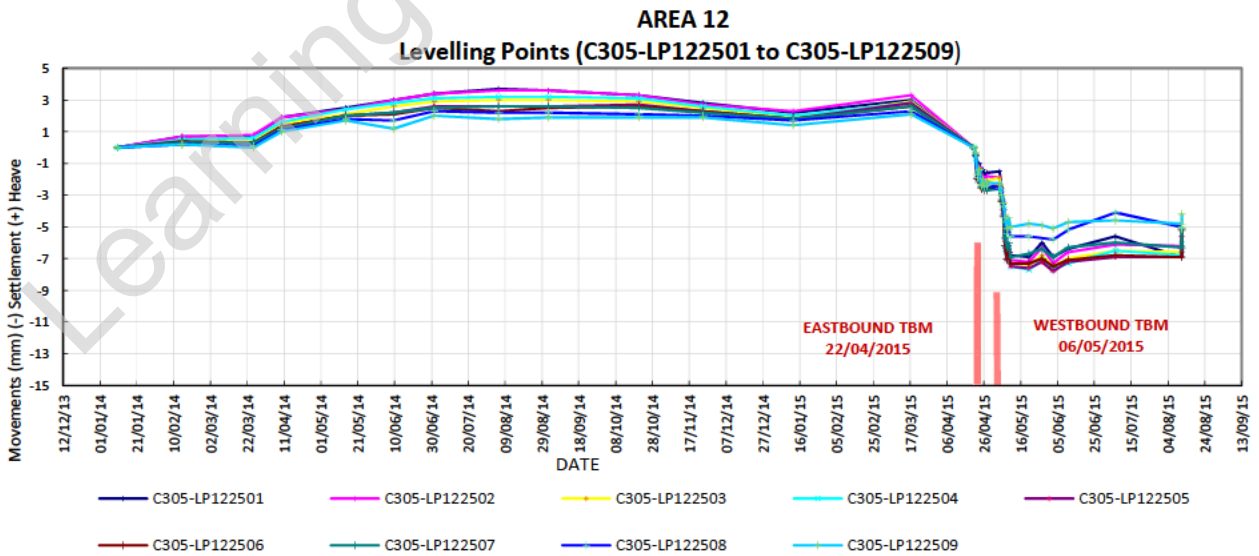
C305-LP122401 to C305-LP122410

The graph below shows there was a settlement of -2.8 mm after the eastbound TBM transit and a total maximum settlement of -7.2 mm after westbound TBM transit.



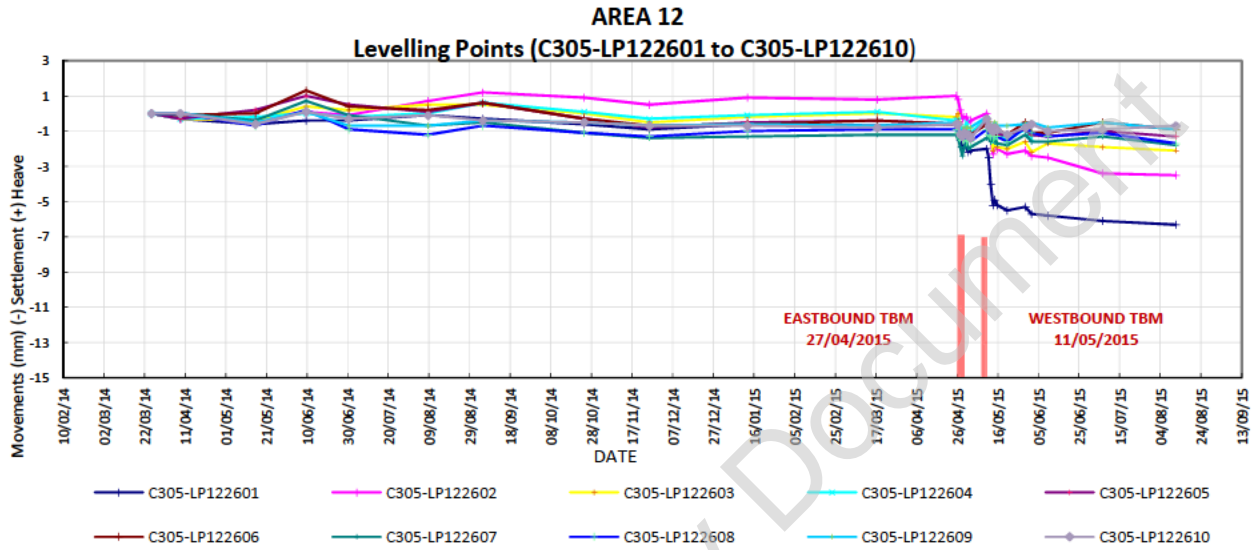
C305-LP122501 to C305-LP122509

The graph below shows there was a settlement of -2.5 mm after the eastbound TBM transit and a total maximum settlement of -7.8 mm after westbound TBM transit.



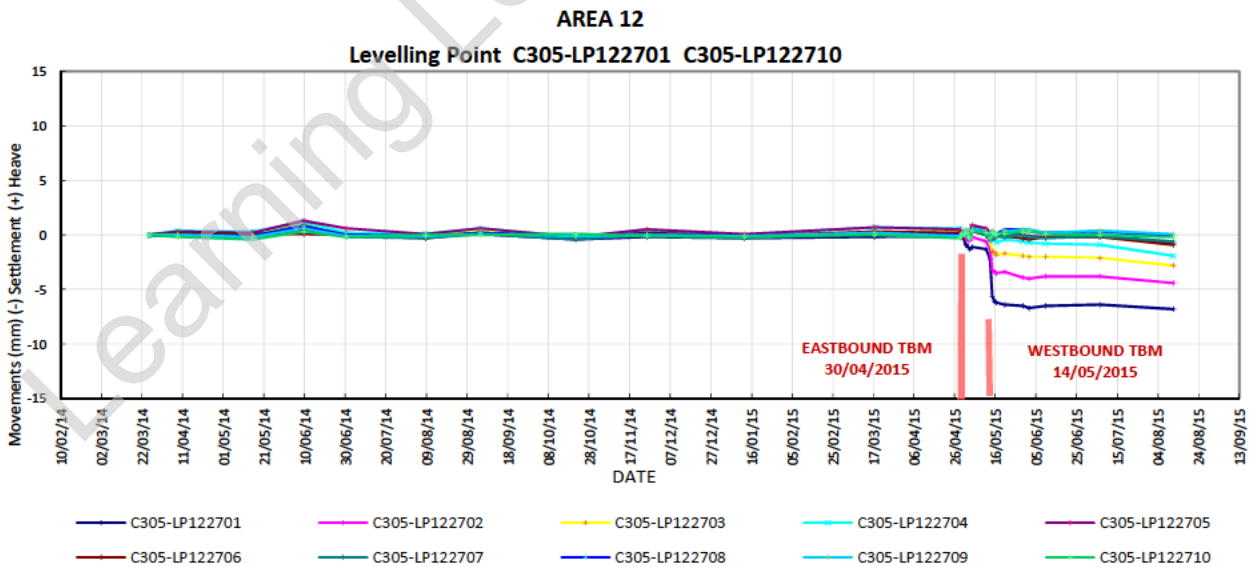
C305-LP122601 to C305-LP122610

The graph below shows there was a settlement of -2.4 mm after the eastbound TBM transit and a total maximum settlement of -6.3 mm after westbound TBM transit.



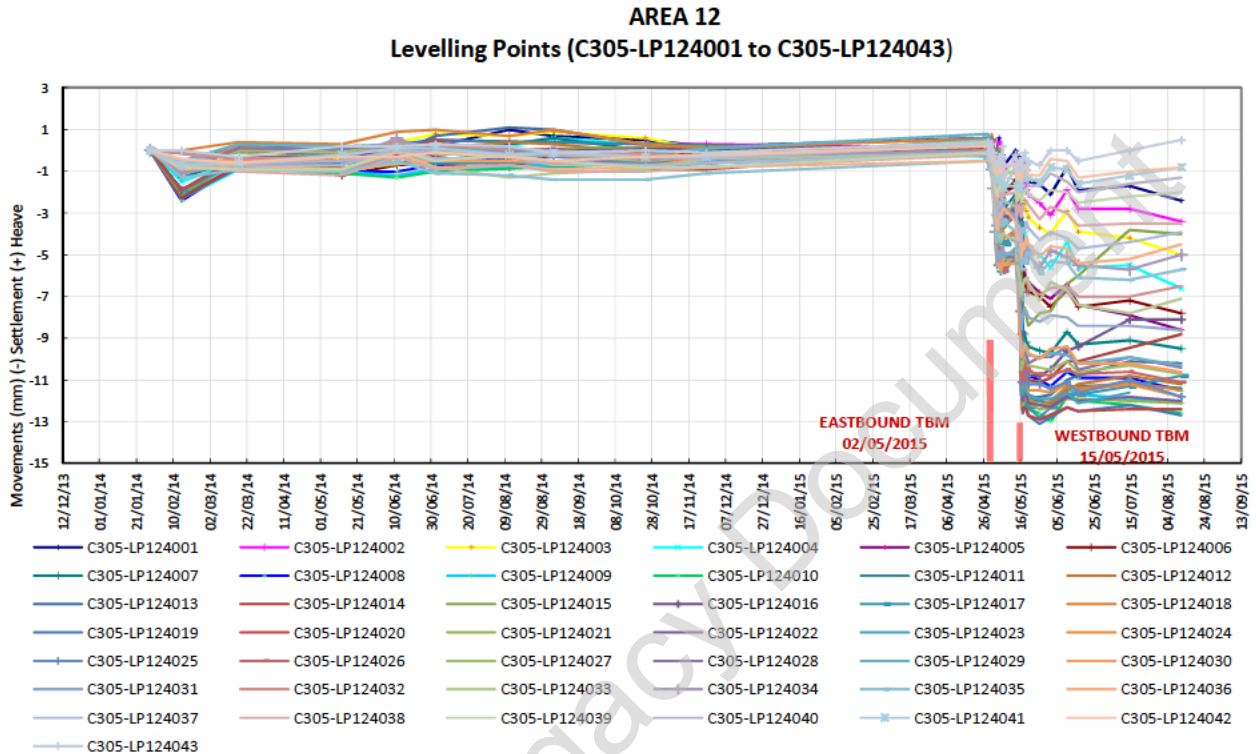
C305-LP122701 to C305-LP122710

The graph below shows there was a settlement of -1.3 mm after the eastbound TBM transit and a total maximum settlement of -6.7 mm after westbound TBM transit.



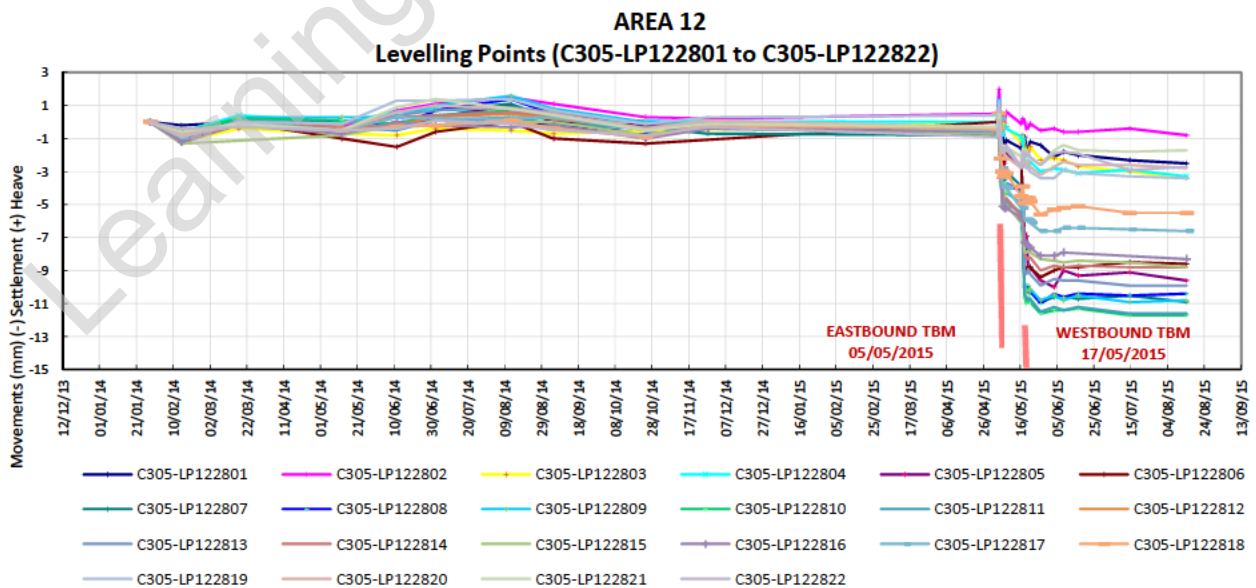
C305-LP124001 to C305-LP124043

The graph below shows there was a settlement of -5.7 mm after the eastbound TBM transit and a total maximum settlement of -13.1 mm after westbound TBM transit.



C305-LP122801 to C305-LP122822

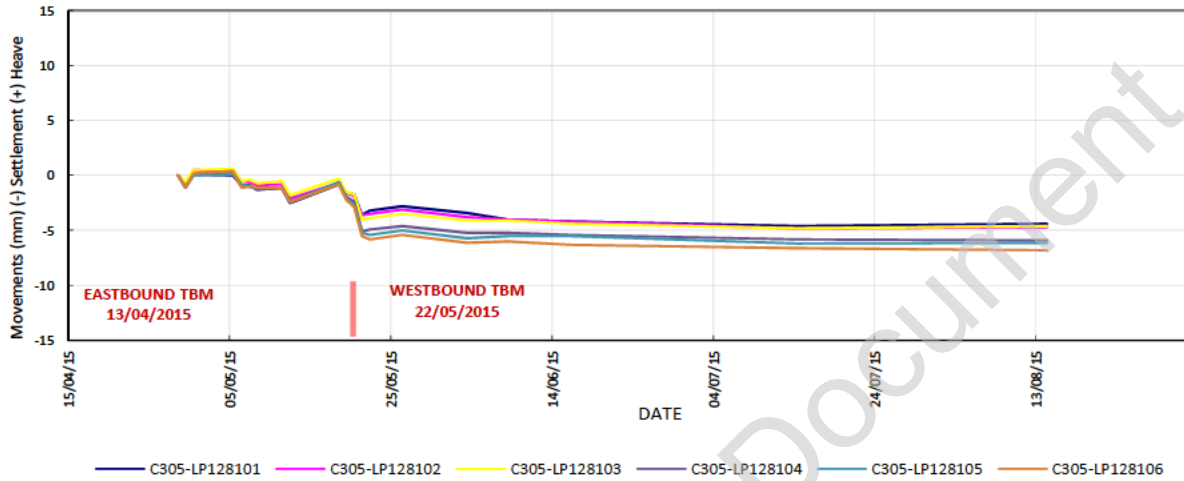
The graph below shows there was a settlement of -5.2 mm after the eastbound TBM transit and a total maximum settlement of -11.6 mm after westbound TBM transit.



C305-LP128101, C305-LP128102, C305-LP128103, C305-LP128104, C305-LP128105 and C305-LP128106

The graph below shows a maximum settlement of -6.8 mm after westbound TBM transit. NOTE: No readings were taken during eastbound TBM passage due to restricted access to this area.

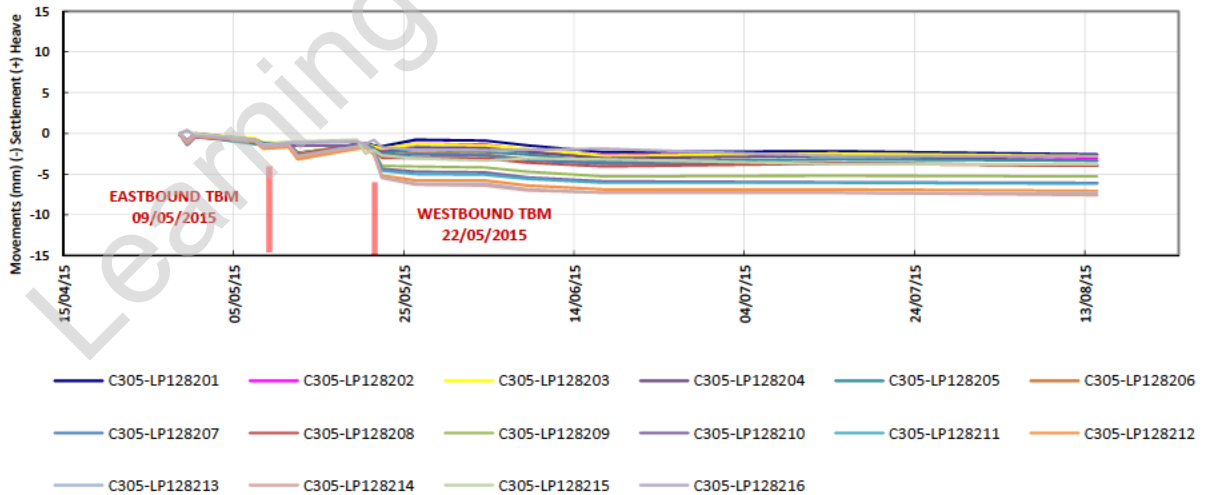
C305-LP128101 to C305-LP128106



C305-LP128201 to C305-LP128216

The graph below shows a maximum settlement of -2.9 mm after eastbound TBM transit, and a total maximum settlement of -7.6 mm after the westbound TBM transit.

C305-LP128201 to C305-LP128216

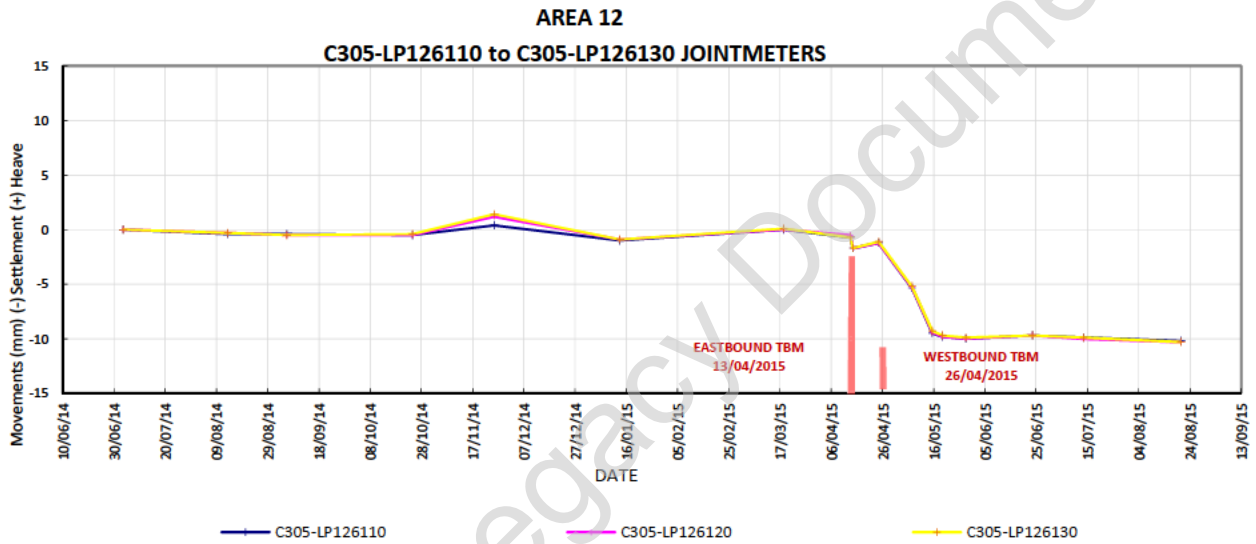


MOOR LANE STREET BRIDGE JOINTMETERS

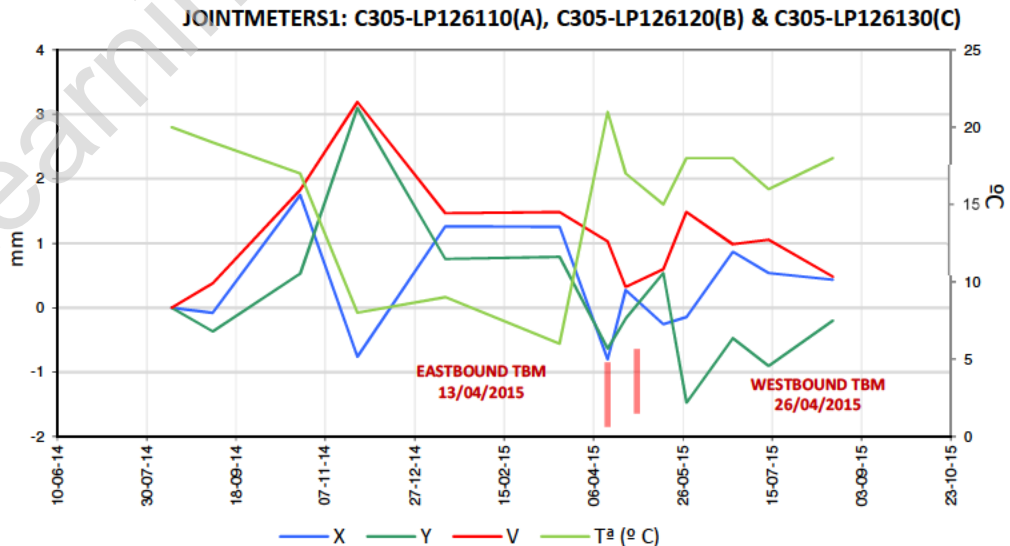
Jointmeters are designed to measure displacements across joints typically in buildings, bridges, dams, pipelines and rock formations and are available for measuring movement along and perpendicular to the joint. In this case three levelling points have been used as a jointmeter, taking readings from their relative displacements between them (X and Y axis), and also from their vertical movement (settlement / heave, Z axis).

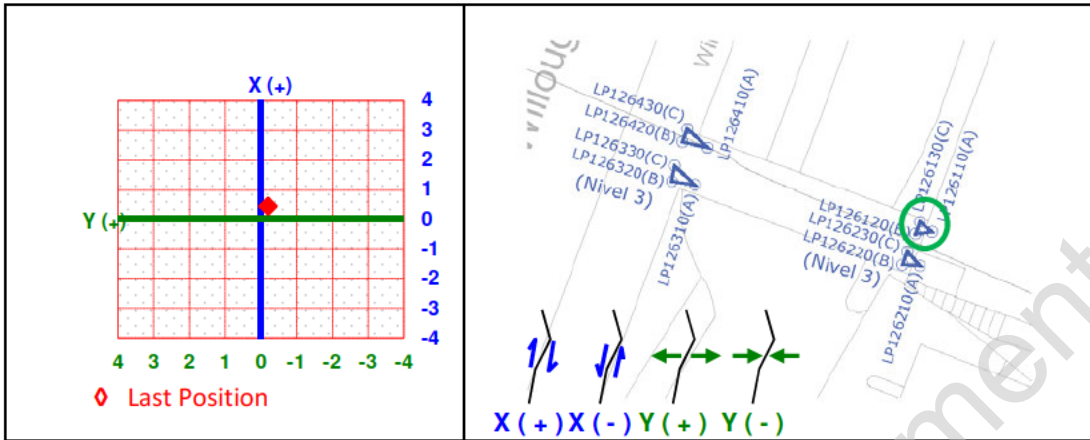
C305-LP126110, C305-LP126120 and C305-LP126130

The graph below shows a maximum settlement of -1.7 mm after eastbound TBM transit, and a total maximum settlement of -9.9 mm after the westbound TBM transit.



The graph presented below shows time/movements in the X axis & Y axis; V vector of movements and temperature °C:





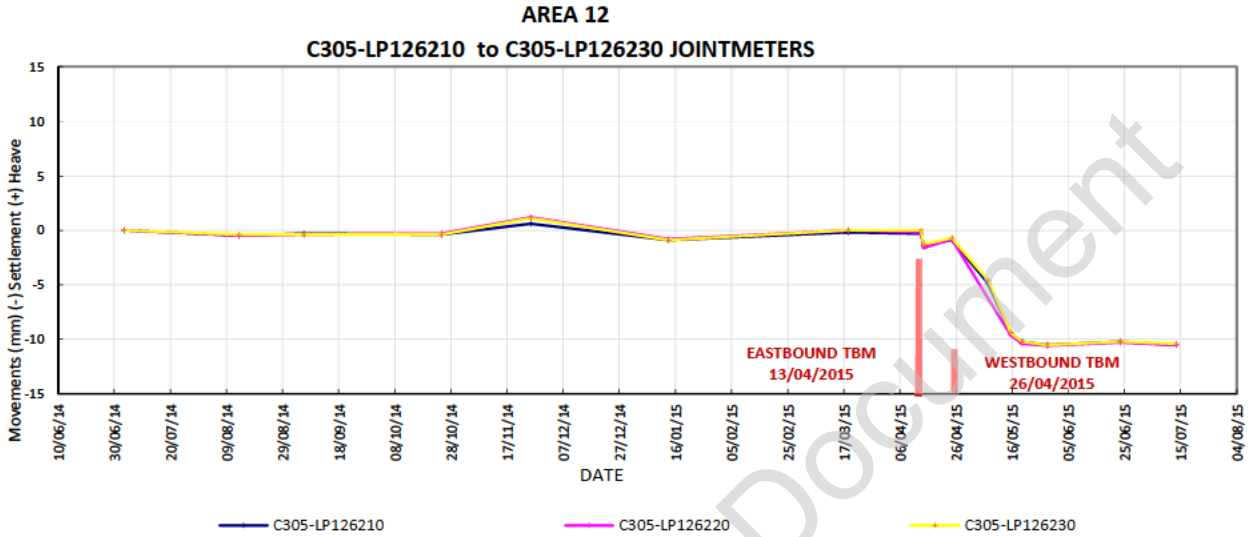
The diagram on the left above shows the last position of the jointmeter (red dot). See above X/Y values of the last position of the jointmeter (red dot)

LAST VALUE (mm)			
X	Y	V	DATE
+0.43	-0.20	0.48	18/08/2015

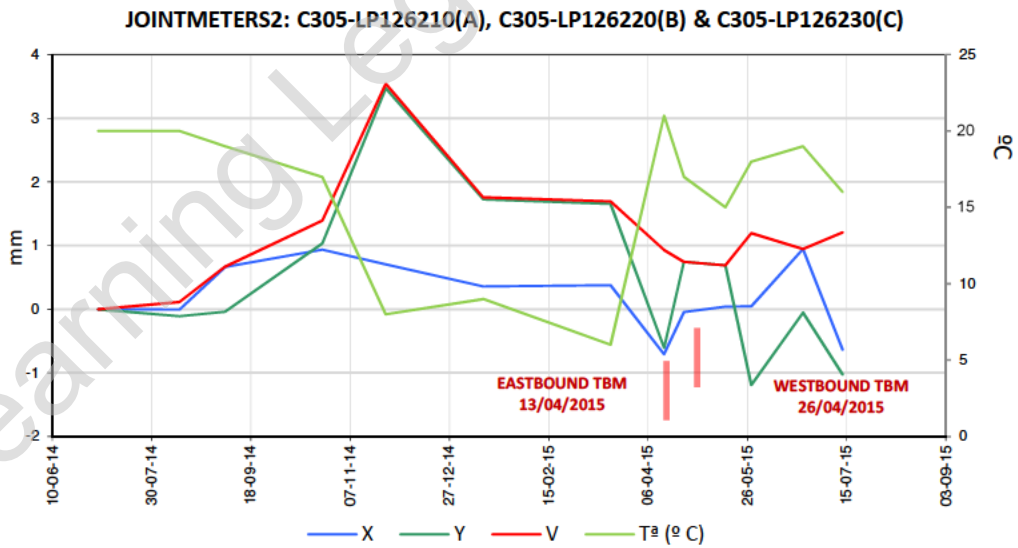
The right plot above shows the location of the jointmeter and the axis sign criteria.

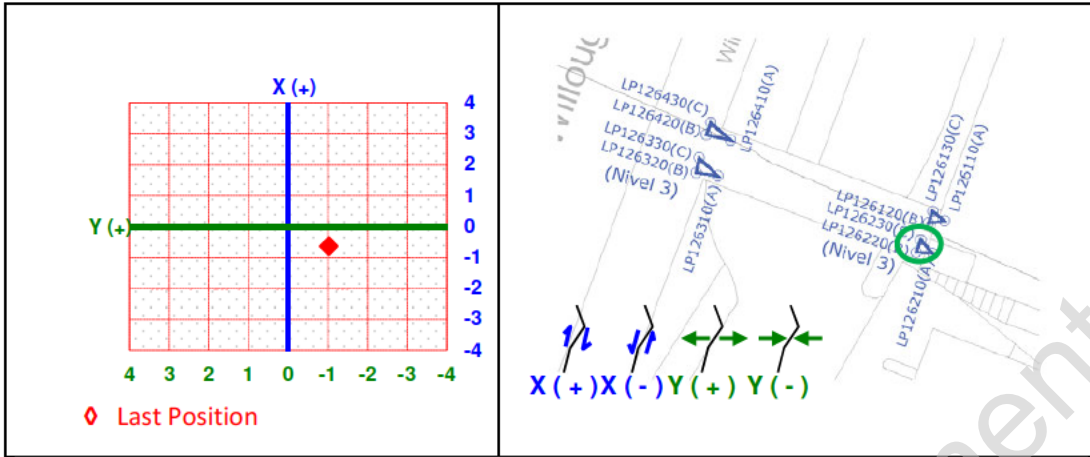
C305-LP126210, C305-LP126220 and C305-LP126230 JOINTMETERS

The graph below shows a maximum settlement of -1.3 mm after eastbound TBM transit, and a total maximum settlement of -10.2 mm after the westbound TBM transit.



The graph presented below shows time/movements in the X axis & Y axis; V vector of movements and temperature °C:





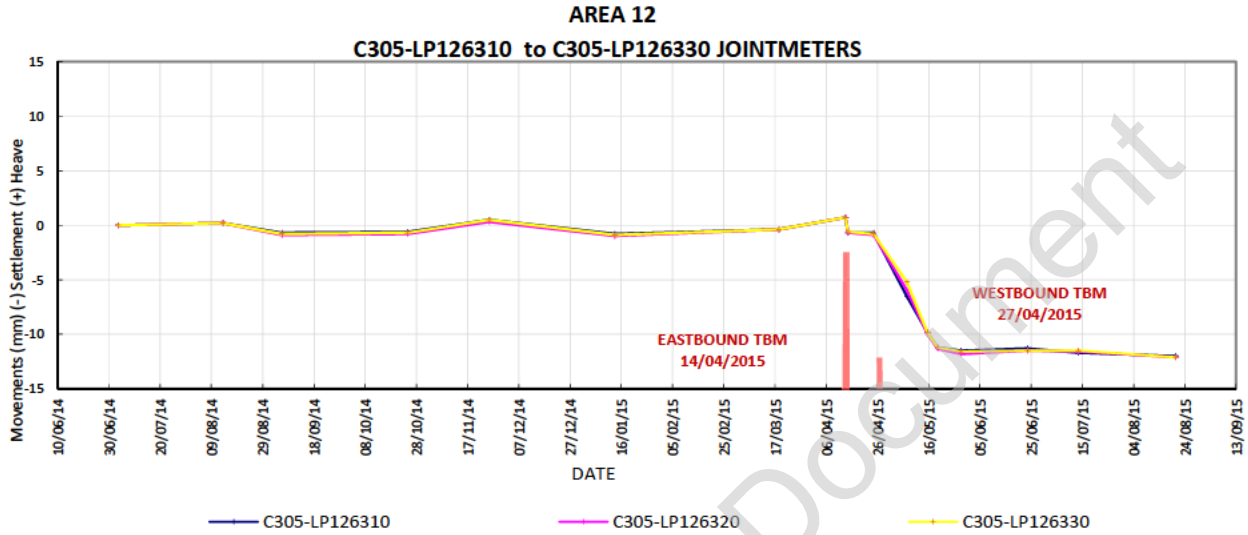
The diagram on the left above shows the last position of the jointmeter (red dot). See below X/Y values of the last position of the jointmeter (red dot)

LAST VALUE (mm)			
X	Y	V	DATE
-0.64	-1.03	1.21	13/07/2015

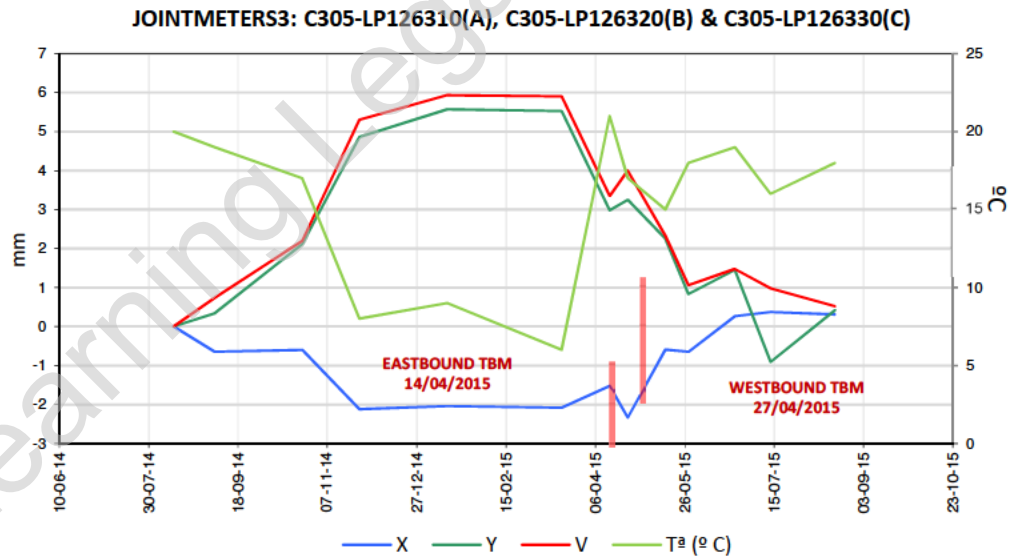
The right plot above shows the location of the jointmeter and the axis sign criteria.

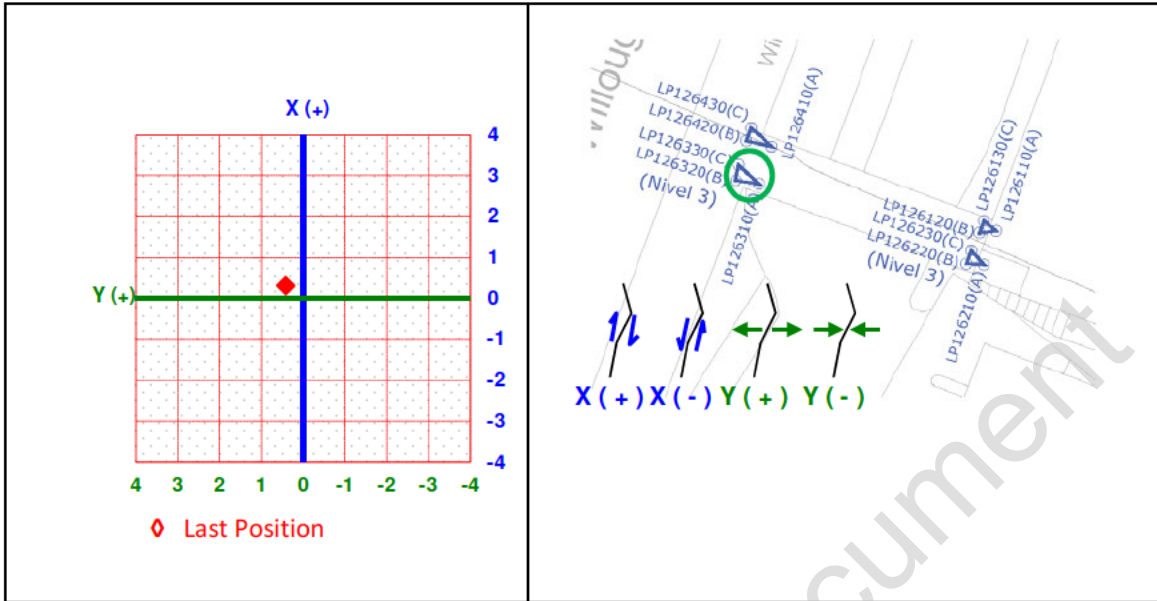
C305-LP126310, C305-LP126320 and C305-LP126330 JOINTMETERS

The graph below shows a maximum settlement of -0.8 mm after eastbound TBM transit, and a total maximum settlement of -11.6 mm after the westbound TBM transit.



The graph presented below shows time/movements in the X axis & Y axis; V vector of movements and temperature °C:





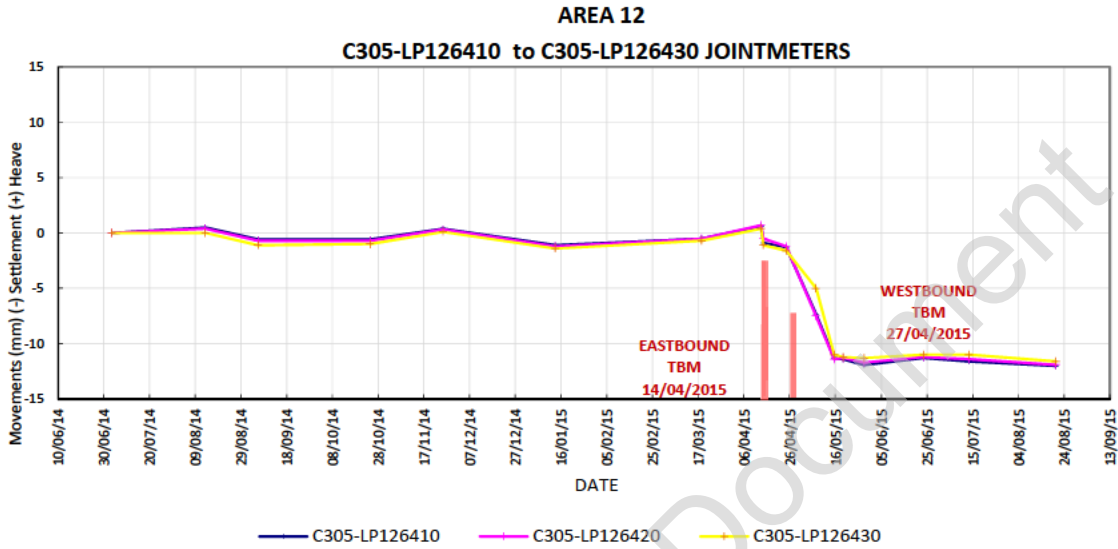
The diagram on the left above shows the last position of the jointmeter (red dot). See below X/Y values of the last position of the jointmeter (red dot)

LAST VALUE (mm)			
X	Y	V	DATE
+0.31	+0.41	0.52	18/08/2015

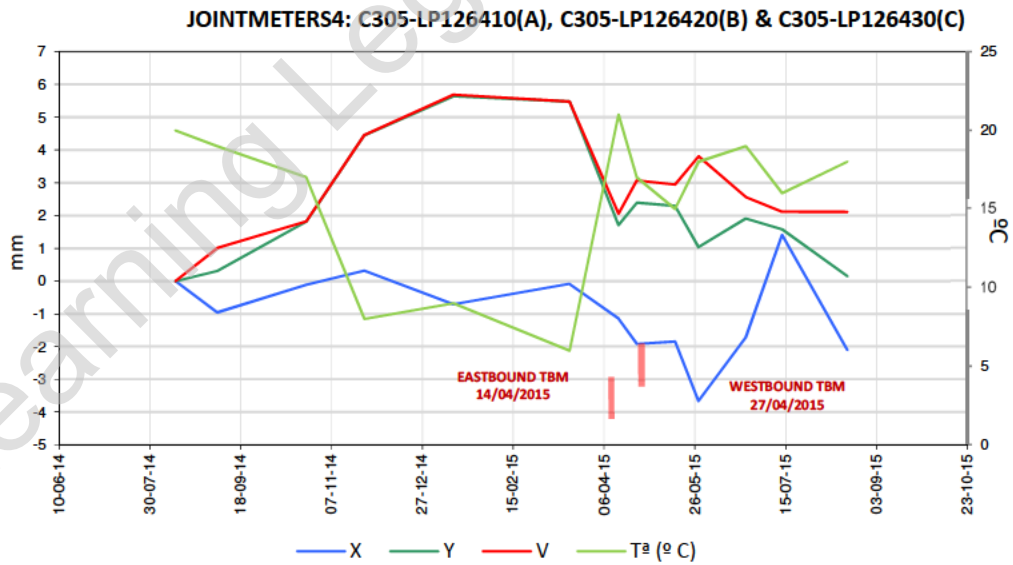
The right plot above shows the location of the jointmeter and the axis sign criteria.

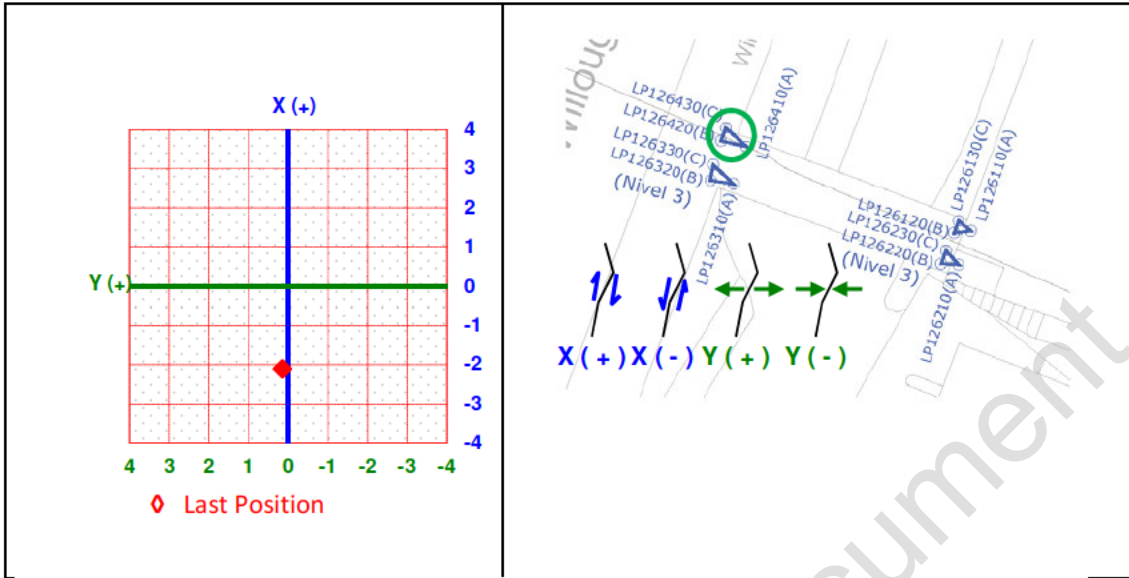
C305-LP126410, C305-LP126420 and C305-LP126430 JOINTMETERS

The graph below shows a maximum settlement of -1.1 mm after eastbound TBM transit, and a total maximum settlement of -11.7 mm after the westbound TBM transit.



The graph presented below shows time/movements in the X axis & Y axis; V vector of movements and temperature °C:





The diagram on the left above shows the last position of the jointmeter (red dot). See below X/Y values of the last position of the jointmeter (red dot)

LAST VALUE (mm)			
X	Y	V	DATE
-2.11	+0.14	2.11	18/08/2015

The right plot above shows the location of the jointmeter and the axis sign criteria.

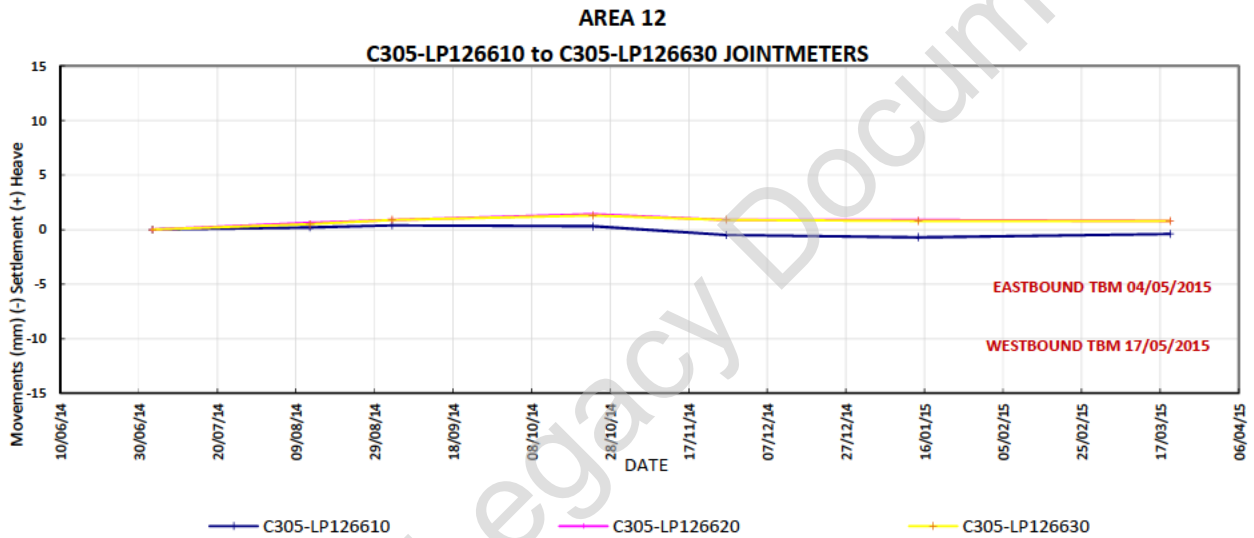
ALDRSGATE STREET BRIDGE JOINTMETERS

C305-LP126510, C305-LP126520 and C305-LP126530 JOINTMETERS

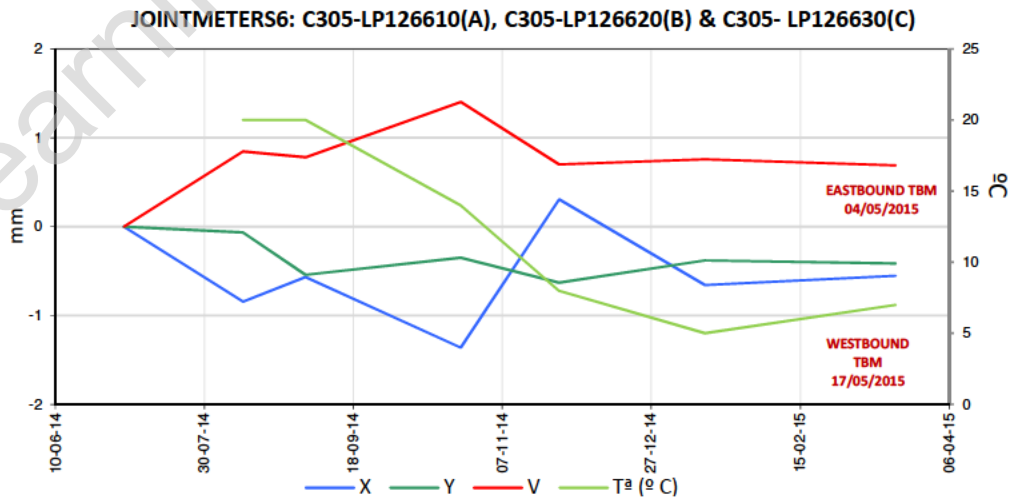
Due refurbishment works on the bridge those three points were covered with tiles before TBMs transit. Monitoring works could not be making in these points. In order to control ALDRSGATE STREET BRIDGE a group of prisms (C305-RP125201 to C305-RP125204) were installed and monitored during TBMs passage.

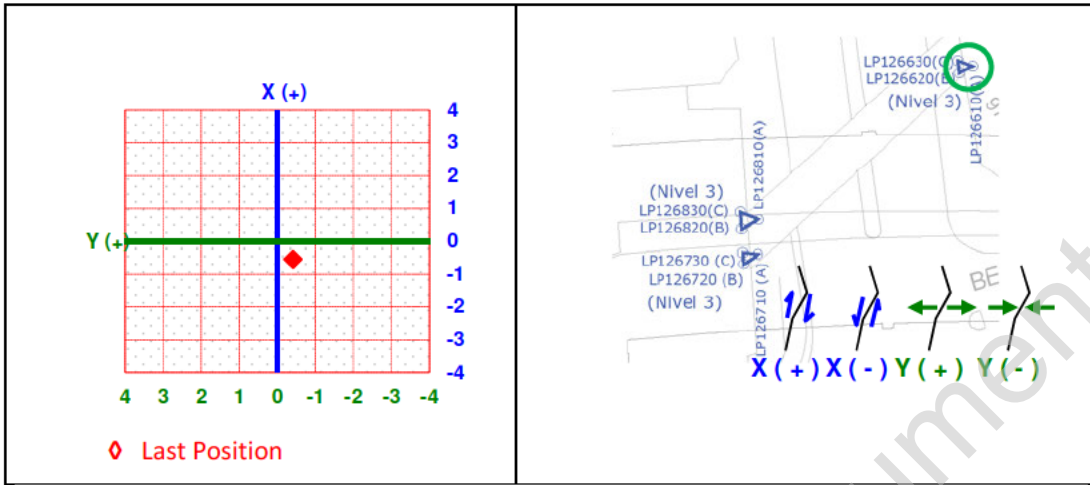
C305-LP126610, C305-LP126620 and C305-LP126630 JOINTMETERS

The graph below shows a maximum settlement of -0.5 mm in the period before the transit of the TBMs. No further readings were possible due to the jointmeters being damaged.



The graph presented below shows time/movements in the X axis & Y axis; V vector of movements and temperature °C:

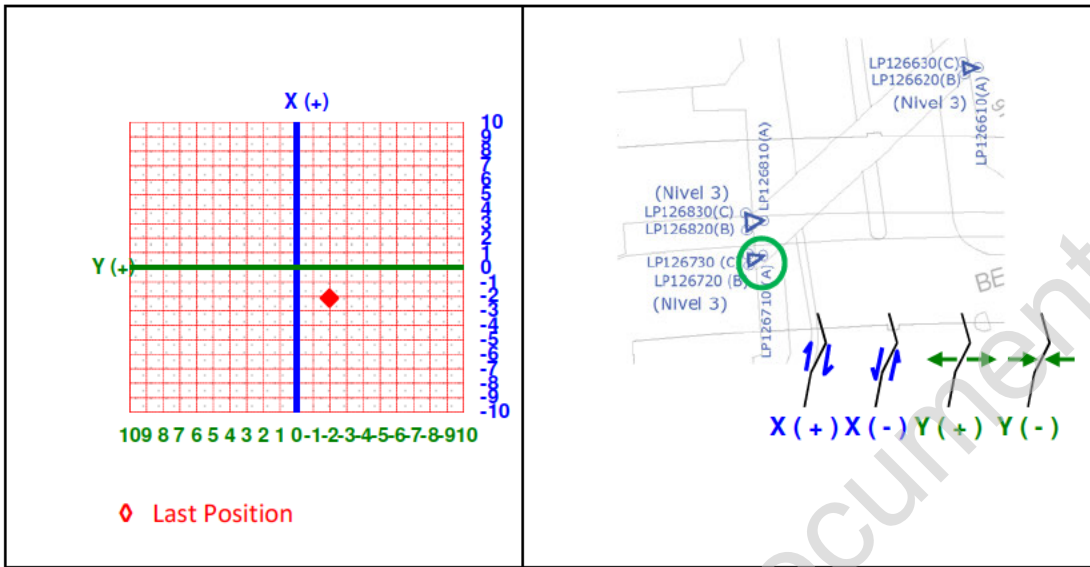




The diagram on the left above shows the last position of the jointmeter (red dot). See below X/Y values of the last position of the jointmeter (red dot)

LAST VALUE (mm)			
X	Y	V	DATE
-0.55	-0.41	0.69	19/03/2015

The right plot above shows the location of the jointmeter and the axis sign criteria.



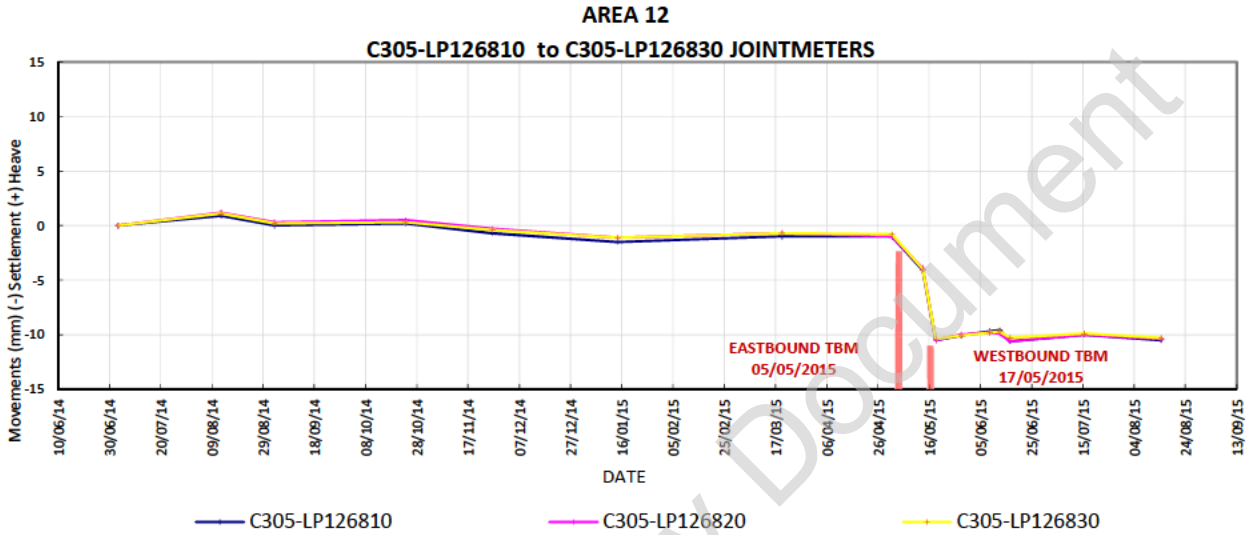
The diagram on the left above shows the last position of the jointmeter (red dot). See below X/Y values of the last position of the jointmeter (red dot)

LAST VALUE (mm)			
X	Y	V	DATE
-2.14	-1.96	2.90	18/08/2015

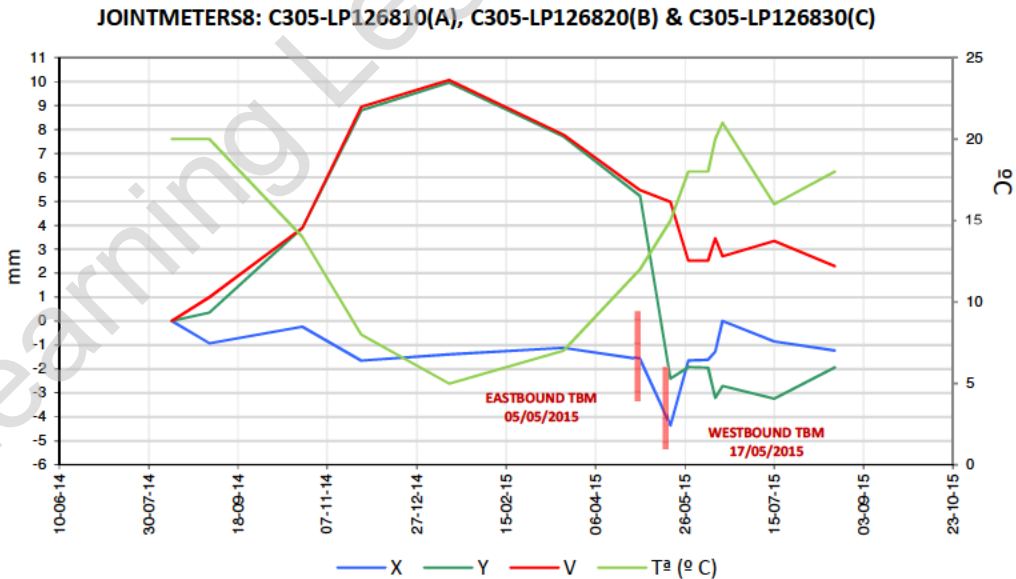
The right plot above shows the location of the jointmeter and the axis sign criteria.

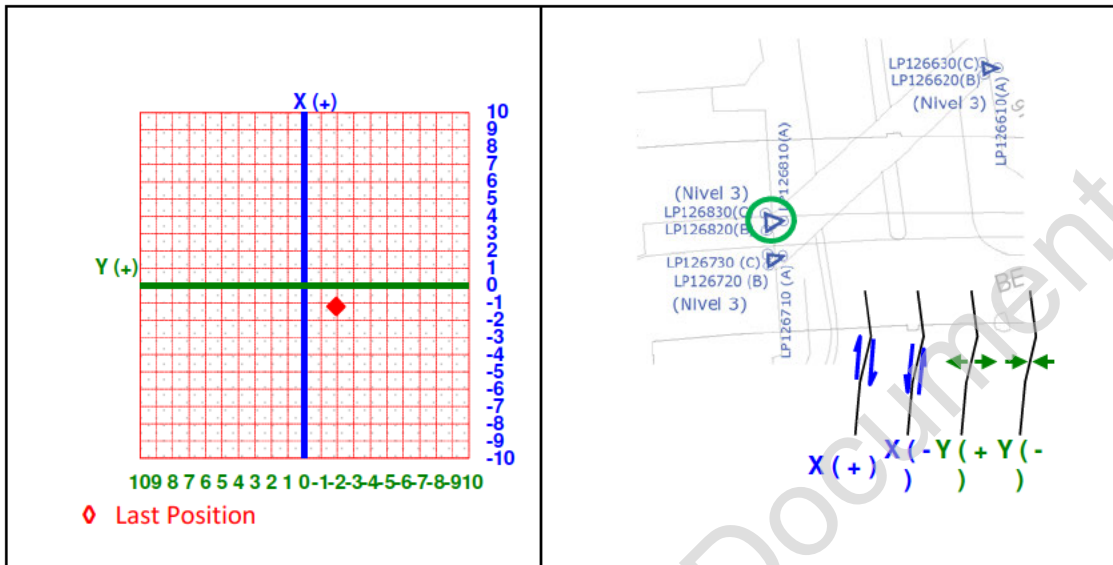
C305-LP126810, C305-LP126820 and C305-LP126830 JOINTMETERS

The graph below shows a total maximum settlement of -10.6 mm after the eastbound and westbound TBM transit.



The graph presented below shows time/movements in the X axis & Y axis; V vector of movements and temperature °C:





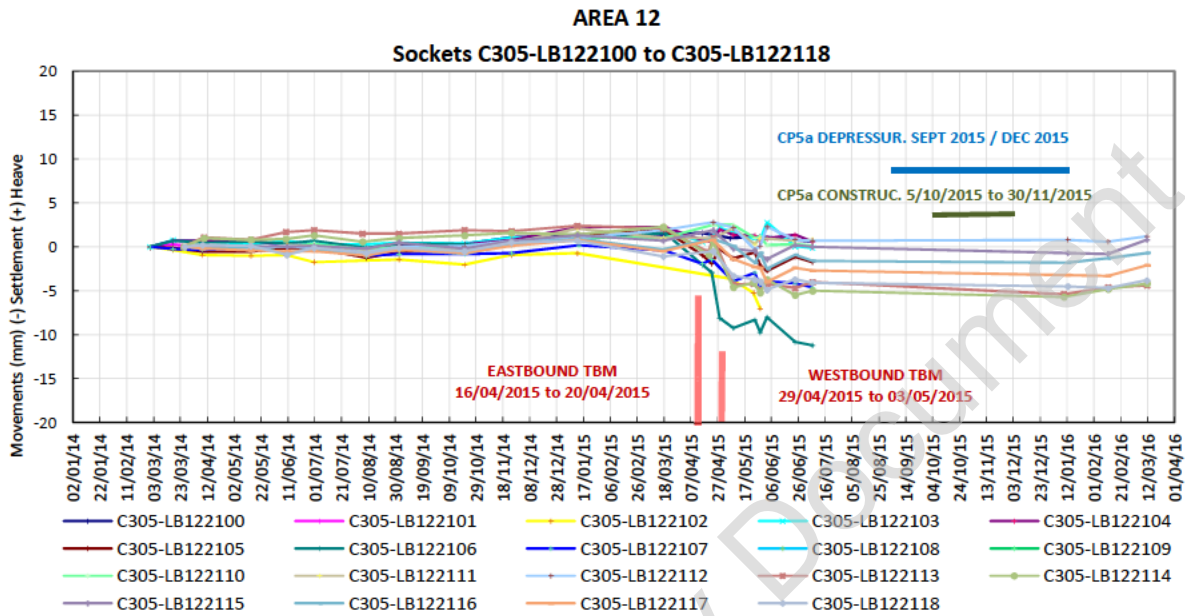
The diagram on the left above shows the last position of the jointmeter (red dot). See below X/Y values of the last position of the jointmeter (red dot)

LAST VALUE (mm)			
X	Y	V	DATE
-1.23	-1.93	2.28	18/08/2015

The right plot above shows the location of the jointmeter and the axis sign criteria.

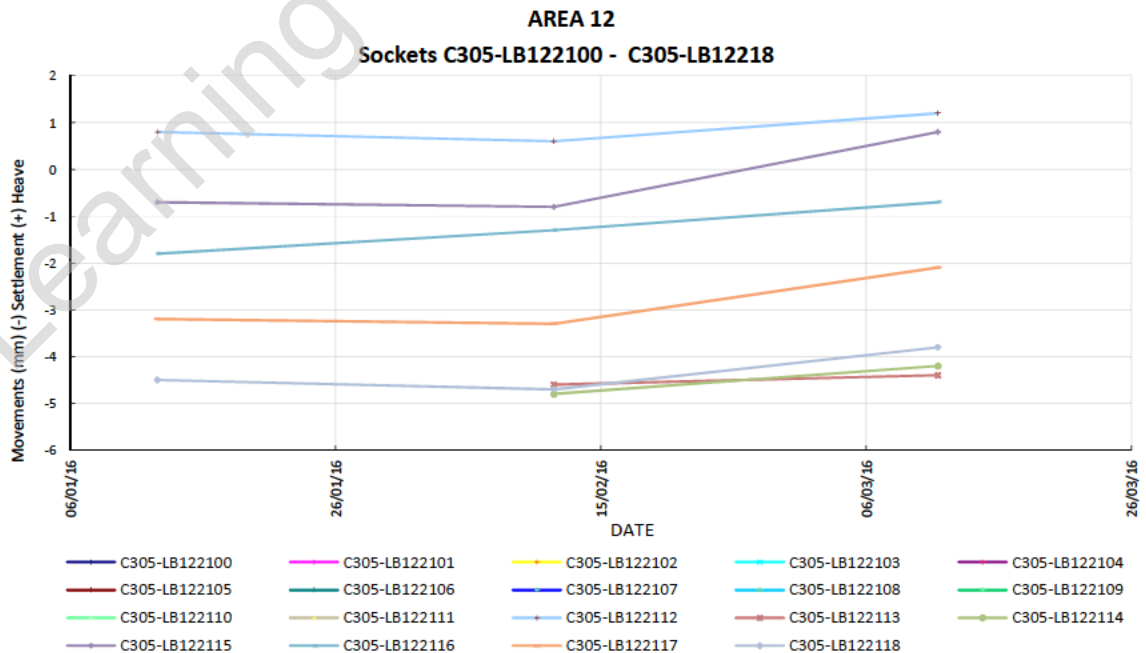
SOCKETS

C305-LB122100 to C305-LB122118



The graph above shows a settlement of -8.1 mm after the eastbound TBM transit and a total maximum of -11.2 mm of settlement after the westbound TBM transit in July of 2015. These sockets were used to monitor the construction of and depressurisation for CP5a.

The graph below shows the trend line adjustment for each socket:



The table below lists the annual settlement rate for each socket:

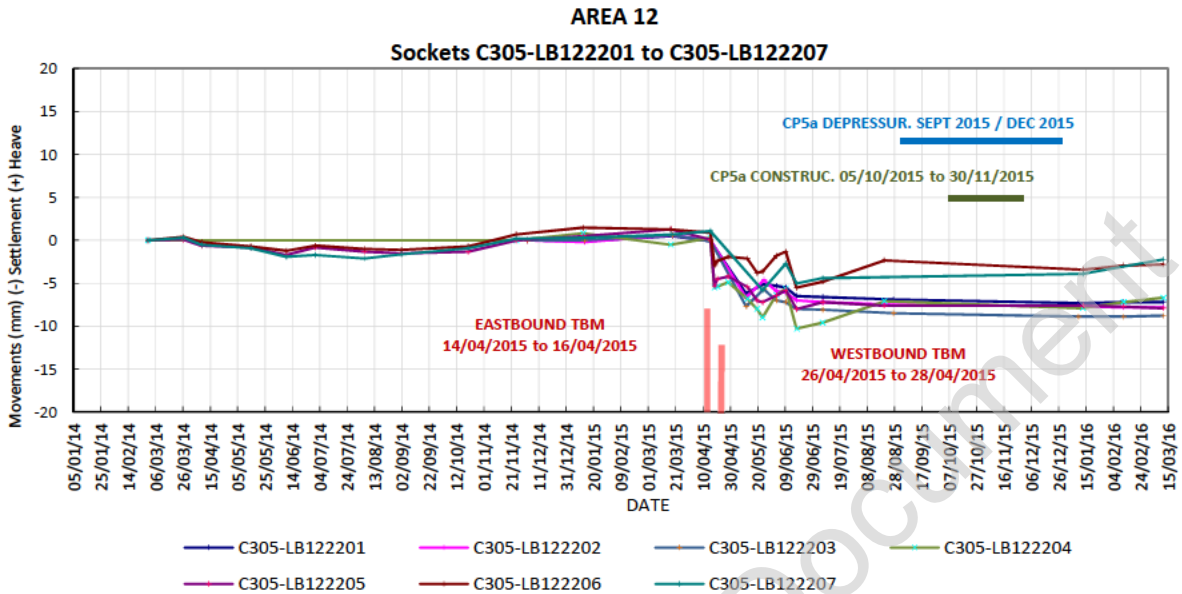
	Registered movement (mm)			mm/year
	12/01/2016	11/02/2016	11/03/2016	
C305-LB122112	0,80	0,60	1,20	2,453
C305-LB122113	#N/A	-4,60	-4,40	2,521
C305-LB122114	#N/A	-4,80	-4,20	7,563
C305-LB122115	-0,70	-0,80	0,80	9,241
C305-LB122116	-1,80	-1,30	-0,70	6,816
C305-LB122117	-3,20	-3,30	-2,10	6,775
C305-LB122118	-4,50	-4,70	-3,80	4,302
	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

#N/A: No readings

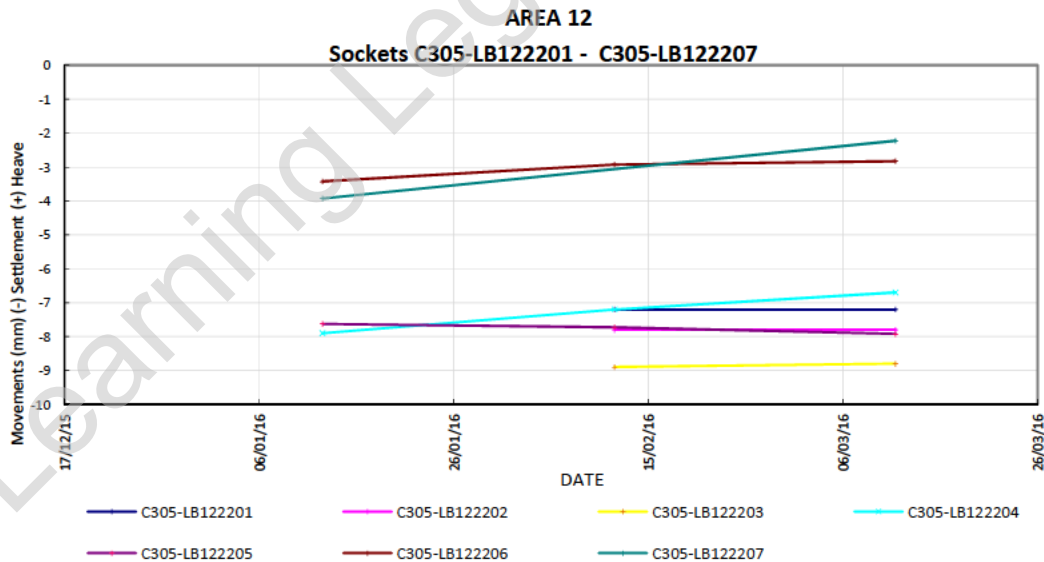
The table above shows that all sockets are showing heave (+values) and the percentage of sockets with a settlement rate less than 2 mm/year is 100%.

C305-LB122201 to C305-LB122207



The graph above shows a settlement of -5.3 mm after the eastbound TBM transit, and a maximum settlement of -10.3 mm of settlement was recorded in July 2015 after the westbound TBM transit. These sockets were used to monitor the construction of and depressurisation for CP5a.

The graph below shows the trend line adjustment for each socket:



The table below illustrates the annual settlement rate for each socket:

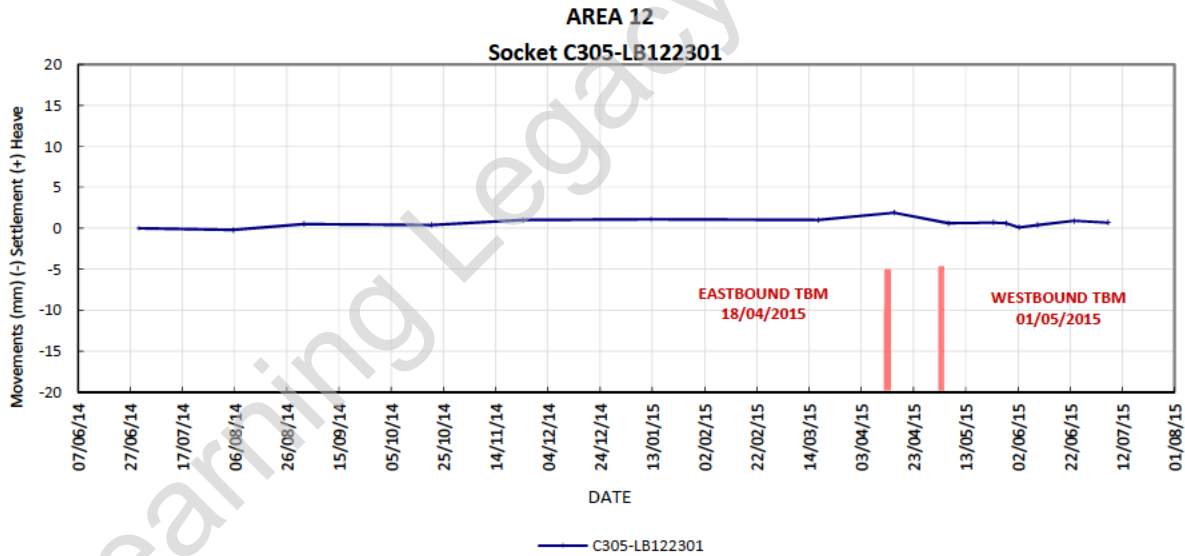
	Registered movement (mm)			mm/year
	12/01/2016	11/02/2016	11/03/2016	
C305-LB122201	#N/A	-7,20	-7,20	0,000
C305-LB122202	#N/A	-7,80	-7,80	0,000
C305-LB122203	#N/A	-8,90	-8,80	1,263
C305-LB122204	-7,90	-7,20	-6,70	7,444
C305-LB122205	-7,62	-7,72	-7,92	-1,855
C305-LB122206	-3,42	-2,92	-2,82	3,733
C305-LB122207	-3,92	#N/A	-2,22	10,536
	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
 #N/A: No readings

The table above shows that all sockets are showing heave (+values) and the percentage of sockets with a settlement rate less than 2 mm/year is 100%.

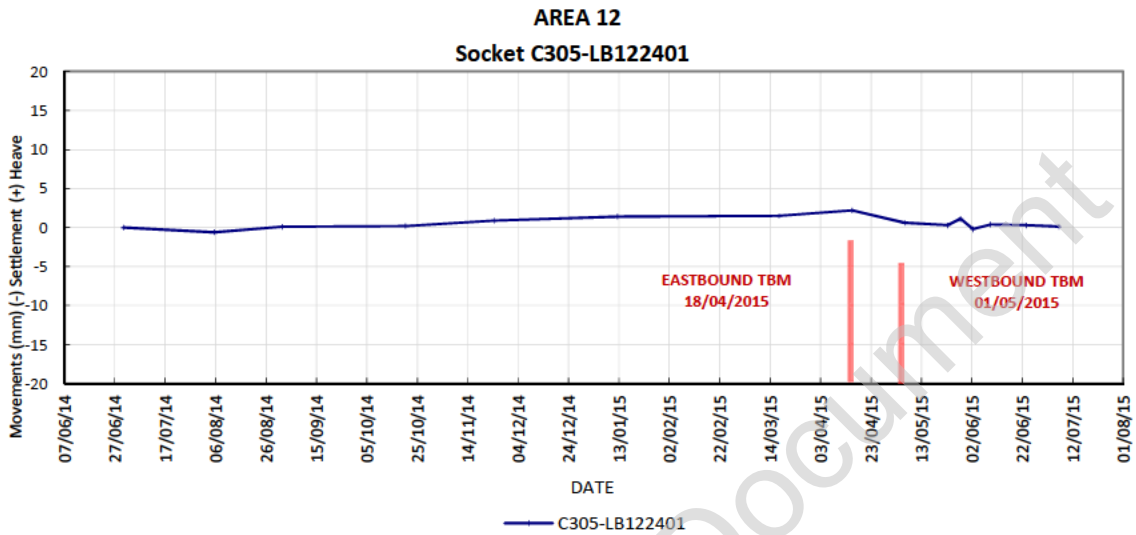
C305-LB122301

The graph below shows no significant settlement after both TBM transits.



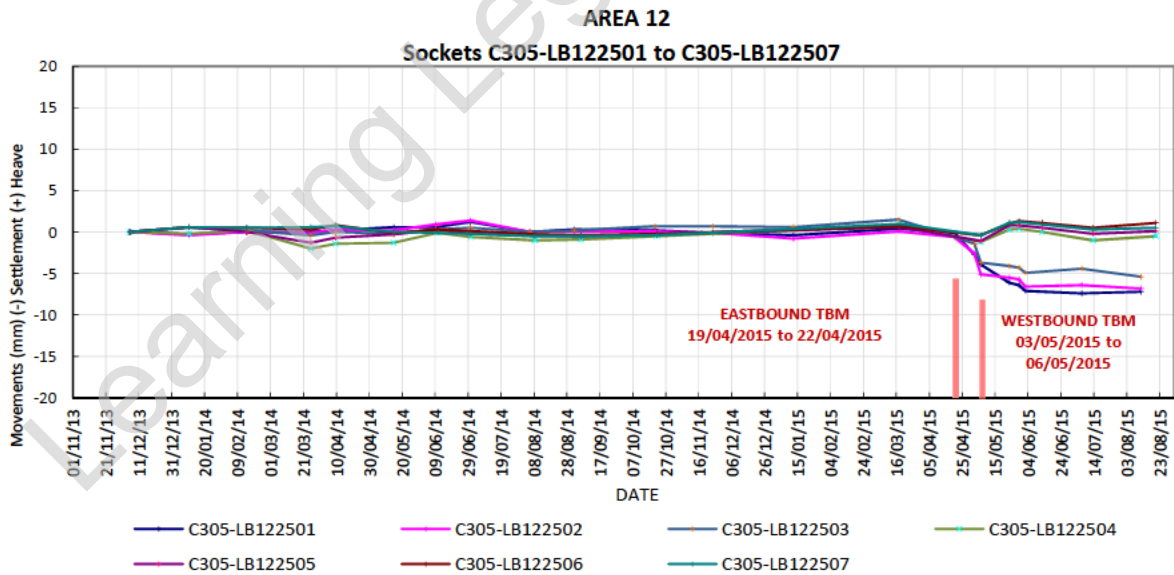
C305-LB122401

The graph below shows no significant settlement after both TBM transits.

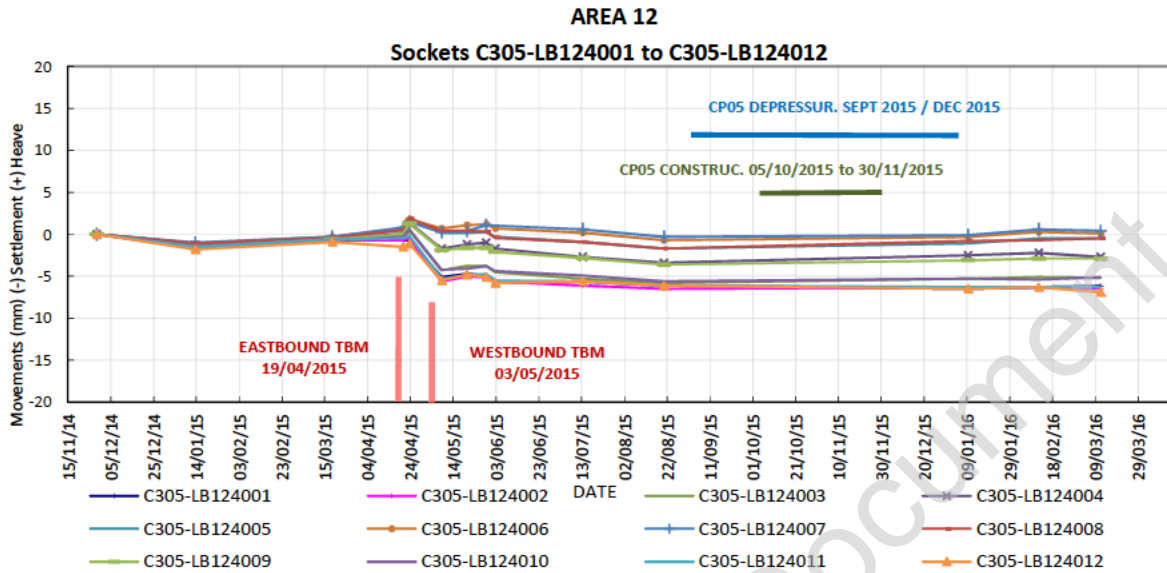


C305-LB122501 to C305-LB122507

The graph below shows a settlement of -3.7 mm after the eastbound TBM and a maximum settlement of -7.4 mm after the westbound TBM transit.

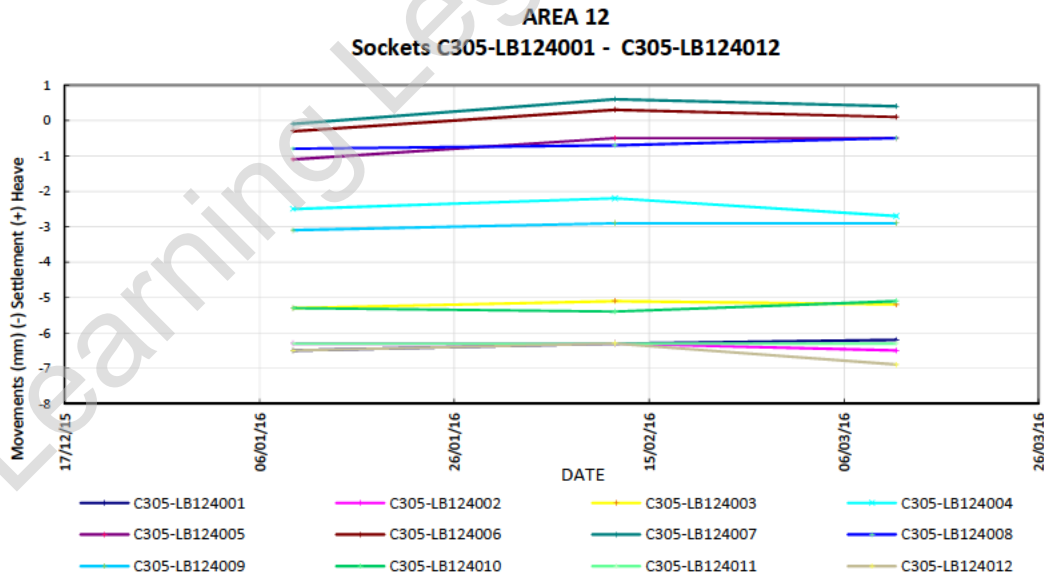


C305-LB124001 to C305-LB124012



The graph above shows a settlement of -5.8 mm after the westbound TBM transit, a maximum of -6.9 mm of settlement was recorded in March 2016. These sockets were used to monitor the construction of and depressurisation for CP5a.

The graph below shows the trend line adjustment for each socket:



The table below illustrates the annual settlement rate for each socket:

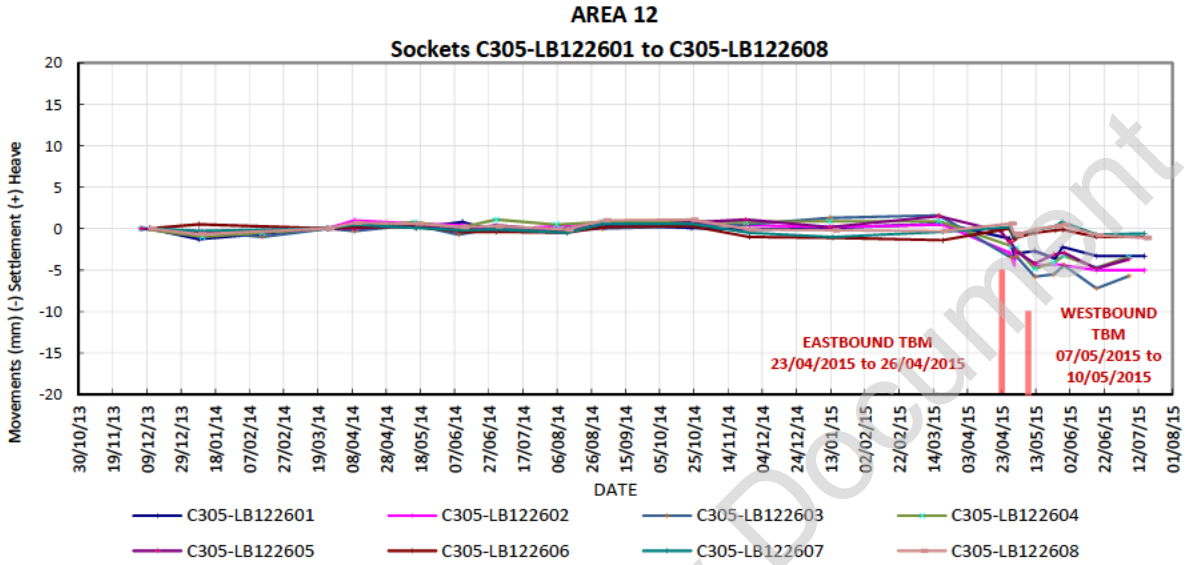
	Registered movement (mm)			mm/year
	09/01/2016	11/02/2016	11/03/2016	
C305-LB124001	-6,50	-6,30	-6,20	1,778
C305-LB124002	-6,30	-6,30	-6,50	-1,151
C305-LB124003	-5,30	-5,10	-5,20	0,627
C305-LB124004	-2,50	-2,20	-2,70	-1,073
C305-LB124005	-1,10	-0,50	-0,50	3,607
C305-LB124006	-0,30	0,30	0,10	2,456
C305-LB124007	-0,10	0,60	0,40	3,058
C305-LB124008	-0,80	-0,70	-0,50	1,752
C305-LB124009	-3,10	-2,90	-2,90	1,202
C305-LB124010	-5,30	-5,40	-5,10	1,125
C305-LB124011	-6,30	-6,30	-6,30	0,000
C305-LB124012	-6,50	-6,30	-6,90	-2,250
	Rate less than -2.5 mm/year		% less 2 mm/ year	91.6%
	Rate greater than -3.5 mm/year		% less 3 mm/ year	100%

Note: All the movements are in mm. (-) Settlement / (+) Heave
 #N/A: No readings

The percentage of sockets with a settlement rate less than 2 mm/year is 91.6% and less than 3 mm/year is 100%.

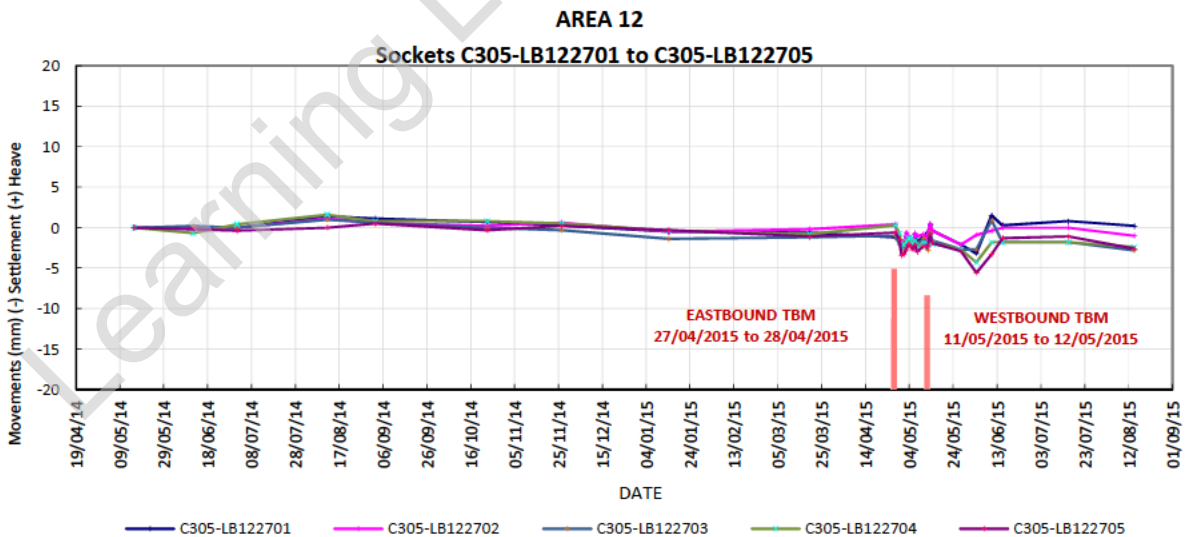
C305-LB122601 to C305-LB122608

The graph below shows a settlement of -3.5 mm after the eastbound TBM transit and a maximum of -7.2 mm settlement after the westbound TBM transit.



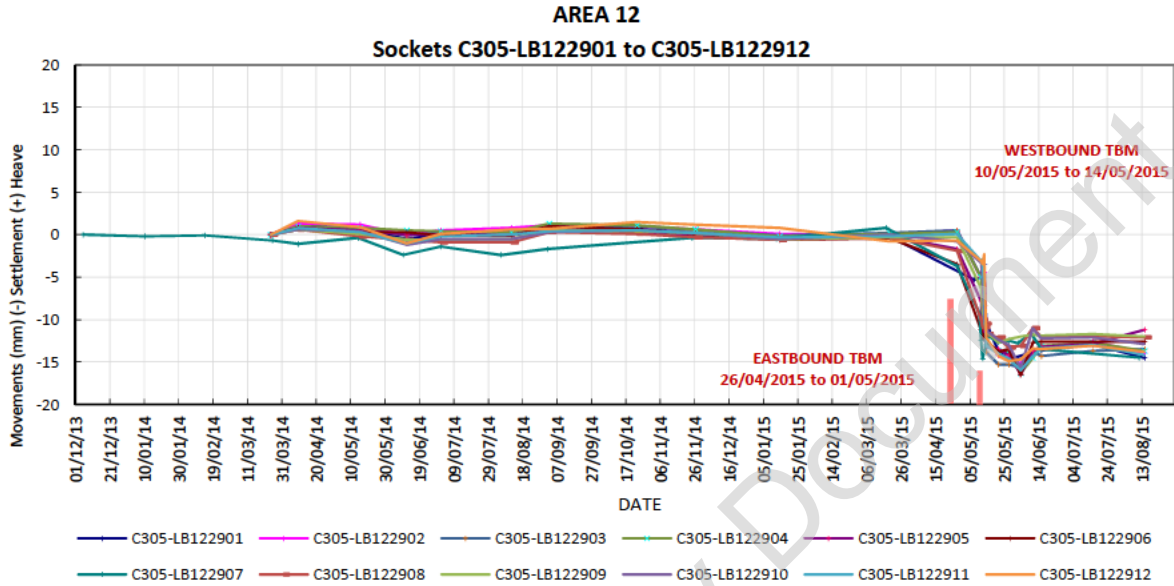
C305-LB122701 to C305-LB122705

The graph below shows a settlement of -3.3 mm after the eastbound TBM transit and a maximum of -5.6 mm settlement after the westbound TBM transit.



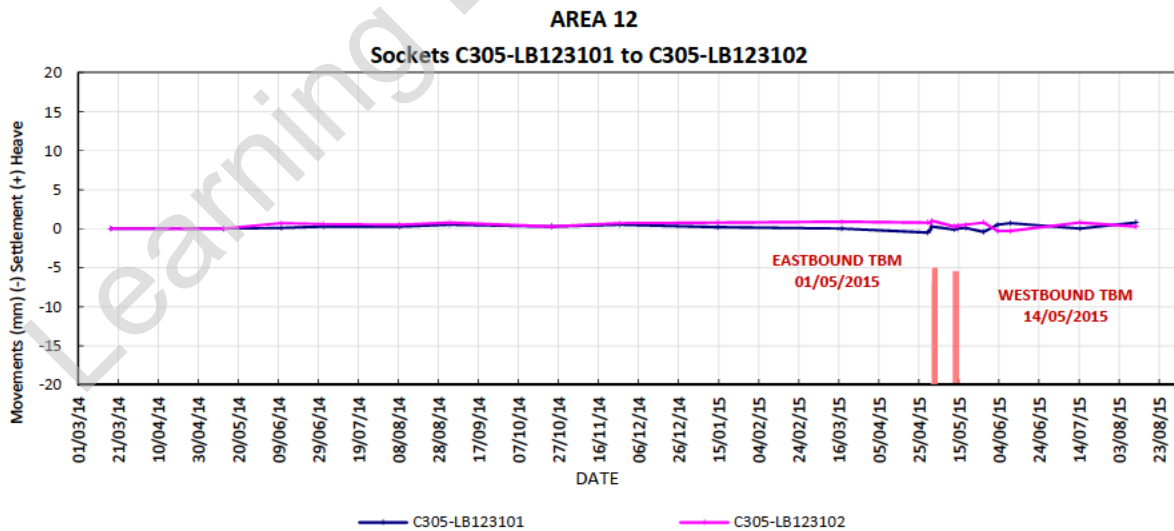
C305-LB122901 to C305-LB122912

The graph below shows a settlement of -3.7 mm after the eastbound TBM transit and a maximum of -16.5 mm settlement after the westbound TBM transit.



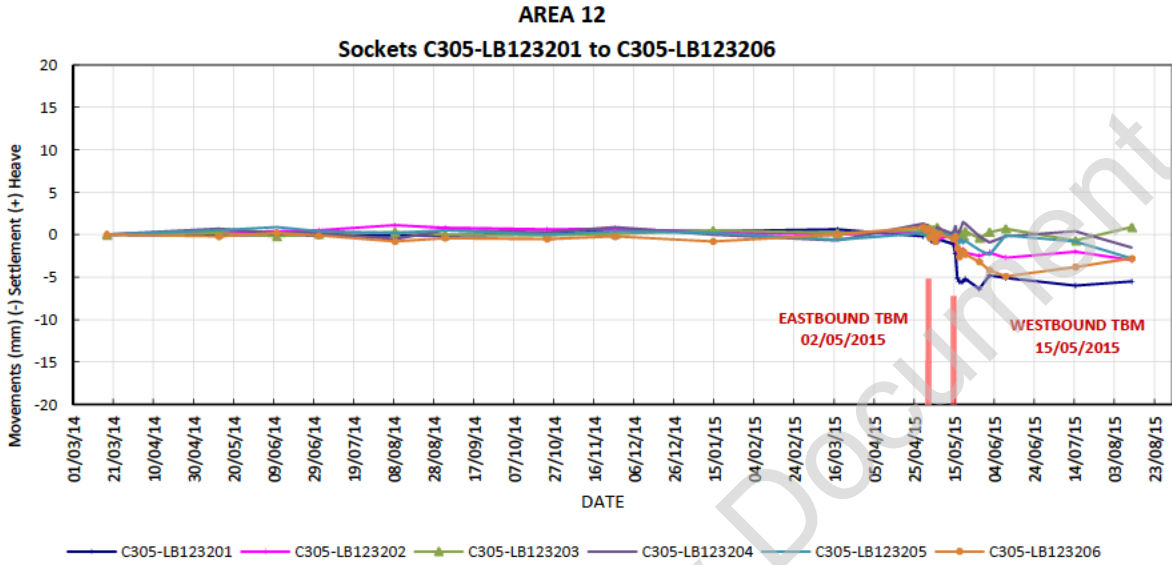
C305-LB123101 to C305-LB123102

The graph below shows no significant settlement effects after the transit of both TBMs.



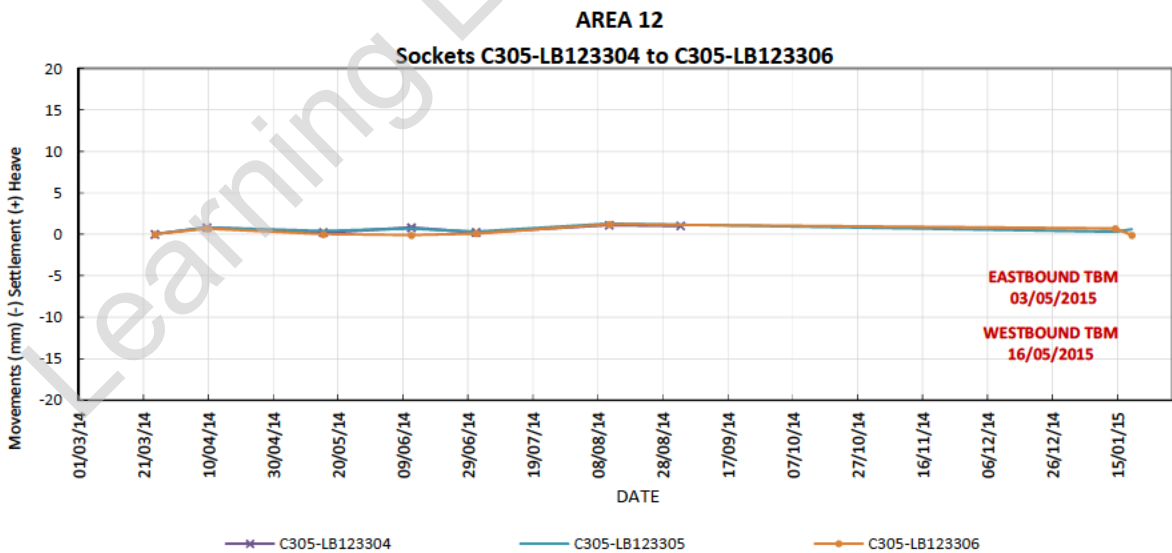
C305-LB123201 to C305-LB123206

The graph below shows a settlement of -0.8 mm after the eastbound TBM transit and a maximum of -6.4 mm settlement after the westbound TBM transit.



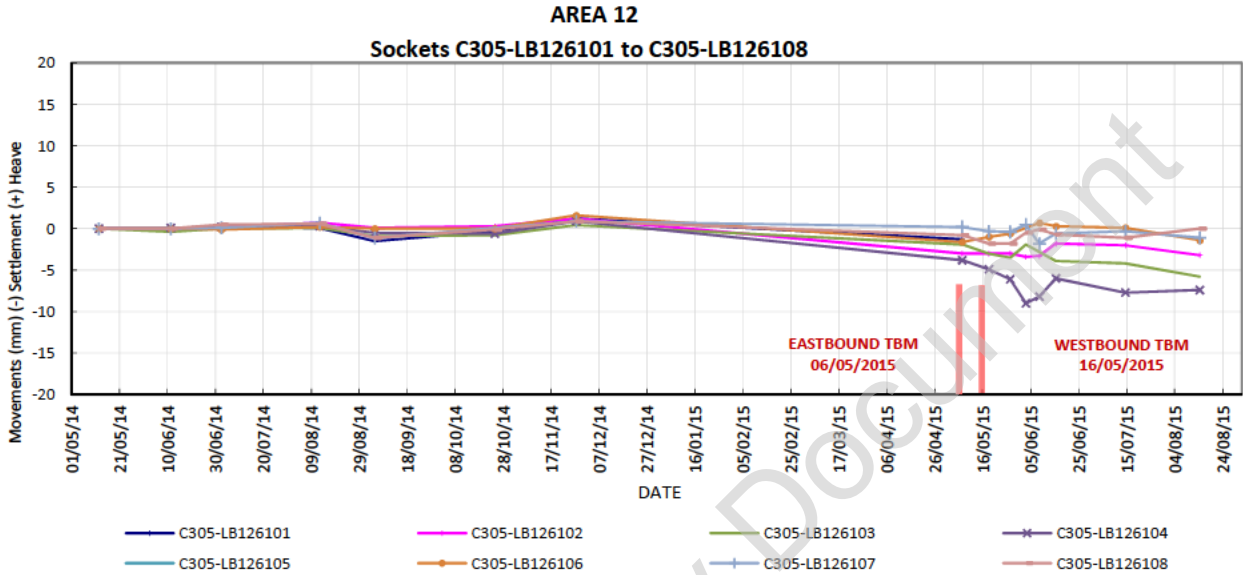
C305-LB123304 to C305-LB123306

The graph below shows no significant settlement effects. Note: No readings during and after TBMs passage due to works in this area.



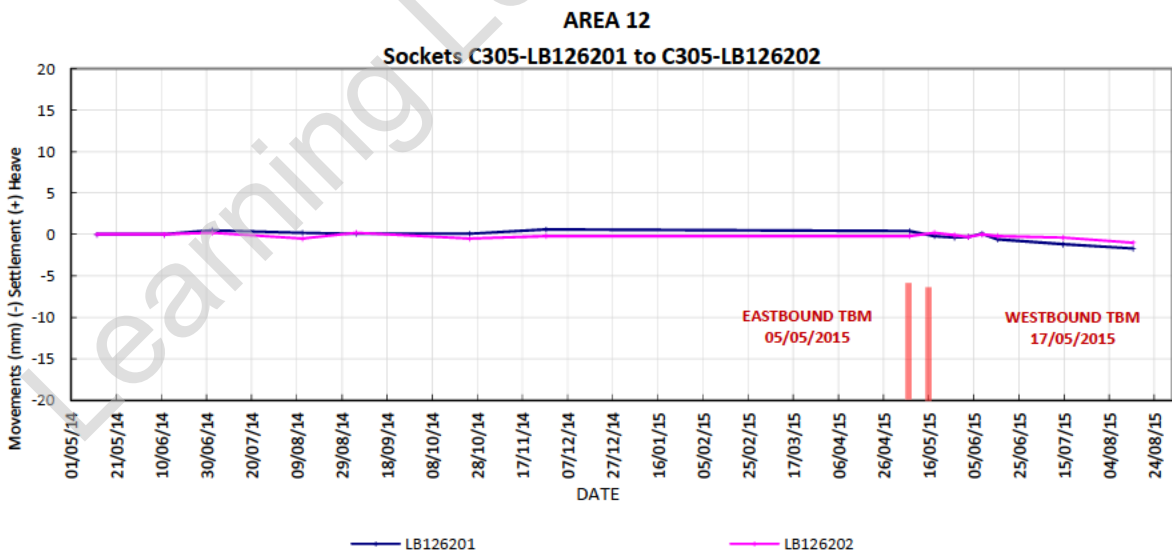
C305-LB126101 to C305-LB126108

The graph below shows a settlement of -3.8 mm after the eastbound TBM transit and a maximum of -9 mm settlement after the westbound TBM transit.



C305-LB126201 to C305-LB126202

The graph below shows no significant settlement after the eastbound TBM passage and a maximum settlement of -1.7 mm after the westbound TBM transit.

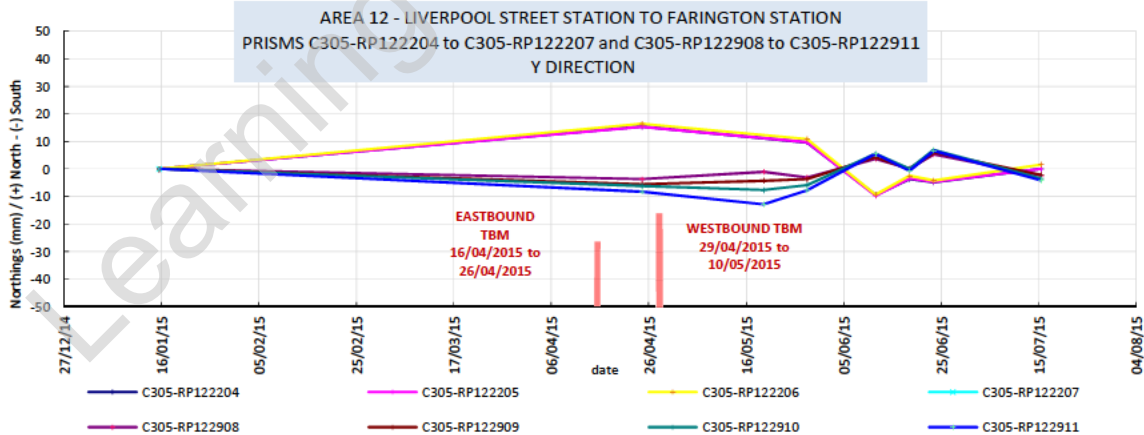
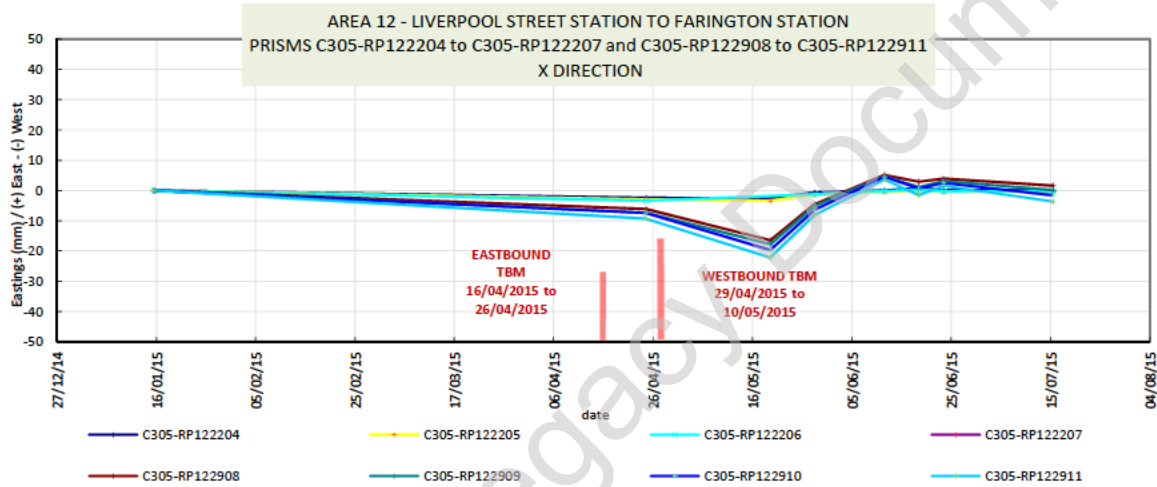


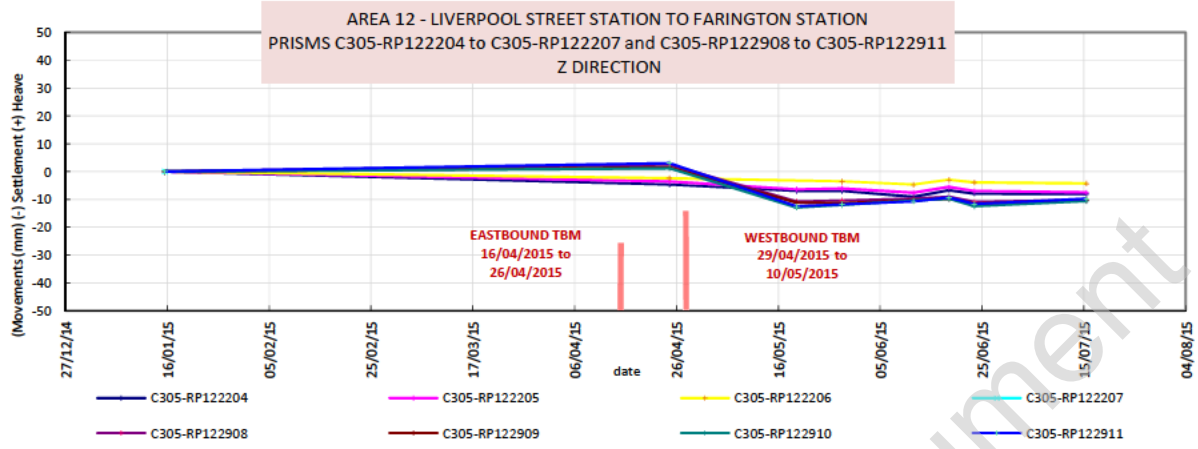
PRISMS

Note: X direction is for longitudinal movement, Y direction is for transverse movement and Z direction for vertical movement (+ heave, - settlement).

C305-RP122204 to C305-RP122207 and C305-RP122908 to C305-RP122911

The graphs below show last data registered in X direction ranging from -3.7 (West) to +1.6 (East), and in Y direction ranging from -4.1 (South) to +1.6 (North). A maximum settlement of -12.5 mm was recorded after the westbound TBM transit.

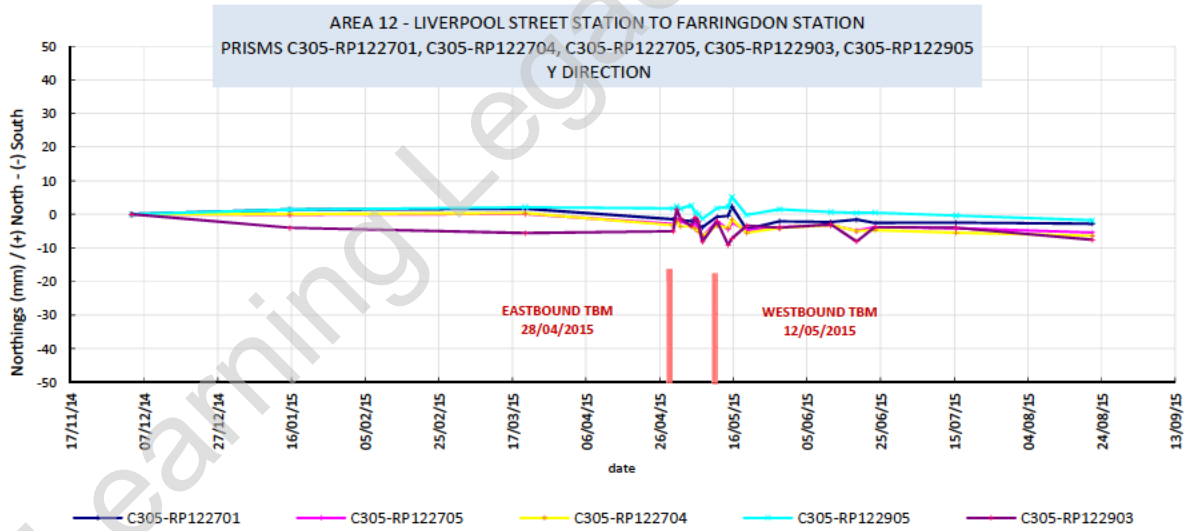
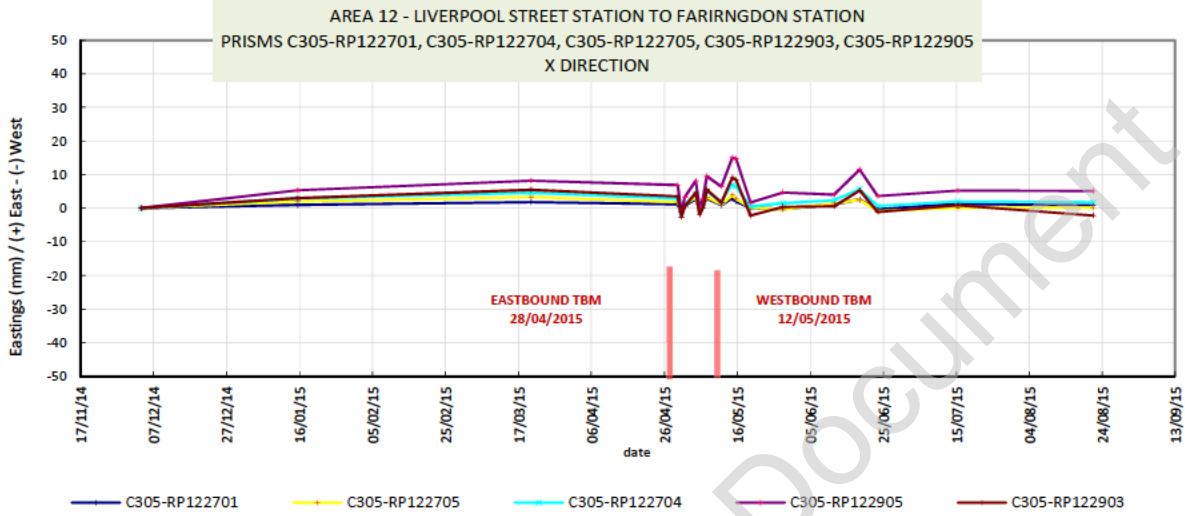


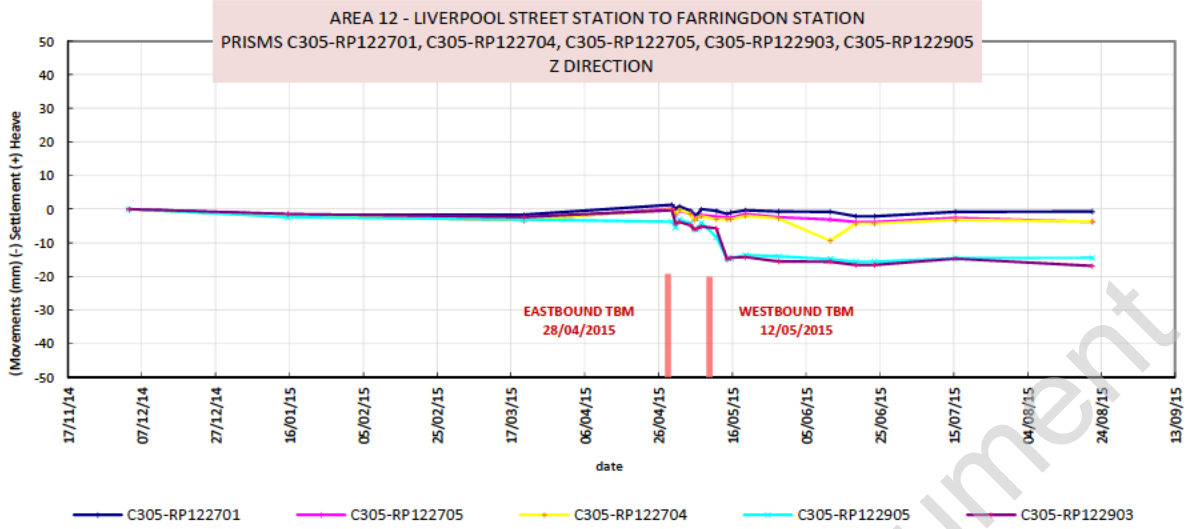


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C305-RP122701, C305-RP122704, C305-RP122705, C305-RP122903, C305-RP122905

The graphs below show last data registered in X direction ranging from -2.2 (West) to +5.1 (East), and in Y direction ranging from -7.6 to -1.8 (South). A maximum settlement of -16.9 mm was recorded after the westbound TBM transit.

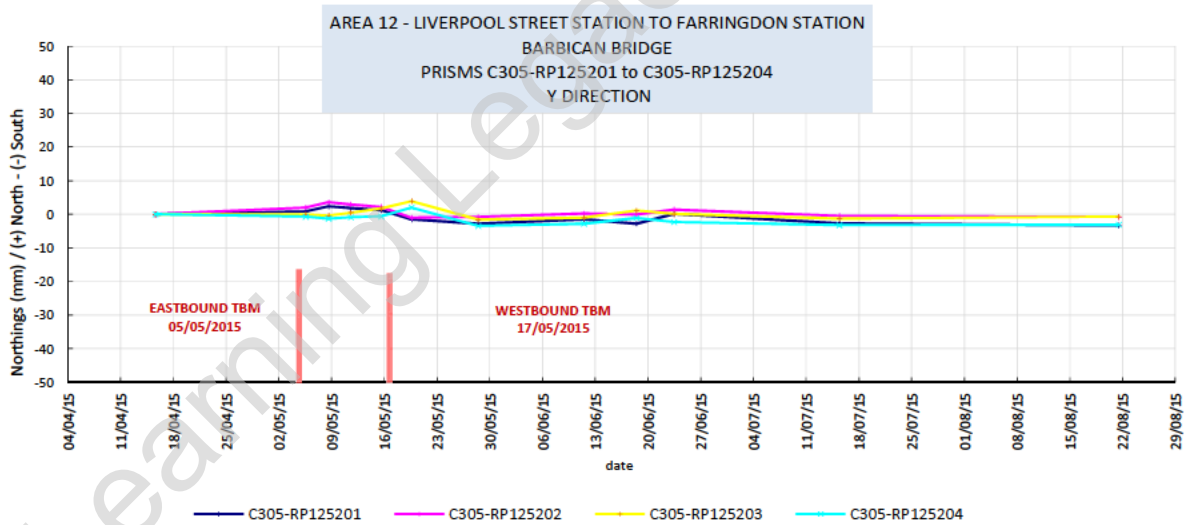
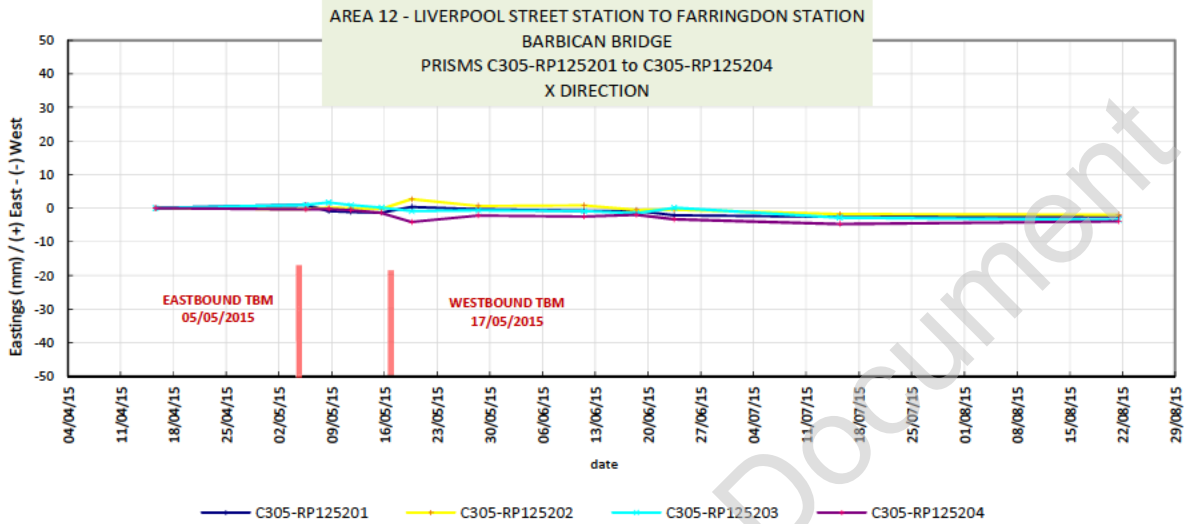


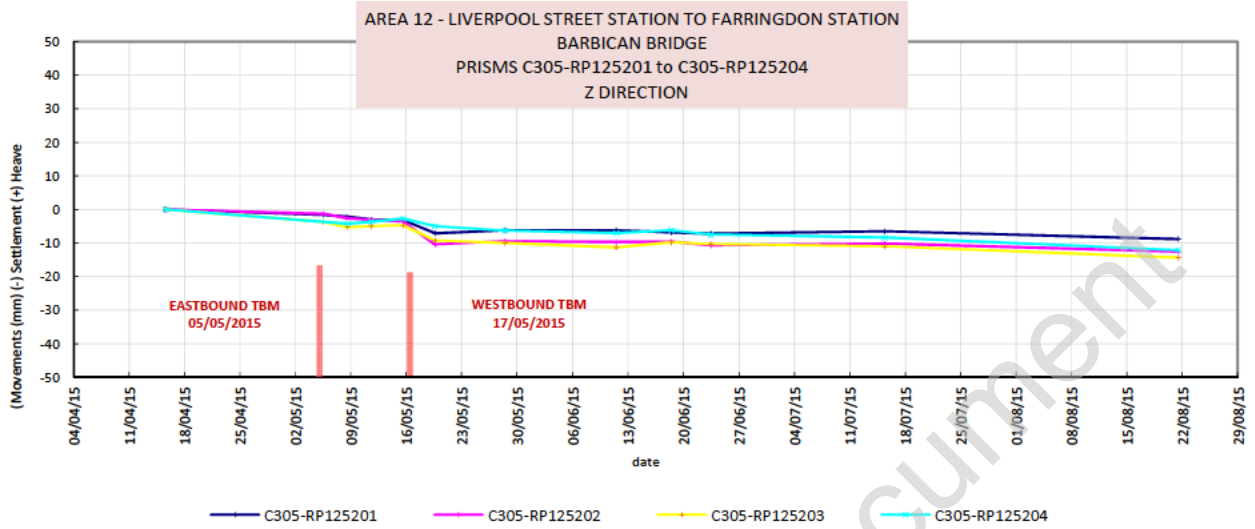


+

BARBICAN BRIDGE C305-RP125201 to C305-RP125204

The graphs below show last data registered in X direction ranging from -3.9 to -1.9 (West), and in Y direction ranging from -3.1 to -0.7 (South). A maximum settlement of -14.4 mm was recorded after the westbound TBM transit.

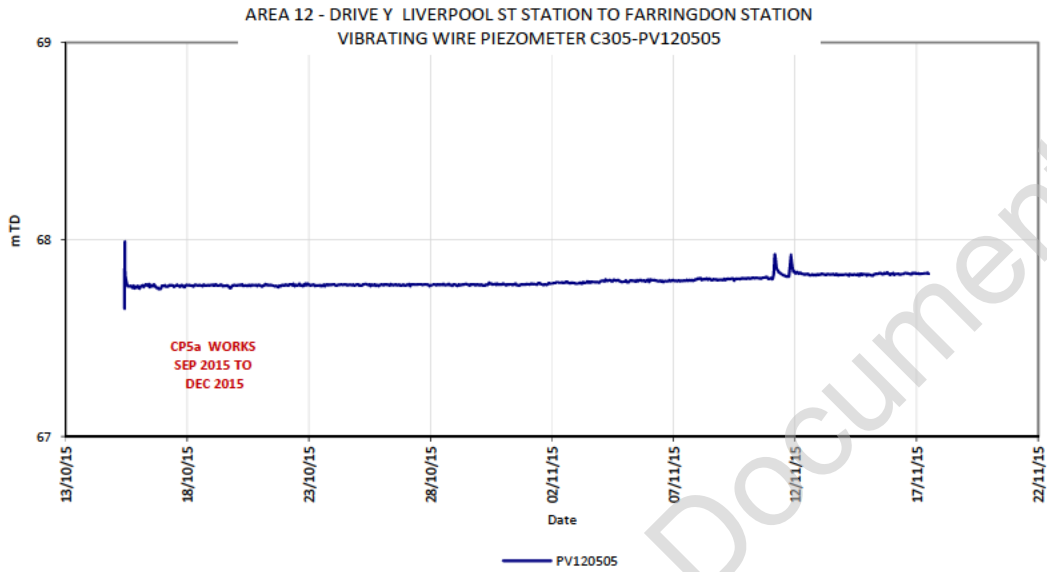




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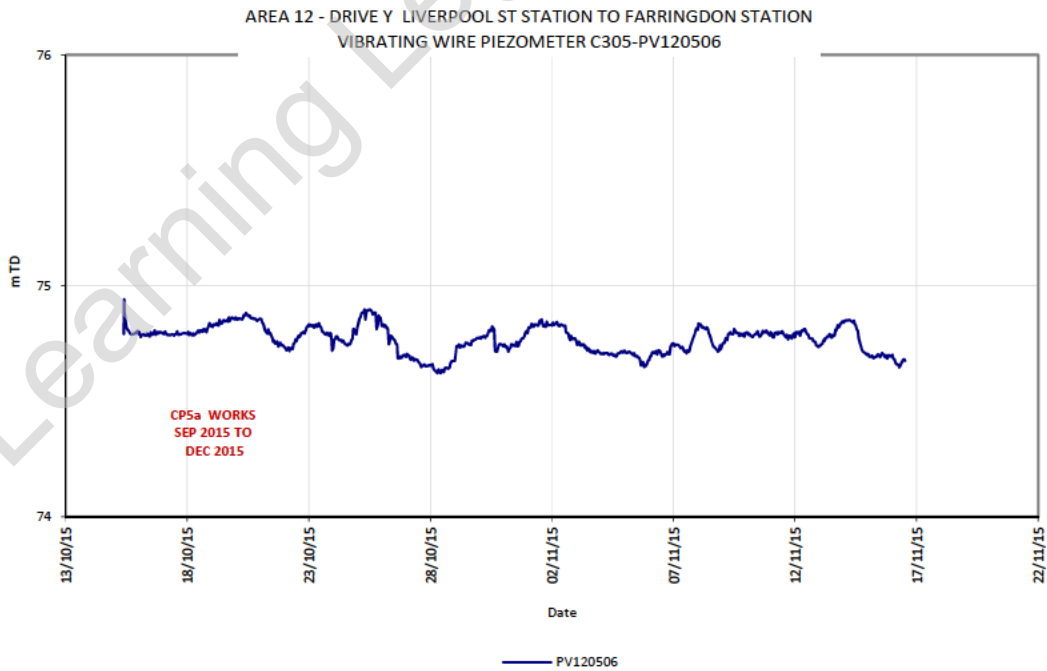
PIEZOMETERS

C305-PV120505



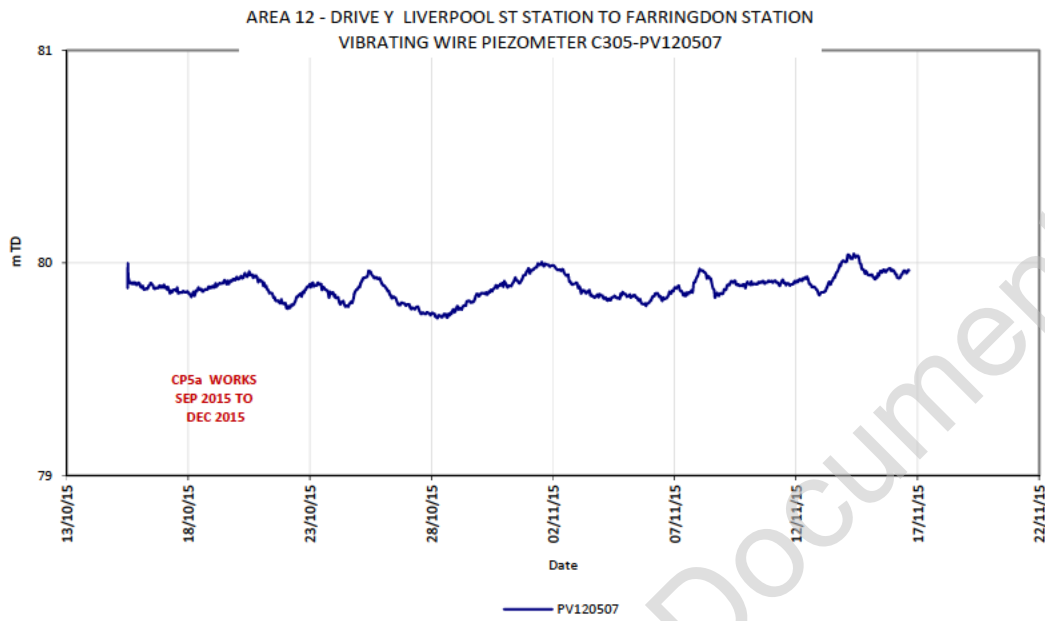
The graph above shows a continuous level from 67.7 to 67.8 m during CP5a works.

C305-PV120506



The graph above shows a continuous level from 74.8 to 74.7 m during CP5a works

C305-PV120507



The graph above shows a continuous level from 79.9 to 80 m during CP5a works.

8 SUMMARY STATEMENT

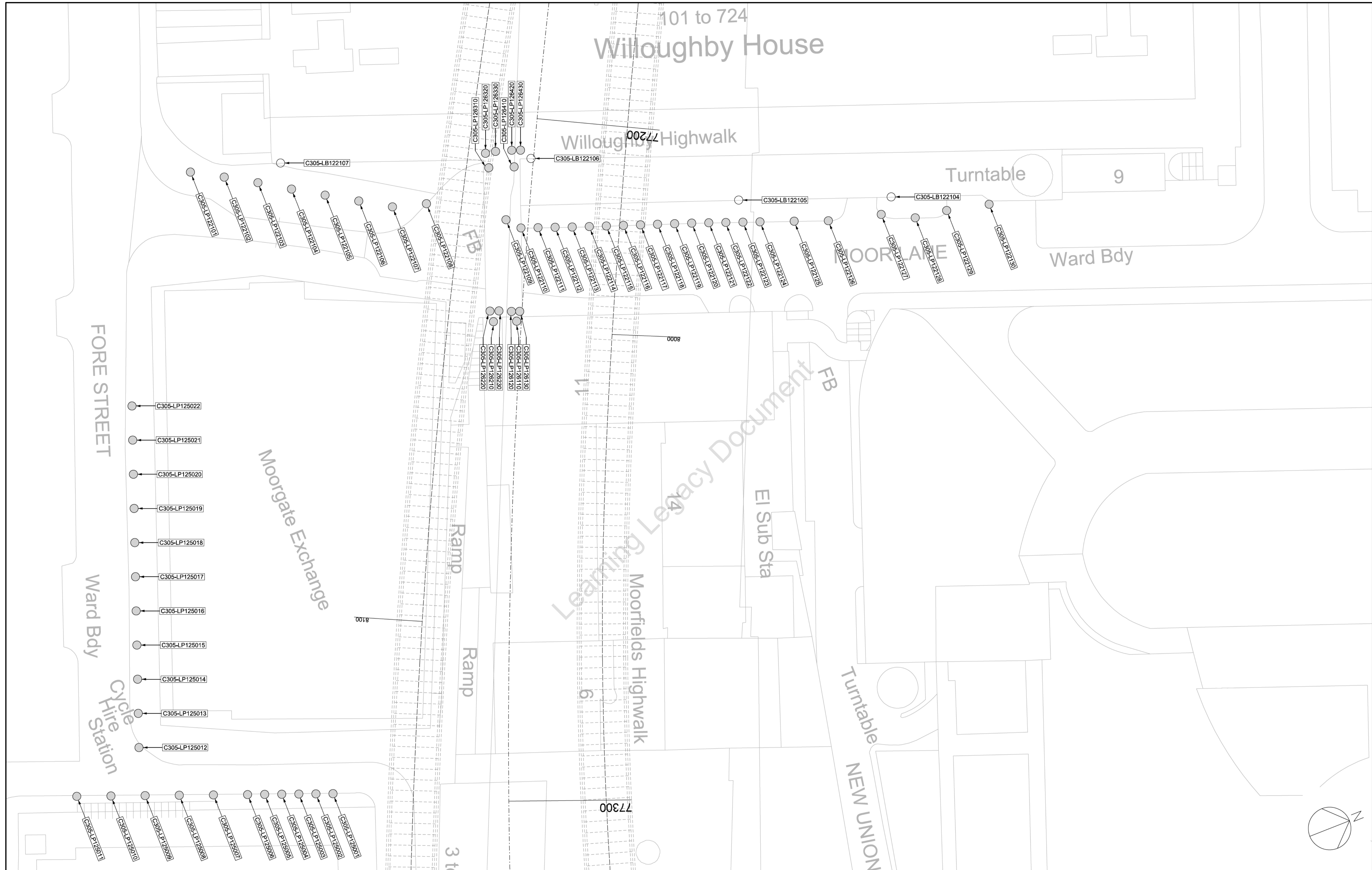
The data presented in this report has been discussed in a monitoring close out review meeting; and it was agreed between the Project Manager, the Designer, the Contractor and the Subcontractor that the instrumentation covered herein (ie: for the monitoring of ground movement effects due to C305 DSJV Works including long term effects) have reached, or are approaching, the specified rate of change and can now be decommissioned.

As per PMI: C305_PMI_1087 the Project Manager confirmed that the long term monitoring of ground movements will continue using satellite radar interferometry by others.

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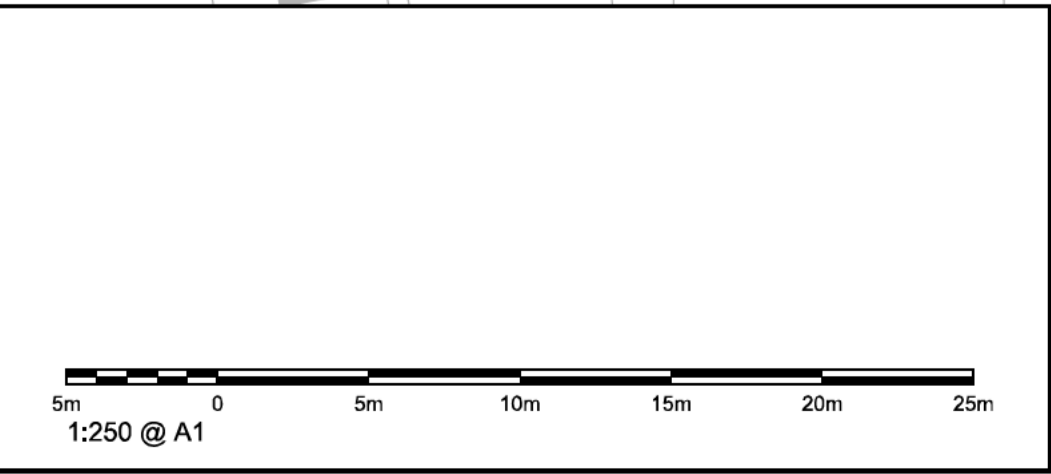
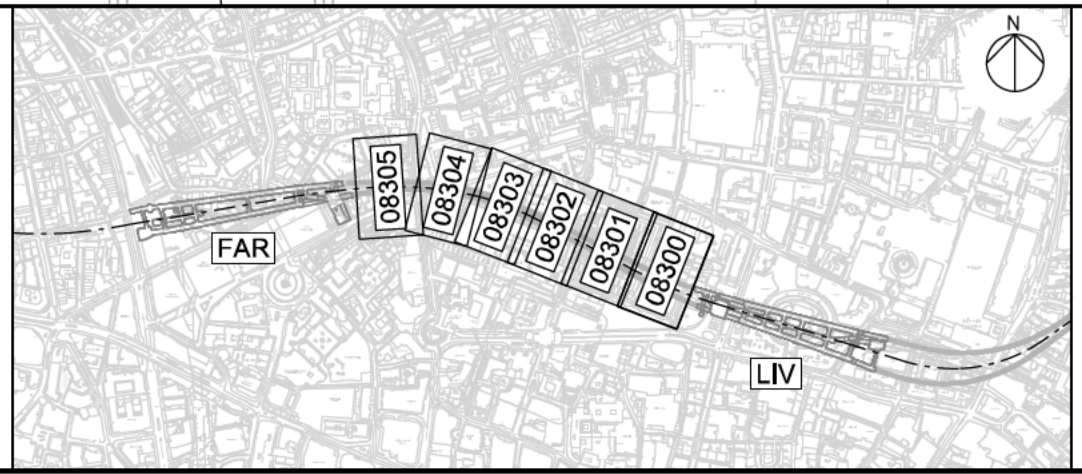
APPENDIX A: INSTRUMENT LOCATION

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Rev.	Date	Description	By	Chkd	App	Auth
P01	09/03/2016	First Issue	MD	MD	MD	-

- Notes**
- Levelling points
 - Sockets
 - 3D Prisms



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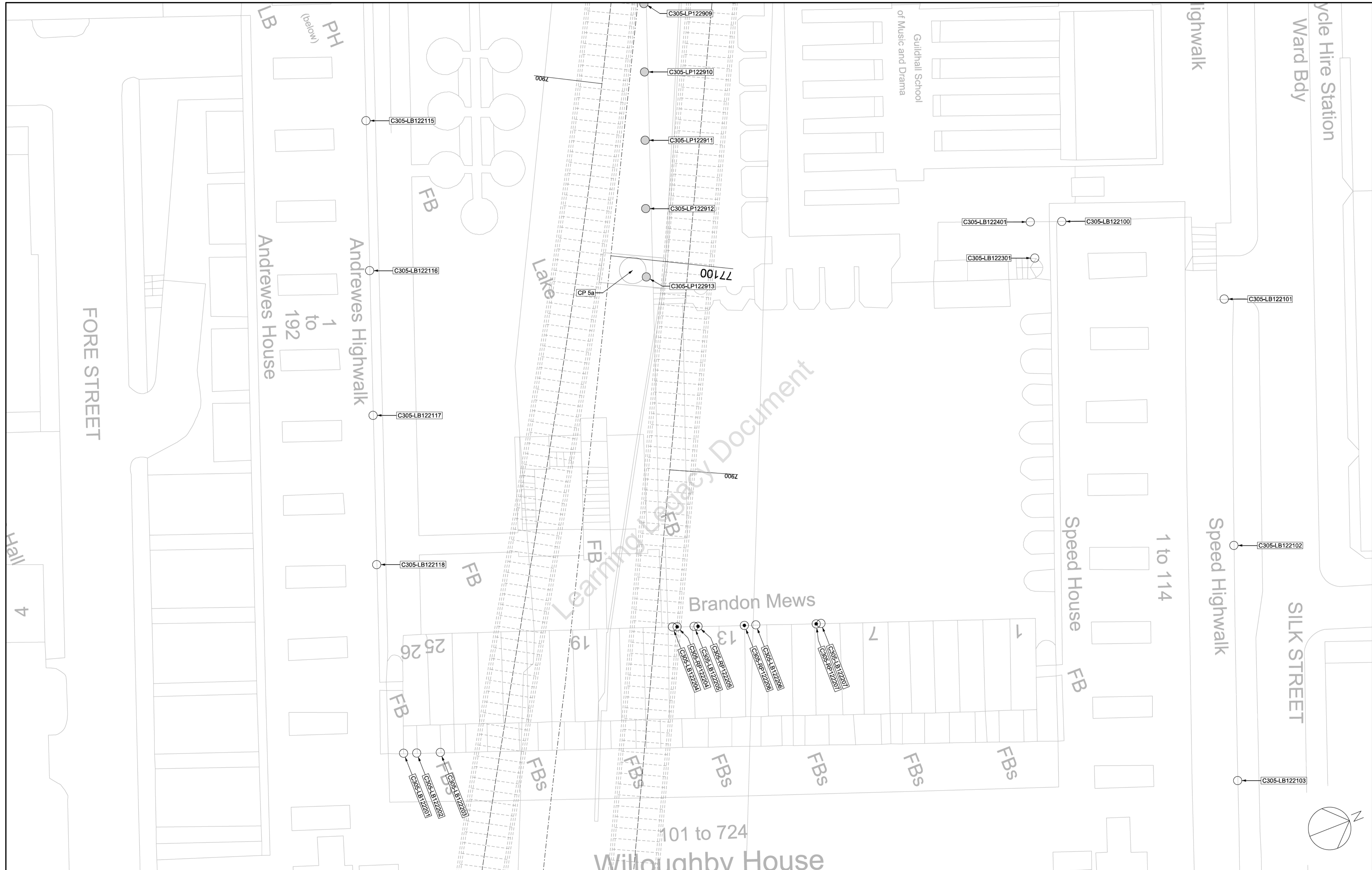
Contract: Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G
 Originator: Dragados Sisk Joint Venture
 Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)

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

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 Scale: 1:250 @ A1
 Drawing and CAD No: C305-DSJ-C2-DDA-CRT00_ST006_1-08300
 Rev: P01
 Suitability: S4

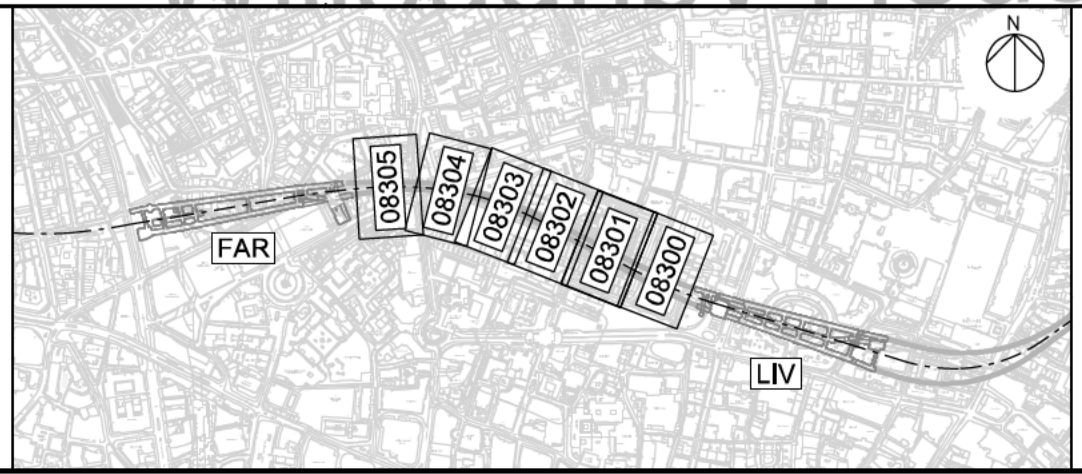
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Scale: 1:250 @ A1

5m 0 5m 10m 15m 20m 25m

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

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 Scale: 1:250 @ A1
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 Rev: P01
 Suitability: S4

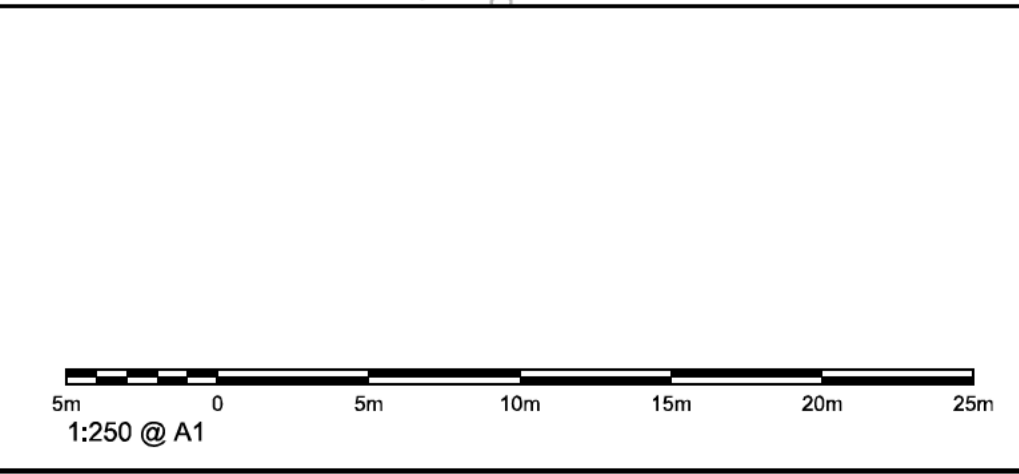
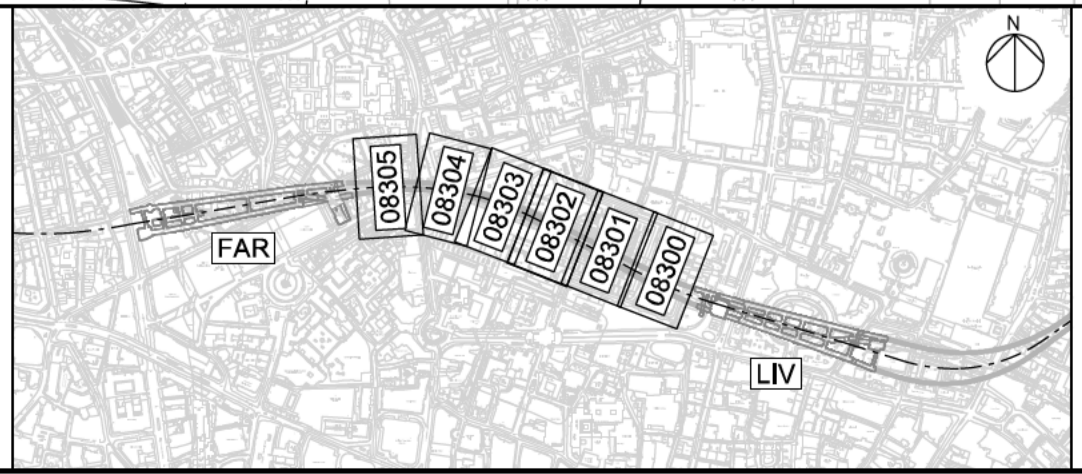
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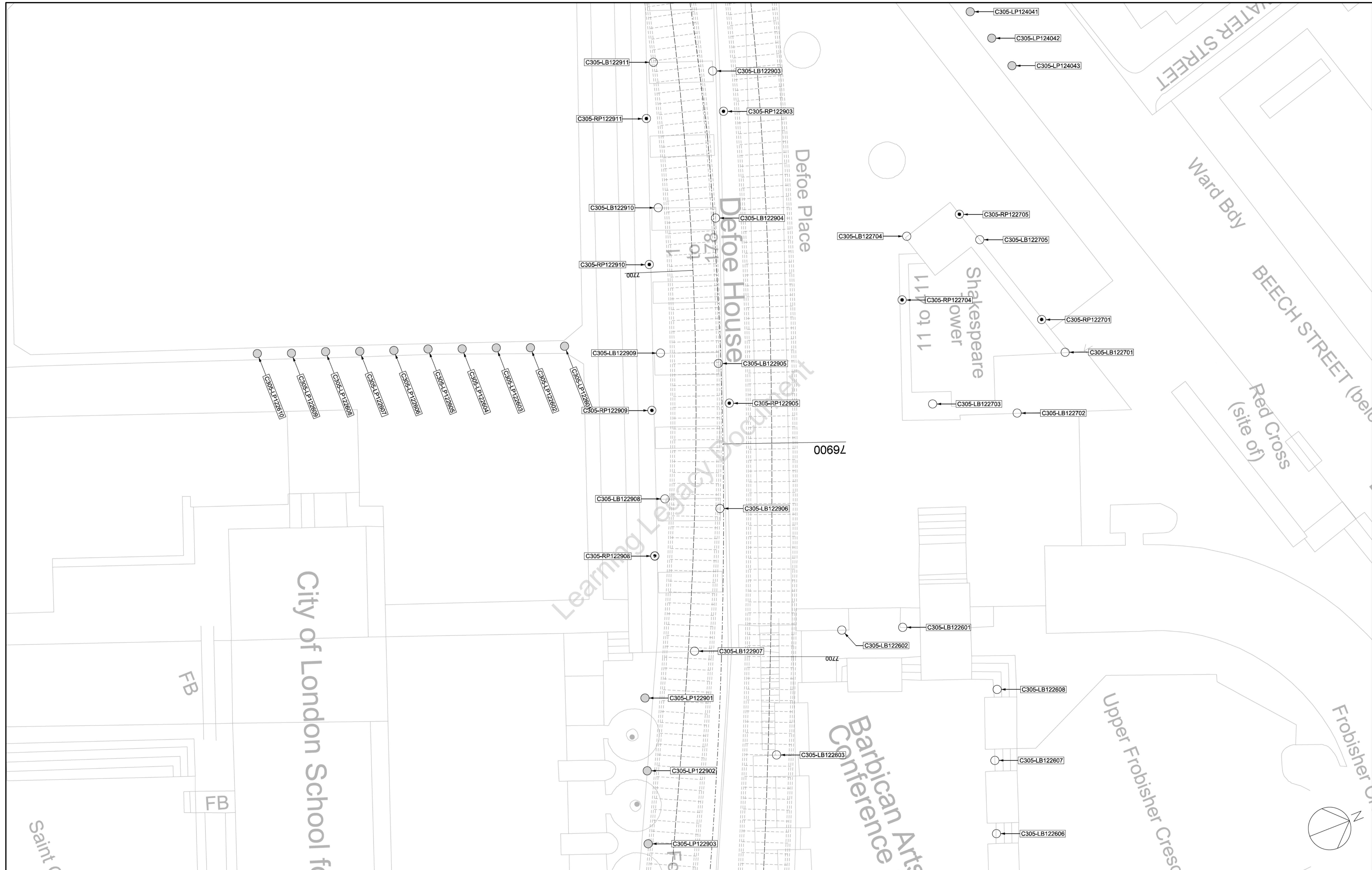
Rev.	Date	Description	By	Chkd	App	Auth
P01	29/02/2016	First Issue	MD	MD	MD	-
P02	15/04/2016	-	MD	MD	MD	-

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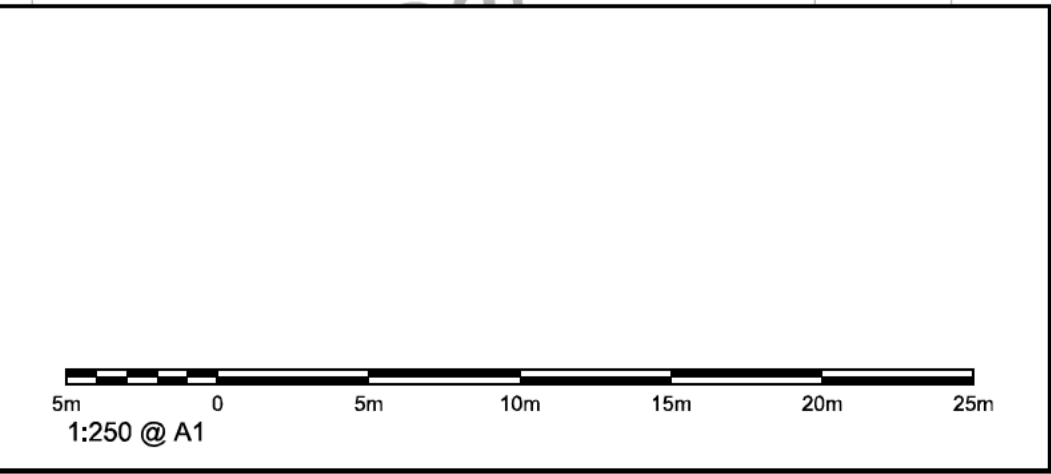
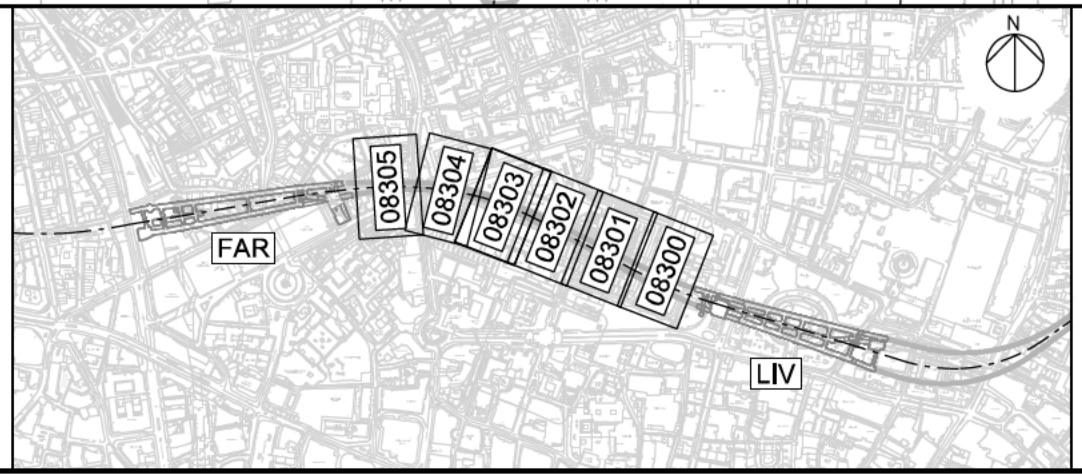
<p>Crossrail Limited 25 Canada Square Canary Wharf London E14 6LQ</p> <p>© Crossrail www.crossrail.co.uk</p>	<p>Contract: Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G</p> <p>Originator: Dragados Sisk Joint Venture</p> <p>Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)</p>	<p>By: M.DAVIS</p> <p>CHK: M.DAVIS</p> <p>APP: M.DAVIS</p> <p>Auth: -</p>	
	<p>Title: Instrumentation & Monitoring I&M Installation Report for Liverpool Street to Farringdon (including Barbican Centre) - (Drive Y)</p> <p>C305-DSJ-C2-RGN-CRG03-50176</p>	<p>Scale: 1:250 @ A1</p>	<p>Rev: P02</p>
	<p>Drawing and CAD No: C305-DSJ-C2-DDA-CRT00_ST006_1-08302</p>	<p>Suitability: S4</p>	<p>Rev: P02</p>
	<p>www.crossrail.co.uk</p>		<p>Rev: P02</p>

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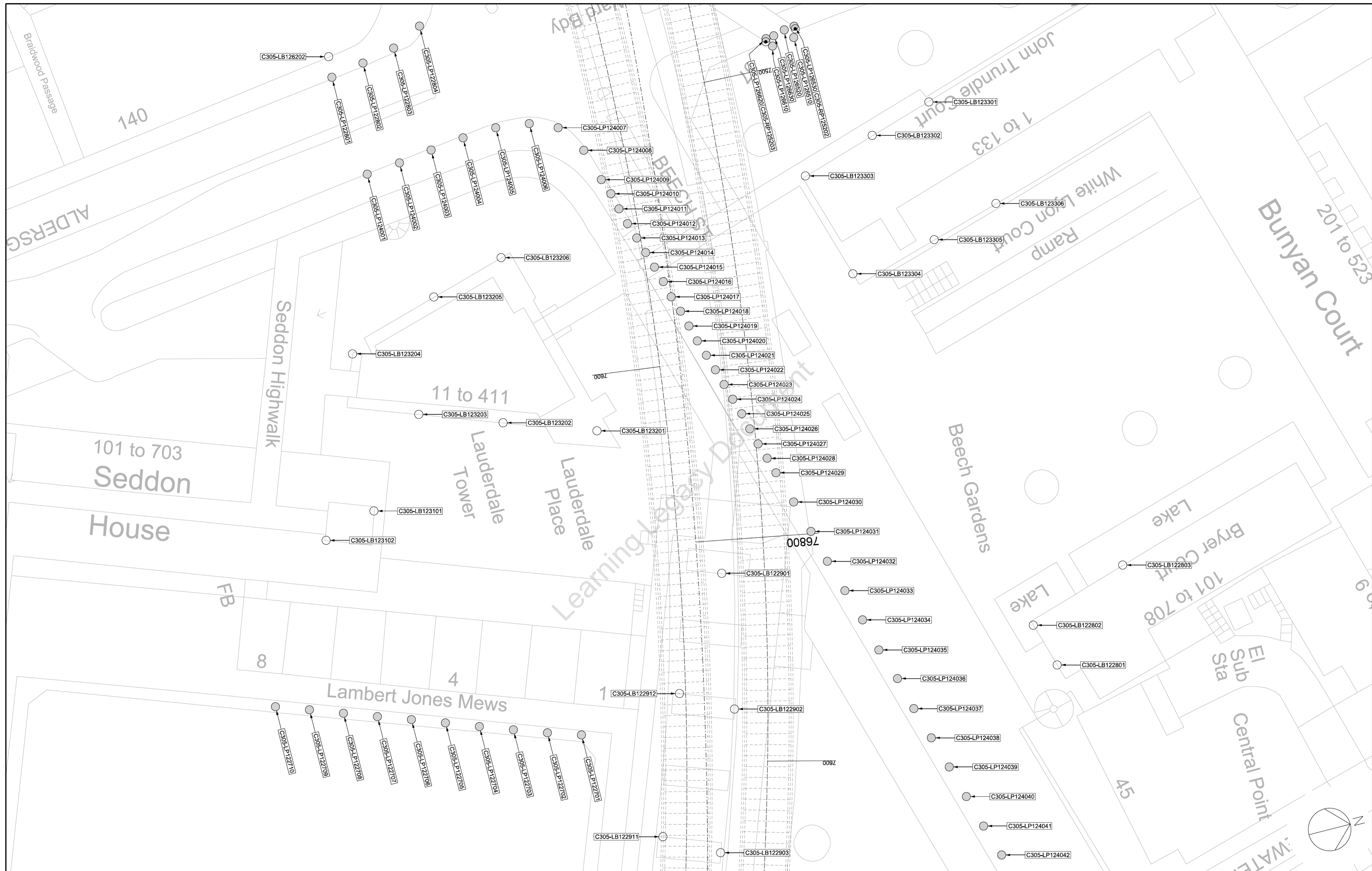
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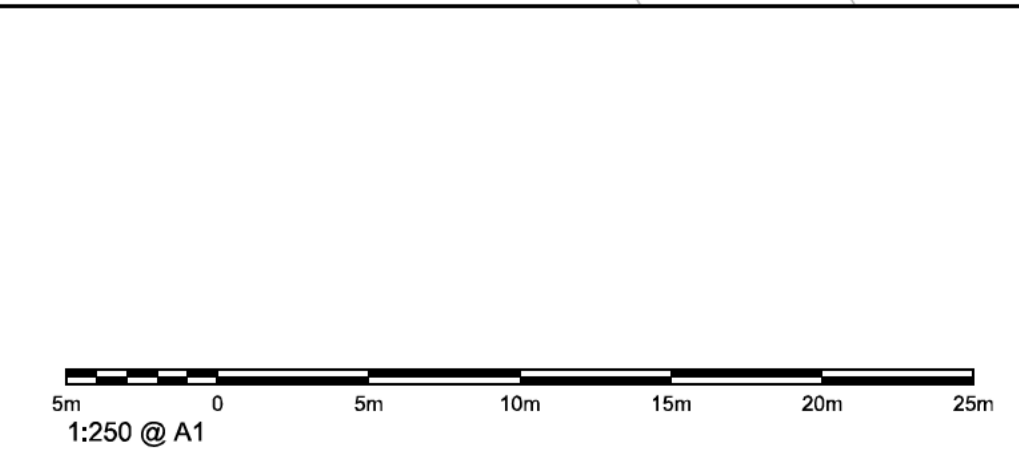
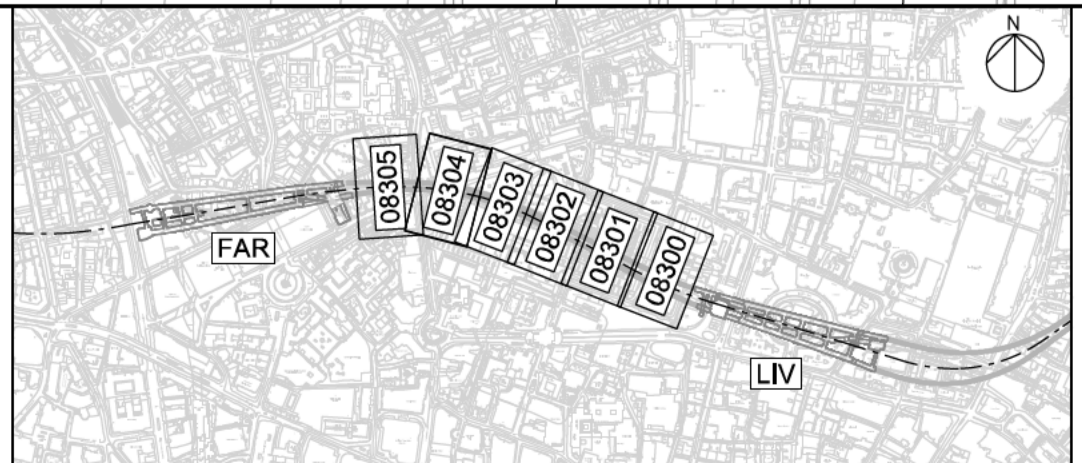
<p>Crossrail Limited 25 Canada Square London E14 6LQ</p> <p>© Crossrail www.crossrail.co.uk</p>	<p>Contract: Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G</p> <p>Originator: Dragados Sisk Joint Venture</p> <p>Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)</p>	<p>By: M.DAVIS</p> <p>CHK: M.DAVIS</p> <p>APP: M.DAVIS</p> <p>Auth: -</p>	
	<p>Title: Instrumentation & Monitoring I&M Installation Report for Liverpool Street to Farringdon (including Barbican Centre) - (Drive Y)</p> <p>C305-DSJ-C2-RGN-CRG03-50176</p>	<p>Scale: 1:250 @ A1</p> <p>Drawing and CAD No: C305-DSJ-C2-DDA-CRT00_ST006_1-08303</p>	<p>Rev: P01</p> <p>Suitability: S4</p>
	<p>Contract: Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & 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>
	<p>Title: Instrumentation & Monitoring I&M Installation Report for Liverpool Street to Farringdon (including Barbican Centre) - (Drive Y)</p> <p>C305-DSJ-C2-RGN-CRG03-50176</p>		<p>Scale: 1:250 @ A1</p> <p>Drawing and CAD No: C305-DSJ-C2-DDA-CRT00_ST006_1-08303</p>

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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 Liverpool Street to
Farringdon (including Barbican Centre) - (Drive Y)
C305-DSJ-C2-RGN-CRG03-50176

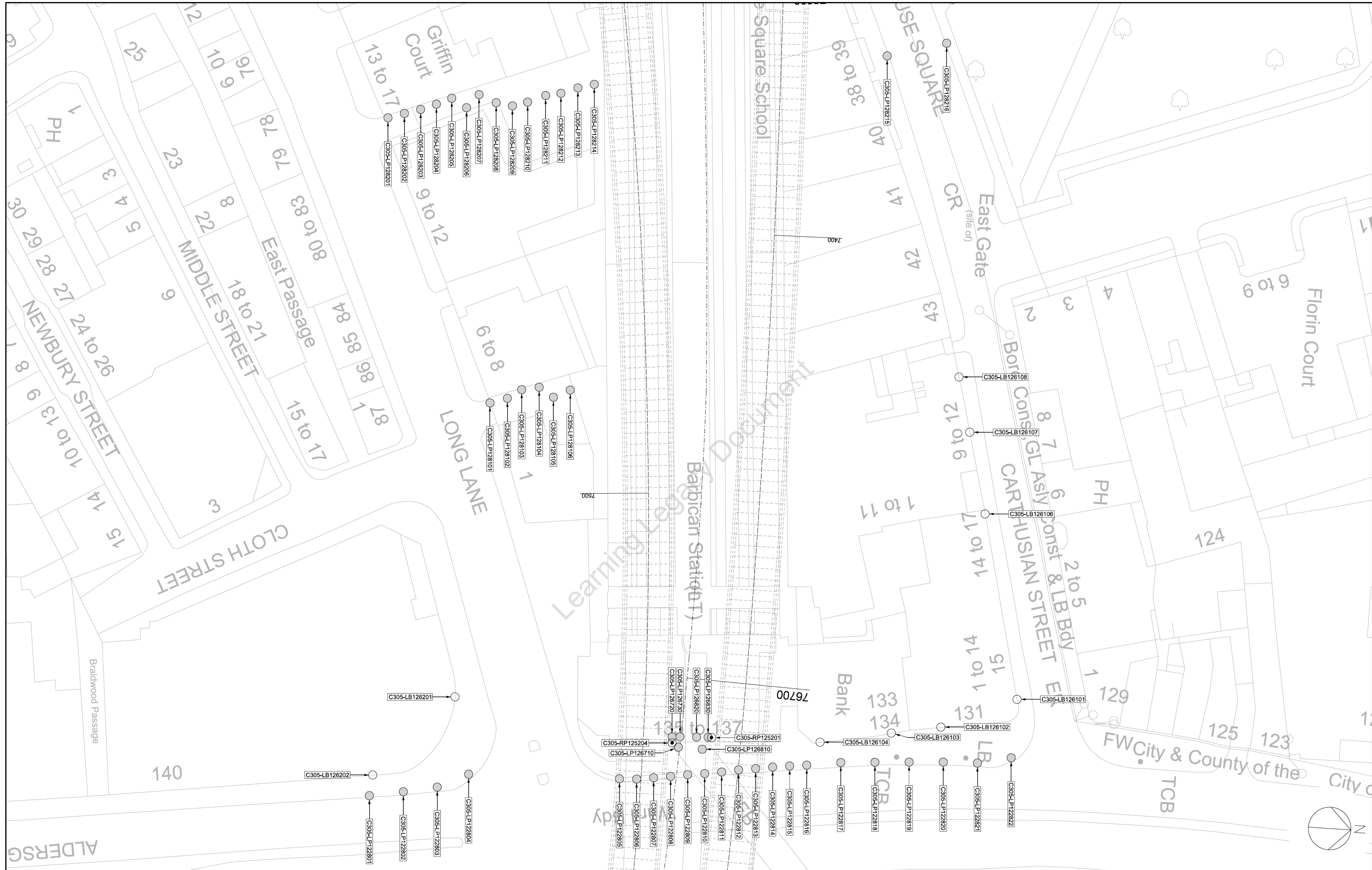
By: M.DAVIS
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APP: M.DAVIS
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1:250 @ A1

Drawing and CAD No:
C305-DSJ-C2-DDA-CRT00_ST006_1-08304

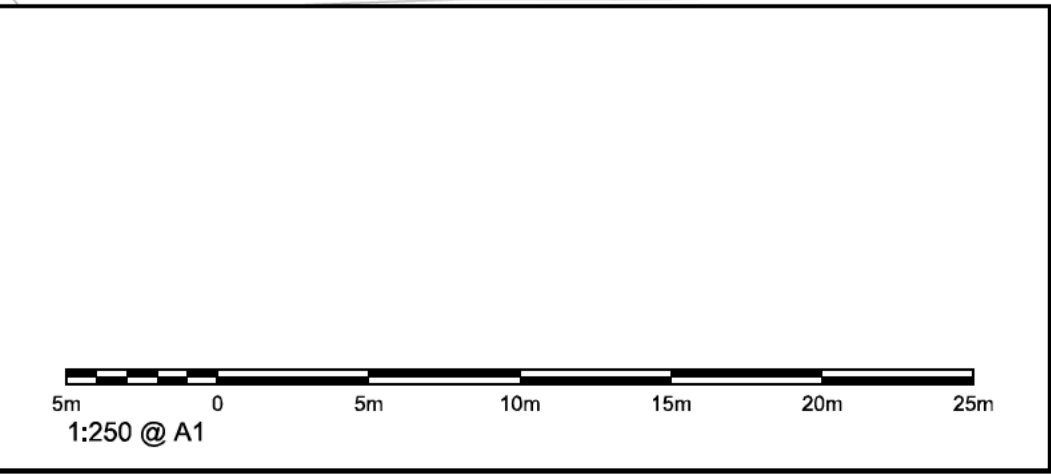
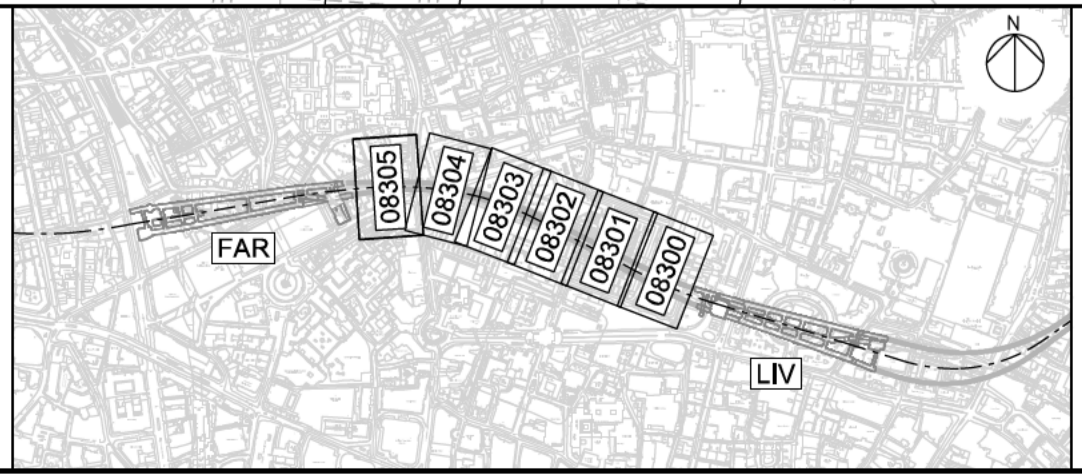
Rev: P01
Suitability: S4

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 - 3D Prisms



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	<p>Title: Instrumentation & Monitoring I&M Installation Report for Liverpool Street to Farringdon (including Barbican Centre) - (Drive Y) C305-DSJ-C2-RGN-CRG03-50176</p>	<p>Scale: 1:250 @ A1</p> <p>Drawing and CAD No: C305-DSJ-C2-DDA-CRT00_ST006_1-08305</p> <p>Rev: P01</p> <p>Suitability: S4</p>

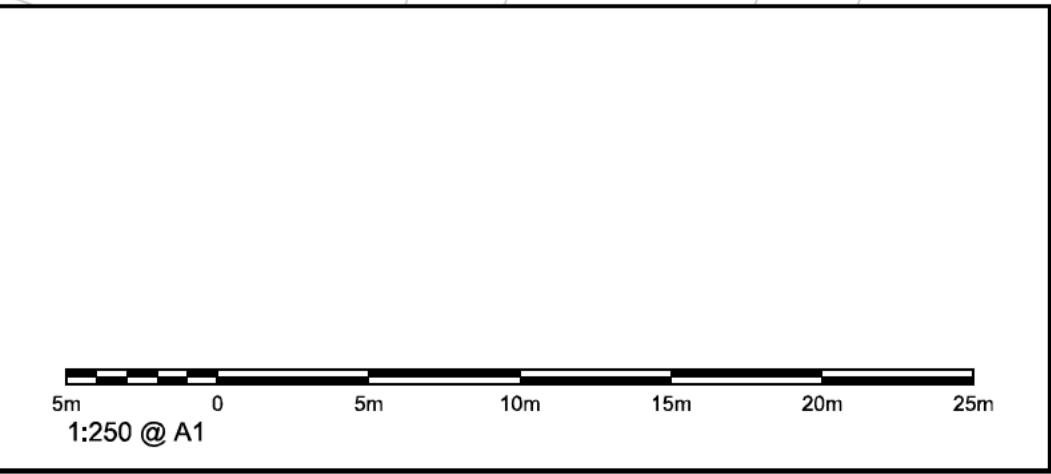
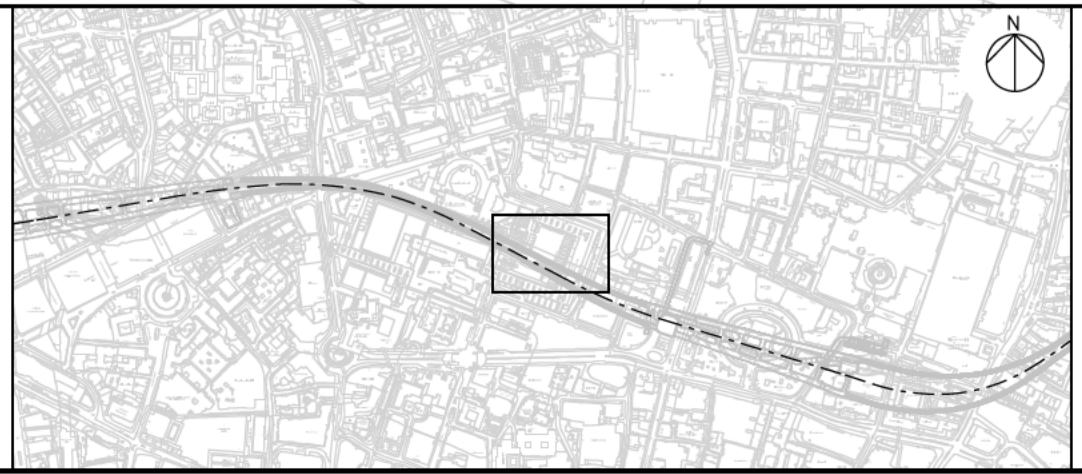
RESTRICTED



Rev.	Date	Description	By	Chkd	App	Auth
P01	15/04/2016	First Issue	MD	MD	MD	-

Notes

- ▽ Vibrating Wire Piezometer



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	<p>Title: Instrumentation & Monitoring I&M Installation Report for CP13, CP14 & CP5 Piezometers (Drive Y) C305-DSJ-C2-RGN-CRG03-50407</p>	<p>Scale: 1:250 @ A1</p>	<p>Rev: P01</p>
	<p>Drawing and CAD No: C305-DSJ-C2-DDA-CRT00_ST006_1-08286</p>	<p>Suitability: S4</p>	<p>Rev: P01</p>
	<p>Contract: FT for authorisation</p>		<p>Rev: P01</p>

APPENDIX B: SUMMARY OF INSTRUMENTATION INSTALLED ON SITE

Learning Legacy Document

IRS Installation Record Sheets – 3D Prism

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commisioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Eastings X (m)	Northings Y (m)	Elevation Z (mATD)
3D Prism	C305-RP122204	27-02-14	Installed	82863.121	36429.982	118.142	15-01-15	82863.121	36429.982	118.142
								82863.120	36429.983	118.143
								82863.120	36429.983	118.143
								82863.120	36429.983	118.143
3D Prism	C305-RP122205	27-02-14	Installed	82864.181	36432.857	120.151	15-01-15	82864.181	36432.857	120.151
								82864.180	36432.856	120.150
								82864.181	36432.856	120.150
								82864.181	36432.857	120.151
3D Prism	C305-RP122206	27-02-14	Installed	82866.534	36439.217	120.149	15-01-15	82866.534	36439.217	120.149
								82866.534	36439.217	120.149
								82866.534	36439.216	120.148
								82866.534	36439.216	120.149
3D Prism	C305-RP122207	27-02-14	Installed	82870.174	36449.074	120.139	15-01-15	82870.174	36449.074	120.139
								82870.174	36449.073	120.139
								82870.174	36449.074	120.139
								82870.174	36449.074	120.139
3D Prism	C305-RP122701	19-03-14	Installed	82629.839	36579.102	125.244	03-12-14	82629.839	36579.102	125.244
								82629.839	36579.102	125.244
								82629.839	36579.102	125.244
								82629.839	36579.102	125.244
3D Prism	C305-RP122704	19-03-14	Installed	82619.692	36561.152	125.249	03-12-14	82619.692	36561.152	125.249
								82619.692	36561.152	125.250
								82619.692	36561.152	125.250
								82619.691	36561.152	125.250
3D Prism	C305-RP122705	19-03-14	Installed	82611.098	36573.539	125.356	03-12-14	82611.098	36573.539	125.356
								82611.098	36573.539	125.355
								82611.098	36573.540	125.355
								82611.098	36573.540	125.355

IRS Installation Record Sheets – 3D Prism

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commisioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Eastings X (m)	Northings Y (m)	Elevation Z (mATD)
3D Prism	C305-RP122903	19-03-14	Installed	82584.434	36546.941	124.353	03-12-14	82584.434	36546.941	124.353
								82584.434	36546.941	124.353
								82584.434	36546.941	124.352
								82584.433	36546.941	124.352
3D Prism	C305-RP122905	19-03-14	Installed	82624.491	36532.089	124.286	03-12-14	82624.491	36532.089	124.286
								82624.491	36532.089	124.285
								82624.491	36532.089	124.285
								82624.491	36532.089	124.285
3D Prism	C305-RP122908	19-03-14	Installed	82641.302	36513.754	124.509	15-01-15	82641.302	36513.754	124.509
								82641.302	36513.754	124.510
								82641.302	36513.754	124.510
								82641.302	36513.754	124.509
3D Prism	C305-RP122909	19-03-14	Installed	82621.324	36521.151	124.440	15-01-15	82621.324	36521.151	124.440
								82621.324	36521.151	124.439
								82621.324	36521.151	124.440
								82621.324	36521.152	124.439
3D Prism	C305-RP122910	19-03-14	Installed	82601.326	36528.611	124.530	15-01-15	82601.326	36528.611	124.530
								82601.326	36528.611	124.529
								82601.325	36528.610	124.530
								82601.325	36528.610	124.529
3D Prism	C305-RP122911	19-03-14	Installed	82581.300	36536.046	124.514	15-01-15	82581.300	36536.046	124.514
								82581.300	36536.046	124.514
								82581.299	36536.046	124.514
								82581.300	36536.047	124.514
3D Prism	C305-RP125201	15-04-15	Installed	82442.500	36569.944	124.942	15-04-15	82442.500	36569.944	124.942
								82442.499	36569.944	124.943
								82442.500	36569.944	124.942
								82442.499	36569.944	124.942

IRS Installation Record Sheets – 3D Prism

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commisioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Eastings X (m)	Northings Y (m)	Elevation Z (mATD)
3D Prism	C305-RP125202	15-04-15	Installed	82464.209	36588.035	124.926	15-04-15	82464.209	36588.035	124.926
								82464.209	36588.035	124.925
								82464.209	36588.034	124.925
								82464.209	36588.034	124.925
3D Prism	C305-RP125203	15-04-15	Installed	82464.984	36583.383	124.943	15-04-15	82464.984	36583.383	124.943
								82464.984	36583.383	124.943
								82464.984	36583.383	124.943
								82464.983	36583.384	124.943
3D Prism	C305-RP125204	15-04-15	Installed	82443.663	36564.258	124.899	15-04-15	82443.663	36564.258	124.899
								82443.663	36564.258	124.899
								82443.662	36564.258	124.899
								82443.662	36564.258	124.899

Note: All elevations or levels presented in this document are metres above tunnel datum (mATD).

IRS Installation Record Sheets – Socket

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commisioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Elevation Z1 (mATD)	Elevation Z2 (mATD)	Elevation Z3 (mATD)
Socket	C305-LB122100	17-06-14	Installed	82828.530	36504.084	114.899	30-06-14	114.899	114.898	114.899
Socket	C305-LB122101	28-02-14	Installed	82847.800	36522.051	115.592	28-02-14	115.593	115.592	115.593
Socket	C305-LB122102	28-02-14	Installed	82881.871	36510.163	115.425	28-02-14	115.424	115.425	115.425
Socket	C305-LB122103	28-02-14	Installed	82914.096	36498.081	114.987	28-02-14	114.987	114.987	114.987
Socket	C305-LB122104	28-02-14	Installed	82927.206	36438.427	114.063	28-02-14	114.063	114.063	114.063
Socket	C305-LB122105	28-02-14	Installed	82919.471	36417.485	114.074	28-02-14	114.074	114.074	114.074
Socket	C305-LB122106	28-02-14	Installed	82902.669	36391.430	114.455	28-02-14	114.455	114.455	114.455
Socket	C305-LB122107	28-02-14	Installed	82889.873	36357.085	113.769	28-02-14	113.769	113.768	113.769
Socket	C305-LB122110	20-03-14	Installed	82751.090	36410.156	112.879	20-03-14	112.879	112.878	112.879
Socket	C305-LB122111	20-03-14	Installed	82739.857	36413.927	112.845	20-03-14	112.845	112.846	112.846
Socket	C305-LB122112	20-03-14	Installed	82743.226	36424.168	112.933	20-03-14	112.933	112.933	112.933
Socket	C305-LB122113	20-03-14	Installed	82765.443	36475.769	114.788	20-03-14	114.788	114.788	114.789
Socket	C305-LB122114	20-03-14	Installed	82770.519	36474.243	114.794	20-03-14	114.794	114.794	114.794
Socket	C305-LB122115	20-03-14	Installed	82777.520	36414.729	114.468	20-03-14	114.468	114.467	114.468
Socket	C305-LB122116	20-03-14	Installed	82798.134	36407.186	114.232	20-03-14	114.231	114.232	114.232
Socket	C305-LB122117	20-03-14	Installed	82818.033	36399.904	114.149	20-03-14	114.149	114.148	114.149
Socket	C305-LB122118	20-03-14	Installed	82838.553	36392.395	114.147	20-03-14	114.148	114.147	114.148
Socket	C305-LB122201	02-12-14	Installed	82865.680	36385.956	119.278	02-12-14	119.278	119.277	119.278
Socket	C305-LB122202	02-12-14	Installed	82866.352	36387.747	119.279	02-12-14	119.280	119.279	119.280
Socket	C305-LB122203	02-12-14	Installed	82867.535	36390.998	119.280	02-12-14	119.279	119.280	119.280
Socket	C305-LB122204	28-02-14	Installed	82862.880	36429.343	114.413	28-02-14	114.413	114.414	114.413
Socket	C305-LB122205	28-02-14	Installed	82863.974	36432.323	114.414	28-02-14	114.414	114.415	114.414
Socket	C305-LB122206	28-02-14	Installed	82867.070	36440.802	114.491	28-02-14	114.491	114.491	114.491
Socket	C305-LB122207	28-02-14	Installed	82870.372	36449.747	114.410	28-02-14	114.411	114.410	114.411
Socket	C305-LB122301	17-06-14	Installed	82832.063	36498.450	114.830	30-06-14	114.830	114.831	114.830
Socket	C305-LB122401	17-06-14	Installed	82826.905	36499.775	114.909	30-06-14	114.909	114.909	114.909
Socket	C305-LB122501	04-12-13	Installed	82725.287	36492.846	115.820	05-12-13	115.821	115.820	115.820
Socket	C305-LB122502	04-12-13	Installed	82741.891	36486.715	115.821	05-12-13	115.821	115.822	115.822
Socket	C305-LB122503	04-12-13	Installed	82759.085	36480.643	115.819	05-12-13	115.819	115.819	115.818
Socket	C305-LB122504	04-12-13	Installed	82774.508	36505.193	113.208	05-12-13	113.208	113.208	113.208
Socket	C305-LB122505	04-12-13	Installed	82783.244	36509.187	114.567	05-12-13	114.567	114.567	114.567
Socket	C305-LB122506	04-12-13	Installed	82795.383	36542.799	117.554	05-12-13	117.554	117.553	117.553
Socket	C305-LB122507	04-12-13	Installed	82805.304	36539.101	117.465	05-12-13	117.464	117.465	117.465

IRS Installation Record Sheets – Socket

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commisioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Elevation Z1 (mATD)	Elevation Z2 (mATD)	Elevation Z3 (mATD)
Socket	C305-LB122601	10-03-14	Installed	82664.297	36543.683	125.387	25-03-14	125.387	125.388	125.387
Socket	C305-LB122602	10-03-14	Installed	82661.407	36535.251	125.377	25-03-14	125.378	125.377	125.378
Socket	C305-LB122603	10-03-14	Installed	82674.910	36519.673	115.825	25-03-14	115.825	115.824	115.825
Socket	C305-LB122604	10-03-14	Installed	82691.336	36513.406	115.841	25-03-14	115.842	115.841	115.841
Socket	C305-LB122605	10-03-14	Installed	82708.121	36508.010	115.925	25-03-14	115.924	115.925	115.925
Socket	C305-LB122606	04-12-13	Installed	82697.415	36545.407	125.689	10-12-13	125.689	125.688	125.689
Socket	C305-LB122607	04-12-13	Installed	82687.355	36549.110	125.445	10-12-13	125.445	125.444	125.444
Socket	C305-LB122608	04-12-13	Installed	82677.810	36553.220	125.484	10-12-13	125.485	125.484	125.484
Socket	C305-LB122701	12-03-14	Installed	82635.545	36580.553	121.372	15-05-14	121.372	121.372	121.372
Socket	C305-LB122702	12-03-14	Installed	82641.246	36570.758	121.447	15-05-14	121.447	121.447	121.447
Socket	C305-LB122703	12-03-14	Installed	82635.475	36559.733	121.400	15-05-14	121.399	121.401	121.400
Socket	C305-LB122704	12-03-14	Installed	82611.250	36565.200	121.415	15-05-14	121.414	121.415	121.414
Socket	C305-LB122705	18-03-14	Installed	82615.632	36574.948	121.418	15-05-14	121.418	121.417	121.418
Socket	C305-LB122801*	28-02-14	Installed	82563.891	36602.141	NULL	NULL	NULL	NULL	NULL
Socket	C305-LB122802*	28-02-14	Installed	82557.390	36600.197	NULL	NULL	NULL	NULL	NULL
Socket	C305-LB122803*	28-02-14	Installed	82552.098	36615.044	NULL	NULL	NULL	NULL	NULL
Socket	C305-LB122901	12-03-14	Installed	82538.756	36557.883	121.364	24-03-14	121.364	121.365	121.364
Socket	C305-LB122902	12-03-14	Installed	82558.468	36554.783	121.266	24-03-14	121.266	121.266	121.266
Socket	C305-LB122903	12-03-14	Installed	82578.341	36547.615	121.267	24-03-14	121.267	121.266	121.266
Socket	C305-LB122904	12-03-14	Installed	82598.530	36540.131	121.384	24-03-14	121.384	121.383	121.384
Socket	C305-LB122905	12-03-14	Installed	82618.486	36532.728	121.233	24-03-14	121.234	121.233	121.233
Socket	C305-LB122906	12-03-14	Installed	82638.320	36525.174	121.349	24-03-14	121.350	121.349	121.349
Socket	C305-LB122907	04-12-13	Installed	82656.385	36514.067	115.810	05-12-13	115.810	115.810	115.809
Socket	C305-LB122908	12-03-14	Installed	82634.058	36518.194	121.203	24-03-14	121.203	121.203	121.202
Socket	C305-LB122909	12-03-14	Installed	82613.963	36525.402	121.210	24-03-14	121.210	121.210	121.210
Socket	C305-LB122910	12-03-14	Installed	82594.050	36532.877	121.203	24-03-14	121.204	121.203	121.203
Socket	C305-LB122911	12-03-14	Installed	82573.981	36540.016	121.289	24-03-14	121.289	121.289	121.289
Socket	C305-LB122912	12-03-14	Installed	82554.277	36547.538	121.247	24-03-14	121.248	121.247	121.247
Socket	C305-LB123101	13-03-14	Installed	82517.330	36510.828	118.456	17-03-14	118.456	118.456	118.456
Socket	C305-LB123102	13-03-14	Installed	82519.761	36502.978	118.540	17-03-14	118.540	118.540	118.540
Socket	C305-LB123201	13-03-14	Installed	82514.028	36545.350	118.656	17-03-14	118.656	118.656	118.656
Socket	C305-LB123202	13-03-14	Installed	82509.488	36532.329	118.639	17-03-14	118.639	118.639	118.639
Socket	C305-LB123203	13-03-14	Installed	82505.246	36520.674	118.523	17-03-14	118.522	118.523	118.523

IRS Installation Record Sheets – Socket

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commisioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Elevation Z1 (mATD)	Elevation Z2 (mATD)	Elevation Z3 (mATD)
Socket	C305-LB123204	13-03-14	Installed	82494.271	36513.472	118.359	17-03-14	118.359	118.359	118.359
Socket	C305-LB123205	13-03-14	Installed	82489.141	36527.061	118.505	17-03-14	118.505	118.505	118.505
Socket	C305-LB123206	13-03-14	Installed	82485.997	36538.022	118.522	17-03-14	118.522	118.521	118.522
Socket	C305-LB123301*	22-05-14	Installed	82479.408	36604.321	NULL	NULL	NULL	NULL	NULL
Socket	C305-LB123302*	22-05-14	Installed	82482.093	36595.072	NULL	NULL	NULL	NULL	NULL
Socket	C305-LB123303*	22-05-14	Installed	82485.427	36584.136	NULL	NULL	NULL	NULL	NULL
Socket	C305-LB123304	28-02-14	Installed	82501.022	36587.324	124.471	24-03-14	124.470	124.471	124.470
Socket	C305-LB123305	28-02-14	Installed	82499.120	36600.086	124.438	24-03-14	124.437	124.438	124.438
Socket	C305-LB123306	28-02-14	Installed	82496.228	36610.155	124.478	24-03-14	124.478	124.478	124.478
Socket	C305-LB124001	27-11-14	Installed	82768.573	36470.311	122.162	28-11-14	122.163	122.162	122.163
Socket	C305-LB124002	27-11-14	Installed	82764.746	36460.365	122.150	28-11-14	122.150	122.150	122.150
Socket	C305-LB124003	27-11-14	Installed	82760.919	36450.508	122.176	28-11-14	122.176	122.175	122.176
Socket	C305-LB124004	27-11-14	Installed	82757.420	36441.135	122.177	28-11-14	122.177	122.177	122.177
Socket	C305-LB124005	27-11-14	Installed	82753.623	36431.188	122.160	28-11-14	122.160	122.161	122.160
Socket	C305-LB124006	27-11-14	Installed	82749.981	36421.291	122.200	28-11-14	122.200	122.199	122.200
Socket	C305-LB124007	27-11-14	Installed	82745.220	36423.131	122.215	28-11-14	122.216	122.215	122.215
Socket	C305-LB124008	27-11-14	Installed	82749.121	36432.937	122.186	28-11-14	122.187	122.185	122.186
Socket	C305-LB124009	27-11-14	Installed	82752.978	36442.772	122.178	28-11-14	122.178	122.178	122.178
Socket	C305-LB124010	27-11-14	Installed	82756.554	36452.104	122.175	28-11-14	122.176	122.175	122.175
Socket	C305-LB124011	27-11-14	Installed	82760.334	36462.047	122.159	28-11-14	122.159	122.159	122.160
Socket	C305-LB124012	27-11-14	Installed	82764.118	36471.996	122.157	28-11-14	122.157	122.157	122.157
Socket	C305-LB126101	07-04-14	Installed	82433.919	36614.178	118.994	12-05-14	118.994	118.993	118.994
Socket	C305-LB126102	07-04-14	Installed	82438.707	36603.330	119.086	12-05-14	119.086	119.086	119.087
Socket	C305-LB126103	07-04-14	Installed	82440.066	36596.156	118.601	12-05-14	118.602	118.601	118.601
Socket	C305-LB126104	07-04-14	Installed	82442.100	36585.841	118.384	12-05-14	118.384	118.385	118.384
Socket	C305-LB126106	07-04-14	Installed	82407.155	36607.711	119.106	12-05-14	119.106	119.105	119.106
Socket	C305-LB126107	07-04-14	Installed	82395.374	36604.677	118.523	12-05-14	118.523	118.523	118.523
Socket	C305-LB126108	07-04-14	Installed	82387.415	36602.553	118.562	12-05-14	118.563	118.562	118.563
Socket	C305-LB126201	07-04-14	Installed	82439.050	36532.082	119.137	12-05-14	119.136	119.137	119.137
Socket	C305-LB126202	07-04-14	Installed	82451.257	36520.841	118.903	12-05-14	118.904	118.903	118.903

*Note: All elevations or levels presented in this document are metres above tunnel datum (mATD).
(*These sockets were installed but we couldn't have acces to monitoring them).*

IRS Installation Record Sheets – Levelling Point

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commissioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Elevation Z1 (mATD)	Elevation Z2 (mATD)	Elevation Z3 (mATD)
Levelling Point	C305-LP122101	06-01-14	Installed	82886.280	36344.325	113.431	08-01-14	113.431	113.431	113.431
Levelling Point	C305-LP122102	06-01-14	Installed	82888.776	36348.658	113.356	08-01-14	113.356	113.356	113.356
Levelling Point	C305-LP122103	06-01-14	Installed	82891.341	36352.949	113.358	08-01-14	113.358	113.358	113.359
Levelling Point	C305-LP122104	06-01-14	Installed	82894.012	36357.176	113.324	08-01-14	113.324	113.325	113.325
Levelling Point	C305-LP122105	06-01-14	Installed	82896.634	36361.433	113.356	08-01-14	113.356	113.356	113.356
Levelling Point	C305-LP122106	06-01-14	Installed	82899.236	36365.703	113.463	08-01-14	113.463	113.463	113.463
Levelling Point	C305-LP122107	06-01-14	Installed	82901.839	36369.972	113.565	08-01-14	113.565	113.565	113.565
Levelling Point	C305-LP122108	06-01-14	Installed	82903.233	36374.772	113.843	08-01-14	113.843	113.843	113.844
Levelling Point	C305-LP122109	06-01-14	Installed	82909.682	36384.745	113.921	08-01-14	113.921	113.922	113.922
Levelling Point	C305-LP122110	06-01-14	Installed	82911.603	36386.344	113.942	08-01-14	113.942	113.941	113.941
Levelling Point	C305-LP122111	06-01-14	Installed	82912.475	36388.688	113.937	08-01-14	113.937	113.937	113.937
Levelling Point	C305-LP122112	06-01-14	Installed	82913.346	36391.031	113.941	08-01-14	113.941	113.941	113.941
Levelling Point	C305-LP122113	06-01-14	Installed	82914.218	36393.374	113.937	08-01-14	113.937	113.937	113.937
Levelling Point	C305-LP122114	06-01-14	Installed	82915.070	36395.724	113.928	08-01-14	113.928	113.929	113.929
Levelling Point	C305-LP122115	06-01-14	Installed	82915.907	36398.080	113.916	08-01-14	113.916	113.915	113.916
Levelling Point	C305-LP122116	06-01-14	Installed	82916.744	36400.435	113.900	08-01-14	113.900	113.900	113.900
Levelling Point	C305-LP122117	06-01-14	Installed	82917.581	36402.791	113.886	08-01-14	113.886	113.886	113.886
Levelling Point	C305-LP122118	06-01-14	Installed	82918.418	36405.147	113.891	08-01-14	113.891	113.890	113.890
Levelling Point	C305-LP122119	06-01-14	Installed	82919.255	36407.503	113.872	08-01-14	113.872	113.872	113.872
Levelling Point	C305-LP122120	06-01-14	Installed	82920.092	36409.858	113.849	08-01-14	113.849	113.849	113.849
Levelling Point	C305-LP122121	06-01-14	Installed	82920.957	36412.204	113.832	08-01-14	113.832	113.832	113.832
Levelling Point	C305-LP122122	06-01-14	Installed	82921.831	36414.546	113.816	08-01-14	113.816	113.816	113.816
Levelling Point	C305-LP122123	06-01-14	Installed	82922.705	36416.888	113.800	08-01-14	113.800	113.800	113.800
Levelling Point	C305-LP122124	06-01-14	Installed	82923.579	36419.231	113.777	08-01-14	113.777	113.777	113.777
Levelling Point	C305-LP122125	06-01-14	Installed	82925.327	36423.915	113.727	08-01-14	113.727	113.727	113.727
Levelling Point	C305-LP122126	06-01-14	Installed	82927.089	36428.594	113.725	08-01-14	113.725	113.725	113.725
Levelling Point	C305-LP122127	06-01-14	Installed	82929.069	36436.134	113.572	08-01-14	113.572	113.572	113.572
Levelling Point	C305-LP122128	06-01-14	Installed	82931.350	36440.584	113.678	08-01-14	113.678	113.678	113.679
Levelling Point	C305-LP122129	06-01-14	Installed	82932.036	36445.260	113.654	08-01-14	113.654	113.654	113.653
Levelling Point	C305-LP122130	06-01-14	Installed	82933.462	36451.373	113.822	08-01-14	113.822	113.822	113.822
Levelling Point	C305-LP122401	07-01-14	Installed	82755.267	36467.424	114.470	10-01-14	114.470	114.470	114.469
Levelling Point	C305-LP122402	07-01-14	Installed	82756.130	36469.770	114.480	10-01-14	114.480	114.480	114.479
Levelling Point	C305-LP122403	07-01-14	Installed	82756.992	36472.117	114.480	10-01-14	114.480	114.480	114.480

IRS Installation Record Sheets – Levelling Point

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commissioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Elevation Z1 (mATD)	Elevation Z2 (mATD)	Elevation Z3 (mATD)
Levelling Point	C305-LP122404	07-01-14	Installed	82757.855	36474.463	114.475	10-01-14	114.475	114.474	114.474
Levelling Point	C305-LP122405	07-01-14	Installed	82758.718	36476.810	114.468	10-01-14	114.468	114.468	114.468
Levelling Point	C305-LP122406	07-01-14	Installed	82759.581	36479.156	114.471	10-01-14	114.471	114.471	114.471
Levelling Point	C305-LP122407	07-01-14	Installed	82760.448	36481.501	114.472	10-01-14	114.472	114.472	114.472
Levelling Point	C305-LP122408	07-01-14	Installed	82761.325	36483.842	114.478	10-01-14	114.478	114.478	114.478
Levelling Point	C305-LP122409	07-01-14	Installed	82762.203	36486.182	114.487	10-01-14	114.487	114.487	114.487
Levelling Point	C305-LP122410	07-01-14	Installed	82763.081	36488.523	114.482	10-01-14	114.482	114.482	114.483
Levelling Point	C305-LP122501	07-01-14	Installed	82716.096	36483.086	114.486	10-01-14	114.486	114.486	114.486
Levelling Point	C305-LP122502	07-01-14	Installed	82716.940	36485.417	114.496	10-01-14	114.496	114.496	114.496
Levelling Point	C305-LP122503	07-01-14	Installed	82717.795	36487.763	114.494	10-01-14	114.494	114.494	114.494
Levelling Point	C305-LP122504	07-01-14	Installed	82718.676	36490.156	114.504	10-01-14	114.504	114.504	114.504
Levelling Point	C305-LP122505	07-01-14	Installed	82719.549	36492.501	114.503	10-01-14	114.503	114.504	114.504
Levelling Point	C305-LP122506	07-01-14	Installed	82720.389	36494.769	114.499	10-01-14	114.499	114.499	114.499
Levelling Point	C305-LP122507	07-01-14	Installed	82721.105	36496.683	114.501	10-01-14	114.501	114.501	114.500
Levelling Point	C305-LP122508	07-01-14	Installed	82721.943	36499.021	114.494	10-01-14	114.494	114.493	114.493
Levelling Point	C305-LP122509	07-01-14	Installed	82722.796	36501.389	114.485	10-01-14	114.485	114.485	114.485
Levelling Point	C305-LP122601	05-03-14	Installed	82607.888	36512.706	112.537	25-03-14	112.537	112.537	112.537
Levelling Point	C305-LP122602	05-03-14	Installed	82606.267	36507.976	112.576	25-03-14	112.576	112.576	112.576
Levelling Point	C305-LP122603	05-03-14	Installed	82604.456	36503.316	112.580	25-03-14	112.580	112.580	112.580
Levelling Point	C305-LP122604	05-03-14	Installed	82602.764	36498.614	112.582	25-03-14	112.582	112.582	112.582
Levelling Point	C305-LP122605	05-03-14	Installed	82600.957	36493.952	112.578	25-03-14	112.578	112.578	112.577
Levelling Point	C305-LP122606	05-03-14	Installed	82599.325	36489.226	112.578	25-03-14	112.578	112.577	112.577
Levelling Point	C305-LP122607	05-03-14	Installed	82597.614	36484.533	112.568	25-03-14	112.568	112.568	112.568
Levelling Point	C305-LP122608	05-03-14	Installed	82595.830	36479.862	112.566	25-03-14	112.566	112.566	112.567
Levelling Point	C305-LP122609	05-03-14	Installed	82594.213	36475.130	112.563	25-03-14	112.563	112.563	112.563
Levelling Point	C305-LP122610	05-03-14	Installed	82592.437	36470.462	112.559	25-03-14	112.559	112.559	112.559
Levelling Point	C305-LP122701	05-03-14	Installed	82556.599	36532.147	112.542	25-03-14	112.542	112.542	112.542
Levelling Point	C305-LP122702	05-03-14	Installed	82555.057	36527.395	112.560	25-03-14	112.560	112.560	112.560
Levelling Point	C305-LP122703	05-03-14	Installed	82553.407	36522.676	112.548	25-03-14	112.548	112.548	112.548
Levelling Point	C305-LP122704	05-03-14	Installed	82551.723	36517.973	112.564	25-03-14	112.564	112.564	112.564
Levelling Point	C305-LP122705	05-03-14	Installed	82549.967	36513.291	112.563	25-03-14	112.563	112.563	112.563
Levelling Point	C305-LP122706	05-03-14	Installed	82548.265	36508.590	112.545	25-03-14	112.545	112.544	112.544
Levelling Point	C305-LP122707	05-03-14	Installed	82546.618	36503.875	112.538	25-03-14	112.538	112.538	112.537

IRS Installation Record Sheets – Levelling Point

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commisioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Elevation Z1 (mATD)	Elevation Z2 (mATD)	Elevation Z3 (mATD)
Levelling Point	C305-LP122708	05-03-14	Installed	82544.907	36499.178	112.563	25-03-14	112.563	112.562	112.562
Levelling Point	C305-LP122709	05-03-14	Installed	82543.194	36494.480	112.556	25-03-14	112.556	112.556	112.556
Levelling Point	C305-LP122710	05-03-14	Installed	82541.518	36489.770	112.563	25-03-14	112.563	112.563	112.563
Levelling Point	C305-LP122801	27-01-14	Installed	82454.302	36520.557	117.525	28-01-14	117.525	117.525	117.525
Levelling Point	C305-LP122802	27-01-14	Installed	82453.404	36525.476	117.568	28-01-14	117.568	117.568	117.568
Levelling Point	C305-LP122803	27-01-14	Installed	82452.394	36530.373	117.493	28-01-14	117.493	117.494	117.494
Levelling Point	C305-LP122804	27-01-14	Installed	82450.203	36534.833	117.772	28-01-14	117.772	117.772	117.773
Levelling Point	C305-LP122805	27-01-14	Installed	82449.396	36556.906	117.829	28-01-14	117.829	117.829	117.829
Levelling Point	C305-LP122806	27-01-14	Installed	82449.276	36559.414	117.856	28-01-14	117.856	117.855	117.855
Levelling Point	C305-LP122807	27-01-14	Installed	82448.902	36561.881	117.889	28-01-14	117.889	117.889	117.889
Levelling Point	C305-LP122808	27-01-14	Installed	82448.542	36564.357	117.912	28-01-14	117.912	117.911	117.911
Levelling Point	C305-LP122809	27-01-14	Installed	82448.129	36566.823	117.926	28-01-14	117.926	117.926	117.926
Levelling Point	C305-LP122810	27-01-14	Installed	82447.808	36569.302	117.940	28-01-14	117.940	117.940	117.940
Levelling Point	C305-LP122811	27-01-14	Installed	82447.409	36571.763	118.003	28-01-14	118.003	118.002	118.002
Levelling Point	C305-LP122812	27-01-14	Installed	82446.936	36574.214	117.873	28-01-14	117.873	117.873	117.873
Levelling Point	C305-LP122813	27-01-14	Installed	82446.578	36576.688	118.046	28-01-14	118.046	118.046	118.046
Levelling Point	C305-LP122814	27-01-14	Installed	82446.187	36579.157	118.068	28-01-14	118.068	118.067	118.068
Levelling Point	C305-LP122815	28-01-14	Installed	82445.869	36581.637	118.105	28-01-14	118.105	118.105	118.105
Levelling Point	C305-LP122816	28-01-14	Installed	82445.569	36584.119	118.140	28-01-14	118.140	118.140	118.139
Levelling Point	C305-LP122817	28-01-14	Installed	82444.870	36589.066	118.214	28-01-14	118.214	118.214	118.214
Levelling Point	C305-LP122818	28-01-14	Installed	82444.494	36594.052	118.272	28-01-14	118.272	118.271	118.271
Levelling Point	C305-LP122819	28-01-14	Installed	82444.134	36599.039	118.346	28-01-14	118.346	118.346	118.346
Levelling Point	C305-LP122820	28-01-14	Installed	82443.803	36604.028	118.401	28-01-14	118.401	118.401	118.402
Levelling Point	C305-LP122821	28-01-14	Installed	82443.613	36609.025	118.476	28-01-14	118.476	118.476	118.476
Levelling Point	C305-LP122822	28-01-14	Installed	82442.509	36613.901	118.534	28-01-14	118.534	118.535	118.534
Levelling Point	C305-LP122901	07-01-14	Installed	82660.112	36504.804	114.509	10-01-14	114.509	114.509	114.509
Levelling Point	C305-LP122902	07-01-14	Installed	82670.146	36501.209	114.501	10-01-14	114.501	114.501	114.501
Levelling Point	C305-LP122903	07-01-14	Installed	82680.132	36497.420	114.501	10-01-14	114.501	114.501	114.501
Levelling Point	C305-LP122904	07-01-14	Installed	82690.167	36493.834	114.500	10-01-14	114.500	114.500	114.500
Levelling Point	C305-LP122905	07-01-14	Installed	82700.191	36490.125	114.494	10-01-14	114.494	114.493	114.494
Levelling Point	C305-LP122906	07-01-14	Installed	82728.754	36477.122	114.479	10-01-14	114.479	114.479	114.479
Levelling Point	C305-LP122907	07-01-14	Installed	82741.964	36472.290	114.456	10-01-14	114.456	114.456	114.455
Levelling Point	C305-LP122908	07-01-14	Installed	82767.383	36462.992	114.468	10-01-14	114.468	114.467	114.467

IRS Installation Record Sheets – Levelling Point

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commissioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Elevation Z1 (mATD)	Elevation Z2 (mATD)	Elevation Z3 (mATD)
Levelling Point	C305-LP122909	01-04-14	Installed	82776.468	36458.843	114.469	09-04-14	114.469	114.469	114.469
Levelling Point	C305-LP122910	01-04-14	Installed	82785.806	36455.265	114.476	09-04-14	114.476	114.476	114.476
Levelling Point	C305-LP122911	01-04-14	Installed	82795.144	36451.688	114.480	09-04-14	114.480	114.480	114.480
Levelling Point	C305-LP122912	01-04-14	Installed	82804.482	36448.110	114.478	09-04-14	114.478	114.478	114.478
Levelling Point	C305-LP122913	01-04-14	Installed	82813.820	36444.533	114.479	09-04-14	114.479	114.479	114.479
Levelling Point	C305-LP124001	27-01-14	Installed	82469.314	36522.059	117.599	28-01-14	117.599	117.599	117.600
Levelling Point	C305-LP124002	27-01-14	Installed	82468.888	36527.041	117.595	28-01-14	117.595	117.595	117.595
Levelling Point	C305-LP124003	27-01-14	Installed	82468.212	36531.995	117.526	28-01-14	117.526	117.525	117.526
Levelling Point	C305-LP124004	27-01-14	Installed	82467.630	36536.961	117.699	28-01-14	117.699	117.699	117.698
Levelling Point	C305-LP124005	27-01-14	Installed	82467.382	36541.970	117.745	28-01-14	117.745	117.745	117.745
Levelling Point	C305-LP124006	27-01-14	Installed	82468.015	36546.877	117.805	28-01-14	117.805	117.805	117.805
Levelling Point	C305-LP124007	27-01-14	Installed	82469.637	36550.813	117.891	28-01-14	117.891	117.891	117.890
Levelling Point	C305-LP124008	27-01-14	Installed	82473.769	36553.628	117.900	28-01-14	117.900	117.900	117.900
Levelling Point	C305-LP124009	27-01-14	Installed	82478.559	36555.062	117.895	28-01-14	117.895	117.896	117.896
Levelling Point	C305-LP124010	27-01-14	Installed	82480.912	36555.907	117.901	28-01-14	117.901	117.901	117.901
Levelling Point	C305-LP124011	27-01-14	Installed	82483.341	36556.498	117.822	28-01-14	117.822	117.822	117.821
Levelling Point	C305-LP124012	27-01-14	Installed	82485.747	36557.177	117.810	28-01-14	117.810	117.810	117.810
Levelling Point	C305-LP124013	27-01-14	Installed	82488.117	36557.972	117.809	28-01-14	117.809	117.809	117.808
Levelling Point	C305-LP124014	27-01-14	Installed	82490.504	36558.710	117.817	28-01-14	117.817	117.817	117.817
Levelling Point	C305-LP124015	27-01-14	Installed	82492.893	36559.426	117.912	28-01-14	117.912	117.912	117.912
Levelling Point	C305-LP124016	27-01-14	Installed	82495.280	36560.169	117.936	28-01-14	117.936	117.936	117.936
Levelling Point	C305-LP124017	27-01-14	Installed	82497.716	36560.731	117.953	28-01-14	117.953	117.953	117.953
Levelling Point	C305-LP124018	27-01-14	Installed	82500.091	36561.527	117.959	28-01-14	117.959	117.959	117.960
Levelling Point	C305-LP124019	27-01-14	Installed	82502.491	36562.187	117.965	28-01-14	117.965	117.965	117.965
Levelling Point	C305-LP124020	27-01-14	Installed	82504.906	36562.840	117.966	28-01-14	117.966	117.965	117.965
Levelling Point	C305-LP124021	27-01-14	Installed	82507.282	36563.597	117.973	28-01-14	117.973	117.973	117.973
Levelling Point	C305-LP124022	27-01-14	Installed	82509.667	36564.355	117.976	28-01-14	117.976	117.976	117.976
Levelling Point	C305-LP124023	27-01-14	Installed	82512.064	36565.054	117.986	28-01-14	117.986	117.987	117.987
Levelling Point	C305-LP124024	27-01-14	Installed	82514.464	36565.750	117.986	28-01-14	117.986	117.986	117.986
Levelling Point	C305-LP124025	27-01-14	Installed	82516.847	36566.499	117.982	28-01-14	117.982	117.982	117.982
Levelling Point	C305-LP124026	27-01-14	Installed	82519.276	36567.090	117.995	28-01-14	117.995	117.995	117.995
Levelling Point	C305-LP124027	27-01-14	Installed	82521.712	36567.721	117.994	28-01-14	117.994	117.994	117.994
Levelling Point	C305-LP124028	27-01-14	Installed	82524.079	36568.487	117.942	28-01-14	117.942	117.942	117.942

IRS Installation Record Sheets – Levelling Point

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commissioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Elevation Z1 (mATD)	Elevation Z2 (mATD)	Elevation Z3 (mATD)
Levelling Point	C305-LP124029	27-01-14	Installed	82526.457	36569.222	117.989	28-01-14	117.989	117.989	117.989
Levelling Point	C305-LP124030	27-01-14	Installed	82531.243	36570.667	117.953	28-01-14	117.953	117.953	117.953
Levelling Point	C305-LP124031	27-01-14	Installed	82536.044	36572.056	117.950	28-01-14	117.950	117.950	117.950
Levelling Point	C305-LP124032	27-01-14	Installed	82540.875	36573.304	117.952	28-01-14	117.952	117.952	117.951
Levelling Point	C305-LP124033	27-01-14	Installed	82545.665	36574.727	117.954	28-01-14	117.954	117.954	117.954
Levelling Point	C305-LP124034	27-01-14	Installed	82550.455	36576.171	117.960	28-01-14	117.960	117.960	117.960
Levelling Point	C305-LP124035	27-01-14	Installed	82555.303	36577.390	117.972	28-01-14	117.972	117.972	117.972
Levelling Point	C305-LP124036	27-01-14	Installed	82560.039	36579.003	117.983	28-01-14	117.983	117.983	117.983
Levelling Point	C305-LP124037	27-01-14	Installed	82564.892	36580.227	117.879	28-01-14	117.879	117.879	117.879
Levelling Point	C305-LP124038	27-01-14	Installed	82569.680	36581.656	117.852	28-01-14	117.852	117.852	117.852
Levelling Point	C305-LP124039	27-01-14	Installed	82574.456	36583.145	117.947	28-01-14	117.947	117.947	117.947
Levelling Point	C305-LP124040	27-01-14	Installed	82579.267	36584.500	117.933	28-01-14	117.933	117.933	117.933
Levelling Point	C305-LP124041	27-01-14	Installed	82584.073	36585.872	117.917	28-01-14	117.917	117.917	117.917
Levelling Point	C305-LP124042	27-01-14	Installed	82588.832	36587.384	117.904	28-01-14	117.904	117.904	117.904
Levelling Point	C305-LP124043	27-01-14	Installed	82593.665	36588.665	117.886	28-01-14	117.886	117.886	117.886
Levelling Point	C305-LP125001	28-03-14	Installed	82978.574	36330.432	113.660	02-07-14	113.660	113.660	113.660
Levelling Point	C305-LP125002	28-03-14	Installed	82977.682	36328.096	113.646	03-07-14	113.647	113.646	113.646
Levelling Point	C305-LP125003	28-03-14	Installed	82976.791	36325.761	113.634	04-07-14	113.634	113.634	113.634
Levelling Point	C305-LP125004	28-03-14	Installed	82975.900	36323.425	113.730	05-07-14	113.730	113.731	113.731
Levelling Point	C305-LP125005	28-03-14	Installed	82975.008	36321.089	113.710	06-07-14	113.710	113.710	113.709
Levelling Point	C305-LP125006	28-03-14	Installed	82974.117	36318.754	113.690	07-07-14	113.692	113.692	113.692
Levelling Point	C305-LP125007	28-03-14	Installed	82972.334	36314.082	113.641	08-07-14	113.641	113.642	113.642
Levelling Point	C305-LP125008	28-03-14	Installed	82970.552	36309.411	113.604	09-07-14	113.605	113.605	113.604
Levelling Point	C305-LP125009	28-03-14	Installed	82968.768	36304.740	113.562	10-07-14	113.563	113.563	113.563
Levelling Point	C305-LP125010	28-03-14	Installed	82966.985	36300.068	113.536	11-07-14	113.536	113.536	113.536
Levelling Point	C305-LP125011	28-03-14	Installed	82965.203	36295.397	113.482	12-07-14	113.482	113.482	113.482
Levelling Point	C305-LP125012	28-03-14	Installed	82961.891	36306.481	113.562	13-07-14	113.562	113.562	113.562
Levelling Point	C305-LP125013	28-03-14	Installed	82957.203	36308.216	113.567	14-07-14	113.567	113.567	113.567
Levelling Point	C305-LP125014	28-03-14	Installed	82952.514	36309.951	113.586	15-07-14	113.586	113.585	113.585
Levelling Point	C305-LP125015	28-03-14	Installed	82947.825	36311.686	113.594	16-07-14	113.594	113.594	113.594
Levelling Point	C305-LP125016	28-03-14	Installed	82943.135	36313.422	113.602	17-07-14	113.602	113.601	113.601
Levelling Point	C305-LP125017	28-03-14	Installed	82938.446	36315.157	113.610	18-07-14	113.610	113.610	113.610
Levelling Point	C305-LP125018	28-03-14	Installed	82933.757	36316.892	113.612	19-07-14	113.612	113.612	113.612

IRS Installation Record Sheets – Levelling Point

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commissioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Elevation Z1 (mATD)	Elevation Z2 (mATD)	Elevation Z3 (mATD)
Levelling Point	C305-LP125019	28-03-14	Installed	82929.068	36318.628	113.622	20-07-14	113.622	113.622	113.622
Levelling Point	C305-LP125020	28-03-14	Installed	82924.379	36320.363	113.656	21-07-14	113.656	113.656	113.656
Levelling Point	C305-LP125021	28-03-14	Installed	82919.689	36322.098	113.670	22-07-14	113.670	113.670	113.670
Levelling Point	C305-LP125022	28-03-14	Installed	82915.000	36323.834	113.688	23-07-14	113.688	113.688	113.688
Levelling Point	C305-LP126110	23-05-14	Installed	82924.072	36380.767	120.796	03-07-14	120.796	120.796	120.796
Levelling Point	C305-LP126120	23-05-14	Installed	82922.464	36380.576	120.799	03-07-14	120.799	120.800	120.799
Levelling Point	C305-LP126130	23-05-14	Installed	82922.894	36381.704	120.799	03-07-14	120.799	120.798	120.798
Levelling Point	C305-LP126210	23-05-14	Installed	82922.893	36377.578	120.824	03-07-14	120.824	120.824	120.823
Levelling Point	C305-LP126220	23-05-14	Installed	82921.263	36377.675	120.827	03-07-14	120.827	120.827	120.827
Levelling Point	C305-LP126230	23-05-14	Installed	82921.716	36378.902	120.824	03-07-14	120.824	120.824	120.824
Levelling Point	C305-LP126310	23-05-14	Installed	82901.680	36385.183	120.987	03-07-14	120.987	120.987	120.986
Levelling Point	C305-LP126320	23-05-14	Installed	82899.526	36385.515	120.986	03-07-14	120.986	120.986	120.986
Levelling Point	C305-LP126330	23-05-14	Installed	82899.817	36386.987	120.984	03-07-14	120.984	120.984	120.984
Levelling Point	C305-LP126410	23-05-14	Installed	82902.915	36388.687	120.990	03-07-14	120.990	120.990	120.991
Levelling Point	C305-LP126420	23-05-14	Installed	82900.529	36389.251	120.991	03-07-14	120.991	120.991	120.990
Levelling Point	C305-LP126430	23-05-14	Installed	82900.990	36390.454	120.992	03-07-14	120.992	120.993	120.992
Levelling Point	C305-LP126510*	22-05-14	Installed	82465.376	36587.487	NULL	03-07-14	NULL	NULL	NULL
Levelling Point	C305-LP126520*	22-05-14	Installed	82463.949	36586.428	NULL	03-07-14	NULL	NULL	NULL
Levelling Point	C305-LP126530*	22-05-14	Installed	82463.786	36587.943	NULL	03-07-14	NULL	NULL	NULL
Levelling Point	C305-LP126610	22-05-14	Installed	82465.811	36584.166	124.628	03-07-14	124.628	124.628	124.628
Levelling Point	C305-LP126620	22-05-14	Installed	82464.537	36583.510	124.618	03-07-14	124.618	124.617	124.617
Levelling Point	C305-LP126630	22-05-14	Installed	82464.400	36584.720	124.618	03-07-14	124.618	124.618	124.618
Levelling Point	C305-LP126710	23-05-14	Installed	82444.213	36565.198	124.578	03-07-14	124.578	124.579	124.579
Levelling Point	C305-LP126720	23-05-14	Installed	82442.779	36564.192	124.593	03-07-14	124.593	124.592	124.593
Levelling Point	C305-LP126730	23-05-14	Installed	82442.678	36565.341	124.592	03-07-14	124.592	124.592	124.592
Levelling Point	C305-LP126810	23-05-14	Installed	82444.279	36568.706	124.602	03-07-14	124.602	124.602	124.602
Levelling Point	C305-LP126820	23-05-14	Installed	82442.561	36567.761	124.597	03-07-14	124.597	124.597	124.597
Levelling Point	C305-LP126830	23-05-14	Installed	82442.464	36569.441	124.598	03-07-14	124.598	124.599	124.599
Levelling Point	C305-LP128101	04-03-15	Installed	82395.781	36534.324	118.016	28-04-15	118.016	118.016	118.016
Levelling Point	C305-LP128102	04-03-15	Installed	82394.945	36536.817	118.028	28-04-15	118.028	118.028	118.027
Levelling Point	C305-LP128103	04-03-15	Installed	82393.534	36538.825	118.053	28-04-15	118.053	118.053	118.053
Levelling Point	C305-LP128104	04-03-15	Installed	82393.015	36541.354	118.077	28-04-15	118.077	118.077	118.077
Levelling Point	C305-LP128105	04-03-15	Installed	82394.331	36543.533	118.085	28-04-15	118.085	118.085	118.085

IRS Installation Record Sheets – Levelling Point

Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commissioning Readings (m)			
				Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	Date	Elevation Z1 (mATD)	Elevation Z2 (mATD)	Elevation Z3 (mATD)
Levelling Point	C305-LP128106	04-03-15	Installed	82393.124	36545.925	118.013	28-04-15	118.013	118.013	118.013
Levelling Point	C305-LP128201	04-03-15	Installed	82355.144	36516.642	117.600	28-04-15	117.600	117.600	117.600
Levelling Point	C305-LP128202	04-03-15	Installed	82354.336	36518.999	117.628	28-04-15	117.628	117.627	117.627
Levelling Point	C305-LP128203	04-03-15	Installed	82353.605	36521.335	117.649	28-04-15	117.649	117.649	117.649
Levelling Point	C305-LP128204	04-03-15	Installed	82352.675	36523.582	117.665	28-04-15	117.665	117.664	117.664
Levelling Point	C305-LP128205	04-03-15	Installed	82351.662	36525.761	117.683	28-04-15	117.683	117.683	117.683
Levelling Point	C305-LP128206	04-03-15	Installed	82352.902	36528.021	117.701	28-04-15	117.701	117.701	117.701
Levelling Point	C305-LP128207	04-03-15	Installed	82350.875	36529.721	117.723	28-04-15	117.723	117.723	117.723
Levelling Point	C305-LP128208	04-03-15	Installed	82351.886	36532.295	117.641	28-04-15	117.641	117.641	117.641
Levelling Point	C305-LP128209	04-03-15	Installed	82352.183	36534.692	117.659	28-04-15	117.659	117.659	117.659
Levelling Point	C305-LP128210	04-03-15	Installed	82351.485	36536.879	117.714	28-04-15	117.714	117.714	117.714
Levelling Point	C305-LP128211	04-03-15	Installed	82350.349	36539.452	117.769	28-04-15	117.769	117.769	117.769
Levelling Point	C305-LP128212	04-03-15	Installed	82349.879	36541.658	117.803	28-04-15	117.803	117.803	117.803
Levelling Point	C305-LP128213	04-03-15	Installed	82348.921	36544.084	117.888	28-04-15	117.888	117.888	117.888
Levelling Point	C305-LP128214	04-03-15	Installed	82348.250	36546.438	118.117	28-04-15	118.117	118.117	118.117
Levelling Point	C305-LP128215	04-03-15	Installed	82341.227	36588.934	117.686	28-04-15	117.686	117.686	117.686
Levelling Point	C305-LP128216	04-03-15	Installed	82338.791	36597.491	117.882	28-04-15	117.882	117.881	117.881

*Note: All elevations or levels presented in this document are metres above tunnel datum (mATD).
(*These levelling points were installed but we couldn't have access to monitoring them)*

IRS Installation Record Sheets – Vibrating Wire Piezometer												
Sensor Type	Sensor ID	Sensor Serial Number	Depth (m bgl)	Date Installation	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
						Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	AVERAGE	17/11/2015	17/11/2015	17/11/2015
Vibrating Wire Piezometer	C305-PV120505	1404564	38.8 meter	07/10/2015	Installed	82809.1812	36448.1183	104.3321	67.828	67.824	67.833	67.828
									AVERAGE	17/11/2015	17/11/2015	17/11/2015
Vibrating Wire Piezometer	C305-PV120506	1402372	29.5 meters	07/10/2015	Installed	82809.1812	36448.1183	104.3321	74.626	74.612	74.634	74.632
									AVERAGE	17/11/2015	17/11/2015	17/11/2015
Vibrating Wire Piezometer	C305-PV120507	1402368	24.8 meters	15/10/2015	Installed	82817.8506	36443.2843	104.4715	79.937	79.936	79.943	79.933

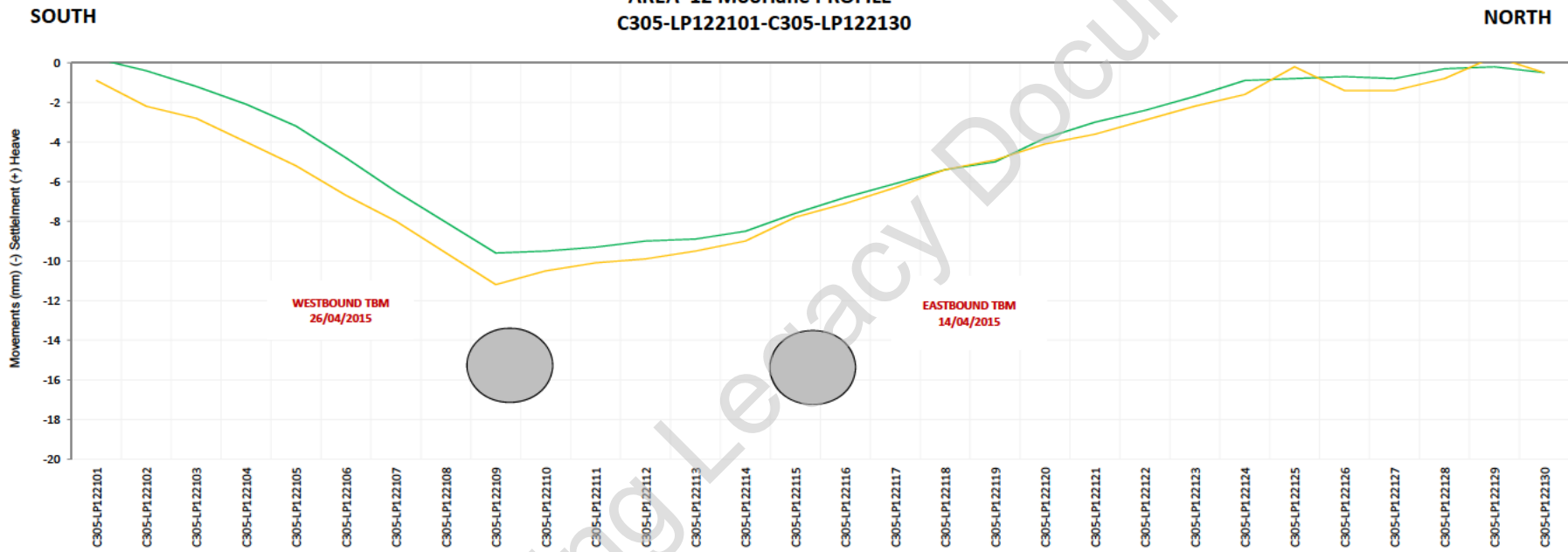
Notes:

- * The difference between the Elevation Z reading and Commissioning reading is due to commissioning readings represents the piezometric level.
- * All elevations or levels presented in this document are metres above tunnel datum (mATD).

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APPENDIX C: DEFLECTION RATIO

**AREA 12 Moorlane PROFILE
C305-LP122101-C305-LP122130**



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

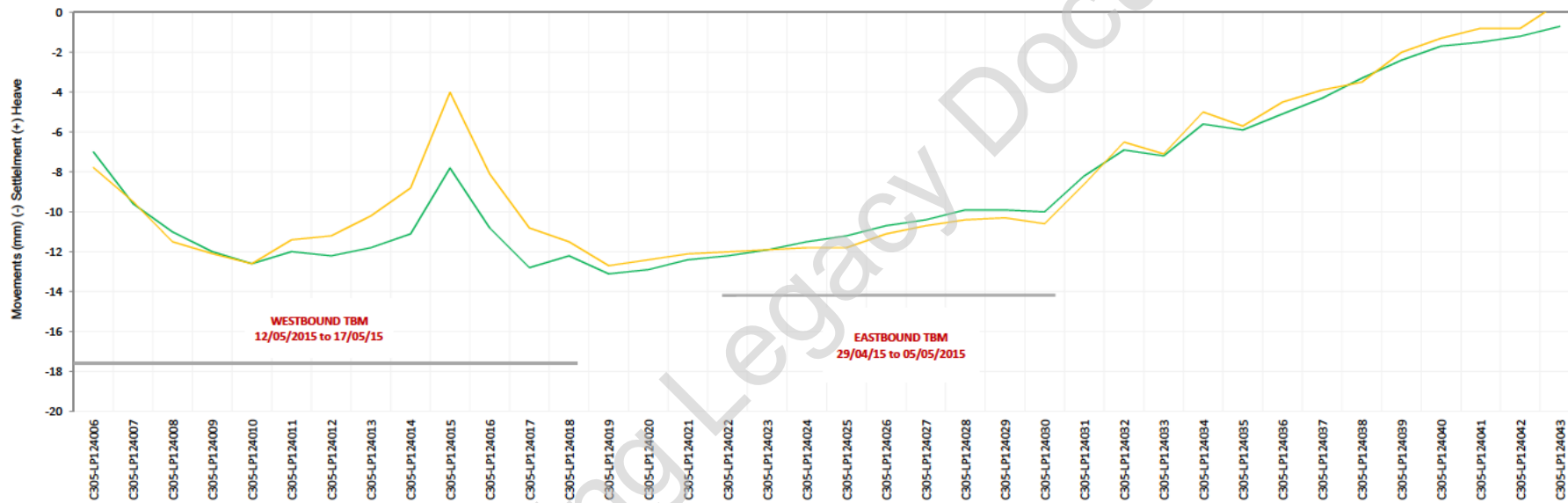
TRANSECT	ALERT VALUE	MAX DEFLECTION RATIO	
		TBMs Passage	Long Term
12 A	1/2000	1/24233	1/11060

— 14/05/2015 AFTER TBMs TRANSIT
— 13/07/2015 LONG TERM

**AREA 12 Beech Street PROFILE
C305-LP124006-C305-LP124043**

SOUTH-WEST

NORTH-EAST

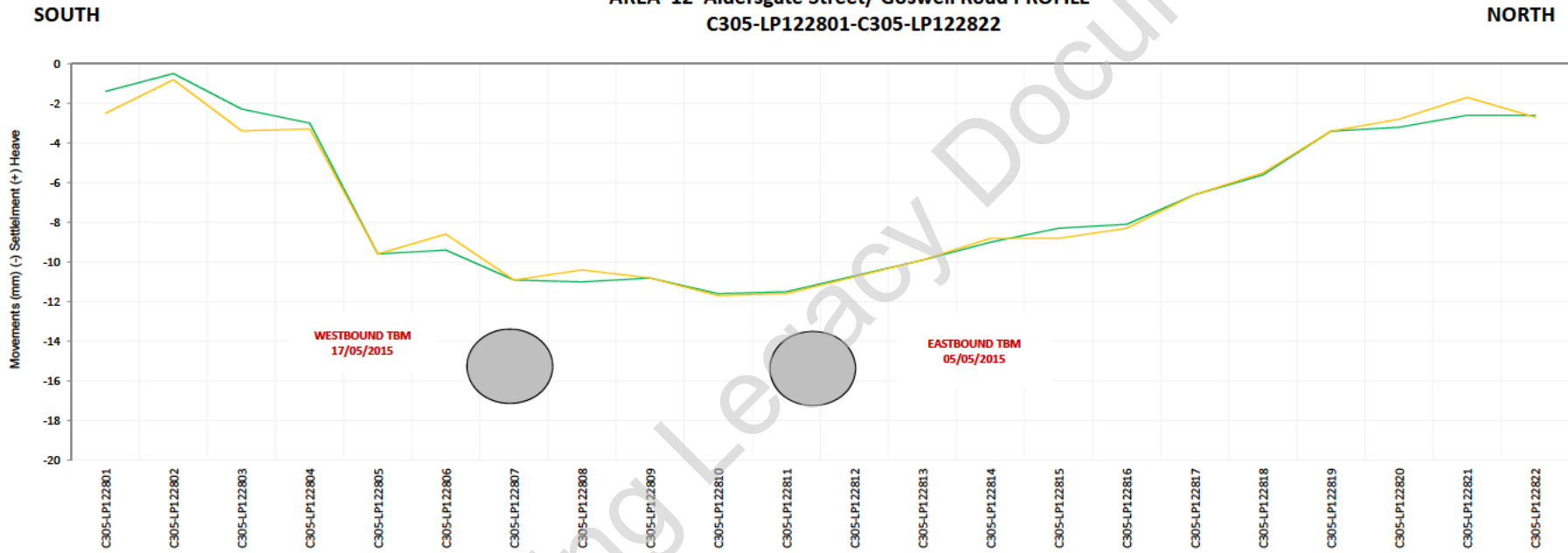


NOTE: x axis is of monitoring points and is not a scaled distance

TRANSECT	ALERT VALUE	MAX DEFLECTION RATIO	
		TBMs Passage	Long Term
Beech St.	1/2000	1/3892	1/2724

— 26/05/2015 AFTER TBMs TRANSIT
— 11/08/2015 LONG TERM

**AREA 12 Aldersgate Street/ Goswell Road PROFILE
C305-LP122801-C305-LP122822**



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

TRANSECT	ALERT VALUE	MAX DEFLECTION RATIO	
		TBMs Passage	Long Term
12 C	1/2900	1/14074	1/7569

— 27/05/2015 AFTER TBMs TRANSIT
— 14/08/2015 LONG TERM

C305 Deflection Ratio - Area 12 Tracker (DR calculation no required)

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	LIS-FAR	12	Fore Street	-7	LP125001 - LP125009 +LP125012 - LP125022	-	2000	2000	

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