C305 - Eastern Running Tunnels

I&M Close Out Report from Limmo Shaft to Victoria Dock Portal (Drive G)

CRL Document Number: C305-DSJ-C2-RGN-CRG03-50400

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1. Contractor Document Submittal History:

Revision:	Date:	Prepared by:	Checked by:	Approved by:	Reason for Issue:
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2a. Stakeholder Review Required? YES [ ] NO [ ]

Stakeholder submission required: LU [ ] RfI [ ] Purpose of submission: For no objection [ ]
NR [ ] LO [ ] For information [ ]
DLR [ ] Other.

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: Role: Name: Date:

Sign: Role: Name: Date:

2b. Review by Stakeholder (If required):

Stakeholder Organisation	Job Title	Name	Signature	Date	Acceptance
					[ ]
					[ ]
					[ ]

3. Acceptance by *Crossrail*:

***Crossrail* Review and Acceptance Decal**

This decal is to be used for submitted documents requiring acceptance by *Crossrail*.

[x]	Code 1.	Accepted. Work May Proceed
[ ]	Code 2.	Not Accepted. Revise and resubmit. Work may proceed subject to incorporation of changes indicated
[ ]	Code 3.	Not Accepted. Revise and resubmit. Work may not proceed
[ ]	Code 4.	Received for information only. Receipt is confirmed

Reviewed/Accepted by:	Print Name:	Position:	Date:
[redacted]	[redacted]	[redacted]	2/6/16

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GEOCISA UK	C305-CLOUT-160304

I&M Close Out Report from Limmo Shaft to Victoria Dock Portal (Drive G)

C305 Crossrail Eastern Running Tunnels

Current Version of the Documents & Signatures :

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Document History :

Revision:	Date:	Prepared by:	Checked by:	Engineering Approved by:
1.0	11-04-16	[redacted]		

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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 recorded movements to the construction activities and dewatering of cross passages which produce any observed changes. For construction activities: this report includes the monitoring data for the excavation of the C305 twin bored tunnels and dewatering of cross passages, impacts from other CRL contracts are not included in this report.

The long term readings for Cross Passage 15 (CP15) presented in this report 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 works are no longer impacting the area concerned. As stated in the specifications the settlement rate of 2 mm/yr has been defined. 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 situated within Area 2, Limmo Shaft to Victoria Dock Portal, between project chainage 84960 to 85800. The instrumentation was installed within DLR boundaries and on the nearby building and structures affected by the construction activities.

See Appendix A for the instrument location.

3. DOCUMENTATION SUMMARY

CROSSRAIL NUMBER	DOCUMENT NAME	REASON FOR ISSUE
C305-DSJ-C2-RGN-CRG03-50294	I&M Installation Report for Sockets, 3D Prisms, Retro Targets & Tiltmeters (Drive G)	Installation Report
C305-DSJ-C2-RGN-CRG03-50295	I&M Installation Report for Levelling Points along Drive G	Installation Report
C305-DSJ-C2-RGN-CRG03-50186	installation Report for I&M MS “Drive G Shallow Datum (84960-85800)	Installation Report
C305-XRL-C2-RGN-CR144-50001	DLR Baseline Report Drive G Rev 3.0	Base Line Report

4. SUMMARY OF INSTALLED INSTRUMENTATION ON SITE

The total number instruments installed were:

- 3D Prisms - 18
- Sockets - 46
- Retro Targets -20
- Levelling Points – 149
- Shallow Datums - 5

See Appendix B for the summary of the instrumentation installed.

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.

5. CONSTRUCTION ACTIVITY

TBM PASSAGE

DRIVE G	RINGS	PROJECT CHAINAGE	DATES
Eastbound	1 – 518	84960 - 85800	11/09/2014 to 19/10/2014
Westbound	1 – 523	84960 - 85800	03/06/2014 to 11/08/2014

Stoppage periods:

Eastbound Drive-G	Ring 52	(Project chainage - 85060)	15/09/14 to 18/09/14
	Ring 83	(Project chainage - 85100)	21/09/14 to 27/09/14
Westbound Drive-G	Ring 10	(Project chainage - 84490)	07/06/14 to 08/06/14
	Ring 49	(Project chainage - 85050)	13/06/14 to 22/06/14
	Ring 81	(Project chainage - 85100)	26/06/14 to 14/07/14

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

CONSTRUCTION AND DEWATERING FROM LIMMO SHAFT TO VICTORIA DOCK PORTAL

Construction Cross passage 15: 8th December 2014 to 7th February 2015
Dewatering Cross passage 15: 15th October 2014 to 18th February 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.

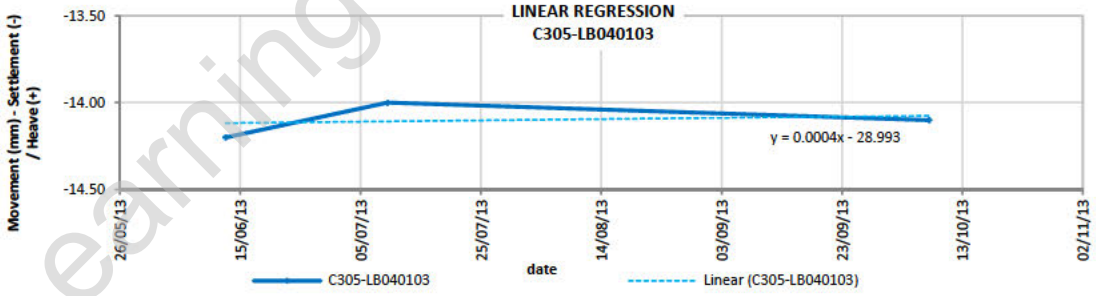
$$b = \frac{\sum_{i=1}^{n}(X_i - \overline{X}_i) \cdot (Y_i - \overline{Y}_i)}{\sum_{i=1}^{n}(X_i - \overline{X}_i)^2}$$

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	$X_i - \overline{X}_i$	$Y_i - \overline{Y}_i$	$(X_i - \overline{X}_i)^2$	$(X_i - \overline{X}_i) \cdot (Y_i - \overline{Y}_i)$
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

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

7. SUMMARY OF THE DATA

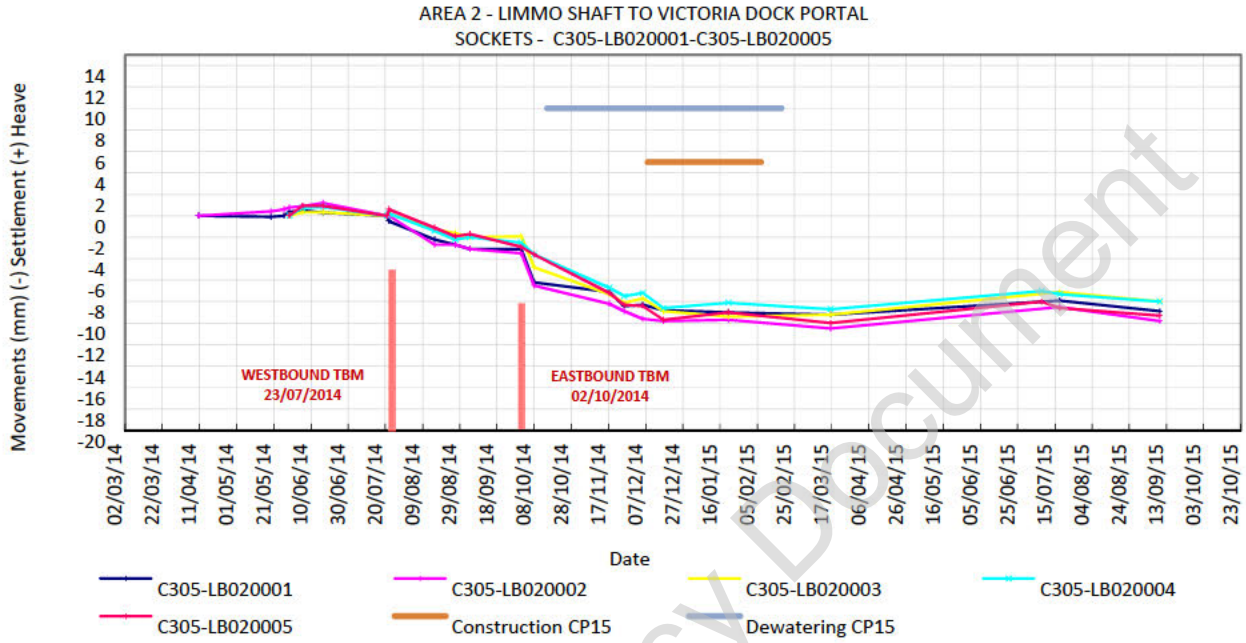
The methodology described for sockets in section 6, is applied here for sockets, levelling points and shallow datum.

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 D.

SOCKETS

C305-LB020001 - C305-LB020005



The graph above shows there was a settlement of -3mm after the westbound TBM transit and a total maximum settlement of -10.5 mm after the eastbound TBM transit.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

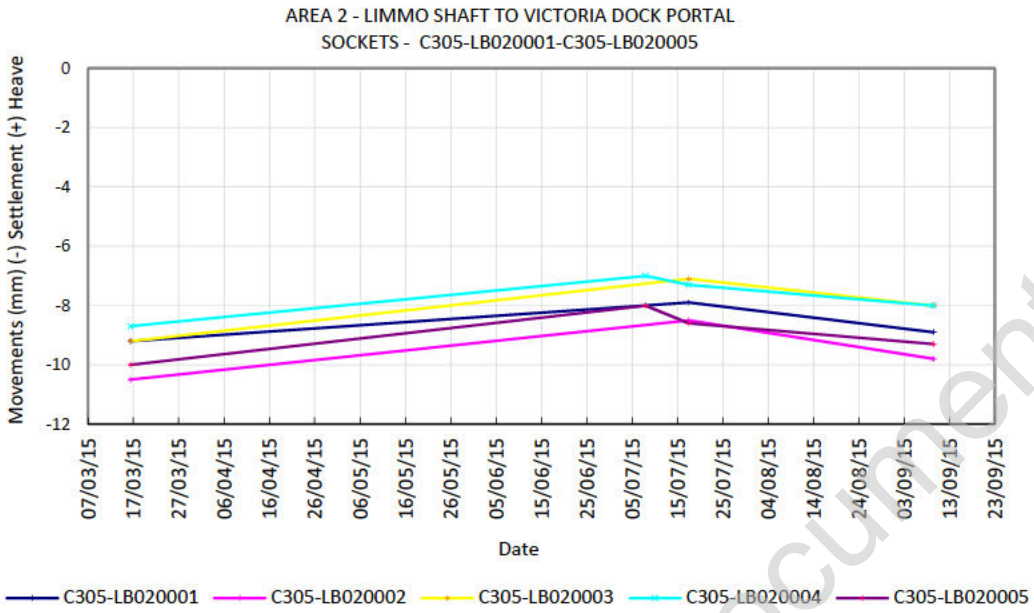
The table below shows the annual rate for the sockets in this array.

	Registered movement (mm)				mm/year
	16/03/2015	08/07/2015	17/07/2015	09/09/2015	
C305-LB020001	-9.20	#N/A	-7.90	-8.90	1.176
C305-LB020002	-10.50	#N/A	-8.50	-9.80	2.216
C305-LB020003	-9.20	#N/A	-7.10	-8.00	3.120
C305-LB020004	-8.70	-7.00	-7.30	-8.00	2.117
C305-LB020005	-10.00	-8.00	-8.60	-9.30	2.184
	Rate less than -2.5		% less 2 mm/ year		100%
	Rate greater than -3.5		% less 3 mm/ year		100%

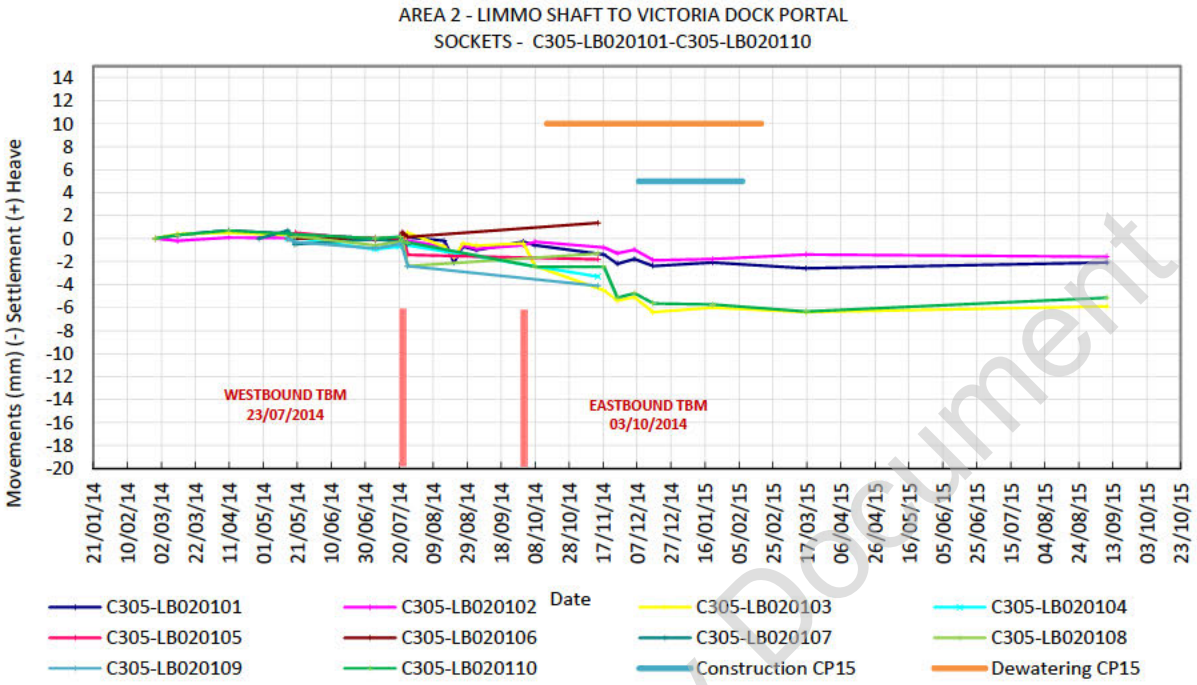
Note: All the movements are in mm. (-) Settlement / (+) Heave

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

The next plot shows the trend line adjustment for the sockets in this array.



C305-LB020101 - C305-LB020110



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

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

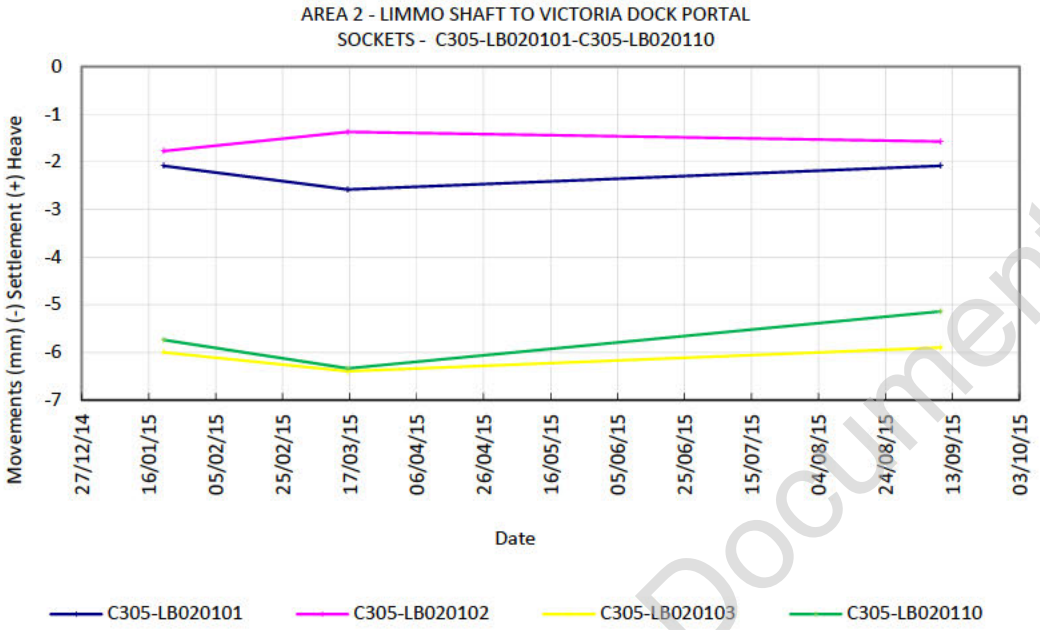
The table below shows the annual rate for the sockets in this array.

	Registered movement (mm)				mm/year
	20/01/2015	16/03/2015	16/03/2015	09/09/2015	
C305-LB020101	-2.08	-2.58	#N/A	-2.08	0.253
C305-LB020102	-1.78	-1.38	#N/A	-1.58	0.137
C305-LB020103	-6.00	-6.40	#N/A	-5.90	0.371
C305-LB020104	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LB020105	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LB020106	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LB020107	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LB020108	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LB020109	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LB020110	-5.74	-6.34	#N/A	-5.14	1.319
	Rate less than -2.5		% less 2 mm/ year		100%
	Rate less than -3.5		% less 3 mm/ year		100%

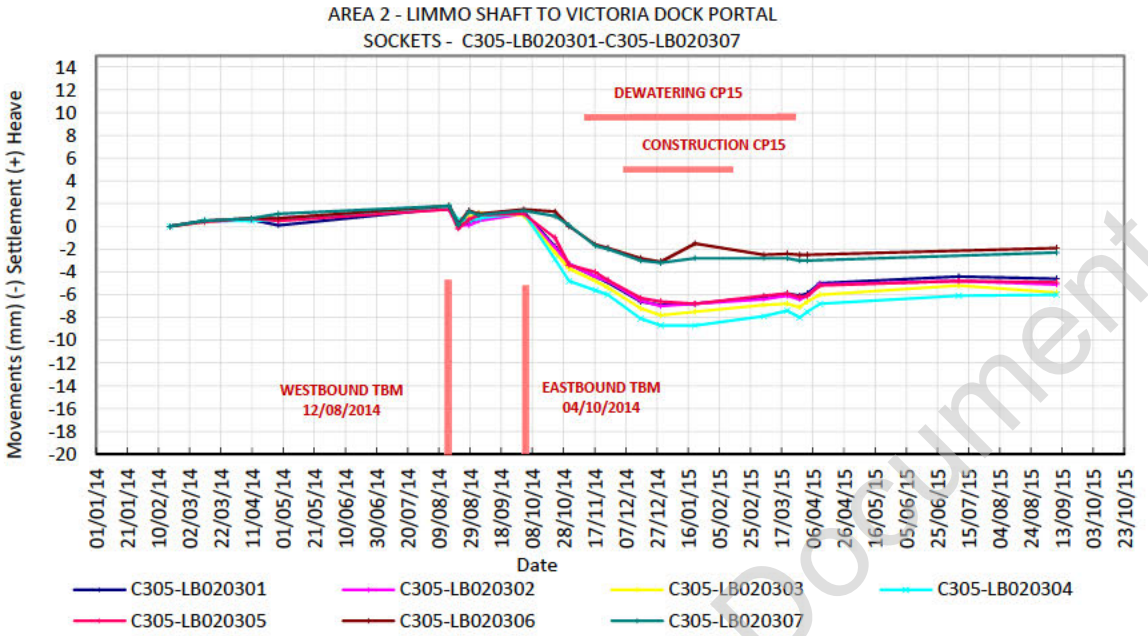
Note: All the movements are in mm. (-) Settlement / (+) Heave

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

The next plot shows the trend line adjustment for the sockets in this array.



C305-LB020301 - C305-LB020307



The graph above shows there was no significant settlement after the westbound TBM transit (approximately -0.6mm) and a total maximum settlement of -8.7 mm after the eastbound TBM transit.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

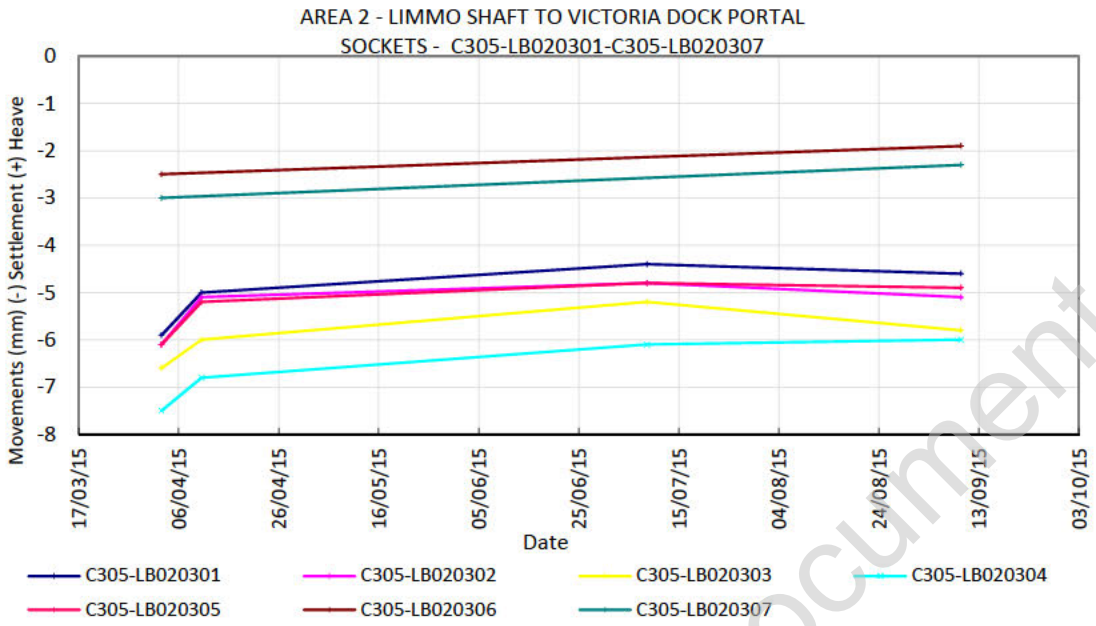
The table below shows the annual rate for the sockets in this array.

	Registered movement (mm)				mm/year
	02/04/2015	10/04/2015	08/07/2015	09/09/2015	
C305-LB020301	-5.90	-5.00	-4.40	-4.60	2.410
C305-LB020302	-6.10	-5.10	-4.80	-5.10	1.574
C305-LB020303	-6.60	-6.00	-5.20	-5.80	1.733
C305-LB020304	-7.50	-6.80	-6.10	-6.00	2.979
C305-LB020305	-6.10	-5.20	-4.80	-4.90	2.086
C305-LB020306	-2.50	#N/A	#N/A	-1.90	1.369
C305-LB020307	-3.00	#N/A	#N/A	-2.30	1.598
	Rate less than -2.5 mm/year		% less 2 mm/ year		100%
	Rate greater than -3.5 mm/year		% less 3 mm/ year		100%

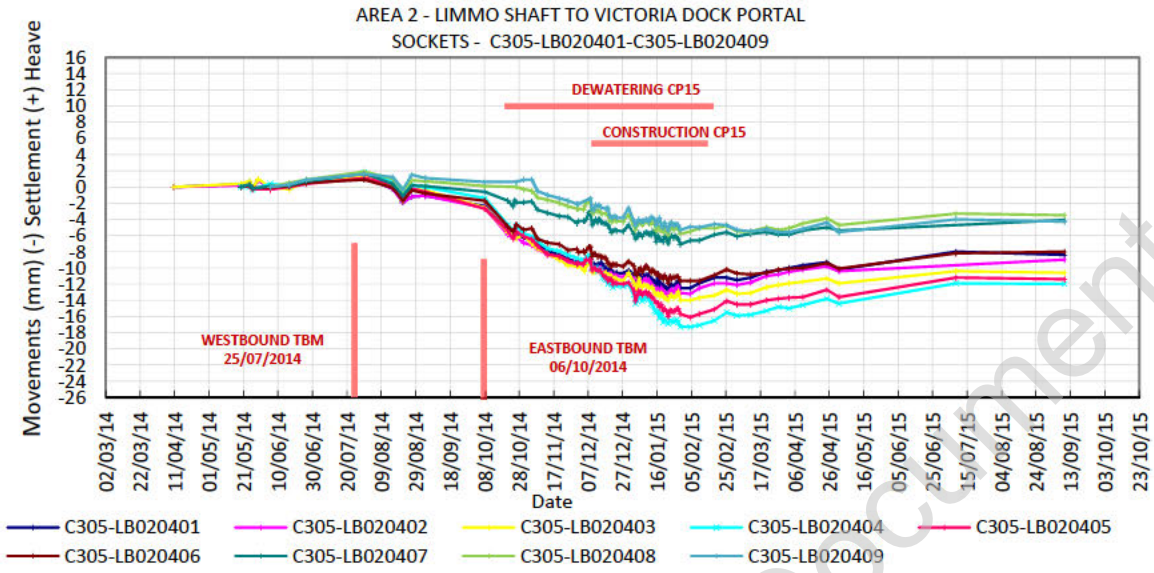
Note: All the movements are in mm. (-) Settlement / (+) Heave

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

The next plot shows the trend line adjustment for the sockets in this array.



C305-LB020401 - C305-LB020409



The graph above shows there was a settlement of -2mm after the westbound TBM transit and a total maximum settlement of -17.3 mm after the eastbound TBM transit and CP 15 works.

The effect of the construction and dewatering of Cross Passage 15 is also evident in the graph above; however over time the recent readings show a reduction of the settlement rate. In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

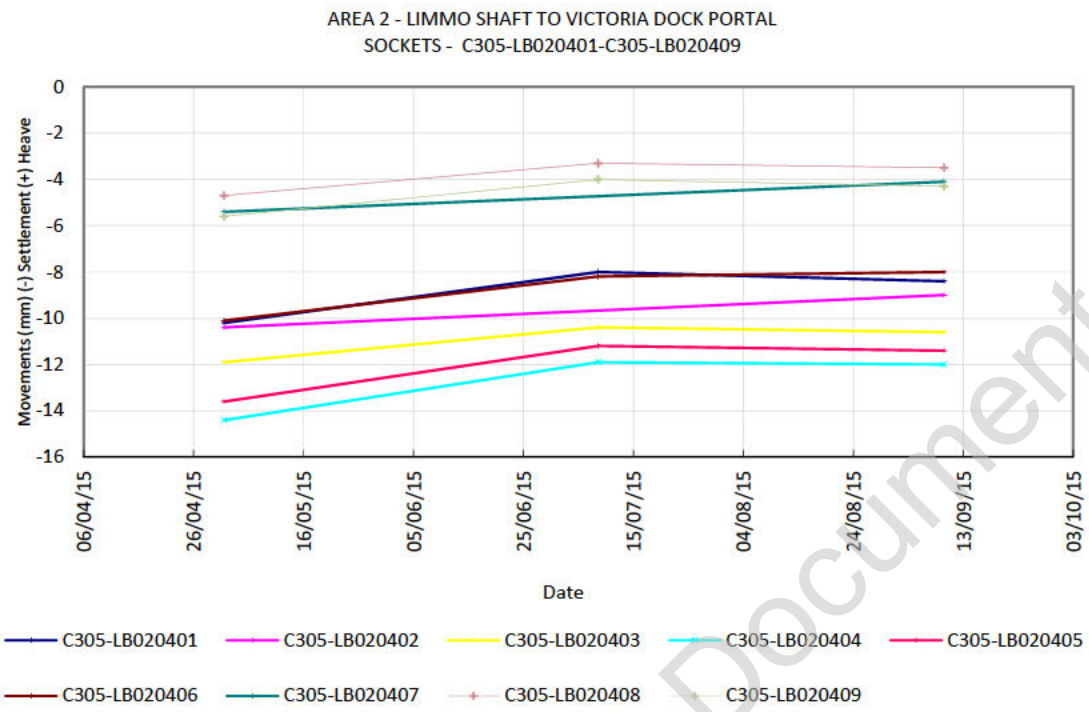
The table below shows the annual rate for the sockets in this array.

	Registered movement (mm)			mm/year
	01/05/2015	08/07/2015	09/09/2015	
C305-LB020401	-10.20	-8.00	-8.40	5.110
C305-LB020402	-10.40	#N/A	-9.00	3.903
C305-LB020403	-11.90	-10.40	-10.60	3.684
C305-LB020404	-14.40	-11.90	-12.00	6.782
C305-LB020405	-13.60	-11.20	-11.40	6.224
C305-LB020406	-10.10	-8.20	-8.00	5.913
C305-LB020407	-5.40	#N/A	-4.10	3.624
C305-LB020408	-4.70	-3.30	-3.50	3.402
C305-LB020409	-5.60	-4.00	-4.30	3.691
	Rate less than -2.5 mm/year		% less 2 mm/ year	100%
	Rate less than -3.5 mm/year		% less 3 mm/ year	100%

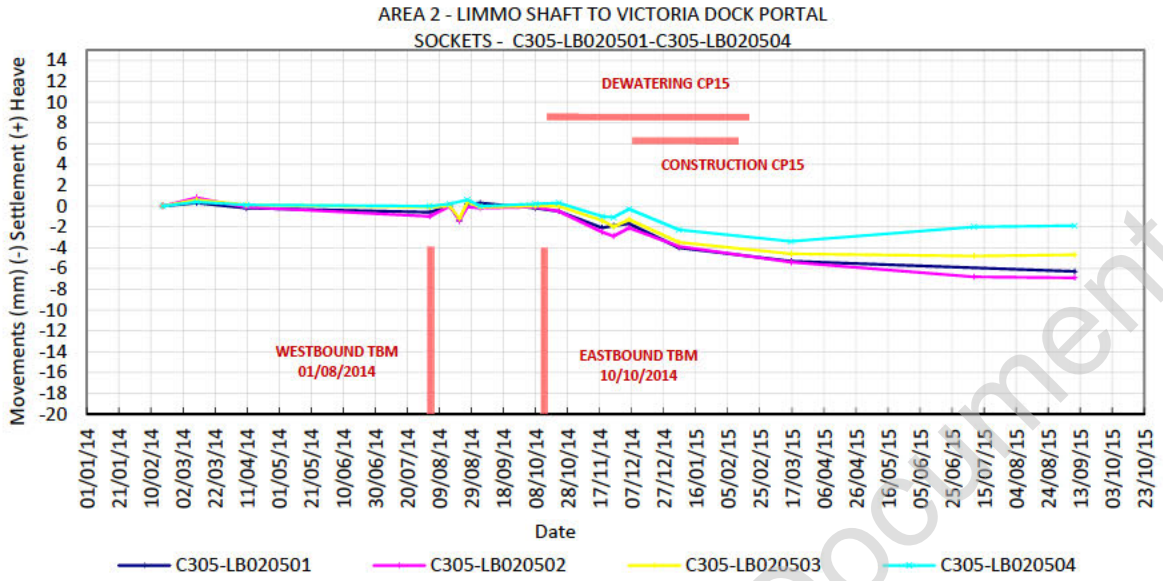
Note: All the movements are in mm. (-) Settlement / (+) Heave

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

The next plot shows the trend line adjustment for the sockets in this array.



C305-LB020501 - C305-LB020504



The graph above shows there was a settlement of -1.2mm after the westbound TBM transit and a total maximum settlement of -6.9mm after the eastbound TBM transit and CP15 works.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

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

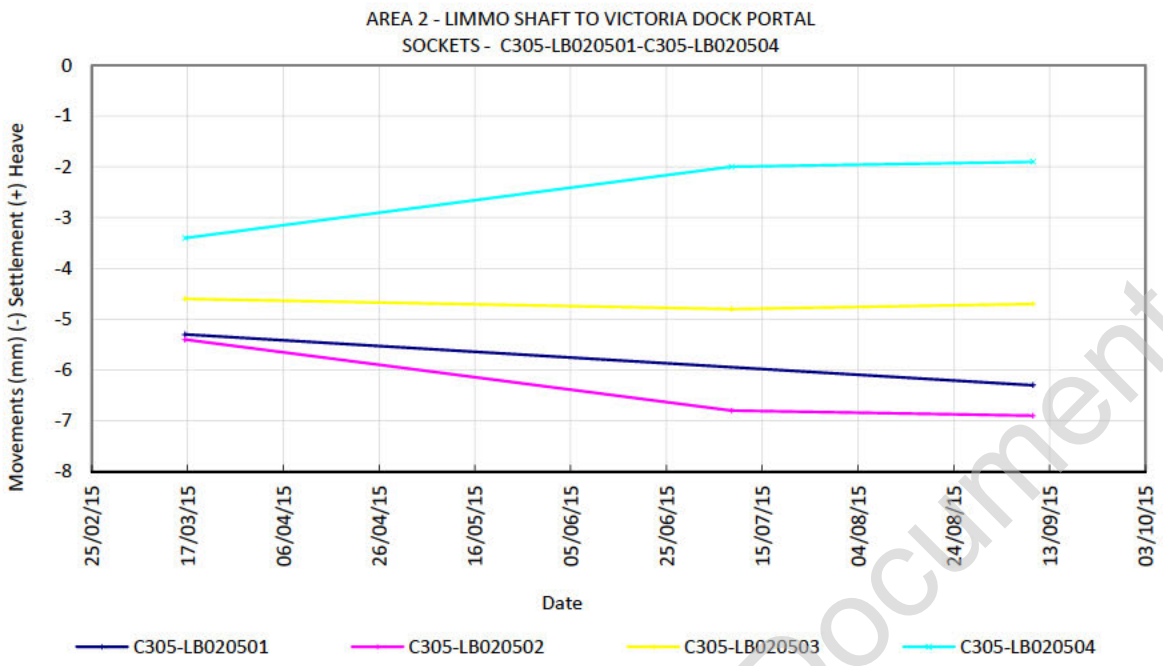
	Registered movement (mm)			mm/year
	16/03/2015	08/07/2015	09/09/2015	
C305-LB020501	-5.30	#N/A	-6.30	-2.062
C305-LB020502	-5.40	-6.80	-6.90	-3.260
C305-LB020503	-4.60	-4.80	-4.70	-0.259
C305-LB020504	-3.40	-2.00	-1.90	3.260
	Rate less than -2.5 mm/year		% less 2 mm/ year	75%
	Rate less than -3.5 mm/year		% less 3 mm/ year	100%

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

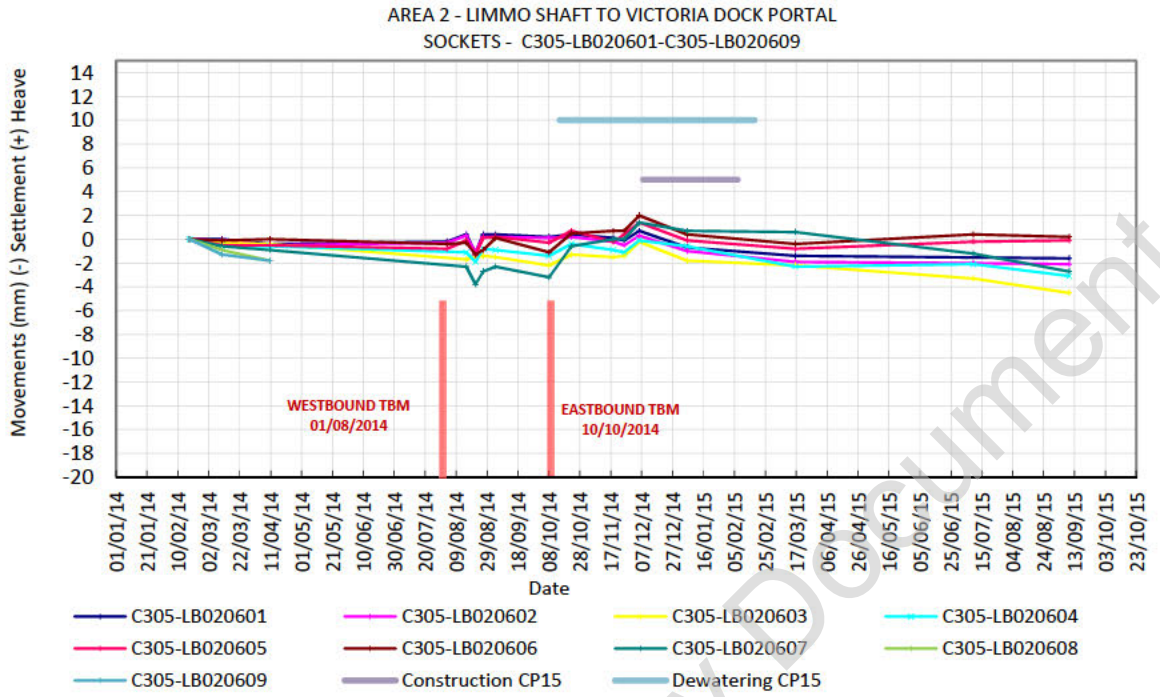
The percentage of the sockets with a settlement rate less than -2 mm/year is 75%.

The percentage of the sockets with a settlement rate less than -3 mm/year is 100%.

The next plot shows the trend line adjustment for the sockets in this array.



C305-LB020601 - C305-LB020609



The graph above there was a settlement of -3.8mm after the westbound TBM transit. Evident in the graph is a heave to 2mm after the eastbound TBM transit and further settlement to a maximum of approximately -4.5mm. C305-LB020608 and C305-LB020609 were not included because after last set of readings at 10/04/2014, these points were damaged.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

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

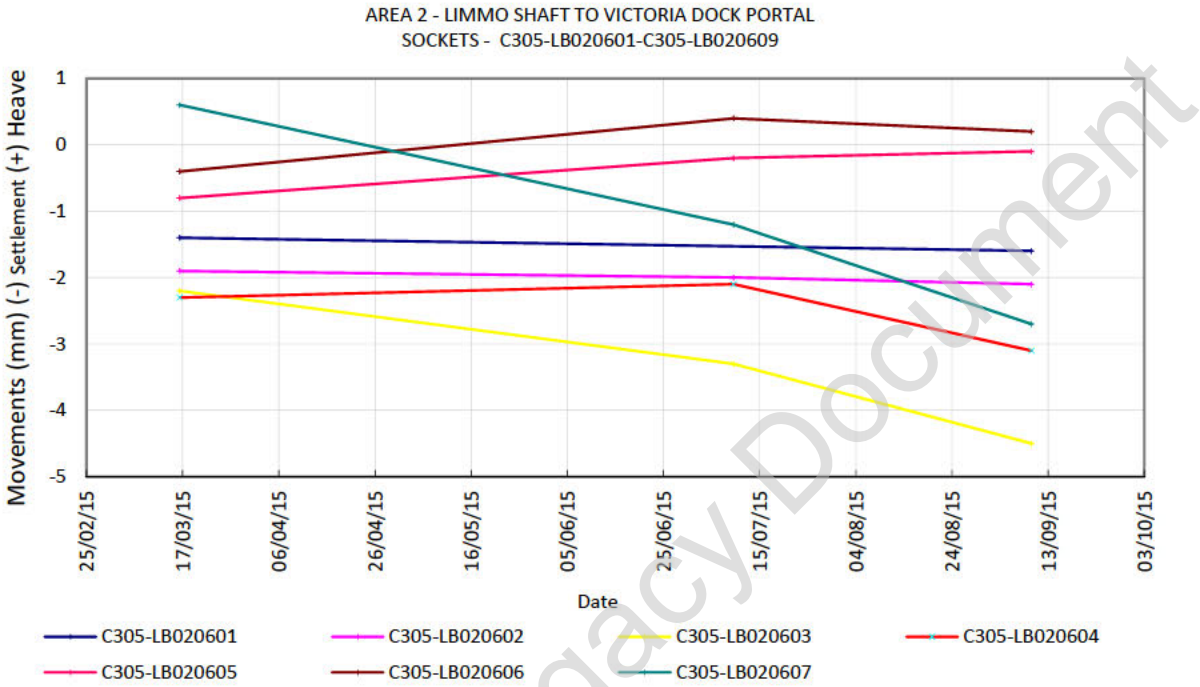
	Registered movement (mm)			mm/year
	16/03/2015	09/07/2015	09/09/2015	
C305-LB020601	-1.40	#N/A	-1.60	#N/A
C305-LB020602	-1.90	-2.00	-2.10	-0.400
C305-LB020603	-2.20	-3.30	-4.50	-4.581
C305-LB020604	-2.30	-2.10	-3.10	-1.360
C305-LB020605	-0.80	-0.20	-0.10	1.501
C305-LB020606	-0.40	0.40	0.20	1.401
C305-LB020607	0.60	-1.20	-2.70	-6.662
C305-LB020608	#N/A	#N/A	#N/A	#N/A
C305-LB020609	#N/A	#N/A	#N/A	#N/A
	Rate less than -2.5 mm/year		% less 2 mm/ year	67%
	Rate less than -3.5 mm/year		% less 3 mm/ year	67%

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

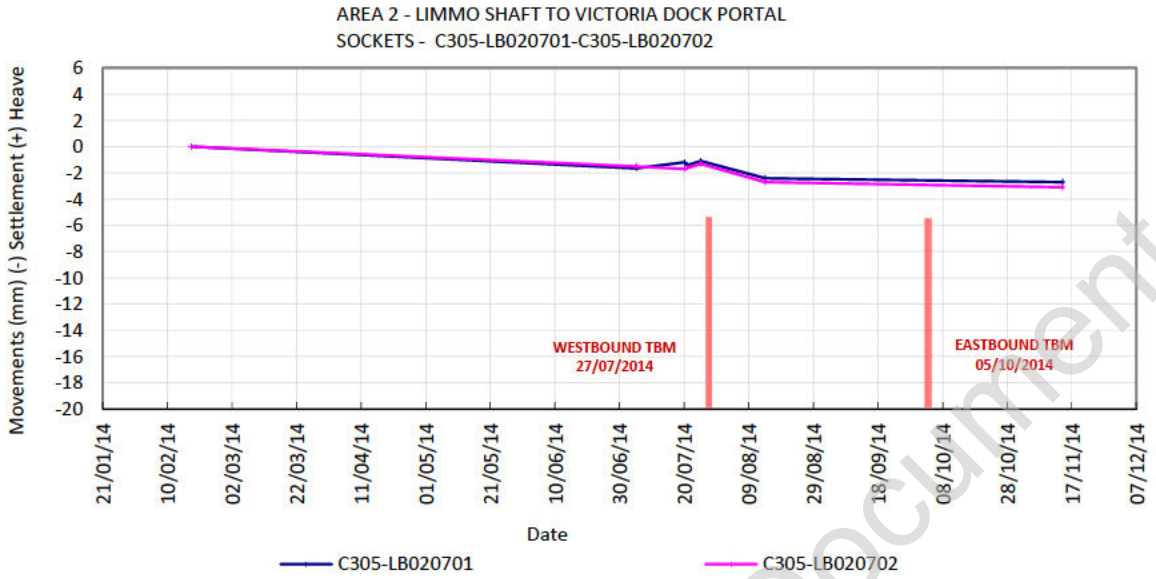
The percentage of the sockets with a settlement rate less than -2 mm/year is 67%.

The percentage of the sockets with a settlement rate less than -3 mm/year is 67%.

The next plot shows the trend line adjustment for the sockets in this array.



C305-LB020701 - C305-LB020702



The graph above shows a settlement of -2.7mm after the westbound TBM transit and a total maximum settlement of -3.1mm after the eastbound TBM transit.

In order to check whether the rate of change in the data has reached an acceptably small value, the last two readings were used to calculate the annual projection.

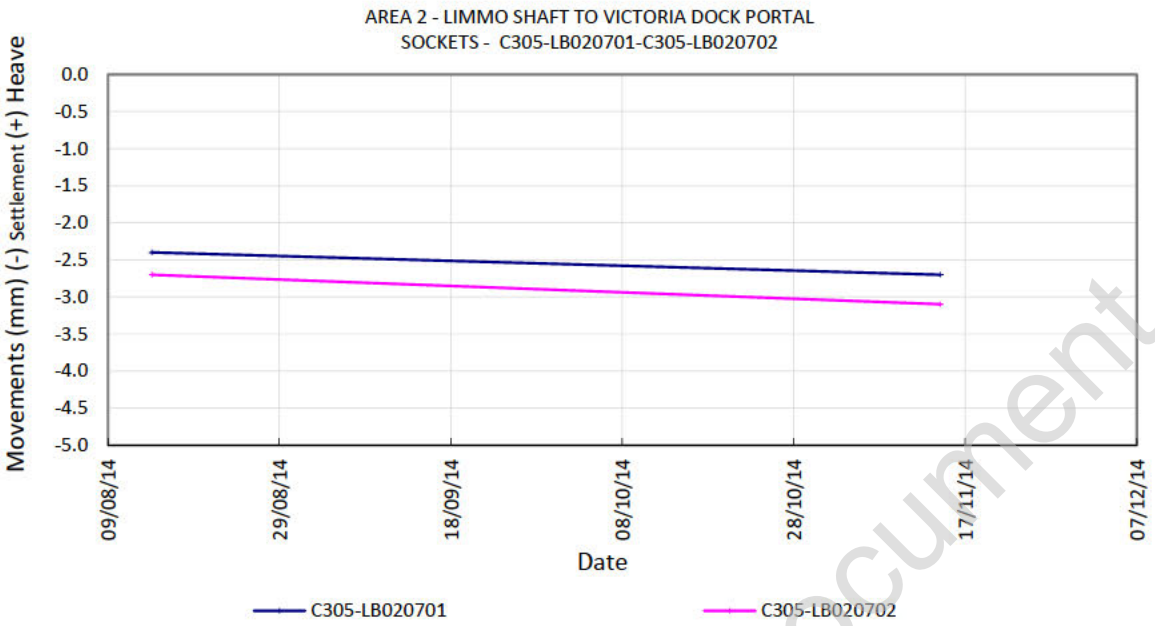
The table below shows the annual rate for the sockets in this array.

	Registered movement (mm)		mm/year
	14/08/2014	14/11/2014	
C305-LB020701	-2.40	-2.70	-1.190
C305-LB020702	-2.70	-3.10	-1.587
	Rate less than -2.5 mm/year	% less 2 mm/ year	100%
	Rate less than -3.5 mm/year	% less 3 mm/ year	100%

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

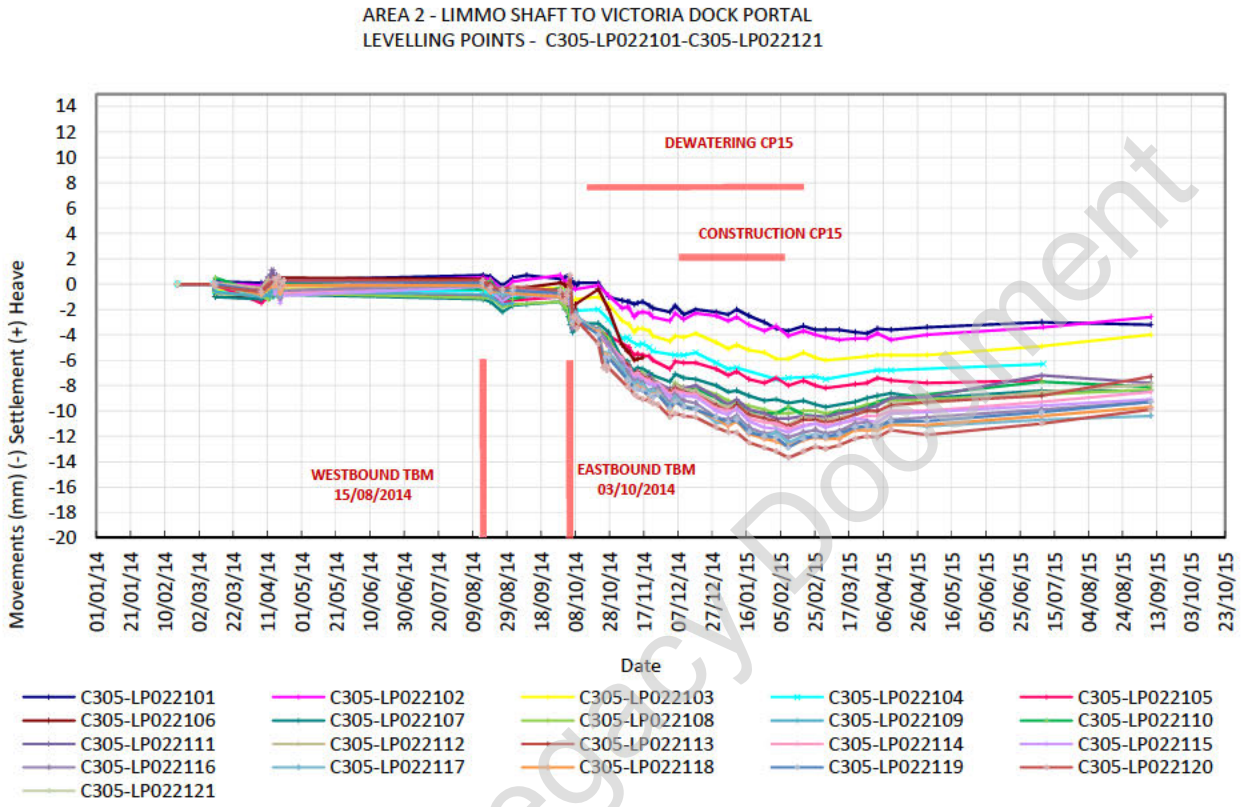
The percentage of the sockets with a settlement rate less than -2 mm/year is 100%.

The next plot shows the trend line adjustment for the sockets in this array.



LEVELLING POINTS

C305-LP022101-C305-LP022183



The graph above this section, located on the surface along the westbound TBM crown, shows a settlement of -2.2mm after the westbound TBM transit and a total maximum settlement of -13.7mm after the eastbound TBM transit.

The effect of the dewatering in the Cross Passage 15 is also evident; however, with time, the most recent set of readings show a reduction of the settlement rate. In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

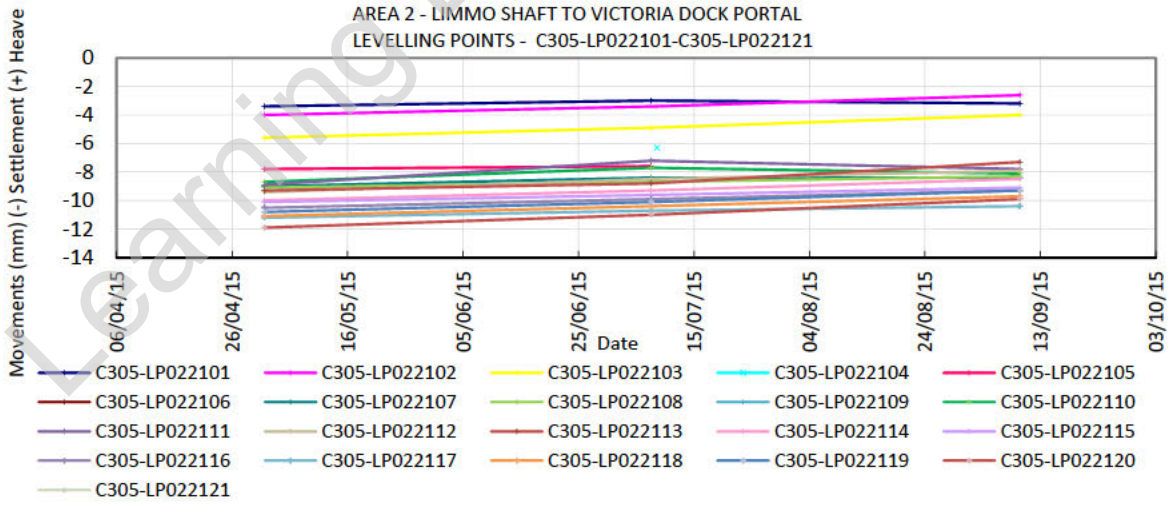
The table below shows the annual rate for the leveling points in this array.

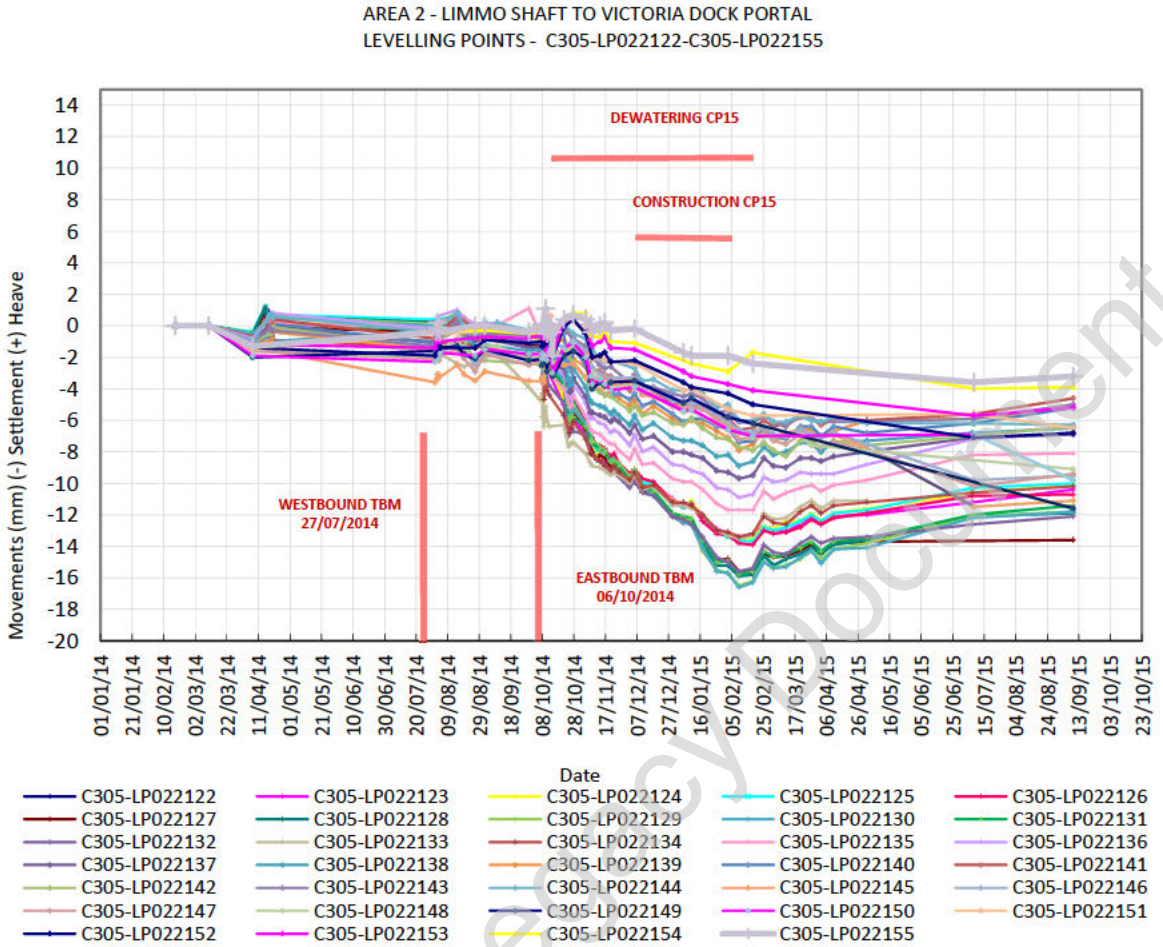
	Registered movement (mm)				mm/year
	01/05/2015	07/07/2015	08/07/2015	09/09/2015	
C305-LP022101	-3.40	-3.00	#N/A	-3.20	0.571
C305-LP022102	-4.00	#N/A	-3.40	-2.60	3.895
C305-LP022103	-5.60	-4.90	#N/A	-4.00	4.457
C305-LP022104	#N/A	#N/A	-6.30	#N/A	#N/A
C305-LP022105	-7.80	-7.60	#N/A	#N/A	#N/A
C305-LP022106	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP022107	-9.00	-8.40	#N/A	-8.40	1.686
C305-LP022108	-9.10	-8.70	#N/A	-8.30	2.231
C305-LP022109	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP022110	-8.70	-7.70	#N/A	-8.10	1.704
C305-LP022111	-8.90	-7.20	#N/A	-7.80	3.119
C305-LP022112	-9.40	-8.50	#N/A	-7.90	4.189
C305-LP022113	-9.30	-8.80	#N/A	-7.30	5.554
C305-LP022114	-10.00	-9.30	#N/A	-8.50	4.180
C305-LP022115	-10.10	-9.60	#N/A	-9.10	2.788
C305-LP022116	-10.50	-9.90	#N/A	-9.30	3.346
C305-LP022117	-11.20	-10.70	#N/A	-10.40	2.235
C305-LP022118	-11.10	-10.40	#N/A	-9.70	3.904
C305-LP022119	-10.80	-10.10	#N/A	-9.30	4.180
C305-LP022120	-11.90	-11.00	#N/A	-9.90	5.572
C305-LP022121	#N/A	#N/A	#N/A	#N/A	#N/A
	Rate less than -2.5		% less 2 mm/ year		100%
	Rate less than -3.5		% less 3 mm/ year		100%

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

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

The next plot shows the trend line adjustment for the leveling points in this array.





The graph above this section, located on the surface along the westbound TBM crown, shows a settlement of -3.5mm after the westbound TBM transit and a total maximum settlement of -16.6 mm after the eastbound TBM transit.

The effect of the dewatering in the Cross Passage 15 is also evident; however, with time, the most recent set of readings show a reduction of the settlement rate. In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

After switch-off the dewatering of CP15 a heave was registered at all points from C305-LP022122 to C305-LP022144 due to ground water recovery. The remaining leveling points showed different settlement behaviour in a period of two months (8 July 2015 to 9 September 2015) with recorded movements of about 3mm.

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

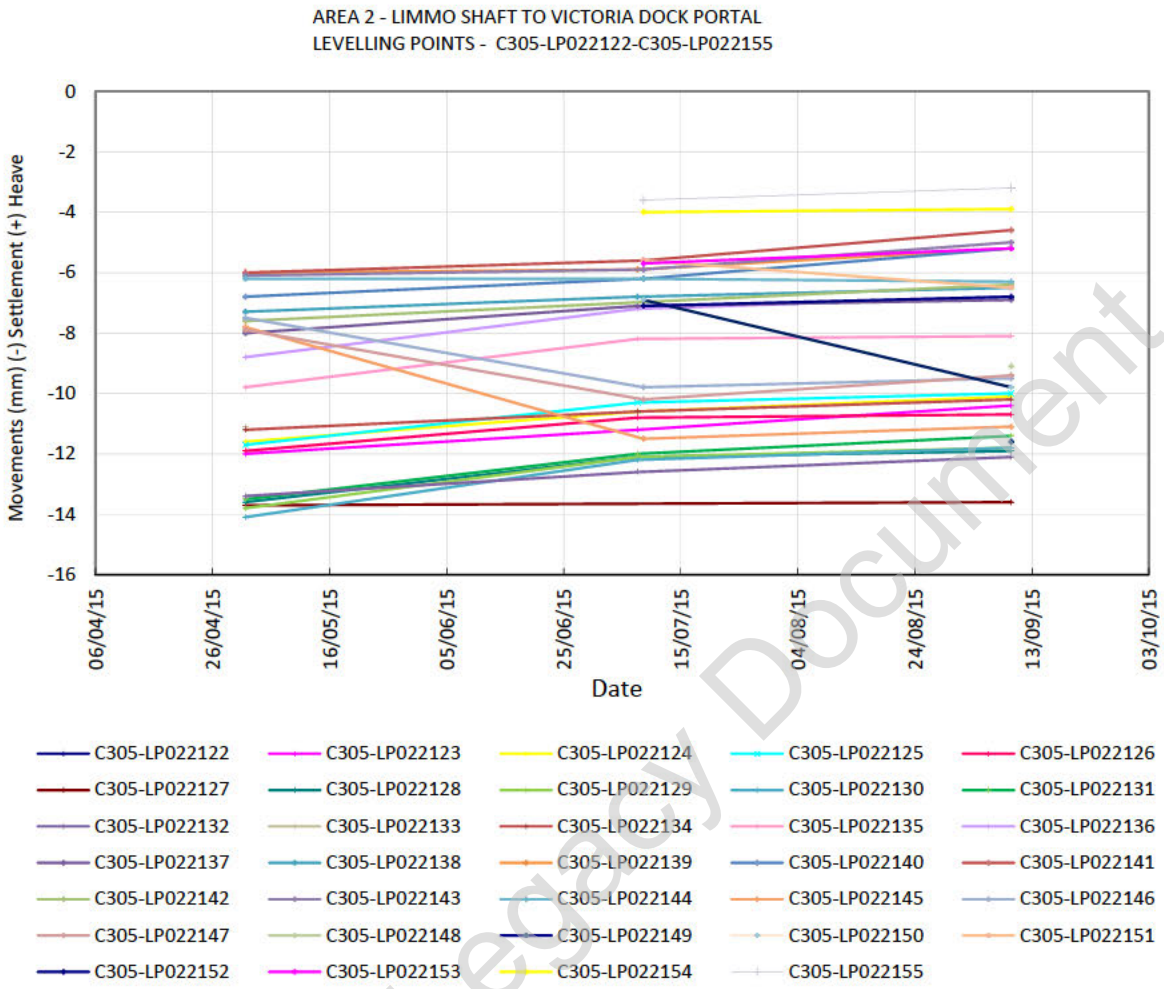
	Registered movement (mm)				mm/year
	01/05/2015	07/07/2015	08/07/2015	09/09/2015	
C305-LP022122	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP022123	-12.00	-11.20	#N/A	-10.40	4.461
C305-LP022124	-11.60	-10.60	#N/A	-10.10	4.194
C305-LP022125	-11.70	-10.30	#N/A	-10.00	4.765
C305-LP022126	-11.90	-10.80	#N/A	-10.70	3.368
C305-LP022127	-13.70	#N/A	#N/A	-13.60	0.279
C305-LP022128	-13.60	-12.10	#N/A	-11.90	4.769
C305-LP022129	-13.80	-12.10	#N/A	-11.80	5.608
C305-LP022130	-14.10	-12.20	#N/A	-11.80	6.447
C305-LP022131	-13.50	-12.00	#N/A	-11.40	5.876
C305-LP022132	-13.40	-12.60	#N/A	-12.10	3.632
C305-LP022133	-11.10	#N/A	#N/A	#N/A	#N/A
C305-LP022134	-11.20	-10.60	#N/A	-10.20	2.793
C305-LP022135	-9.80	-8.20	#N/A	-8.10	4.774
C305-LP022136	-8.80	-7.20	#N/A	-6.80	5.604
C305-LP022137	-8.00	-7.10	#N/A	-6.90	3.083
C305-LP022138	-7.30	-6.80	#N/A	-6.50	2.235
C305-LP022139	-6.00	-5.90	#N/A	-5.20	2.217
C305-LP022140	-6.80	#N/A	-6.20	-5.20	4.445
C305-LP022141	-6.00	#N/A	-5.60	-4.60	3.881
C305-LP022142	-7.60	#N/A	#N/A	-6.40	3.347
C305-LP022143	-6.10	#N/A	-5.90	-5.00	3.041
C305-LP022144	-6.20	#N/A	-6.20	-6.30	-0.275
C305-LP022145	-7.80	#N/A	-11.50	-11.10	-9.349
C305-LP022146	-7.50	#N/A	-9.80	-9.50	-5.670
C305-LP022147	-7.90	#N/A	-10.20	-9.40	-4.295
C305-LP022148	#N/A	#N/A	#N/A	-9.10	#N/A
C305-LP022149	#N/A	#N/A	#N/A	-11.60	#N/A
C305-LP022150	#N/A	#N/A	-6.90	-9.80	-16.839
C305-LP022151	#N/A	#N/A	-5.60	-6.50	-5.226
C305-LP022152	#N/A	#N/A	-7.10	-6.80	1.742
C305-LP022153	#N/A	#N/A	-5.70	-5.20	2.903
C305-LP022154	#N/A	#N/A	-4.00	-3.90	0.581
C305-LP022155	#N/A	#N/A	-3.60	-3.20	2.323
	Rate less than -2.5		% less 2 mm/ year		83%
	Rate less than -3.5		% less 3 mm/ year		83%

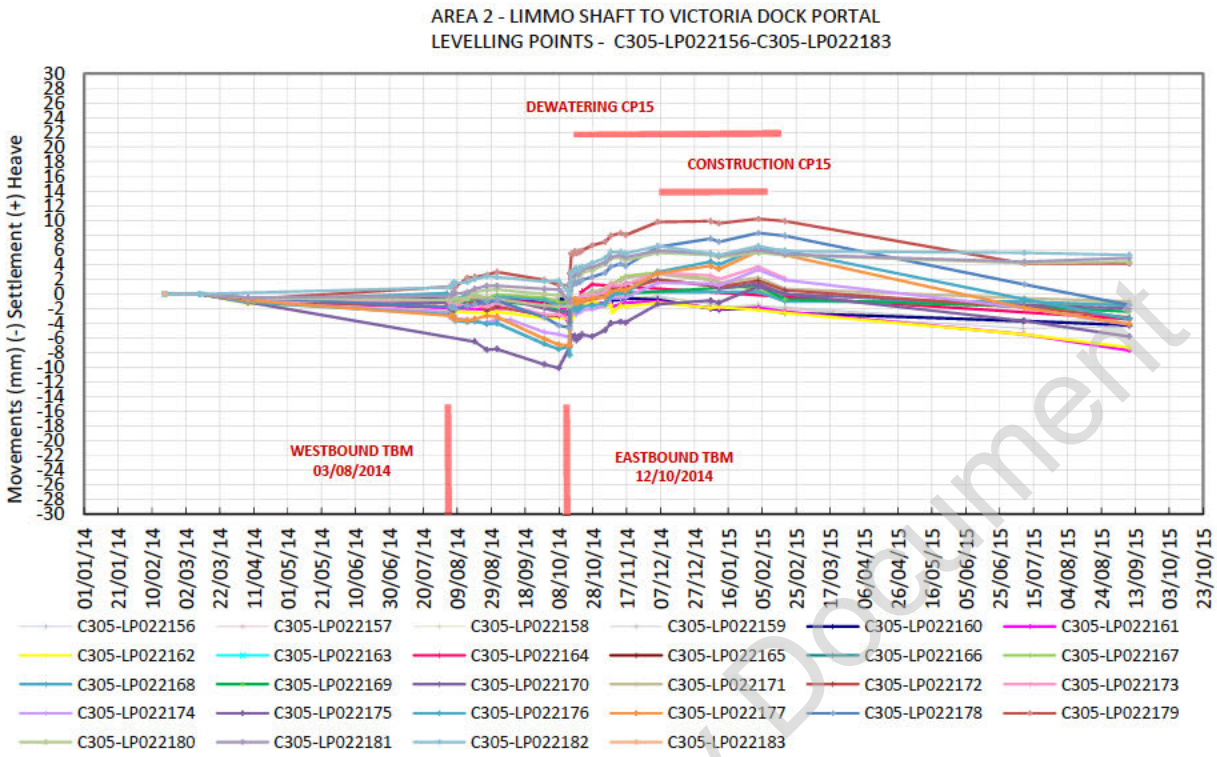
Note: All the movements are in mm. (-) Settlement / (+) Heave

The percentage of the leveling points sockets with a settlement rate less than -2 mm/year is 83%.

The percentage of the leveling points with a settlement rate less than -3 mm/year is 83%.

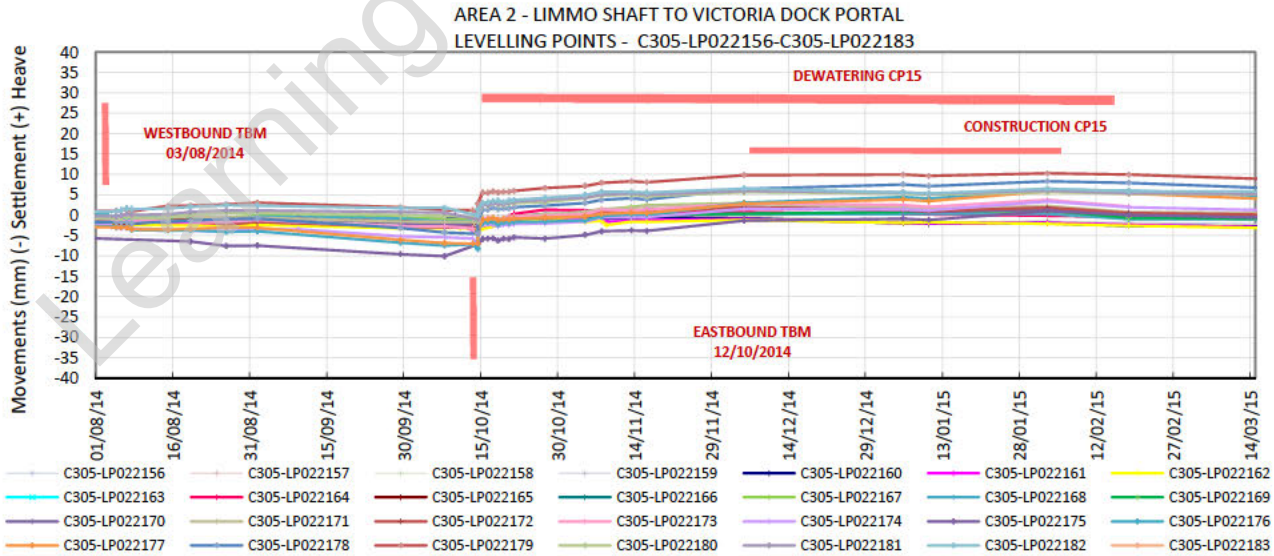
The next plot shows the trend line adjustment for the leveling points in this array.





The graph above presents the readings for an array located on the surface along the westbound crown this section, and shows a settlement of -7.6mm after the westbound TBM transit, a maximum total settlement of -10.1mm just before the eastbound TBM transit, and a subsequent heave of approximately 4mm after the eastbound TBM transit.

See below magnified view of the graph including C305 construction activities.



In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

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

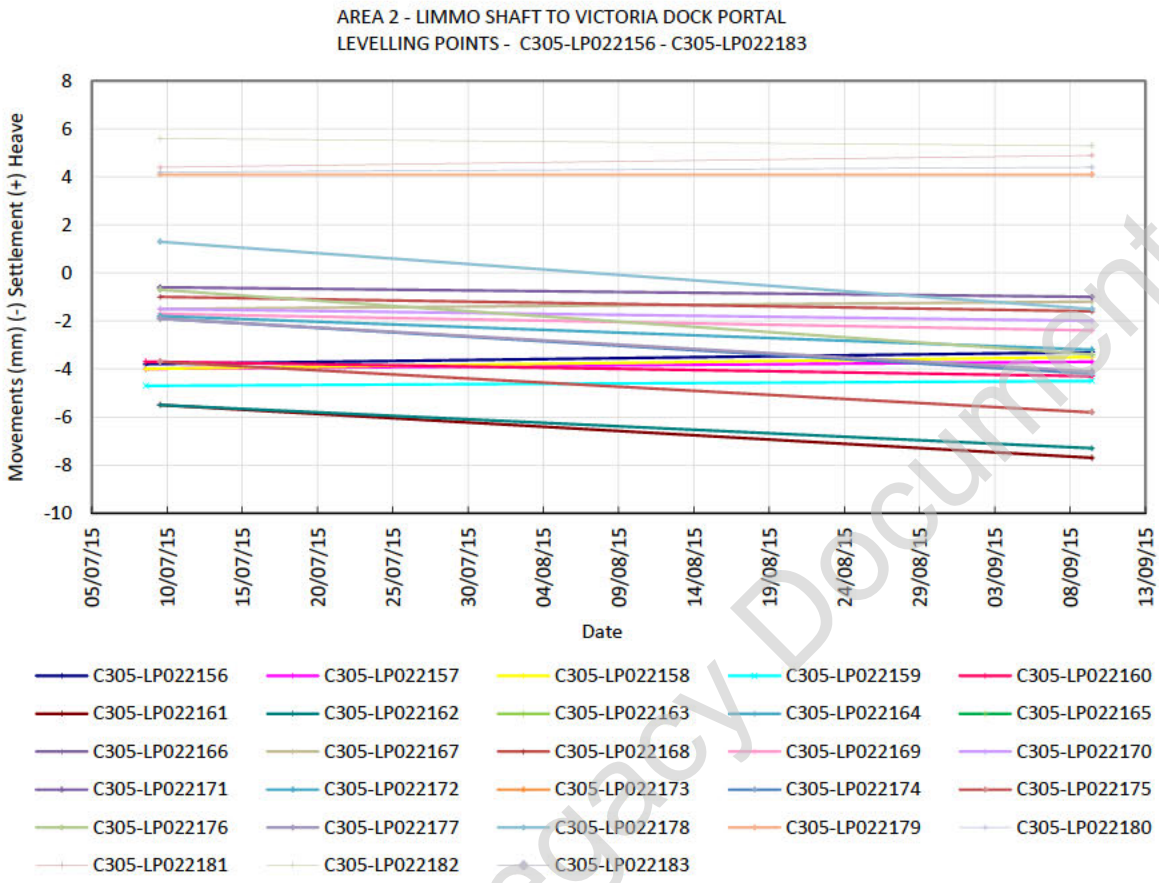
	Registered movement (mm)			mm/year
	08/07/2015	09/07/2015	09/09/2015	
C305-LP022156	-3.8	#N/A	-3.30	#N/A
C305-LP022157	-4	#N/A	-3.70	#N/A
C305-LP022158	-4	#N/A	-3.50	#N/A
C305-LP022159	-4.7	#N/A	-4.50	#N/A
C305-LP022160	-3.70	-3.70	-4.30	-3.510
C305-LP022161	#N/A	-5.50	-7.70	#N/A
C305-LP022162	#N/A	-5.50	-7.30	#N/A
C305-LP022163	#N/A	#N/A	#N/A	#N/A
C305-LP022164	#N/A	#N/A	-3.40	#N/A
C305-LP022165	#N/A	#N/A	#N/A	#N/A
C305-LP022166	#N/A	#N/A	#N/A	#N/A
C305-LP022167	#N/A	-1.50	-1.20	1.769
C305-LP022168	#N/A	-1.00	-1.60	#N/A
C305-LP022169	#N/A	-1.70	-2.40	#N/A
C305-LP022170	#N/A	-1.50	-2.00	-2.948
C305-LP022171	#N/A	-0.60	-1.00	-2.359
C305-LP022172	#N/A	-1.80	-3.20	#N/A
C305-LP022173	#N/A	#N/A	#N/A	#N/A
C305-LP022174	#N/A	-1.90	-4.20	#N/A
C305-LP022175	#N/A	-3.70	-5.80	#N/A
C305-LP022176	#N/A	-0.70	-3.40	#N/A
C305-LP022177	#N/A	-1.90	-4.10	#N/A
C305-LP022178	#N/A	1.30	-1.50	#N/A
C305-LP022179	#N/A	4.10	4.10	0.000
C305-LP022180	#N/A	4.20	4.40	1.179
C305-LP022181	#N/A	4.40	4.90	2.948
C305-LP022182	#N/A	5.60	5.30	-1.769
C305-LP022183	#N/A	#N/A	#N/A	#N/A
	Rate less than -2.5		% less 2 mm/ year	75%
	Rate less than -3.5		% less 3 mm/ year	88%

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

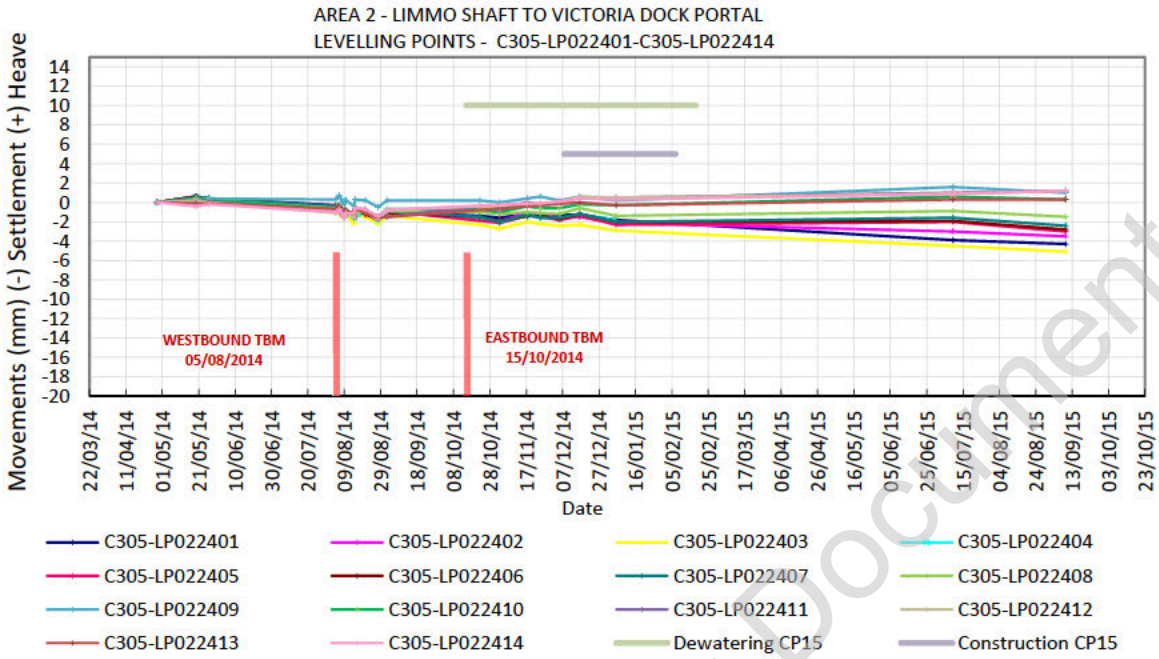
The percentage of the leveling points with a settlement rate less than -2 mm/year is 75%.

The percentage of the leveling points with a settlement rate less than -3 mm/year is 88%.

The next plot shows the trend line adjustment for the leveling points in this array.



C305-LP022401-C305-LP022414



The graph above presents the readings for an array located to the south of westbound tunnel, and shows a settlement of -1.5mm after the westbound TBM transit and a total maximum settlement of -5.1mm after the eastbound TBM transit.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

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

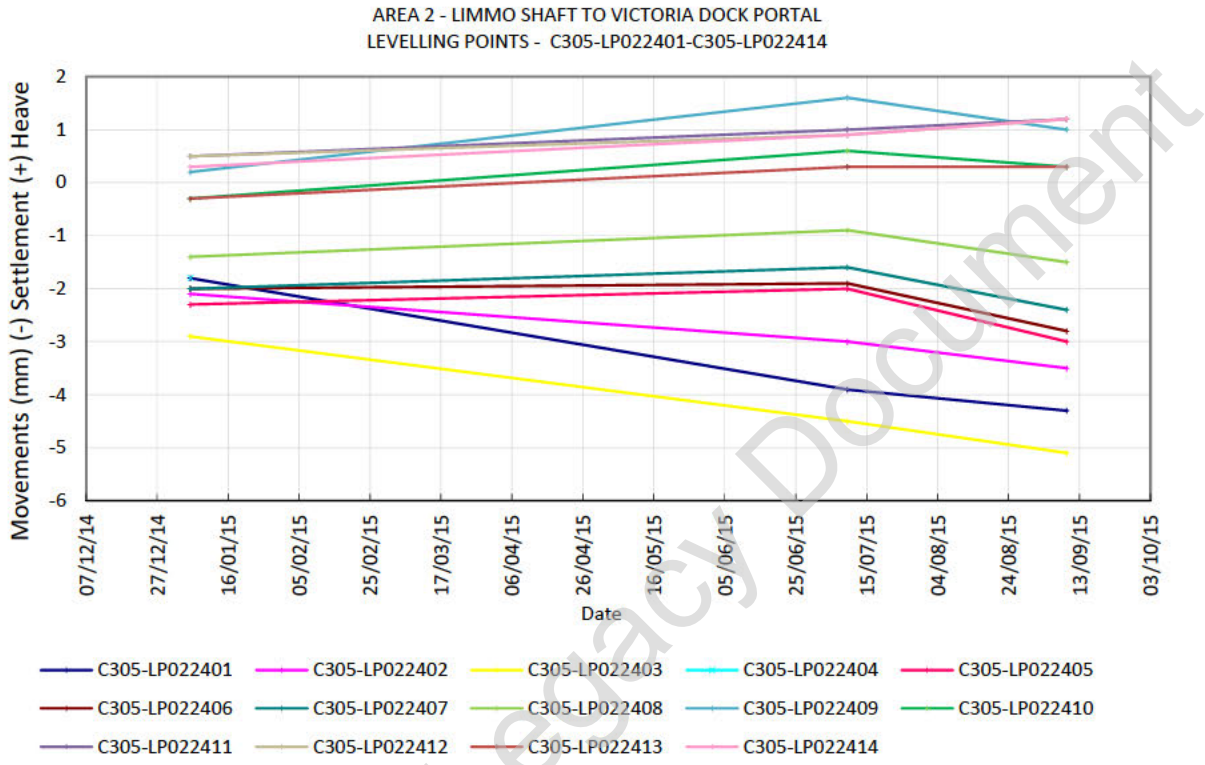
	Registered movement (mm)			mm/year
	05/01/2015	09/07/2015	09/09/2015	
C305-LP022401	-1.80	-3.90	-4.30	-3.797
C305-LP022402	-2.10	-3.00	-3.50	-2.001
C305-LP022403	-2.90	-4.50	-5.10	-3.229
C305-LP022404	-1.80	#N/A	#N/A	#N/A
C305-LP022405	-2.30	-2.00	-3.00	-0.660
C305-LP022406	-2.00	-1.90	-2.80	-0.864
C305-LP022407	-2.00	-1.60	-2.40	-0.273
C305-LP022408	-1.40	-0.90	-1.50	0.113
C305-LP022409	0.20	1.60	1.00	1.546
C305-LP022410	-0.30	0.60	0.30	1.091
C305-LP022411	0.50	1.00	1.20	1.023
C305-LP022412	0.50	0.90	1.20	0.978
C305-LP022413	-0.30	0.30	0.30	0.955
C305-LP022414	0.30	0.90	1.20	1.296
	Rate less than -2.5		% less 2 mm/ year	85%
	Rate less than -3.5		% less 3 mm/ year	92%

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

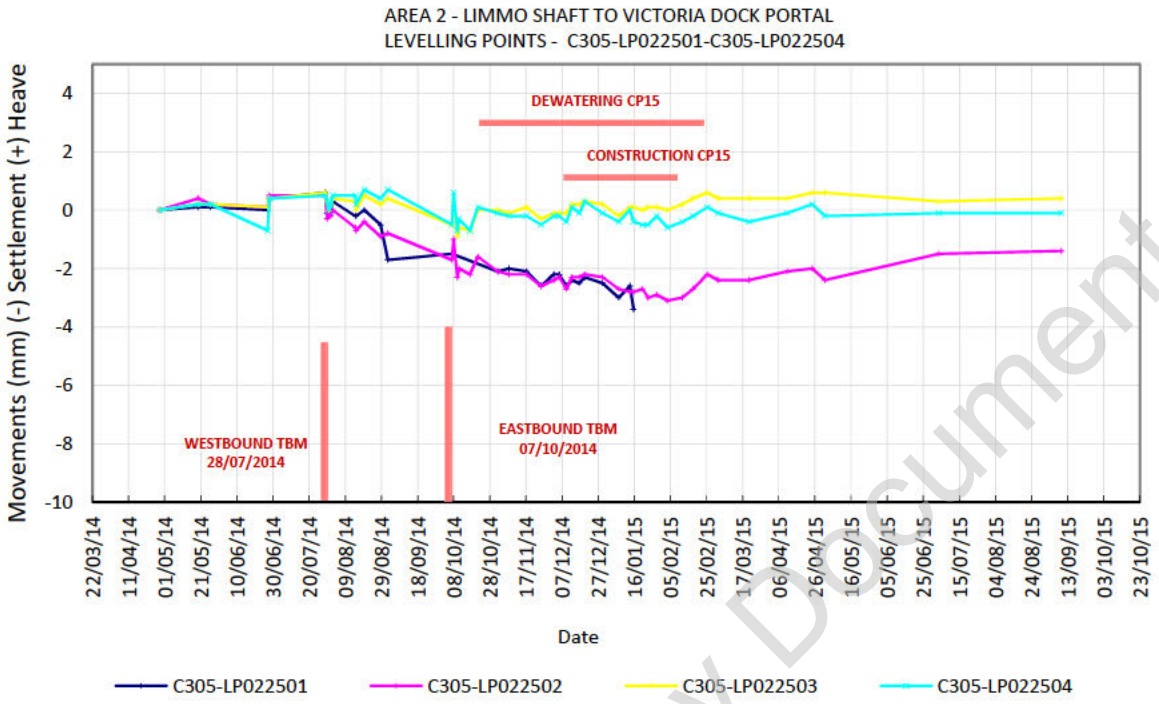
The percentage of the levelling points with a settlement rate less than -2 mm/year is 85%.

The percentage of the leveling points with a settlement rate less than -3 mm/year is 92%.

The next plot shows the trend line adjustment for the leveling points in this array.



C305-LP022501-C305-LP022504



The graph above presents the readings for an array located to the south of westbound tunnel, and shows a settlement of -1.7mm after the westbound TBM transit and a total maximum settlement of -3.4 mm after the eastbound TBM transit and during CP15 works.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

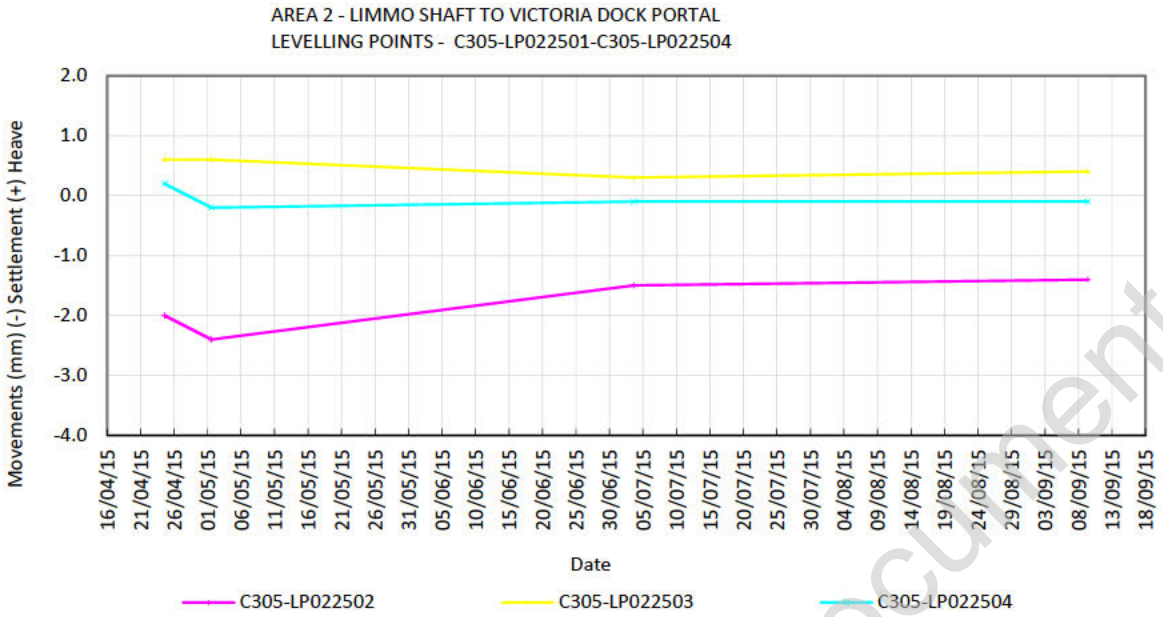
The table below shows the annual rate for the leveling points in this array.

	Registered movement (mm)				mm/year
	24/04/2015	01/05/2015	03/07/2015	09/09/2015	
C305-LP022501	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP022502	-2.00	-2.40	-1.50	-1.40	3.636
C305-LP022503	0.60	0.60	0.30	0.40	-1.632
C305-LP022504	0.20	-0.20	-0.10	-0.10	-0.716
	Rate less than -2.5		% less 2 mm/ year		100%
	Rate less than -3.5		% less 3 mm/ year		100%

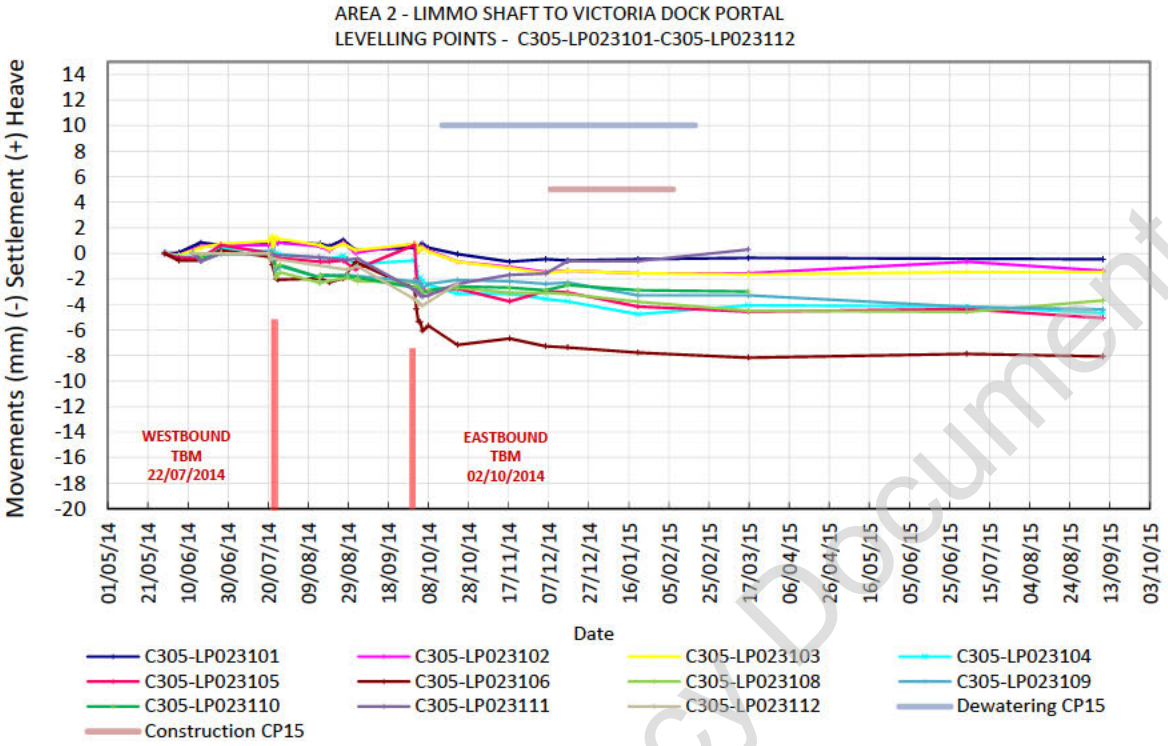
Note: All the movements are in mm. (-) Settlement / (+) Heave

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

The next plot shows the trend line adjustment for the leveling points in this array.



C305-LP023101-C305-LP023112



The graph above presents the readings for an array located to the south and north of the tunnels, and shows a settlement of -2.3mm after the westbound TBM transit and a total maximum settlement of -8.1mm after the eastbound TBM transit.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

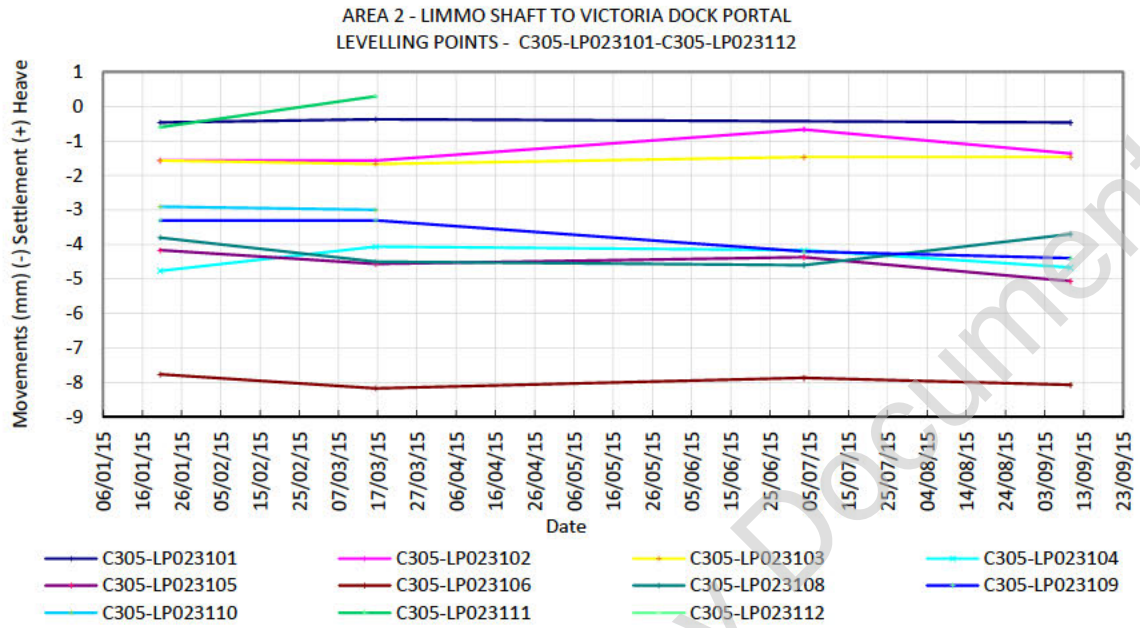
The table below shows the annual rate for the leveling points in this array.

	Registered movement (mm)				mm/year
	20/01/2015	16/03/2015	03/07/2015	09/09/2015	
C305-LP023101	-0.47	-0.37	#N/A	-0.47	-0.050
C305-LP023102	-1.57	-1.57	-0.67	-1.37	0.777
C305-LP023103	-1.57	-1.67	-1.47	-1.47	0.253
C305-LP023104	-4.77	-4.07	-4.17	-4.67	0.025
C305-LP023105	-4.17	-4.57	-4.37	-5.07	-1.048
C305-LP023106	-7.77	-8.17	-7.87	-8.07	-0.197
C305-LP023108	-3.80	-4.50	-4.60	-3.70	0.126
C305-LP023109	-3.30	-3.30	-4.20	-4.40	-1.967
C305-LP023110	-2.90	-3.00	#N/A	#N/A	-0.664
C305-LP023111	-0.60	0.30	#N/A	#N/A	5.973
C305-LP023112	#N/A	#N/A	#N/A	#N/A	#N/A
	Rate less than -2.5		% less 2 mm/ year		100%
	Rate less than -3.5		% less 3 mm/ year		100%

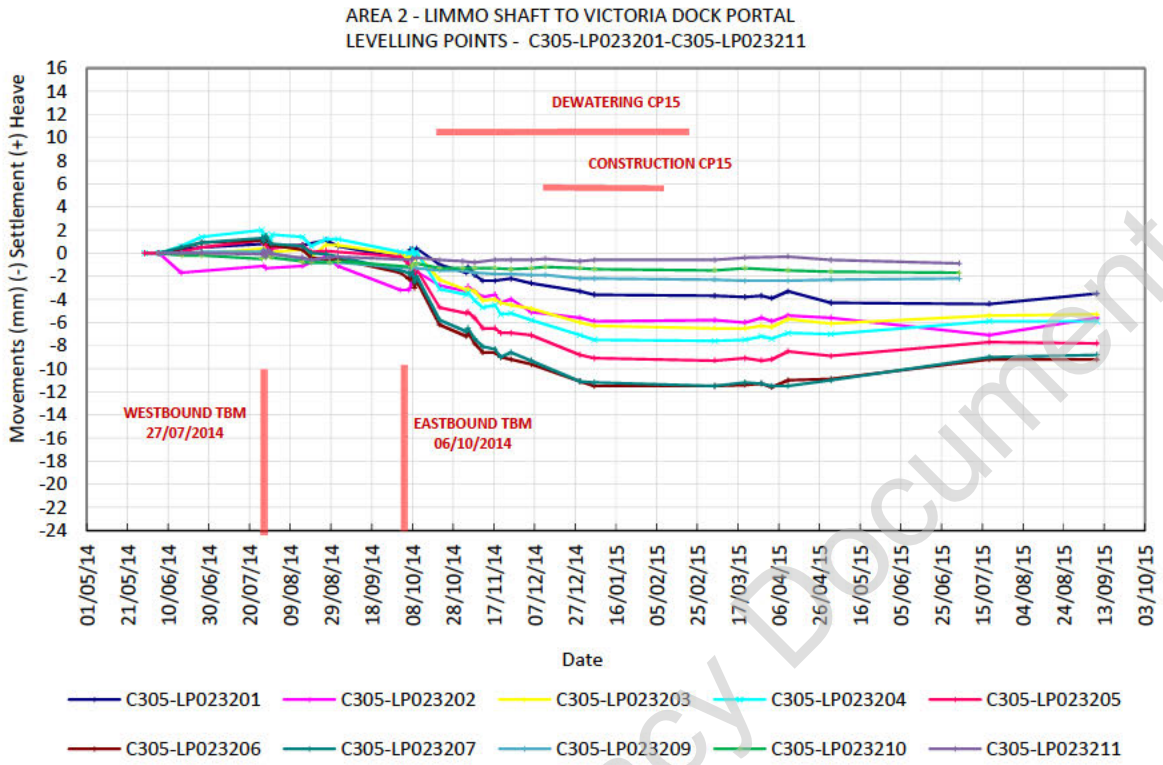
Note: All the movements are in mm. (-) Settlement / (+) Heave

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

The next plot shows the trend line adjustment for the leveling points in this array.



C305-LP023201-C305-LP023211



The graph above presents the readings for an array located on the surface along the westbound crown and shows a settlement of -1.3mm after the westbound TBM transit and a total maximum settlement of -11.5mm after the eastbound TBM transit and CP15 works.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

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

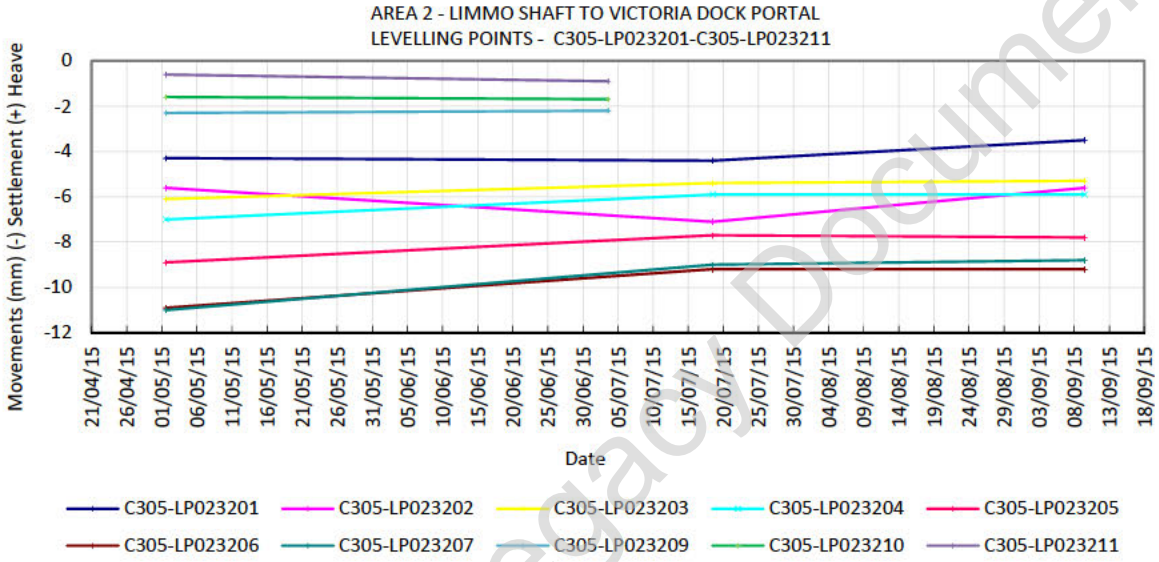
	Registered movement (mm)				mm/year
	01/05/2015	03/07/2015	18/07/2015	09/09/2015	
C305-LP023201	-4.30	#N/A	-4.40	-3.50	2.029
C305-LP023202	-5.60	#N/A	-7.10	-5.60	#N/A
C305-LP023203	-6.10	#N/A	-5.40	-5.30	3.279
C305-LP023204	-7.00	#N/A	-5.90	-5.90	5.152
C305-LP023205	-8.90	#N/A	-7.70	-7.80	5.620
C305-LP023206	-10.90	#N/A	-9.20	-9.20	7.962
C305-LP023207	-11.00	#N/A	-9.00	-8.80	9.367
C305-LP023209	-2.30	-2.20	#N/A	#N/A	0.579

	Registered movement (mm)				mm/year
	01/05/2015	03/07/2015	18/07/2015	09/09/2015	
C305-LP023210	-1.60	-1.70	#N/A	#N/A	-0.579
C305-LP023211	-0.60	-0.90	#N/A	#N/A	-1.736
	Rate less than -2.5		% less 2 mm/ year		100%
	Rate less than -3.5		% less 3 mm/ year		100%

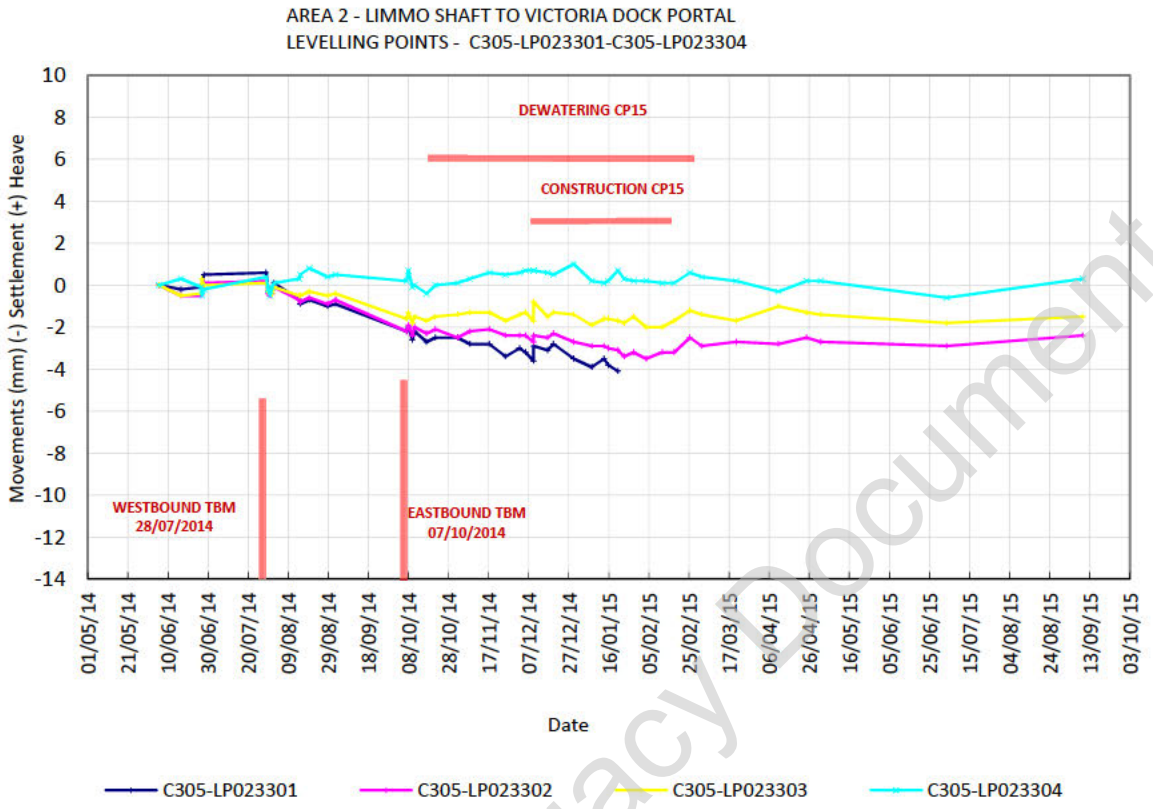
Note: All the movements are in mm. (-) Settlement / (+) Heave

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

The next plot shows the trend line adjustment for the leveling points in this array.



C305-LP023301-C305-LP023304



The graph above presents the readings for an array located to the south of the westbound tunnel, and shows a settlement of -1mm after the westbound TBM transit and a total maximum settlement of -4.1mm after the eastbound TBM transit and during CP15 works.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

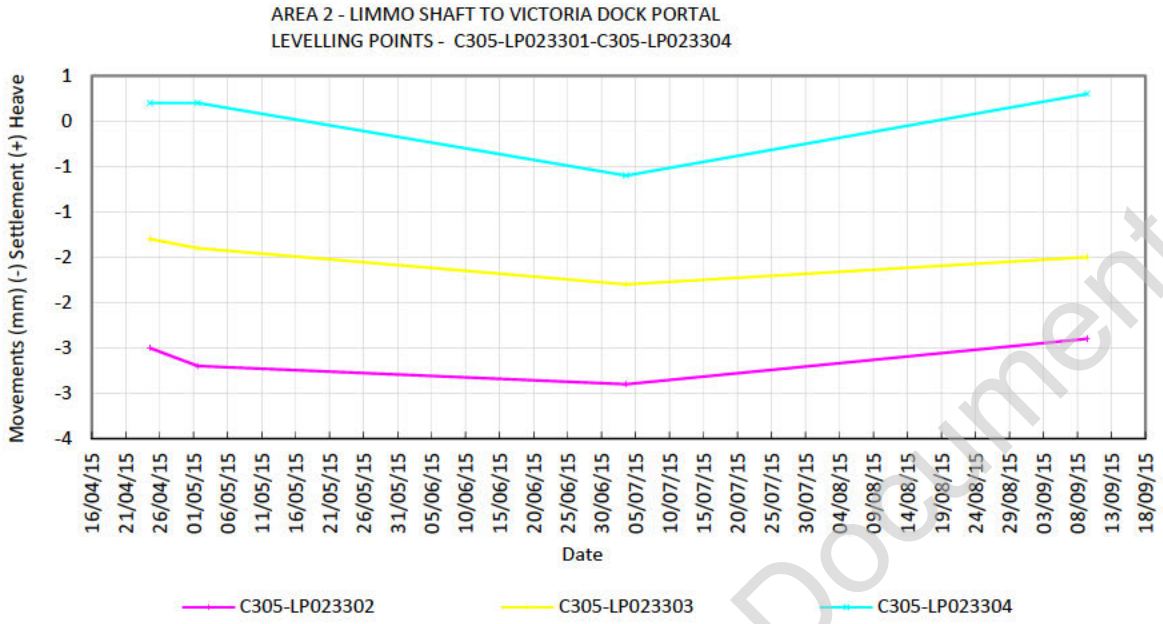
The table below shows the annual rate for the sockets in this array.

	Registered movement (mm)				mm/year
	24/04/2015	01/05/2015	03/07/2015	09/09/2015	
C305-LP023301	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP023302	-2.50	-2.70	-2.90	-2.40	0.330
C305-LP023303	-1.30	-1.40	-1.80	-1.50	-0.597
C305-LP023304	0.20	0.20	-0.60	0.30	-0.137
	Rate less than -2.5		% less 2 mm/ year		100%
	Rate less than -3.5		% less 3 mm/ year		100%

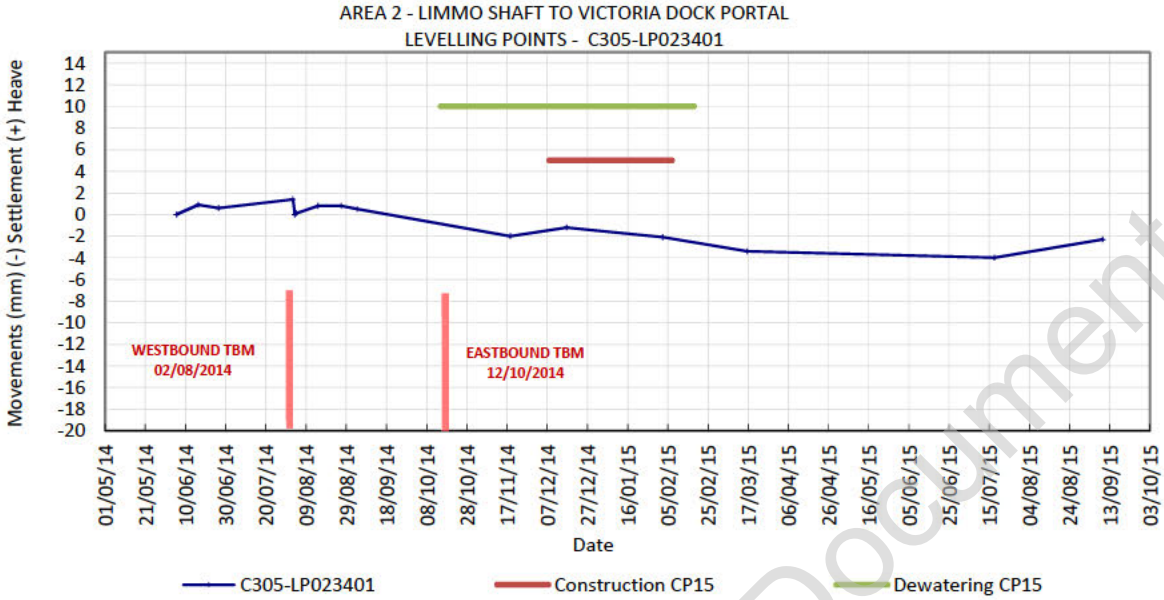
Note: All the movements are in mm. (-) Settlement / (+) Heave

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

The next plot shows the trend line adjustment for the sockets in this array.



C305-LP023401



The graph above presents the readings for a levelling point located above the eastbound tunnel, and shows negligible after the westbound TBM transit and a total maximum settlement of -4mm after the eastbound TBM transit.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

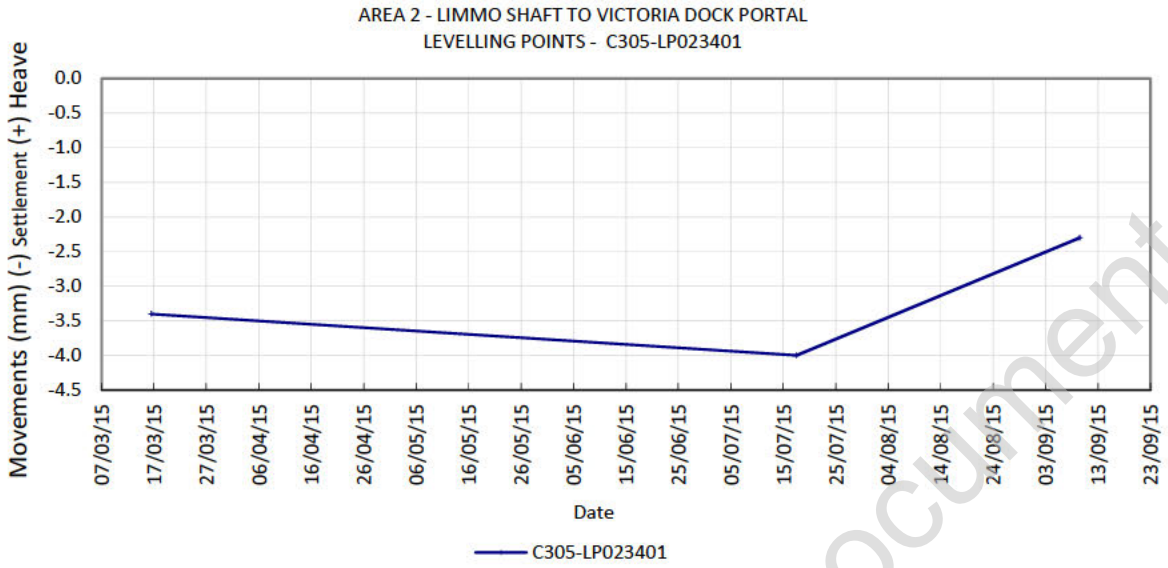
The table below shows the annual rate for the leveling points in this array.

	Registered movement (mm)			mm/year
	16/03/2015	17/07/2015	09/09/2015	
C305-LP023401	-3.40	-4.00	-2.30	1.572
	Rate less than -2.5		% less 2 mm/ year	100%
	Rate less than -3.5		% less 3 mm/ year	100%

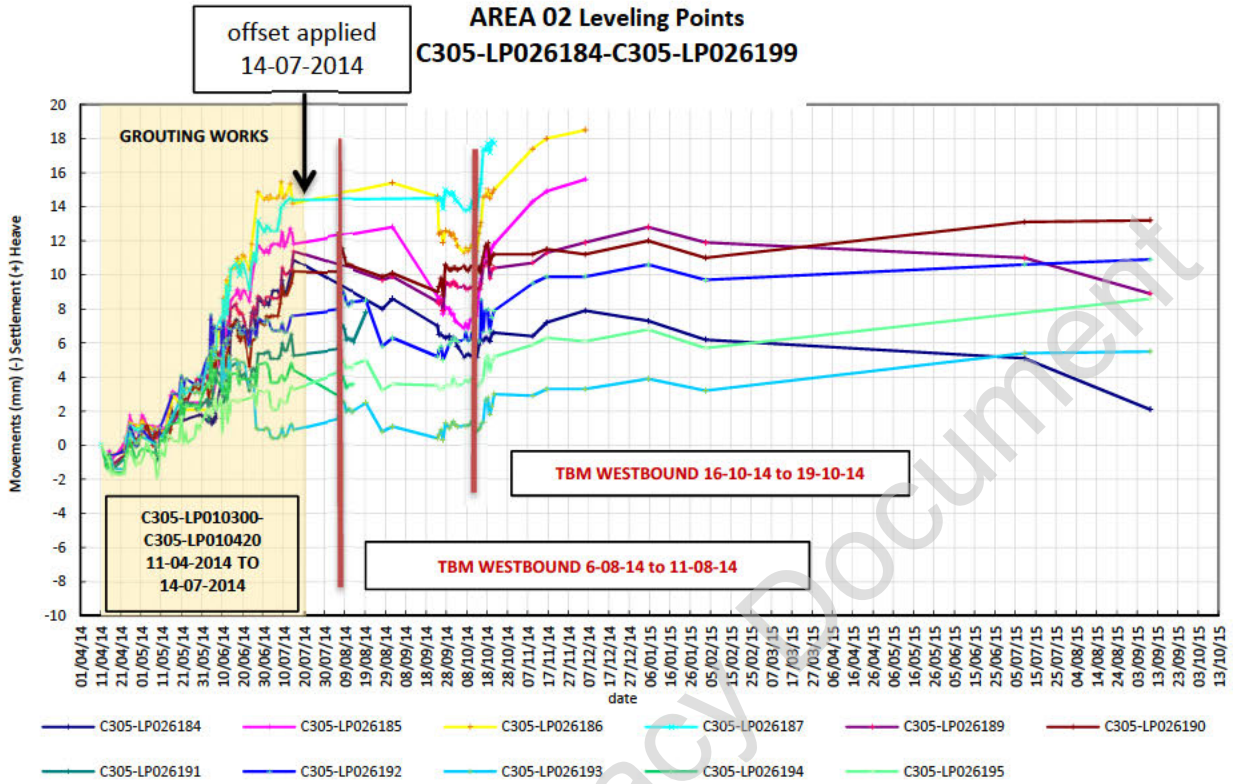
Note: All the movements are in mm. (-) Settlement / (+) Heave

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

The next plot shows the trend line adjustment for the leveling points in this array.



C305-LP026184-C305-LP026195



The graph above presents the readings for array located to the north of the eastbound tunnel.

Section C305-LP010300-C305-LP010420 was installed to monitor ground treatment works between 11 April 2014 and 14 July 2014 for which historical movement is shown in the graph above. These points were destroyed in September 2014 due to construction works. Second array C305-LP026184-C305-LP026195 was installed 1m distance offset (north) and parallel to C305-LP010300-LP010420 on which survey was carried out on the 14 July 2014. Ground movement readings taken for the 14 July 2014 of instruments (C305-LP010300-C305-LP010420) were applied to the newly installed instruments (C305-LP026184-C305-LP026195). See offset values in the Table below.

	14/07/2014 OFFSET		15/07/2014 FIRST READING + OFFSET
C305-LP010310	10.2	C305-LP026184	10.9
C305-LP010320	12.8	C305-LP026185	11.8
C305-LP010330	15.4	C305-LP026186	14.2
C305-LP010340	14.5	C305-LP026187	14.4
C305-LP010360	10.3	C305-LP026189	11.4
C305-LP010370	9.5	C305-LP026190	10.2
C305-LP010380	6.5	C305-LP026191	5.3
C305-LP010390	7.6	C305-LP026192	7.6
C305-LP010400	1.3	C305-LP026193	0.9
C305-LP010410	4.8	C305-LP026194	4.4
C305-LP010420	3.5	C305-LP026195	3.3

Analysis and reporting of points (C305-LP010300-C305-LP010420) installed to monitor the ground treatment works can be found in close out report 'I&M VDP Electrolevels and additional Long LP in soft ground(C305-DSJ-C2-RGN-CRG03-50326 Rev 2.0)'.

Graph shows a maximum heave of 18.5 mm after the ground treatment works and TBMs transit.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

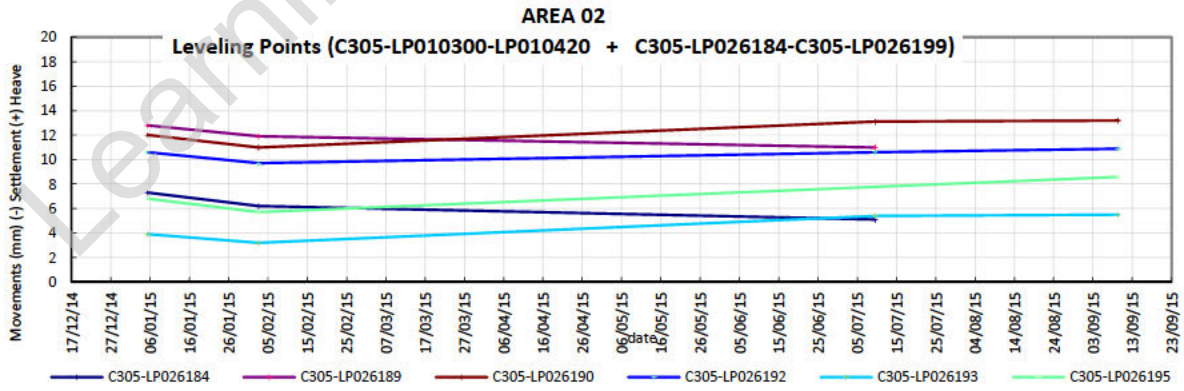
The table below shows the annual rate for the leveling points in this array.

	Registered movement (mm)				Rate
	05/01/2015	02/02/2015	09/07/2015	09/09/2015	mm/year
C305-LP026184	7.30	6.20	5.10	#N/A	-3.73
C305-LP026185	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP026186	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP026187	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP026189	12.80	11.90	11.00	#N/A	-3.056
C305-LP026190	12.00	11.00	13.10	13.20	2.728
C305-LP026191	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP026192	10.60	9.70	10.60	10.90	0.997
C305-LP026193	3.90	3.20	5.40	5 50	3.192
C305-LP026194	#N/A	#N/A	#N/A	#N/A	#N/A
C305-LP026195	6.80	5.70	#N/A	8.60	3.487
	Rate less than -2.5 mm/year		% less 2 mm/ year		67%
	Rate greater than -3.5 mm/year		% less 3 mm/ year		83%

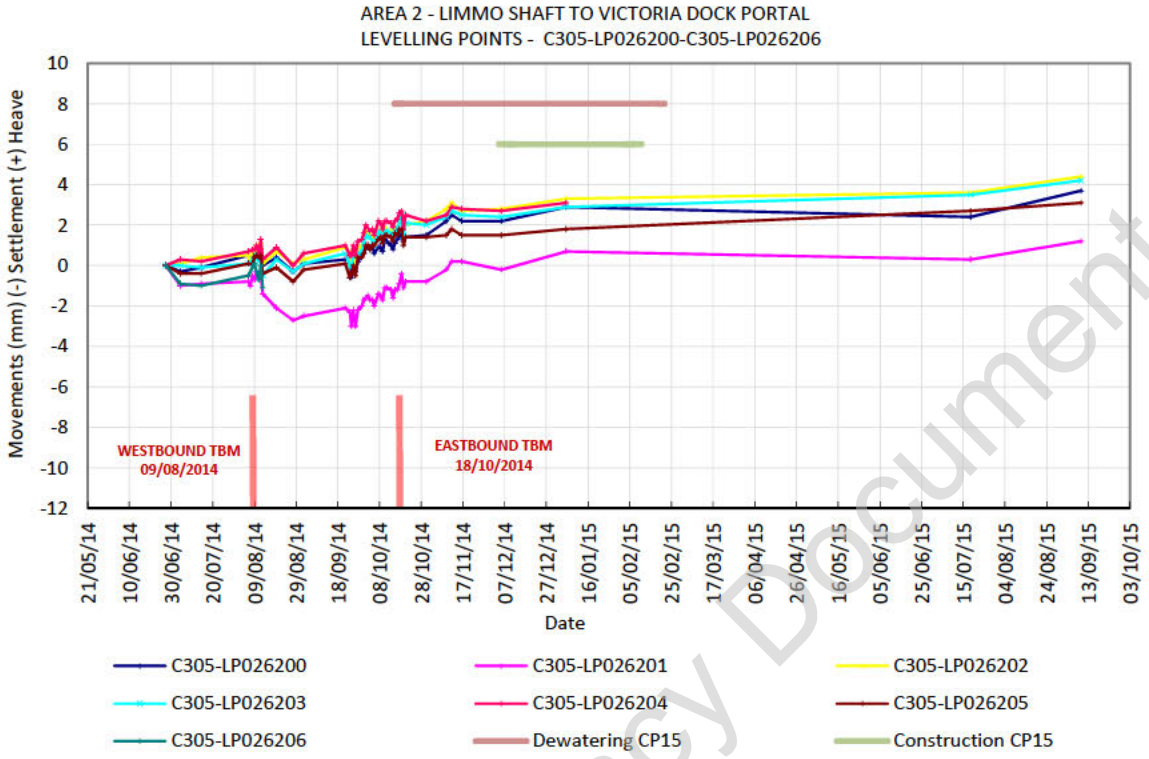
Note: All the movements are in mm. (-) Settlement / (+) Heave

The percentage of the leveling points with a settlement rate less than -2 mm/year is 67%. The percentage of the leveling points with a settlement rate less than -3 mm/year is 83%.

The next plot shows the trend line adjustment for the leveling points in this array.



C305-LP026200-C305-LP026206



The graph above presents the readings for an array located to the north of the eastbound tunnel, and shows a settlement of -3mm after the westbound TBM transit and heave of 3mm during the eastbound TBM transit. No offset has been applied to these points due to grouting works.

In order to check whether the rate of change in the data has reached an acceptably small value, the last readings were used to calculate the annual projection.

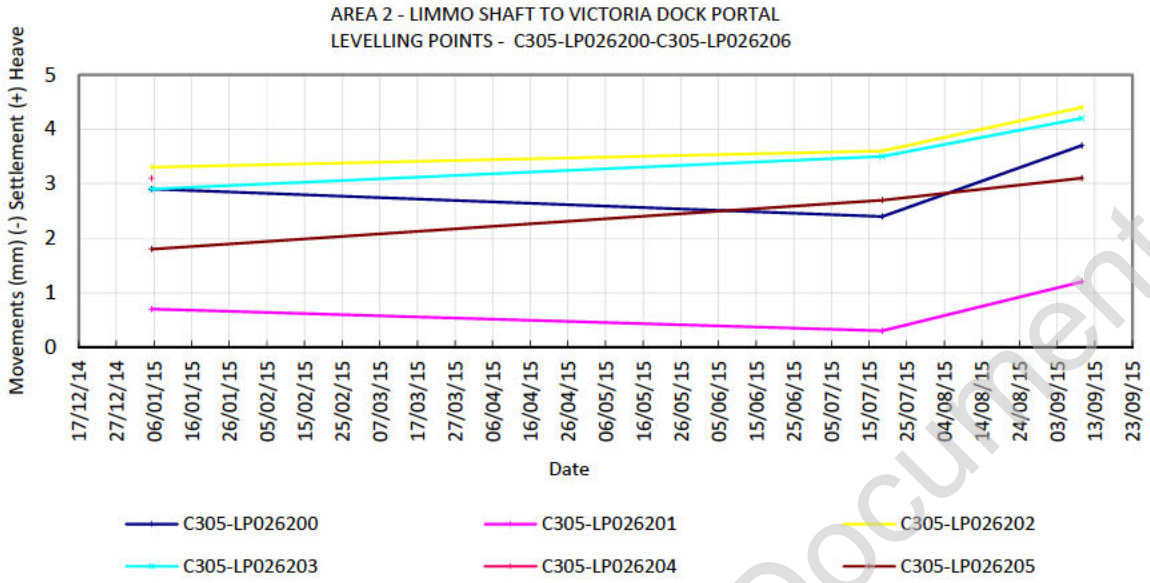
The table below shows the annual rate for the leveling points in this array.

	Registered movement (mm)			mm/year
	05/01/2015	18/07/2015	09/09/2015	
C305-LP026200	2.90	2.40	3.70	0.609
C305-LP026201	0.70	0.30	1.20	0.336
C305-LP026202	3.30	3.60	4.40	1.339
C305-LP026203	2.90	3.50	4.20	1.707
C305-LP026204	3.10	#N/A	#N/A	#N/A
C305-LP026205	1.80	2.70	3.10	1.859
C305-LP026206	#N/A	#N/A	#N/A	#N/A
	Rate less than -2.5		% less 2 mm/ year	100%
	Rate less than -3.5		% less 3 mm/ year	100%

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

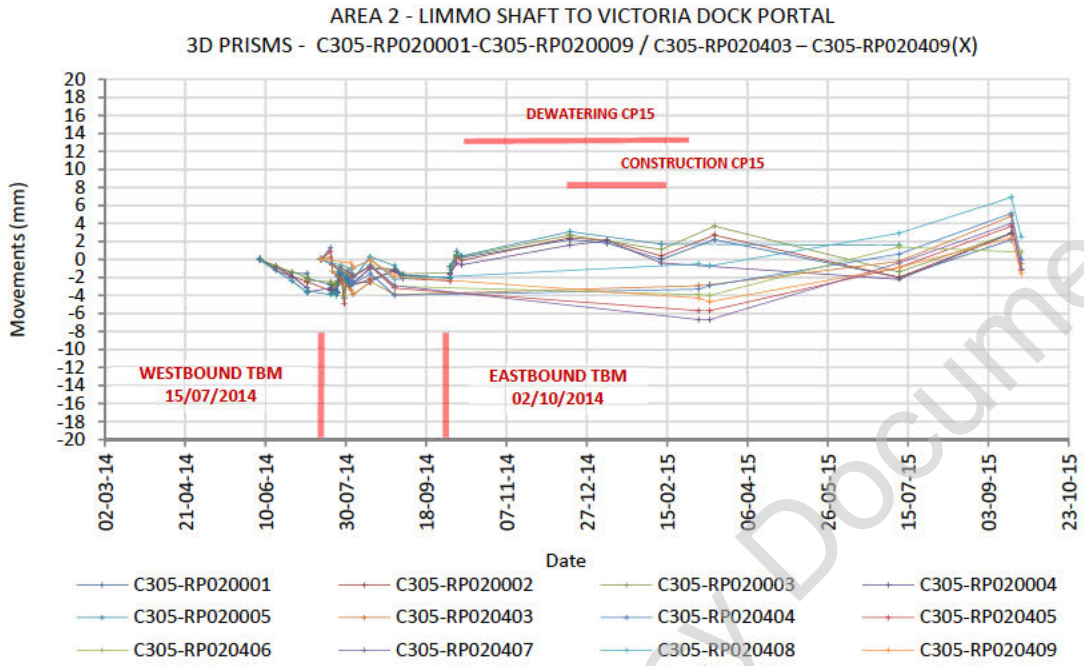
The percentage of the leveling points with a settlement rate less than -2 mm/year is 100%.

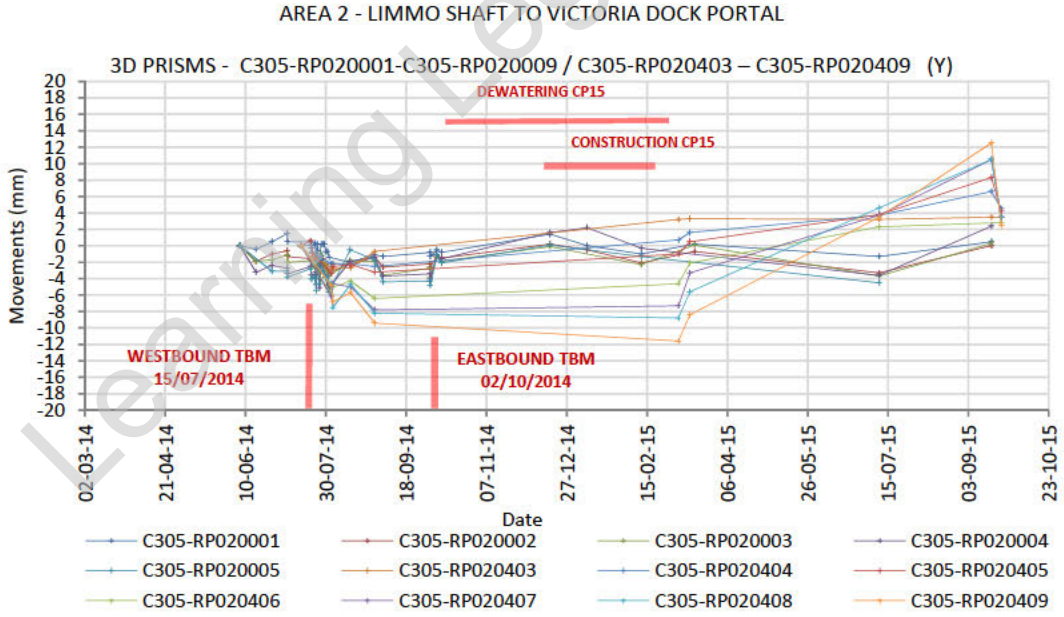
The next plot shows the trend line adjustment for the leveling points in this array.

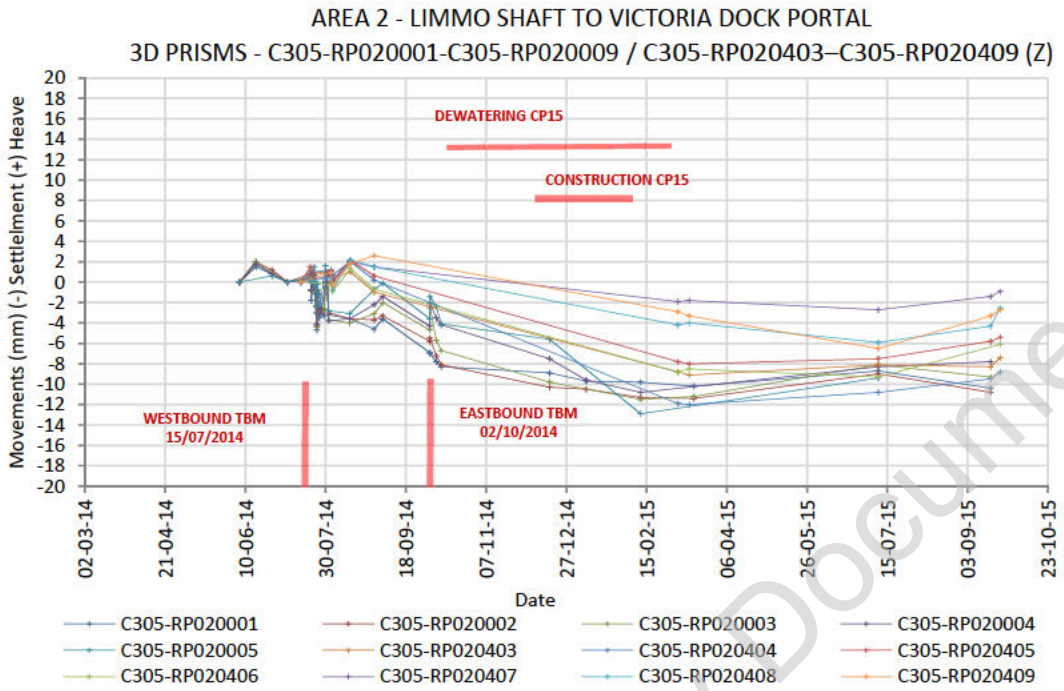


3D PRISMS AND RETRO TARGETS

C305-RP020001 – C305-RP020005 / C305-RP020403 – C305-RP020409





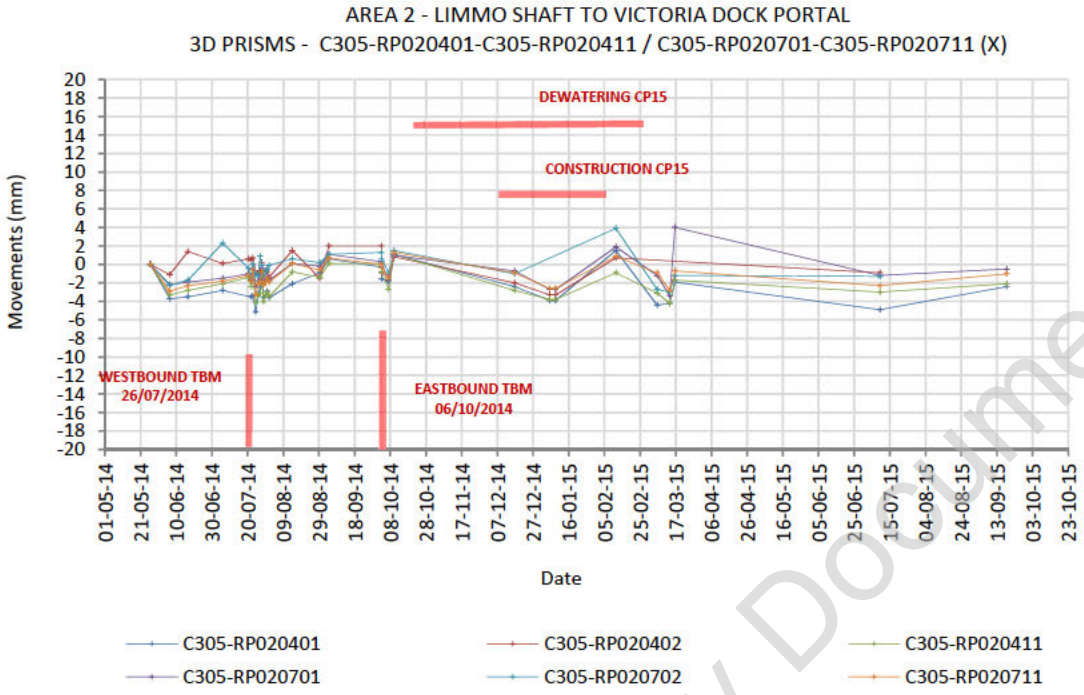


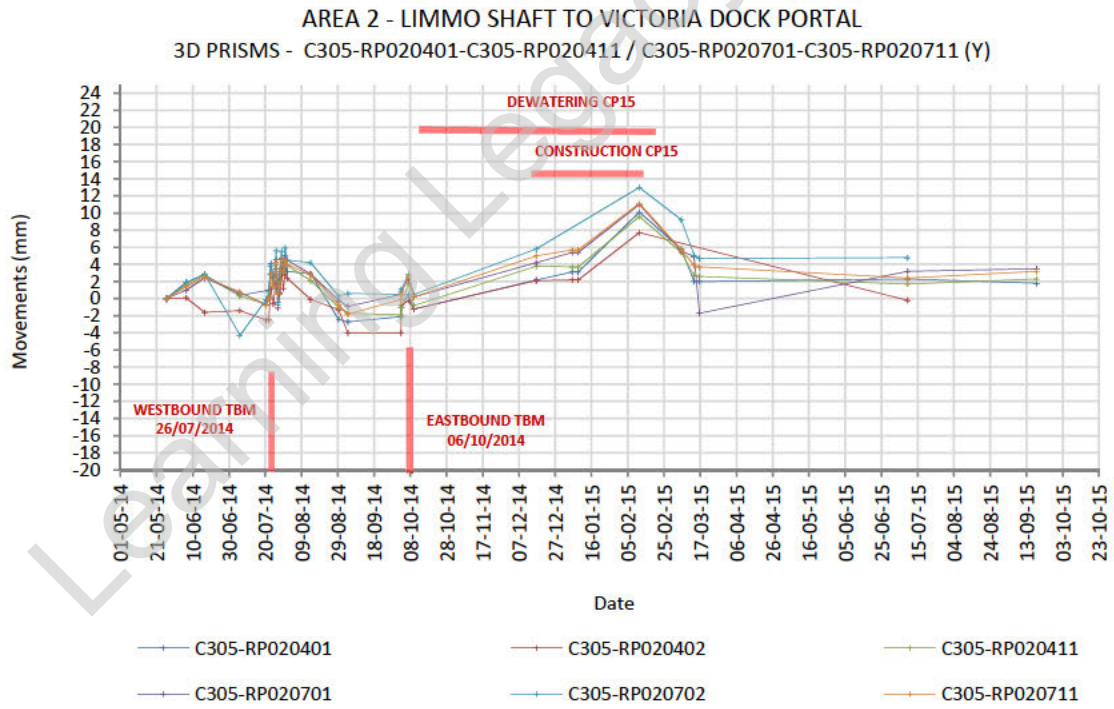
In the X Axis, the range of maximum movement was between +6.9 mm and -6.7 mm, after the eastbound and westbound TBM transits.

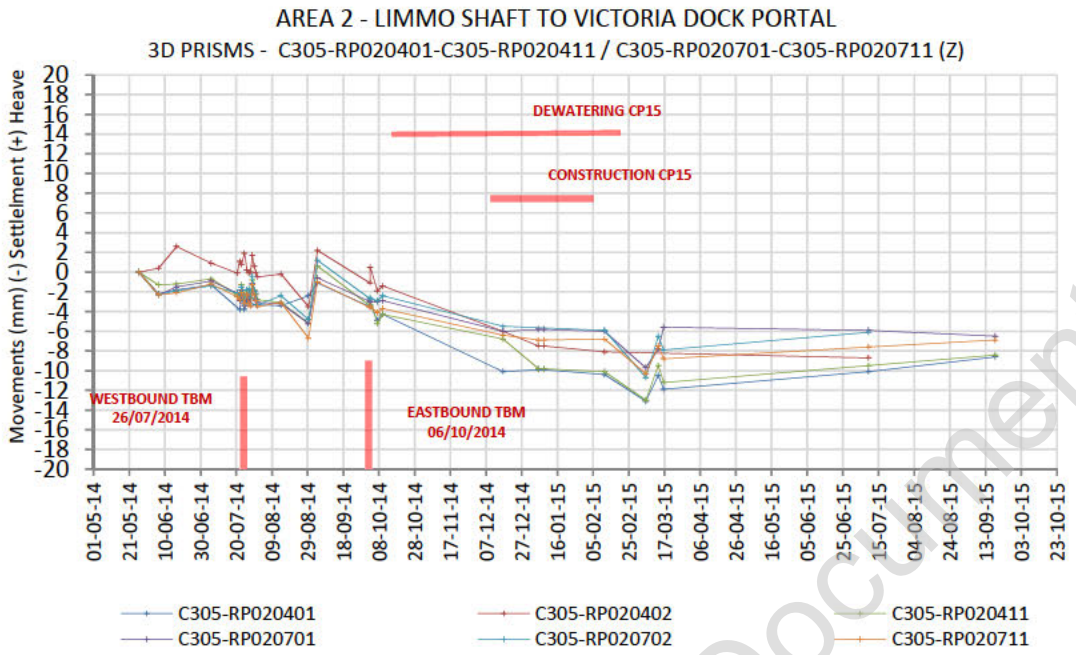
In the Y Axis, the range of maximum movement was between +12.5 mm and -11.6 mm, after the eastbound and westbound TBM transits.

In the Z Axis, the maximum settlement was -12.9mm, after the eastbound and westbound TBM transits.

C305-RP020401 – C305-RP020411 / C305-RP020701 – C305-RP020711





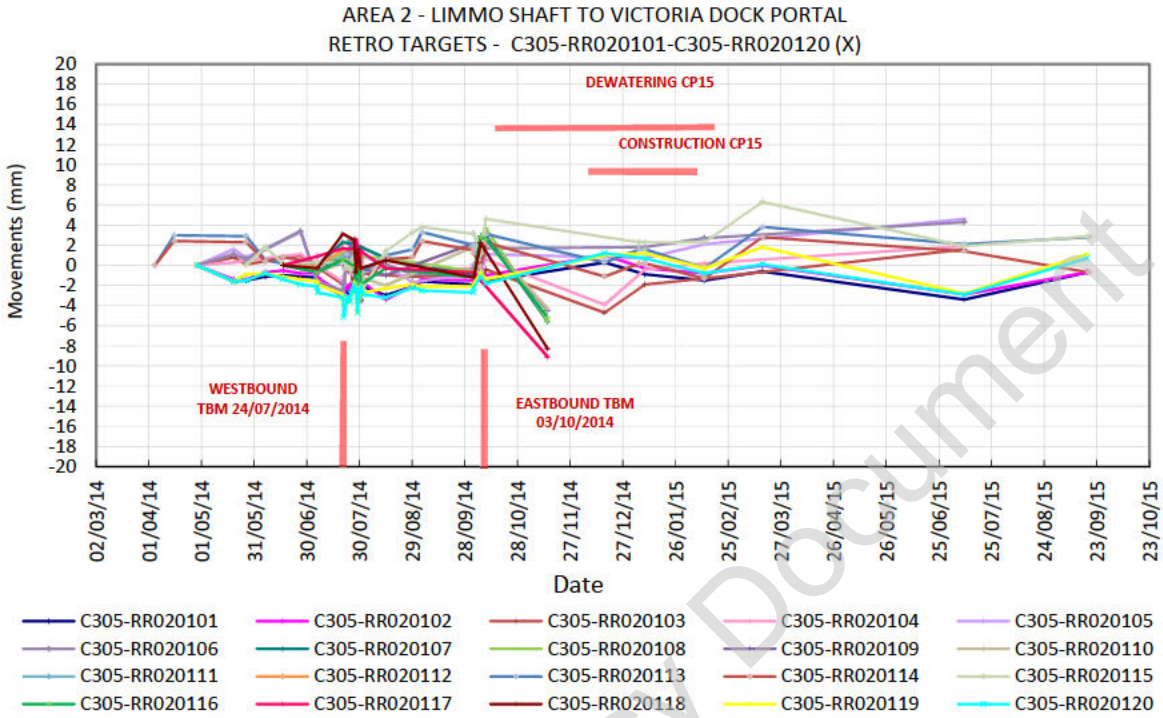


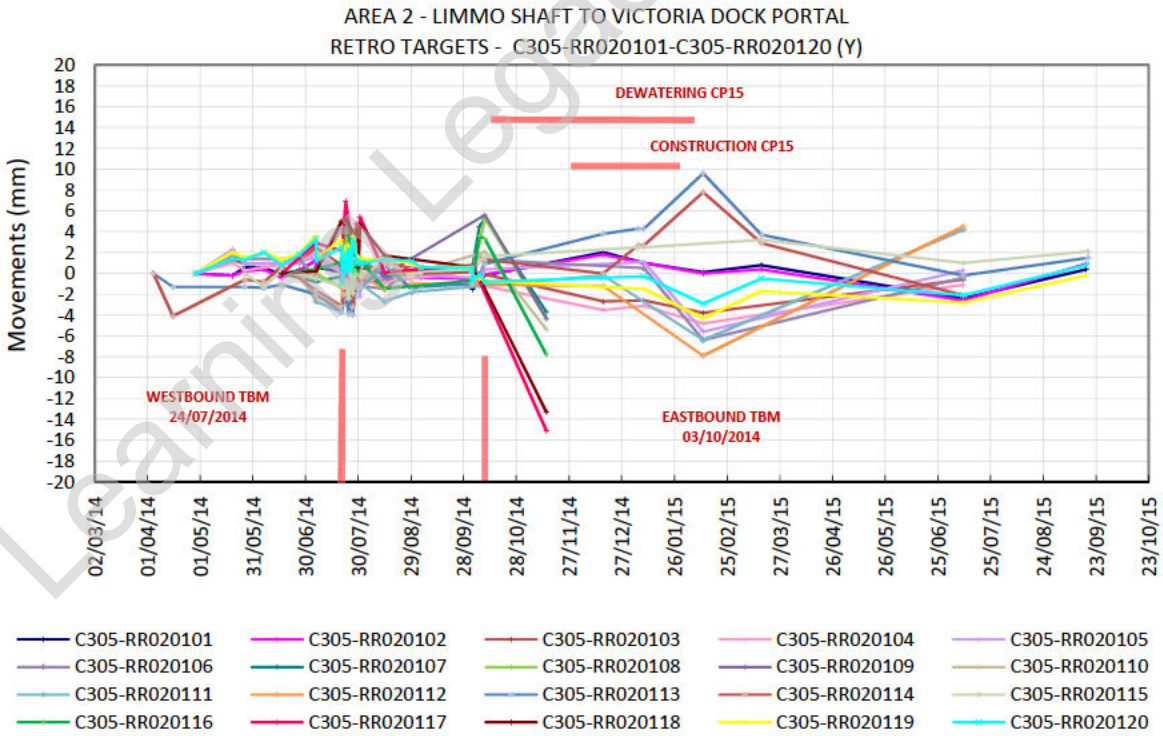
In the X Axis, the range of maximum movement was between +4.0 mm and -4.9 mm, after the eastbound and westbound TBM transits.

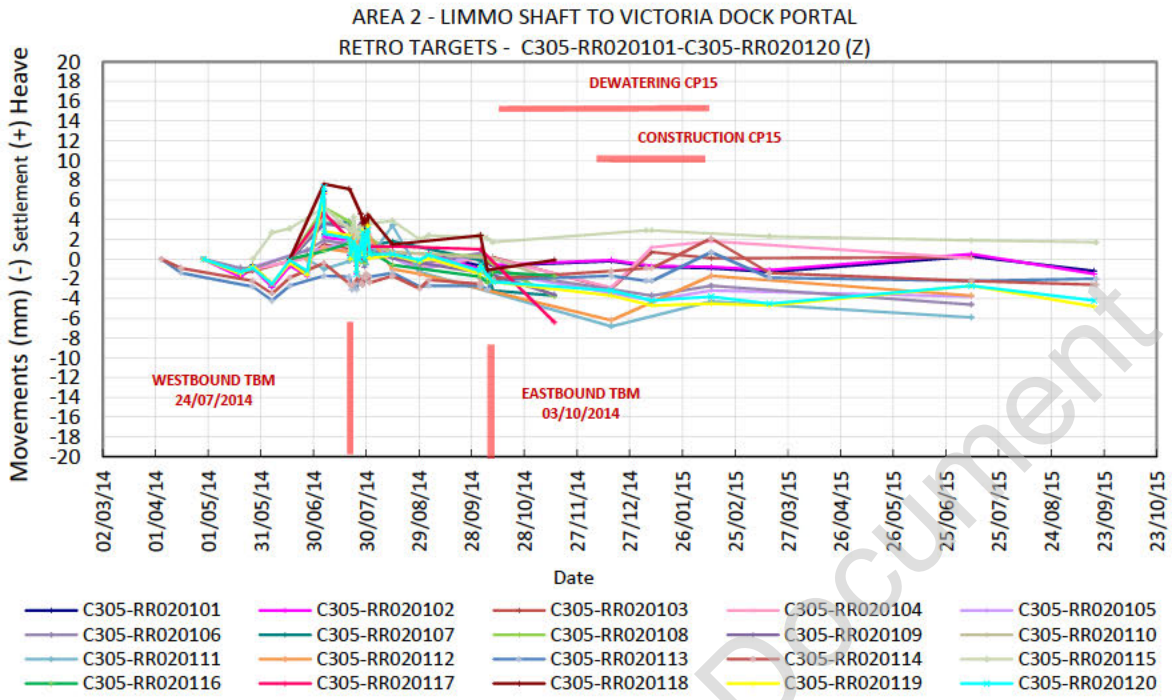
In the Y Axis, the range of maximum movement was between +13.0 mm and -1.7 mm after the eastbound and westbound TBM transits.

In the Z Axis, the maximum settlement was -13mm, after the eastbound and westbound TBM transits.

C305-RR020101 – C305-RR020120







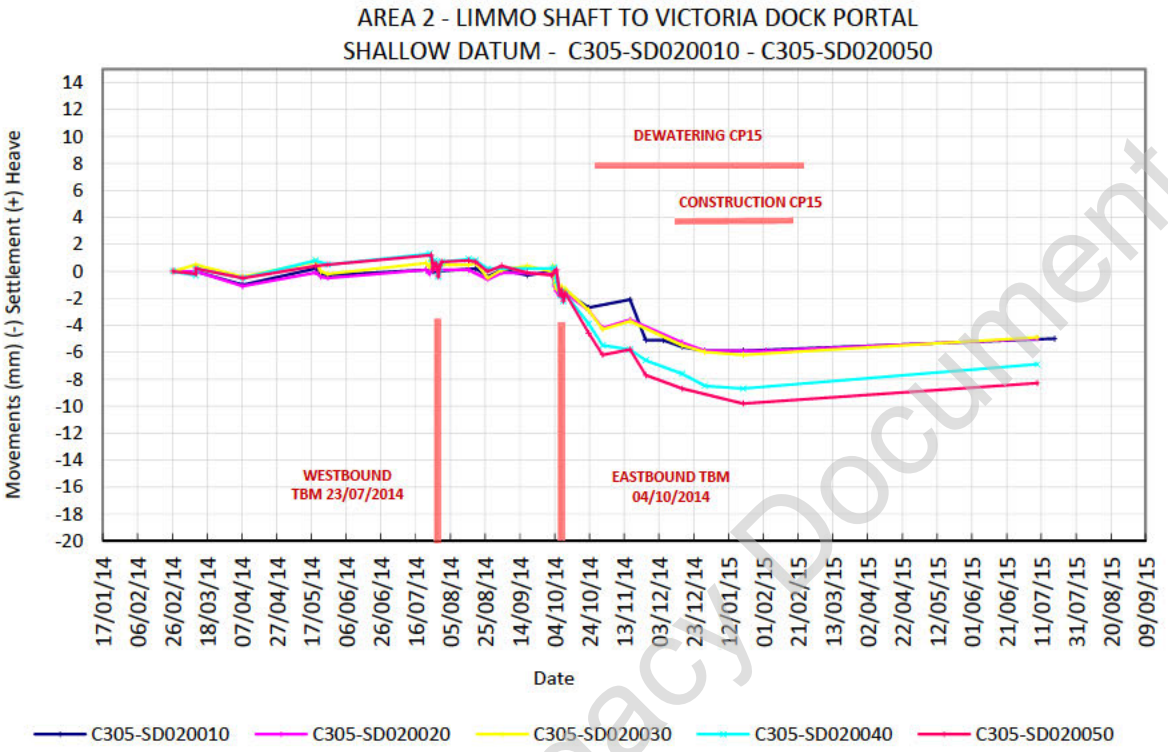
In the X Axis, the range of maximum movement was between +6.3 mm and -9.1 mm, after the eastbound and westbound TBM transits.

In the Y Axis, the range of maximum movement was between +9.6 mm and -15.1 mm, after the eastbound and westbound TBM transits.

In the Z Axis, the maximum settlement was -6.4 mm, after the eastbound and westbound TBM transits.

SHALLOW DATUM

C305-SD020010, C305-SD020020, C305-SD020030, C305-SD020040 and C305-SD020050



The graph above shows a settlement of -0.5mm after the westbound TBM transit and a total maximum settlement of -9.8mm after the eastbound TBM transit.

In order to check whether the rate of change in the data has reached an acceptably small value, the last two readings were used to calculate the annual projection.

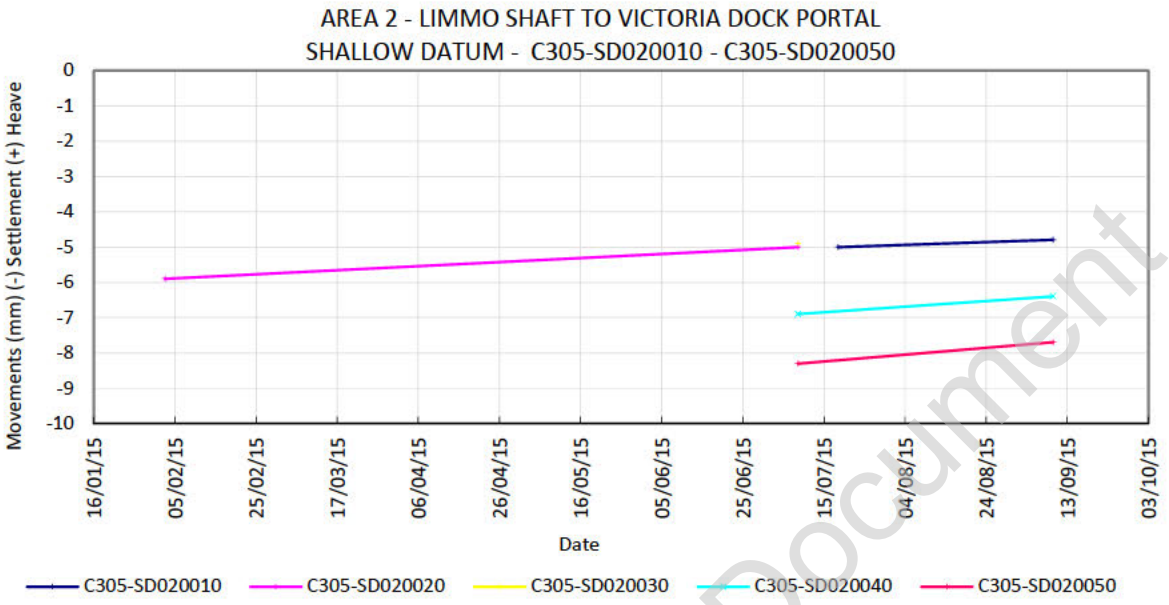
The table below shows the annual rate for the sockets in this array.

	Registered movement (mm)				mm/year
	02/02/2015	08/07/2015	18/07/2015	09/09/2015	
C305-SD020010	#N/A	#N/A	-5.00	-4.80	1.377
C305-SD020020	-5.90	-5.00	#N/A	#N/A	2.104
C305-SD020030	#N/A	-4.90	#N/A	#N/A	#N/A
C305-SD020040	#N/A	-6.90	#N/A	-6.40	2.904
C305-SD020050	#N/A	-8.30	#N/A	-7.70	3.484
	Rate less than -2.5		% less 2 mm/ year		100%
	Rate greater than -3.5		% less 3 mm/ year		100%

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

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

The next plot shows the trend line adjustment for the sockets in this array.



8. SUMMARY STATEMENT

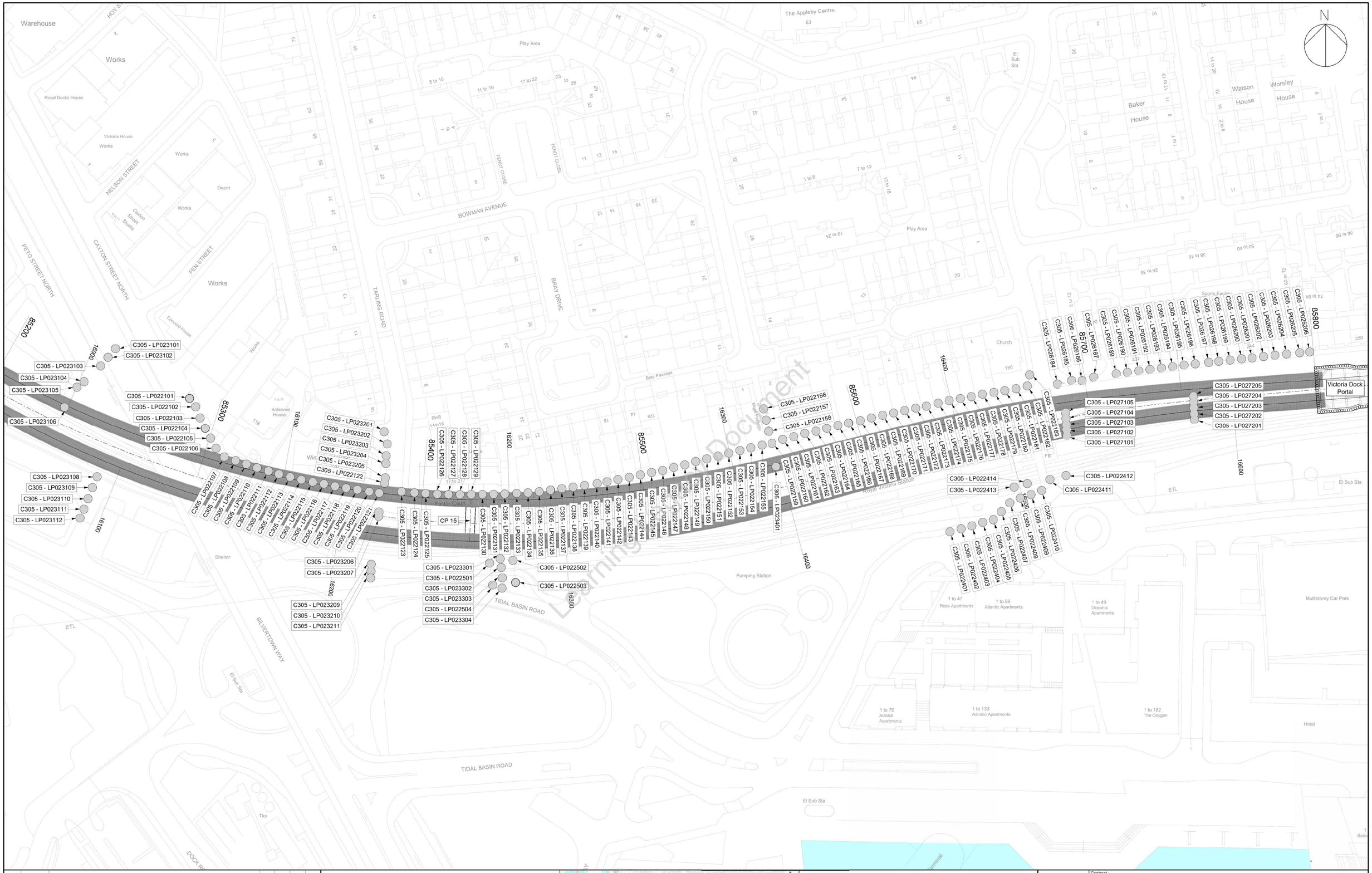
The Project Manager, the Designer, the Contractor and the Sub Contractor have agreed in the close out monitoring review meeting:

- that the long term ground movements for the instruments covered within this report have reached an acceptably small rate,
- that all monitoring should cease,
- and the instrumentation can be decommissioned.

See Appendix C for the meeting minutes.

APPENDIX A:

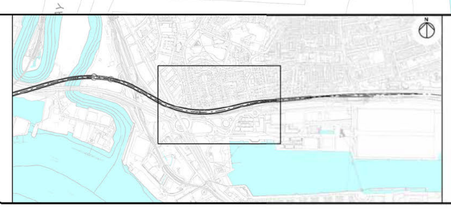
INSTRUMENT LOCATION



Notes

- Levelling Point

Rev.	Date	Description	By	Chkd	App	Auth
P01	06/03/2015	First Issue	MD	AH	RC	-
P02	11/03/2015	---	MD	AH	RC	-
P03	18/03/2015	---	MD	AH	RC	-
P04	01/03/2016	---	MD	MD	MD	-
P05	01/03/2016	---	MD	MD	MD	-



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1:750 @ A1

Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ

www.crossrail.co.uk

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
Levelling Points along Drive G
C305-DSJ-C2-RGN-CRG03-50295

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

Scale : 1:750@ A1

Drawing and CAD file No : C305-DSJ-C2-DDA-CRT00_ST006_Z-08104

Rev : P05

Suitability : S4

Fit for authorisation

RESTRICTED

C305-DSJ-C2-DDA-CRT00_ST006_Z-08104.dgn 01/03/2016 12:02:20

CAXTON STREET NORTH

PETO STREET NORTH

Concord House

Works

1 to 11
Ardennes House

118

1 to 27
Wimborne

N

C305-RR020103 C305-RR020104

C305-LB020102

C305-LB020101

C305-RR020101 C305-RR020102

C305-LB020110

C305-RR020119 C305-RR020120

C305-RR020105 C305-RR020106

C305-LB020103

C305-LB020302

C305-LB020301

85200

16000

85300

16100

C305-RP020001

C305-LB020001

C305-RP020002

C305-LB020002

C305-LB020003

C305-RP020003

C305-RR020117 C305-RR020118

C305-LB020109

C305-LB020004

C305-RP020004

C305-RR020107 C305-RR020108

C305-LB020104

C305-LB020005

C305-RP020005

C305-LB020105

C305-LB020108

C305-RR020109 C305-RR020110

C305-RR020115

C305-RR020116

16100

C305-RR020111

C305-RR020112

C305-LB020106

Shelter

Sub Sta

C305-RR020113 C305-RR020114

C305-LB020107

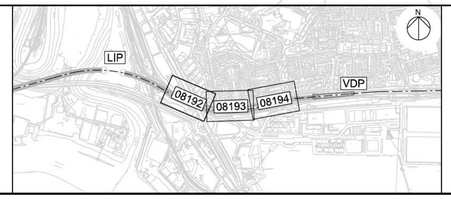
Learning Legacy Document

Fit for authorisation

Rev.	Date	Description	By	Chkd	App	Auth
P01	25/02/2016	First Issue	MD	MD	MD	-
P02	26/02/2016	—	MD	MD	MD	-
P03	04/03/2016	—	MD	MD	MD	-

Notes

- Sockets
- 3D Prisms
- Retro Targets
- Tiltmeter



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1:250 @ A1

Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ

www.crossrail.co.uk

Contract : Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G

Originator : Dragados Sisk Joint Venture

Location : Crossrail Tunnels - Drive G (Limmo Peninsula to Victoria Dock)

Title : Instrumentation & Monitoring
I&M Installation Report for Sockets,
3D Prisms, Retro Targets & Tiltmeters (Drive G)
C305-DSJ-C2-RGN-CRG03-50294

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

Scale : 1:250@ A1

Drawing and CAD file No : C305-DSJ-C2-DDA-CRT00_ST008_1-08192

Rev : P03

Suitability : S4

RESTRICTED

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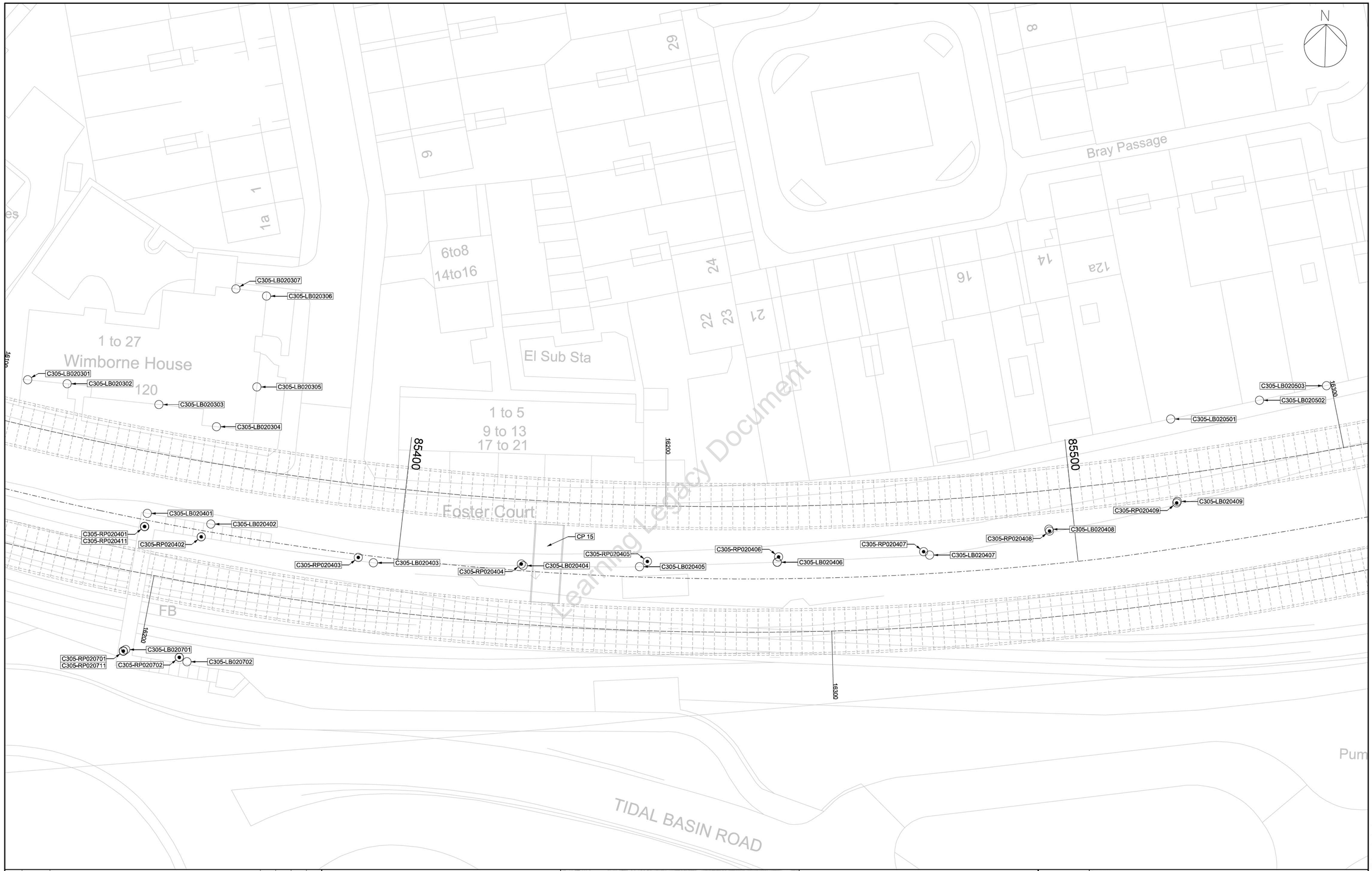
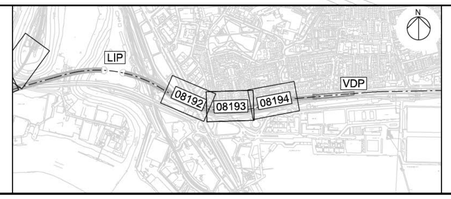


Rev.	Date	Description	By	Chkd	App	Auth
P01	25/02/2016	First Issue	MD	MD	MD	-
P02	26/02/2016	—	MD	MD	MD	-

Notes
- Sockets
- 3D Prisms
- Retro Targets
- Tiltmeter



5m 0 5m 10m 15m 20m 25m
1:250 @ A1

Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ

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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 G (Limmo Peninsula to Victoria Dock)
Title : Instrumentation & Monitoring
I&M Installation Report for Sockets,
3D Prisms, Retro Targets & Tiltmeters (Drive G)
C305-DSJ-C2-RGN-CRG03-50294

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

Scale : 1:250@ A1
Drawing and CAD file No : C305-DSJ-C2-DDA-CRT00_ST008_1-08193
Rev : P02
Suitability : S4

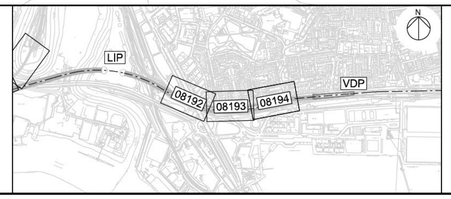
Fit for authorisation

RESTRICTED

C305-DSJ-C2-DDA-CRT00_ST008_1-08193.dgn 26/02/2016 14:11:32

Rev.	Date	Description	By	Chkd	App	Auth
						-
						-
						-
						-
P01	25/02/2016	First Issue	MD	MD	MD	-
P02	26/02/2016	—	MD	MD	MD	-

Notes
- Sockets
- 3D Prisms
- Retro Targets
- Tiltmeters



5m 0 5m 10m 15m 20m 25m
1:250 @ A1

Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ

www.crossrail.co.uk

Contract : Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G
Originator : Dragados Sisk Joint Venture
Location : Crossrail Tunnels - Drive G (Limmo Peninsula to Victoria Dock)
Title : Instrumentation & Monitoring
I&M Installation Report for Sockets,
3D Prisms, Retro Targets & Tiltmeters (Drive G)
C305-DSJ-C2-RGN-CRG03-50294

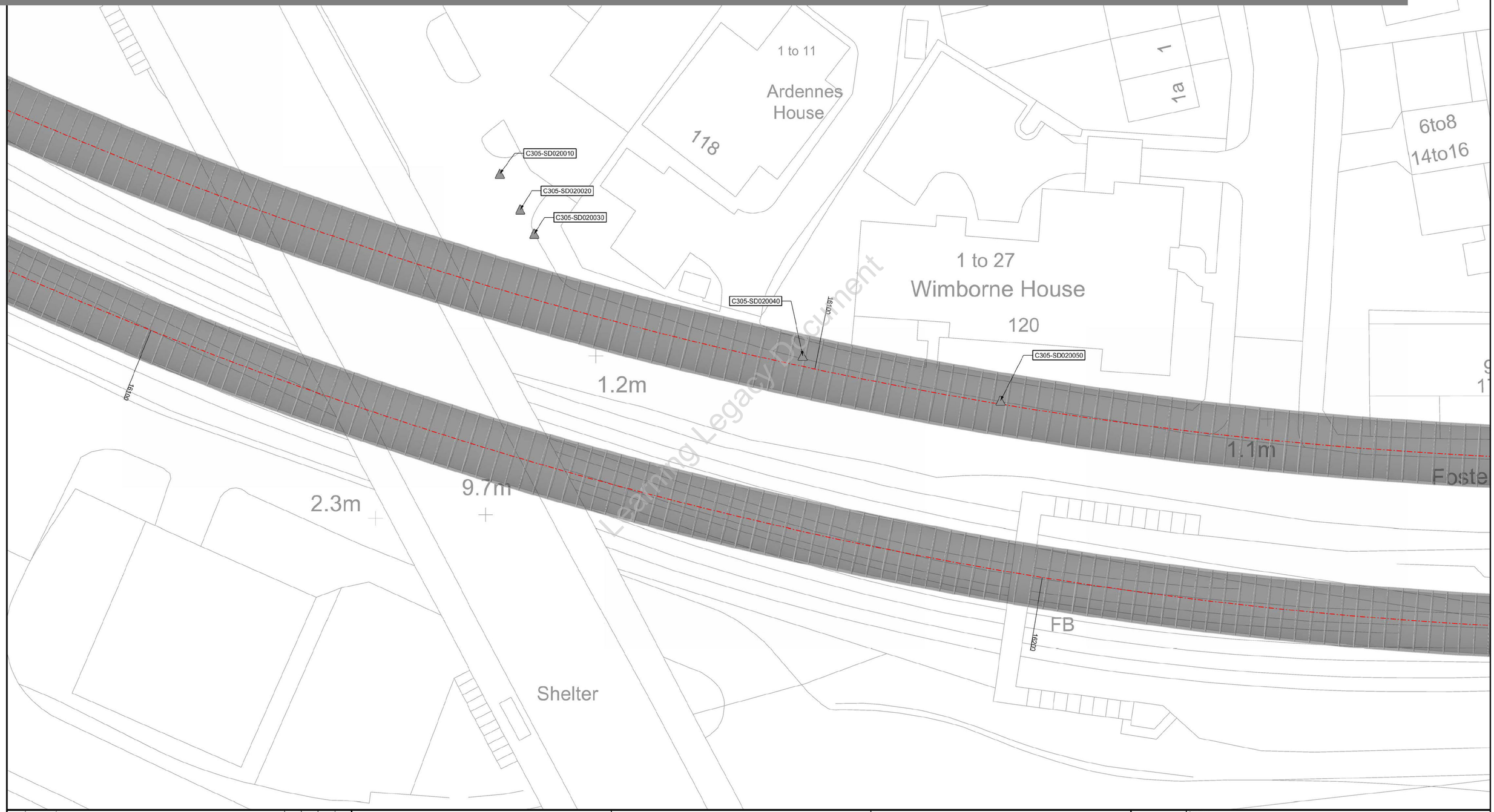
By : M.DAVIS
Chk : M.DAVIS
App : M.DAVIS
Auth : —

Scale : 1:250@ A1
Drawing and CAD file No : C305-DSJ-C2-DDA-CRT00_ST008_1-08194
Rev : P02
Suitability : S4

Fit for authorisation

RESTRICTED

C305-DSJ-C2-DDA-CRT00_ST008_1-08194.dgn 26/02/2016 14:12:39



Rev.	Date	Description	By	Chkd	App	Auth
P01	21/03/2014	First Issue	AH	AH	RC	-
P02	06/03/2015	---	MD	AH	RC	-
P03	18/03/2015	---	MD	AH	RC	-

Notes

△ Shallow Datums

4m 0 4m 8m 12m 16m 20m

1:200 @ A1

Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ

www.crossrail.co.uk

Contract : Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G

Originator : Dragados Sisk Joint Venture

Location : Crossrail Tunnels - Drive G (Limmo Peninsula to Victoria Dock)

Title : Instrumentation & Monitoring
Installation report for I&M MS
Drive G Shallow Datums (84960-85800)
C305-DSJ-C2-GMS-CR144_WS155-50001

By : M.DAVIS
Chk : A.HAWES
App : R.CULLEN
Auth : ---

Scale :	Drawing and CAD file No :	Rev :	Suitability :
1:200 @ A1	C305-DSJ-C2-DDA-CRT00_ST008_Z-08092	P03	S4

Fit for authorisation

RESTRICTED

S Pro/S

C305-DSJ-C2-DDA-CRT00_ST008_Z-08092.dgn 18/03/2015 15:46:26

APPENDIX B:

SUMMARY OF INSTRUMENTATION INSTALLED ON SITE

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-LP022101	11/02/2014	INSTALLED	90141.737	35395.065	100.937	17/02/2014	100.937	100.936	100.937
Levelling Point	C305-LP022102	11/02/2014	INSTALLED	90144.411	35391.367	100.961	17/02/2014	100.961	100.962	100.961
Levelling Point	C305-LP022103	11/02/2014	INSTALLED	90146.285	35386.432	100.852	17/02/2014	100.851	100.852	100.852
Levelling Point	C305-LP022104	11/02/2014	INSTALLED	90148.601	35381.838	100.943	17/02/2014	100.943	100.942	100.943
Levelling Point	C305-LP022105	11/02/2014	INSTALLED	90150.969	35377.438	100.995	17/02/2014	100.995	100.995	100.994
Levelling Point	C305-LP022106	11/02/2014	INSTALLED	90153.317	35373.026	101.239	17/02/2014	101.239	101.240	101.239
Levelling Point	C305-LP022107	11/02/2014	INSTALLED	90156.912	35369.213	101.203	17/02/2014	101.203	101.203	101.203
Levelling Point	C305-LP022108	11/02/2014	INSTALLED	90161.928	35367.544	101.189	17/02/2014	101.189	101.190	101.189
Levelling Point	C305-LP022109	11/02/2014	INSTALLED	90166.622	35366.068	101.162	17/02/2014	101.162	101.163	101.162
Levelling Point	C305-LP022110	11/02/2014	INSTALLED	90171.384	35364.408	101.066	17/02/2014	101.066	101.066	101.066
Levelling Point	C305-LP022111	11/02/2014	INSTALLED	90176.370	35363.046	101.143	17/02/2014	101.143	101.143	101.143
Levelling Point	C305-LP022112	11/02/2014	INSTALLED	90180.976	35361.635	101.159	17/02/2014	101.159	101.159	101.159
Levelling Point	C305-LP022113	11/02/2014	INSTALLED	90185.876	35360.374	101.116	17/02/2014	101.117	101.116	101.116
Levelling Point	C305-LP022114	11/02/2014	INSTALLED	90190.806	35359.244	101.094	17/02/2014	101.094	101.093	101.094
Levelling Point	C305-LP022115	11/02/2014	INSTALLED	90195.788	35358.169	100.932	17/02/2014	100.932	100.932	100.932
Levelling Point	C305-LP022116	11/02/2014	INSTALLED	90200.746	35357.346	101.082	17/02/2014	101.082	101.082	101.082
Levelling Point	C305-LP022117	11/02/2014	INSTALLED	90205.607	35356.332	101.065	17/02/2014	101.065	101.066	101.065
Levelling Point	C305-LP022118	11/02/2014	INSTALLED	90210.491	35355.579	101.046	17/02/2014	101.046	101.045	101.046
Levelling Point	C305-LP022119	11/02/2014	INSTALLED	90215.399	35354.772	101.037	17/02/2014	101.037	101.038	101.037
Levelling Point	C305-LP022120	11/02/2014	INSTALLED	90220.609	35353.981	101.042	17/02/2014	101.042	101.042	101.042
Levelling Point	C305-LP022121	11/02/2014	INSTALLED	90224.992	35353.372	101.025	17/02/2014	101.025	101.026	101.026
Levelling Point	C305-LP022122	11/02/2014	INSTALLED	90227.370	35357.656	101.053	17/02/2014	101.053	101.053	101.054
Levelling Point	C305-LP022123	11/02/2014	INSTALLED	90234.816	35353.977	101.026	17/02/2014	101.026	101.025	101.026
Levelling Point	C305-LP022124	11/02/2014	INSTALLED	90240.475	35353.485	101.172	17/02/2014	101.173	101.172	101.172
Levelling Point	C305-LP022125	11/02/2014	INSTALLED	90245.423	35353.217	101.246	17/02/2014	101.246	101.246	101.246
Levelling Point	C305-LP022126	11/02/2014	INSTALLED	90250.477	35352.886	101.292	17/02/2014	101.292	101.292	101.292
Levelling Point	C305-LP022127	11/02/2014	INSTALLED	90255.486	35352.733	101.359	17/02/2014	101.360	101.359	101.359
Levelling Point	C305-LP022128	11/02/2014	INSTALLED	90260.477	35352.706	101.437	17/02/2014	101.438	101.437	101.437
Levelling Point	C305-LP022129	11/02/2014	INSTALLED	90265.481	35352.708	101.473	17/02/2014	101.473	101.472	101.473
Levelling Point	C305-LP022130	11/02/2014	INSTALLED	90270.447	35352.747	101.513	17/02/2014	101.512	101.513	101.513
Levelling Point	C305-LP022131	11/02/2014	INSTALLED	90275.439	35352.834	101.573	17/02/2014	101.572	101.573	101.573
Levelling Point	C305-LP022132	11/02/2014	INSTALLED	90280.288	35352.981	101.614	17/02/2014	101.614	101.613	101.613
Levelling Point	C305-LP022133	11/02/2014	INSTALLED	90285.522	35353.240	101.651	17/02/2014	101.651	101.650	101.651
Levelling Point	C305-LP022134	11/02/2014	INSTALLED	90290.505	35353.452	101.673	17/02/2014	101.673	101.673	101.673
Levelling Point	C305-LP022135	11/02/2014	INSTALLED	90295.458	35353.927	101.697	17/02/2014	101.697	101.697	101.697
Levelling Point	C305-LP022136	11/02/2014	INSTALLED	90300.473	35354.605	101.743	17/02/2014	101.743	101.743	101.743
Levelling Point	C305-LP022137	11/02/2014	INSTALLED	90305.382	35355.298	101.689	17/02/2014	101.689	101.690	101.689
Levelling Point	C305-LP022138	11/02/2014	INSTALLED	90310.358	35355.972	101.711	17/02/2014	101.711	101.712	101.711
Levelling Point	C305-LP022139	11/02/2014	INSTALLED	90315.333	35356.697	101.662	17/02/2014	101.662	101.663	101.662
Levelling Point	C305-LP022140	11/02/2014	INSTALLED	90320.918	35357.521	101.597	17/02/2014	101.598	101.597	101.597
Levelling Point	C305-LP022141	11/02/2014	INSTALLED	90325.215	35358.338	101.582	17/02/2014	101.582	101.582	101.582
Levelling Point	C305-LP022142	11/02/2014	INSTALLED	90330.058	35359.281	101.548	17/02/2014	101.549	101.548	101.548
Levelling Point	C305-LP022143	11/02/2014	INSTALLED	90334.982	35360.261	101.507	17/02/2014	101.507	101.508	101.507
Levelling Point	C305-LP022144	11/02/2014	INSTALLED	90339.892	35361.303	101.479	17/02/2014	101.480	101.479	101.480
Levelling Point	C305-LP022145	11/02/2014	INSTALLED	90344.789	35362.430	101.411	17/02/2014	101.410	101.412	101.411
Levelling Point	C305-LP022146	11/02/2014	INSTALLED	90349.707	35363.270	101.370	17/02/2014	101.370	101.371	101.370
Levelling Point	C305-LP022147	11/02/2014	INSTALLED	90354.527	35364.561	101.341	17/02/2014	101.341	101.340	101.341
Levelling Point	C305-LP022148	11/02/2014	INSTALLED	90359.444	35365.754	101.328	17/02/2014	101.327	101.328	101.327
Levelling Point	C305-LP022149	11/02/2014	INSTALLED	90364.179	35367.202	101.328	17/02/2014	101.328	101.328	101.327
Levelling Point	C305-LP022150	11/02/2014	INSTALLED	90369.090	35368.404	101.324	17/02/2014	101.324	101.324	101.324
Levelling Point	C305-LP022151	11/02/2014	INSTALLED	90373.940	35369.577	101.320	17/02/2014	101.320	101.319	101.320
Levelling Point	C305-LP022152	11/02/2014	INSTALLED	90378.736	35370.873	101.313	17/02/2014	101.313	101.313	101.313
Levelling Point	C305-LP022153	11/02/2014	INSTALLED	90383.585	35372.071	101.328	17/02/2014	101.327	101.329	101.328
Levelling Point	C305-LP022154	11/02/2014	INSTALLED	90388.436	35373.237	101.322	17/02/2014	101.322	101.321	101.322
Levelling Point	C305-LP022155	11/02/2014	INSTALLED	90393.345	35374.384	101.303	17/02/2014	101.303	101.304	101.303
Levelling Point	C305-LP022156	11/02/2014	INSTALLED	90393.981	35390.426	101.378	17/02/2014	101.378	101.379	101.379
Levelling Point	C305-LP022157	11/02/2014	INSTALLED	90395.169	35385.529	101.356	17/02/2014	101.356	101.356	101.356
Levelling Point	C305-LP022158	11/02/2014	INSTALLED	90396.255	35380.491	101.352	17/02/2014	101.352	101.352	101.352
Levelling Point	C305-LP022159	11/02/2014	INSTALLED	90397.790	35375.256	101.293	17/02/2014	101.292	101.293	101.292
Levelling Point	C305-LP022160	11/02/2014	INSTALLED	90402.548	35376.940	101.267	17/02/2014	101.266	101.267	101.267
Levelling Point	C305-LP022161	11/02/2014	INSTALLED	90407.395	35378.147	101.255	17/02/2014	101.255	101.255	101.255
Levelling Point	C305-LP022162	11/02/2014	INSTALLED	90412.249	35379.563	101.192	17/02/2014	101.191	101.192	101.191
Levelling Point	C305-LP022163	11/02/2014	INSTALLED	90417.156	35380.520	101.159	17/02/2014	101.158	101.159	101.158
Levelling Point	C305-LP022164	11/02/2014	INSTALLED	90421.913	35381.866	101.189	17/02/2014	101.188	101.189	101.189
Levelling Point	C305-LP022165	11/02/2014	INSTALLED	90426.764	35383.067	101.186	17/02/2014	101.185	101.186	101.185
Levelling Point	C305-LP022166	11/02/2014	INSTALLED	90431.517	35384.135	101.199	17/02/2014	101.199	101.198	101.199
Levelling Point	C305-LP022167	11/02/2014	INSTALLED	90436.661	35385.255	101.219	17/02/2014	101.218	101.219	101.219
Levelling Point	C305-LP022168	11/02/2014	INSTALLED	90441.503	35386.420	101.201	17/02/2014	101.201	101.201	101.201
Levelling Point	C305-LP022169	11/02/2014	INSTALLED	90446.449	35387.569	101.220	17/02/2014	101.221	101.220	101.220
Levelling Point	C305-LP022170	11/02/2014	INSTALLED	90451.275	35388.661	101.292	17/02/2014	101.291	101.292	101.292
Levelling Point	C305-LP022171	11/02/2014	INSTALLED	90456.114	35389.681	101.345	17/02/2014	101.345	101.345	101.345
Levelling Point	C305-LP022172	11/02/2014	INSTALLED	90460.971	35390.705	101.336	17/02/2014	101.336	101.337	101.336
Levelling Point	C305-LP022173	11/02/2014	INSTALLED	90465.631	35391.672	101.320	17/02/2014	101.321	101.320	101.321
Levelling Point	C305-LP022174	11/02/2014	INSTALLED	90470.820	35392.931	101.337	17/02/2014	101.336	101.337	101.337
Levelling Point	C305-LP022175	11/02/2014	INSTALLED	90475.671	35394.068	101.345	17/02/2014	101.345	101.344	101.345
Levelling Point	C305-LP022176	11/02/2014	INSTALLED	90480.572	35395.017	101.316	17/02/2014	101.316	101.316	101.316
Levelling Point	C305-LP022177	11/02/2014	INSTALLED	90485.406	35395.824	101.365	17/02/2014	101.366	101.365	101.365
Levelling Point	C305-LP022178	11/02/2014	INSTALLED	90490.266	35396.886	101.396	17/02/2014	101.397	101.396	101.396
Levelling Point	C305-LP022179	11/02/2014	INSTALLED	90495.348	35397.705	101.384	17/02/2014	101.383	101.384	101.383

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-LP022180	11/02/2014	INSTALLED	90500.135	35398.487	101.380	17/02/2014	101.379	101.380	101.380
Levelling Point	C305-LP022181	11/02/2014	INSTALLED	90505.044	35399.310	101.401	17/02/2014	101.401	101.401	101.401
Levelling Point	C305-LP022182	11/02/2014	INSTALLED	90509.986	35400.502	101.429	17/02/2014	101.430	101.429	101.430
Levelling Point	C305-LP022183	11/02/2014	INSTALLED	90510.989	35405.404	101.550	17/02/2014	101.550	101.549	101.550
Levelling Point	C305-LP022401	11/04/2014	INSTALLED	90476.037	35336.384	103.646	28/04/2014	103.646	103.645	103.645
Levelling Point	C305-LP022402	11/04/2014	INSTALLED	90480.919	35337.623	103.433	28/04/2014	103.433	103.433	103.433
Levelling Point	C305-LP022403	11/04/2014	INSTALLED	90485.666	35338.898	103.375	28/04/2014	103.376	103.375	103.375
Levelling Point	C305-LP022404	11/04/2014	INSTALLED	90490.417	35340.458	103.349	28/04/2014	103.348	103.349	103.349
Levelling Point	C305-LP022405	11/04/2014	INSTALLED	90495.068	35341.585	103.323	28/04/2014	103.322	103.323	103.323
Levelling Point	C305-LP022406	11/04/2014	INSTALLED	90498.596	35345.138	103.326	28/04/2014	103.326	103.326	103.326
Levelling Point	C305-LP022407	11/04/2014	INSTALLED	90502.348	35349.047	103.355	28/04/2014	103.355	103.356	103.355
Levelling Point	C305-LP022408	11/04/2014	INSTALLED	90506.908	35351.099	103.397	28/04/2014	103.397	103.398	103.397
Levelling Point	C305-LP022409	11/04/2014	INSTALLED	90511.664	35352.642	103.425	28/04/2014	103.425	103.424	103.425
Levelling Point	C305-LP022410	11/04/2014	INSTALLED	90516.319	35354.467	103.410	28/04/2014	103.411	103.410	103.411
Levelling Point	C305-LP022411	11/04/2014	INSTALLED	90519.929	35359.313	103.472	28/04/2014	103.471	103.472	103.472
Levelling Point	C305-LP022412	11/04/2014	INSTALLED	90526.961	35360.995	103.431	28/04/2014	103.430	103.431	103.431
Levelling Point	C305-LP022413	11/04/2014	INSTALLED	90504.184	35355.995	103.441	28/04/2014	103.442	103.441	103.441
Levelling Point	C305-LP022414	11/04/2014	INSTALLED	90509.971	35357.477	103.479	28/04/2014	103.479	103.479	103.479
Levelling Point	C305-LP022501	10/04/2014	INSTALLED	90273.620	35322.551	102.920	28/04/2014	102.920	102.921	102.921
Levelling Point	C305-LP022502	10/04/2014	INSTALLED	90283.870	35323.760	103.089	28/04/2014	103.089	103.090	103.089
Levelling Point	C305-LP022503	10/04/2014	INSTALLED	90285.082	35314.039	103.212	28/04/2014	103.212	103.212	103.212
Levelling Point	C305-LP022504	10/04/2014	INSTALLED	90275.035	35312.914	103.311	28/04/2014	103.310	103.311	103.311
Levelling Point	C305-LP023101	28/05/2014	INSTALLED	90109.075	35416.875	100.942	29/05/2014	100.942	100.943	100.942
Levelling Point	C305-LP023102	28/05/2014	INSTALLED	90105.813	35413.087	100.981	29/05/2014	100.980	100.981	100.980
Levelling Point	C305-LP023103	28/05/2014	INSTALLED	90102.550	35409.298	101.032	29/05/2014	101.032	101.032	101.032
Levelling Point	C305-LP023104	28/05/2014	INSTALLED	90095.242	35402.397	101.040	29/05/2014	101.041	101.040	101.041
Levelling Point	C305-LP023105	28/05/2014	INSTALLED	90092.096	35399.952	101.118	29/05/2014	101.118	101.119	101.119
Levelling Point	C305-LP023106	28/05/2014	INSTALLED	90086.686	35391.225	101.135	29/05/2014	101.135	101.135	101.135
Levelling Point	C305-LP023108	12/06/2014	INSTALLED	90100.929	35360.480	102.066	12/06/2014	102.066	102.067	102.066
Levelling Point	C305-LP023109	12/06/2014	INSTALLED	90098.933	35355.793	102.086	12/06/2014	102.085	102.086	102.086
Levelling Point	C305-LP023110	12/06/2014	INSTALLED	90096.977	35350.870	102.151	12/06/2014	102.151	102.151	102.152
Levelling Point	C305-LP023111	12/06/2014	INSTALLED	90095.193	35346.291	102.077	12/06/2014	102.076	102.078	102.077
Levelling Point	C305-LP023112	12/06/2014	INSTALLED	90093.478	35342.362	101.999	12/06/2014	101.999	102.000	101.999
Levelling Point	C305-LP023201	28/05/2014	INSTALLED	90227.169	35380.276	101.075	05/06/2014	101.074	101.075	101.075
Levelling Point	C305-LP023202	28/05/2014	INSTALLED	90228.566	35374.893	100.944	05/06/2014	100.944	100.944	100.944
Levelling Point	C305-LP023203	28/05/2014	INSTALLED	90228.006	35369.731	100.975	05/06/2014	100.976	100.975	100.975
Levelling Point	C305-LP023204	28/05/2014	INSTALLED	90227.920	35366.290	101.008	05/06/2014	101.008	101.009	101.008
Levelling Point	C305-LP023205	28/05/2014	INSTALLED	90227.651	35360.036	101.052	05/06/2014	101.052	101.052	101.052
Levelling Point	C305-LP023206	28/05/2014	INSTALLED	90224.866	35344.964	101.220	05/06/2014	101.220	101.220	101.220
Levelling Point	C305-LP023207	28/05/2014	INSTALLED	90224.744	35343.131	101.326	05/06/2014	101.326	101.325	101.326
Levelling Point	C305-LP023209	28/05/2014	INSTALLED	90221.479	35321.990	101.999	05/06/2014	101.999	101.999	101.999
Levelling Point	C305-LP023210	28/05/2014	INSTALLED	90221.366	35318.933	101.961	05/06/2014	101.960	101.962	101.961
Levelling Point	C305-LP023211	28/05/2014	INSTALLED	90221.236	35316.021	101.820	05/06/2014	101.820	101.820	101.820
Levelling Point	C305-LP023301	28/05/2014	INSTALLED	90278.307	35324.473	103.036	05/06/2014	103.037	103.036	103.036
Levelling Point	C305-LP023302	28/05/2014	INSTALLED	90278.785	35320.665	102.954	05/06/2014	102.954	102.955	102.954
Levelling Point	C305-LP023303	28/05/2014	INSTALLED	90279.213	35316.075	102.919	05/06/2014	102.919	102.919	102.919
Levelling Point	C305-LP023304	28/05/2014	INSTALLED	90279.126	35311.577	103.360	05/06/2014	103.360	103.360	103.361
Levelling Point	C305-LP023401	28/05/2014	INSTALLED	90399.518	35364.962	101.343	05/06/2014	101.342	101.343	101.343
Levelling Point	C305-LP026184	20/06/2014	INSTALLED	90523.273	35401.365	101.483	27/06/2014	101.483	101.484	101.483
Levelling Point	C305-LP026185	20/06/2014	INSTALLED	90529.484	35402.918	101.490	27/06/2014	101.491	101.490	101.490
Levelling Point	C305-LP026186	20/06/2014	INSTALLED	90534.224	35402.782	101.430	27/06/2014	101.430	101.430	101.431
Levelling Point	C305-LP026187	20/06/2014	INSTALLED	90539.320	35404.403	101.421	27/06/2014	101.420	101.421	101.420
Levelling Point	C305-LP026189	20/06/2014	INSTALLED	90549.167	35405.875	101.525	27/06/2014	101.524	101.525	101.524
Levelling Point	C305-LP026190	20/06/2014	INSTALLED	90554.145	35406.441	101.453	27/06/2014	101.452	101.453	101.454
Levelling Point	C305-LP026191	20/06/2014	INSTALLED	90559.122	35407.149	101.476	27/06/2014	101.476	101.477	101.476
Levelling Point	C305-LP026192	20/06/2014	INSTALLED	90564.089	35407.760	101.507	27/06/2014	101.507	101.508	101.507
Levelling Point	C305-LP026193	20/06/2014	INSTALLED	90569.050	35408.380	101.501	27/06/2014	101.501	101.501	101.501
Levelling Point	C305-LP026194	20/06/2014	INSTALLED	90574.031	35408.996	101.495	27/06/2014	101.495	101.496	101.496
Levelling Point	C305-LP026195	20/06/2014	INSTALLED	90578.996	35409.626	101.515	27/06/2014	101.516	101.515	101.515
Levelling Point	C305-LP026196	20/06/2014	INSTALLED	90583.952	35410.185	101.514	27/06/2014	101.514	101.513	101.514
Levelling Point	C305-LP026197	20/06/2014	INSTALLED	90589.849	35410.959	101.492	27/06/2014	101.492	101.493	101.492
Levelling Point	C305-LP026198	20/06/2014	INSTALLED	90594.253	35411.371	101.475	27/06/2014	101.475	101.475	101.475
Levelling Point	C305-LP026199	20/06/2014	INSTALLED	90599.225	35411.892	101.479	27/06/2014	101.479	101.478	101.479
Levelling Point	C305-LP026200	20/06/2014	INSTALLED	90604.241	35412.433	101.472	27/06/2014	101.471	101.472	101.471
Levelling Point	C305-LP026201	20/06/2014	INSTALLED	90608.889	35412.781	101.473	27/06/2014	101.473	101.472	101.473
Levelling Point	C305-LP026202	20/06/2014	INSTALLED	90613.912	35413.406	101.443	27/06/2014	101.443	101.444	101.444
Levelling Point	C305-LP026203	20/06/2014	INSTALLED	90618.952	35414.028	101.449	27/06/2014	101.449	101.450	101.449
Levelling Point	C305-LP026204	20/06/2014	INSTALLED	90624.025	35414.563	101.457	27/06/2014	101.457	101.456	101.457
Levelling Point	C305-LP026205	20/06/2014	INSTALLED	90629.819	35415.119	101.482	27/06/2014	101.482	101.483	101.482
Levelling Point	C305-LP026206	20/06/2014	INSTALLED	90634.136	35415.497	101.466	27/06/2014	101.466	101.466	101.465

IRS Installation Record Sheets										
Sensor Type	Sensor ID	Date Installation	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (mATD)			
				Eastings X	Northings Y	Elevation Z (mATD)				
							AVERAGE	14/04/2014		
Socket	C305-LB020001	10/04/2014	Installed	90092.905	35386.745	102.287	102.286	102.286	102.286	102.285
Socket	C305-LB020002	10/04/2014	Installed	90114.356	35374.731	102.316	102.315	102.315	102.314	102.315
								28/05/2014		
Socket	C305-LB020003	28/05/2014	Installed	90128.921	35369.376	102.357	102.356	102.356	102.356	102.356
Socket	C305-LB020004	28/05/2014	Installed	90147.308	35362.292	102.456	102.455	102.455	102.455	102.455
Socket	C305-LB020005	28/05/2014	Installed	90171.509	35353.986	102.263	102.262	102.262	102.262	102.263
								09/01/2014		
Socket	C305-LB020101	07/01/2014	Installed	90103.766	35413.867	102.100	102.100	102.100	102.099	102.100
Socket	C305-LB020102	07/01/2014	Installed	90118.469	35411.915	101.926	101.926	101.926	101.926	101.927
Socket	C305-LB020103	07/01/2014	Installed	90134.495	35381.917	102.116	102.116	102.116	102.116	102.116
								15/05/2014		
Socket	C305-LB020104	15/05/2014	Installed	90148.215	35359.911	103.798	103.798	103.798	103.797	103.798
Socket	C305-LB020105	13/05/2014	Installed	90157.444	35344.318	103.379	103.378	103.378	103.378	103.378
Socket	C305-LB020106	12/05/2014	Installed	90169.413	35323.667	106.281	106.280	106.281	106.280	106.280
								09/01/2014		
Socket	C305-LB020107	07/01/2014	Installed	90152.329	35315.216	103.148	103.147	103.148	103.147	103.147
								15/05/2014		
Socket	C305-LB020108	12/05/2014	Installed	90133.577	35351.737	103.527	103.527	103.527	103.527	103.527
Socket	C305-LB020109	15/05/2014	Installed	90127.043	35365.171	103.778	103.778	103.777	103.778	103.778
								09/01/2014		
Socket	C305-LB020110	07/01/2014	Installed	90115.804	35391.208	102.120	102.120	102.119	102.120	102.119
Socket	C305-LB020301	07/01/2014	Installed	90188.011	35365.952	102.217	102.217	102.217	102.218	102.217
Socket	C305-LB020302	07/01/2014	Installed	90193.821	35365.552	102.195	102.195	102.194	102.195	102.195
Socket	C305-LB020303	07/01/2014	Installed	90207.368	35362.917	102.110	102.110	102.110	102.109	102.110
Socket	C305-LB020304	07/01/2014	Installed	90215.912	35359.931	102.199	102.199	102.198	102.199	102.199
Socket	C305-LB020305	07/01/2014	Installed	90221.655	35365.953	102.192	102.192	102.192	102.192	102.192
Socket	C305-LB020306	07/01/2014	Installed	90222.654	35379.319	102.293	102.293	102.293	102.293	102.293
Socket	C305-LB020307	07/01/2014	Installed	90218.138	35380.228	102.292	102.292	102.293	102.292	102.292
								10/04/2014		
Socket	C305-LB020401	10/04/2014	Installed	90206.164	35346.905	102.410	102.410	102.410	102.410	102.410
Socket	C305-LB020402	10/04/2014	Installed	90215.532	35345.628	102.358	102.358	102.359	102.358	102.358
Socket	C305-LB020403	10/04/2014	Installed	90239.544	35340.691	102.389	102.389	102.389	102.389	102.390
Socket	C305-LB020404	10/04/2014	Installed	90261.523	35340.955	102.646	102.646	102.646	102.646	102.646
Socket	C305-LB020405	10/04/2014	Installed	90278.581	35341.338	102.822	102.822	102.823	102.822	102.823
Socket	C305-LB020406	10/04/2014	Installed	90298.759	35342.622	102.905	102.905	102.904	102.905	102.905
Socket	C305-LB020407	10/04/2014	Installed	90321.068	35344.365	102.907	102.907	102.907	102.908	102.907
								28/05/2014		
Socket	C305-LB020408	28/05/2014	Installed	90338.446	35348.692	102.843	102.843	102.843	102.842	102.843
Socket	C305-LB020409	28/05/2014	Installed	90357.136	35353.368	102.686	102.686	102.686	102.685	102.686
								13/02/2014		
Socket	C305-LB020501	11/02/2014	Installed	90355.795	35365.417	102.520	102.521	102.522	102.521	102.521
Socket	C305-LB020502	11/02/2014	Installed	90368.732	35368.571	102.469	102.470	102.471	102.470	102.470
Socket	C305-LB020503	11/02/2014	Installed	90378.496	35371.008	102.542	102.543	102.543	102.543	102.543
Socket	C305-LB020504	11/02/2014	Installed	90392.151	35374.515	102.541	102.543	102.542	102.543	102.543
Socket	C305-LB020601	11/02/2014	Installed	90394.211	35391.802	102.649	102.651	102.651	102.651	102.651
Socket	C305-LB020602	11/02/2014	Installed	90395.961	35383.396	102.587	102.589	102.589	102.590	102.588
Socket	C305-LB020603	11/02/2014	Installed	90407.630	35378.511	102.533	102.535	102.535	102.534	102.535
Socket	C305-LB020604	11/02/2014	Installed	90419.646	35381.337	102.448	102.450	102.450	102.449	102.450
Socket	C305-LB020605	11/02/2014	Installed	90432.862	35384.370	102.550	102.552	102.552	102.552	102.552
Socket	C305-LB020606	11/02/2014	Installed	90444.649	35387.075	102.530	102.532	102.533	102.532	102.532
Socket	C305-LB020607	11/02/2014	Installed	90462.258	35391.045	102.683	102.685	102.684	102.685	102.685
Socket	C305-LB020608	11/02/2014	Installed	90475.734	35393.901	102.658	102.660	102.660	102.661	102.660
Socket	C305-LB020609	11/02/2014	Installed	90492.058	35397.244	102.665	102.667	102.667	102.666	102.667
								14/05/2014		
Socket	C305-LB020701	12/05/2014	Installed	90203.608	35326.834	103.179	103.179	103.180	103.179	103.180
Socket	C305-LB020702	12/05/2014	Installed	90212.659	35325.327	102.896	102.896	102.896	102.895	102.895

IRS Installation Record Sheets										
Sensor Type	Sensor ID	Date Installation	Status	SENSOR Location - GPS reading (m)				Commissioning Readings (m)		
				Eastings X	Northings Y	Elevation Z (mATD)		Eastings X	Northings Y	Elevation Z (mATD)
								30/05/2014		
3D Prism	C305-RP020001	28/05/2014	Installed	90091.138	35388.092	103.443	Average	90091.138	35388.092	103.443
								90091.139	35388.092	103.442
								90091.138	35388.091	103.443
								90091.138	35388.092	103.443
3D Prism	C305-RP020002	28/05/2014	Installed	90109.311	35378.044	103.466	Average	90109.311	35378.044	103.466
								90109.311	35378.044	103.466
								90109.311	35378.044	103.466
								90109.310	35378.044	103.466
3D Prism	C305-RP020003	28/05/2014	Installed	90129.341	35369.217	103.562	Average	90129.341	35369.217	103.562
								90129.342	35369.216	103.563
								90129.341	35369.217	103.562
								90129.341	35369.217	103.563
3D Prism	C305-RP020004	28/05/2014	Installed	90149.906	35360.695	103.650	Average	90149.906	35360.695	103.650
								90149.906	35360.694	103.651
								90149.906	35360.695	103.650
								90149.906	35360.695	103.650
3D Prism	C305-RP020005	28/05/2014	Installed	90171.405	35353.618	103.472	Average	90171.405	35353.618	103.472
								90171.406	35353.619	103.472
								90171.405	35353.618	103.471
								90171.405	35353.618	103.472
3D Prism	C305-RP020401	21/05/2014	Installed	90205.842	35344.957	104.548	Average	90205.842	35344.957	104.548
								90205.842	35344.957	104.548
								90205.843	35344.956	104.547
								90205.842	35344.957	104.548
3D Prism	C305-RP020402	21/05/2014	Installed	90214.180	35343.712	104.356	Average	90214.180	35343.712	104.356
								90214.180	35343.712	104.356
								90214.179	35343.712	104.355
								90214.180	35343.712	104.356
3D Prism	C305-RP020403	28/05/2014	Installed	90237.305	35341.407	103.620	Average	90237.305	35341.407	103.620
								90237.304	35341.407	103.620
								90237.305	35341.407	103.621
								90237.305	35341.407	103.621
3D Prism	C305-RP020404	28/05/2014	Installed	90261.238	35341.186	103.834	Average	90261.238	35341.186	103.834
								90261.239	35341.185	103.835
								90261.238	35341.186	103.834
								90261.238	35341.186	103.834
3D Prism	C305-RP020405	28/05/2014	Installed	90279.711	35342.134	103.878	Average	90279.711	35342.134	103.878
								90279.711	35342.134	103.878
								90279.711	35342.133	103.878
								90279.711	35342.134	103.878
3D Prism	C305-RP020406	28/05/2014	Installed	90298.935	35343.411	103.886	Average	90298.935	35343.411	103.886
								90298.936	35343.411	103.885
								90298.935	35343.412	103.886
								90298.936	35343.411	103.885
3D Prism	C305-RP020407	28/05/2014	Installed	90320.178	35344.832	103.895	Average	90320.178	35344.832	103.895
								90320.178	35344.832	103.896
								90320.178	35344.832	103.895
								90320.178	35344.833	103.895
3D Prism	C305-RP020408	28/05/2014	Installed	90338.541	35348.435	103.909	Average	90338.541	35348.435	103.909
								90338.541	35348.436	103.909
								90338.541	35348.435	103.909
								90338.541	35348.435	103.909
3D Prism	C305-RP020409	28/05/2014	Installed	90357.062	35353.142	103.780	Average	90357.062	35353.142	103.780
								90357.062	35353.142	103.780
								90357.063	35353.142	103.779
								90357.062	35353.142	103.781
3D Prism	C305-RP020411	21/05/2014	Installed	90205.812	35344.967	106.143	Average	90205.812	35344.967	106.143
								90205.811	35344.967	106.143
								90205.812	35344.967	106.143
								90205.812	35344.967	106.142
3D Prism	C305-RP020701	21/05/2014	Installed	90203.268	35326.611	104.695	Average	90203.268	35326.611	104.695
								90203.268	35326.611	104.694
								90203.268	35326.611	104.695
								90203.268	35326.611	104.695
3D Prism	C305-RP020702	21/05/2014	Installed	90211.515	35325.935	104.624	Average	90211.515	35325.935	104.624
								90211.515	35325.936	104.624
								90211.515	35325.935	104.624
								90211.515	35325.935	104.625
3D Prism	C305-RP020711	21/05/2014	Installed	90203.278	35326.597	106.111	Average	90203.278	35326.597	106.111
								90203.278	35326.598	106.111
								90203.277	35326.597	106.110
								90203.279	35326.597	106.111

IRS Installation Record Sheets										
Sensor Type	Sensor ID	Date Installation	Status	SENSOR Location - GPS reading (m)				Commissioning Readings (m)		
				Eastings X	Northings Y	Elevation Z (mATD)		Eastings X	Northings Y	Elevation Z (mATD)
									10/01/2014	
Retro Target	C305-RR020101	07/01/2014	Installed	90100.669	35411.333	104.873	Average	90100.669	35411.333	104.873
								90100.670	35411.333	104.873
								90100.669	35411.333	104.873
								90100.669	35411.333	104.873
Retro Target	C305-RR020102	07/01/2014	Installed	90100.744	35411.207	103.304	Average	90100.744	35411.207	103.304
								90100.744	35411.207	103.304
								90100.744	35411.207	103.304
								90100.744	35411.207	103.304
Retro Target	C305-RR020103	07/01/2014	Installed	90120.362	35416.467	104.976	Average	90120.362	35416.467	104.976
								90120.362	35416.467	104.976
								90120.362	35416.467	104.976
								90120.362	35416.467	104.976
Retro Target	C305-RR020104	07/01/2014	Installed	90120.347	35416.459	103.038	Average	90120.347	35416.459	103.038
								90120.347	35416.459	103.038
								90120.347	35416.459	103.038
								90120.347	35416.459	103.038
Retro Target	C305-RR020105	07/01/2014	Installed	90138.450	35382.237	105.159	Average	90138.450	35382.237	105.159
								90138.450	35382.238	105.159
								90138.451	35382.236	105.159
								90138.450	35382.237	105.159
Retro Target	C305-RR020106	07/01/2014	Installed	90138.485	35382.204	103.166	Average	90138.485	35382.204	103.166
								90138.486	35382.204	103.167
								90138.485	35382.204	103.166
								90138.485	35382.204	103.166
									15/05/2014	
Retro Target	C305-RR020107	13/05/2014	Installed	90150.411	35359.624	106.259	Average	90150.411	35359.624	106.259
								90150.411	35359.624	106.258
								90150.411	35359.624	106.259
								90150.411	35359.624	106.258
Retro Target	C305-RR020108	13/05/2014	Installed	90149.790	35360.085	104.251	Average	90149.790	35360.085	104.251
								90149.790	35360.085	104.251
								90149.791	35360.085	104.251
								90149.790	35360.084	104.251
Retro Target	C305-RR020109	13/05/2014	Installed	90161.413	35339.470	106.464	Average	90161.413	35339.470	106.464
								90161.413	35339.470	106.464
								90161.413	35339.470	106.464
								90161.413	35339.470	106.464
Retro Target	C305-RR020110	13/05/2014	Installed	90160.661	35339.631	104.103	Average	90160.661	35339.631	104.103
								90160.660	35339.632	104.103
								90160.661	35339.631	104.103
								90160.661	35339.631	104.102
									12/05/2014	
Retro Target	C305-RR020111	12/05/2014	Installed	90168.570	35325.666	111.214	Average	90168.570	35325.666	111.214
								90168.569	35325.665	111.214
								90168.570	35325.666	111.215
								90168.569	35325.665	111.214
Retro Target	C305-RR020112	12/05/2014	Installed	90168.481	35325.627	106.320	Average	90168.481	35325.627	106.320
								90168.481	35325.627	106.320
								90168.481	35325.628	106.321
								90168.482	35325.627	106.319
									10/01/2014	
Retro Target	C305-RR020113	07/01/2014	Installed	90150.611	35317.350	108.358	Average	90150.611	35317.350	108.358
								90150.612	35317.350	108.359
								90150.610	35317.350	108.358
								90150.611	35317.350	108.358
Retro Target	C305-RR020114	07/01/2014	Installed	90150.590	35317.396	104.263	Average	90150.590	35317.396	104.263
								90150.590	35317.396	104.263
								90150.590	35317.397	104.263
								90150.590	35317.396	104.263
									15/05/2014	
Retro Target	C305-RR020115	13/05/2014	Installed	90134.933	35349.283	106.690	Average	90134.933	35349.283	106.690
								90134.933	35349.282	106.691
								90134.933	35349.283	106.690
								90134.933	35349.283	106.691
Retro Target	C305-RR020116	13/05/2014	Installed	90134.706	35348.868	104.078	Average	90134.706	35348.868	104.078
								90134.705	35348.868	104.078
								90134.706	35348.867	104.077
								90134.706	35348.868	104.078
Retro Target	C305-RR020117	13/05/2014	Installed	90122.130	35371.068	106.492	Average	90122.130	35371.068	106.492
								90122.130	35371.068	106.492
								90122.131	35371.068	106.492
								90122.130	35371.068	106.492
Retro Target	C305-RR020118	13/05/2014	Installed	90122.766	35371.203	104.208	Average	90122.766	35371.203	104.208
								90122.767	35371.203	104.208
								90122.766	35371.202	104.208
								90122.766	35371.203	104.208
									10/01/2014	
Retro Target	C305-RR020119	07/01/2014	Installed	90110.643	35392.576	106.497	Average	90110.643	35392.576	106.497
								90110.643	35392.576	106.496
								90110.644	35392.576	106.498
								90110.643	35392.576	106.497
Retro Target	C305-RR020120	07/01/2014	Installed	90110.781	35392.304	103.331	Average	90110.781	35392.304	103.331
								90110.781	35392.304	103.332
								90110.780	35392.304	103.331
								90110.781	35392.304	103.331

IRS Installation Record Sheets - Shallow Datums								
Date Installation	**Sensor ID**	**Status**	**Location SENSOR Eastings X**	**Location SENSOR Northings Y**	**Location SENSOR Elevation Z**	**Commissioning Readings**	**Depth (m bgl)**	**Sensor Type**
31/10/2013	**C305-SD020010**	Installed	90148.95	35381.332	100.813	100.771	3.6m	Shallow Datum
31/10/2013	**C305-SD020020**	Installed	90151.151	35377.462	100.804	100.756	3.6m	Shallow Datum
30/10/2013	**C305-SD020030**	Installed	90152.660	35374.854	101.136	101.079	3.6m	Shallow Datum
01/11/2013	**C305-SD020040**	Installed	90181.583	35361.705	101.133	101.075	3.6m	Shallow Datum
01/11/2013	**C305-SD020050**	Installed	90202.931	35356.865	100.969	100.907	3.6m	Shallow Datum

APPENDIX C:

MEETING MINUTES

I&M Close Out Meeting

Date & Time	12/02/2016 14:00
Meeting No.	10

The purpose of this document is to record review of the monitoring data, and agreement to decommission based on cessation of long term monitoring by DSJV. 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]

[redacted]

Data Reviewed

Monitoring References	Location	Settlement rate	Agreeement to decommission
Area 2 - Drive G			
LEVELLING POINTS			
LP025101-LP025111	1		TO BE REVIEWED AT AREA 3 CLOSEOUT MEETING
LP023101-LP023112	2	<2mm/yr 100%	YES. REVIEWED. TO BE INCLUDED COR
LP022101-LP022121	3a	<2mm/yr 100%	TO BE INCLUDED IN COR YES, REVIEWED
LP022122-LP022155	3b	<2mm/yr 100%	GRAPH TO BE REVIEWED. TO BE INCLUDED IN COR.
LP022155-LP022183	3c	<2mm/yr 75% <3mm/yr 88%	CHANGE FIRST READING DATE. REVIEWED. TO BE INCLUDED IN COR.
LP023201-LP023211	4	<2mm/yr 100%	TO BE INCLUDED IN COR REVIEWED.
LP023301-LP023304	5	<2mm/yr 100%	REVIEWED. TO BE INCLUDED IN COR.
LP022501-LP022504	6	<2mm/yr 100%	TO BE INCLUDED IN COR REVIEWED
LP026184-LP026199	7	<2mm/yr 100%	TO BE INCLUDED IN COR REVIEWED.
LP026200-LP026206	8	<2mm/yr 100%	TO BE INCLUDED IN COR. REVIEWED. GROUND TREATMENT BEFORE EB TBM
LP022401-LP022414	9	<2mm/yr 85% <3mm/yr 92%	TO BE INCLUDED IN COR. REVIEWED.
LP022156-LP022401	10	<2mm/yr 80% <3mm/yr 80%	TO BE INCLUDED IN COR. REVIEWED.
LP027101-LP027105	11		INCLUDED IN EL REPORT
LP027201-LP027205	12		INCLUDED IN EL REPORT
SOCKETS			
LB020001-LB020005	1	<2mm/yr 100%	TO BE INCLUDED IN DLR REPORT AND AREA 2 REPORT. REVIEWED.
LB020101-LB020110	2	<2mm/yr 100%	TO BE INCLUDED IN COR REVIEWED.
LB020301-LB020307	3	<2mm/yr 100%	TO BE INCLUDED IN COR REVIEWED.
LB020401-LB020409	4	<2mm/yr 100%	TO BE INCLUDED IN DLR AND AREA 2 COR. REVIEWED.
LB020501-LB020504	5	<2mm/yr 75% <3mm/yr 100%	TO BE INCLUDED IN COR REVIEWED.

Monitoring References	Location	Settlement rate	Agreeement to decommission
LB020601-LB020609	6	<2mm/yr 67% <3mm/yr 67%	TO BE INCLUDED IN COR. REVIEWED.
LB020701-LB020702	7	<2mm/yr 100%	TO BE INCLUDED IN COR. REVIEWED.
SHALLOW DATUMS			
SD020010			
SD020020		<2mm/yr 100%	TO BE INCLUDED IN COR.
SD020030			REVIEWED
SD020040			
SD020050			
PRISMS / RETRO TARGETS			
RR023101-RR023104	LIMMO PYLON TARGETS	N/A	TO BE INCLUDED IN COR. REVIEWED.
RP020401-RP020402 RP020411; RP020711; RP020701-RP020711 02	DLR FOOTBRIDGE	N/A	TO BE INCLUDED IN DLR AND AREA 2 COR. REVIEWED.
RP020001-RP020005; RP020403-RP020409	DLR WALL	N/A	TO BE INCLUDED IN COR. REVIEWED
RR020101-RR020120	CAXTON STREET / SILVERTOWN WAY	N/A	TO BE INCLUDED IN COR. REVIEWED.
Notes			
Sign off			
DSJV [redacted]	Geocisa [redacted]	Crossrail [redacted]	C122 [redacted]

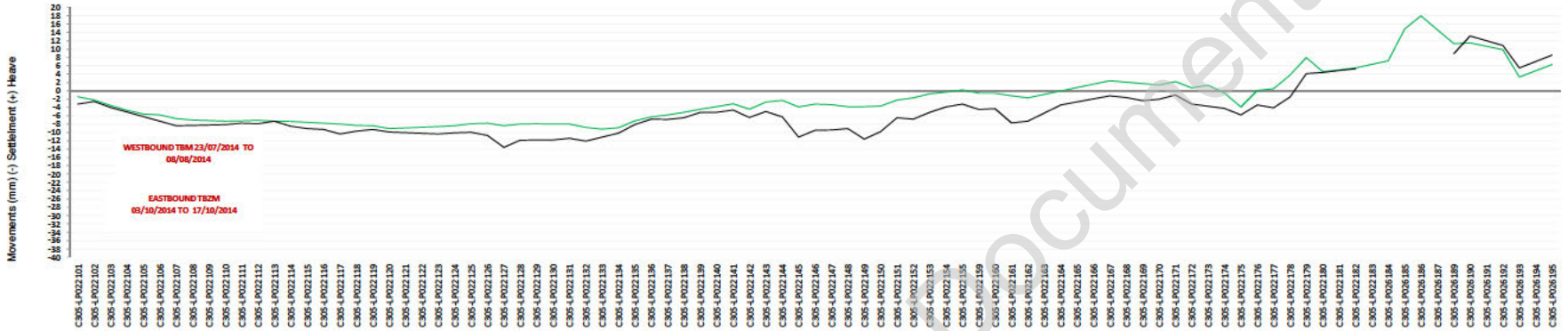
APPENDIX D:

DEFLECTION RATIO

AREA 2 Victoria Dock Road PROFILE
C305-LP022101-C305-LP022155 & C305-LP022159-C305-LP022183 & C305-LP026184-C305-LP026195

WEST

EAST



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

TRANSECT	ALERT VALUE	MAX DEFLECTION RATIO	
		TBMs Passage	Long Term
Victoria Dock Rd	1/3000 1/2700 1/2600 1/2200	1/4307	1/4780

16/11/2014 AFTER TBMs TRANSIT

09/09/2015 LONG TERM