



Work Area: SMM
Work Type: I&M
Originator Company: GEOCISA

C435 Farringdon Main Station

CRL Lead reviewer: [Redacted]
CRL Reviewer:

Monitoring Close-Out Report: Internal Monitoring: Sockets and Crackmeters

CRL Document Number: C435-BFK-C2-RGN-M123-51653

Supplier Document Number: N/A

Contract MDL reference C13.012

1. Contractor Document Submittal History:

Revision:	Date:	Prepared by:	Checked by:	Approved by:	Reason for Issue:
1.0	18-07-2016	[Redacted]	[Redacted]	[Redacted]	For acceptance

2a. Stakeholder Review Required? YES NO

Stakeholder submission required: LU RfL 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
					<input type="checkbox"/>
					<input type="checkbox"/>
					<input type="checkbox"/>

compliance with their contractual obligations and does not constitute
 ds or materials developed or selected by the designer/supplier.

3. Acceptance by Crossrail:

06/12/2016

Contents

A.	INTRODUCTION	3
B.	INSTRUMENTS	3
B.1	DESCRIPTION OF THE INSTRUMENTS	3
B.2	LOCATION OF THE INSTRUMENTS	7
C.	MOVEMENTS	7
C.1	MOVEMENTS RESULTING FROM CONSTRUCTION ACTIVITIES	7
C.1.1	Relevant Crossrail (BFK) Works	7
C.1.2	Resulting Movements	8
C.2	TRIGGER BREACHES	11
C.3	SIGNIFICANT ISSUES WITH THE INSTRUMENTATION	12
C.4	RESIDUAL RISKS	12
D.	CONCLUSIONS	12
APPENDI A: DRAWINGS.		
APPENDI B: GRAPHS.		
APPENDIX: GLOSSARY.		

A. INTRODUCTION

In line with the C122 – M&W Specification K10 – Instrumentation & Monitoring C122-OVE-4-RSP-CR001-00007, this Close-Out Report aims to address the following points in relation to the instrumentation defined in Section 2.

- Identify movements observed by the relevant instruments;
- Relate these movements to construction activities, where applicable;
- Identify trigger breaches that may have occurred;
- Demonstrate that the rate of change of the data is either in line with the required rate or such that residual risks are minimal;
- Identify any such residual risks should there be considered to be any.

Based on the above points, this close out report will provide justification for the decommissioning of the instruments.

B. INSTRUMENTS

B.1 Description of the Instruments

This Close-Out Report relates the sockets and Crackmeters installed inside the buildings. See Table 1 below with the details of the sockets, and Table 2 with the details of the crackmeters.

Sensor	Location	Easting (m)	Northing (m)	Elevation (mATD)
C435-LB14013	25-27 Farringdon Rd.	81867.5049	36505.2674	111.7823
C435-LB14014	25-27 Farringdon Rd.	81867.1314	36505.9978	111.8914
C435-LB14015	25-27 Farringdon Rd.	81869.5835	36506.4199	111.7725
C435-LB14016	25-27 Farringdon Rd.	81869.2749	36507.0367	111.7967
C435-LB14017	25-27 Farringdon Rd.	81870.3791	36506.7932	111.7594
C435-LB14018	25-27 Farringdon Rd.	81870.2168	36507.3937	111.7389
C435-LB14019	25-27 Farringdon Rd.	81872.0257	36506.0694	111.6947
C435-LB14020	25-27 Farringdon Rd.	81872.6951	36506.5966	111.7327
C435-LB14021	25-27 Farringdon Rd.	81872.4314	36504.7920	111.6858
C435-LB14022	25-27 Farringdon Rd.	81872.9124	36505.3161	111.733
C435-LB14023	25-27 Farringdon Rd.	81872.8371	36502.3995	111.679
C435-LB14024	25-27 Farringdon Rd.	81873.4158	36502.9951	111.7351
C435-LB14062	25-27 Farringdon Rd.	81864.0900	36503.4700	112.9349
C435-LB14063	25-27 Farringdon Rd.	81860.7400	36501.8100	112.5193
C435-LB13939	77a Charterhouse St.	82066.9650	36488.7680	108.2327
C435-LB13940	77a Charterhouse St.	82082.8890	36497.3890	108.182
C435-LB13941	77a Charterhouse St.	82087.1250	36489.7870	108.19
C435-LB13942	77a Charterhouse St.	82071.0830	36481.0090	108.1055
C435-LB13943	77a Charterhouse St.	82095.4480	36477.3950	108.1652
C435-LB13944	77a Charterhouse St.	82104.2790	36482.8880	107.9082
C435-LB13945	77a Charterhouse St.	82110.9460	36481.1640	107.5949
C435-LB13946	77a Charterhouse St.	82108.0050	36487.8250	107.726
C435-LB13947	77a Charterhouse St.	82121.0270	36482.5350	107.7326
C435-LB13948	77a Charterhouse St.	82127.5550	36489.7050	107.9457

Sensor	Location	Easting (m)	Northing (m)	Elevation (mATD)
C435-LB13949	77a Charterhouse St.	82123.7110	36497.0730	107.9914
C435-LB13950	77a Charterhouse St.	82130.2610	36484.5720	108.0972
C435-LB13951	77a Charterhouse St.	82136.3520	36495.6810	108.1389
C435-LB13952	77a Charterhouse St.	82132.3520	36493.6830	108.1817
C435-LB13953	77a Charterhouse St.	82135.1760	36488.2750	108.1805
C435-LB13954	90 Cowcross St. (Nicolas).	82117.381	36538.715	114.9219
C435-LB13955	90 Cowcross St. (Nicolas).	82119.9460	36535.7620	114.8973
C435-LB13956	90 Cowcross St. (Nicolas).	82116.7730	36533.1990	114.8883
C435-LB13957	90 Cowcross St. (Nicolas).	82114.0770	36530.9410	114.8846
C435-LB13958	90 Cowcross St. (Nicolas).	82111.0350	36528.2040	114.9361
C435-LB13959	90 Cowcross St. (Nicolas).	82108.6440	36532.1570	114.8698
C435-LB13960	90 Cowcross St (Jasmine).	82125.8980	36528.6870	114.6489
C435-LB13961	90 Cowcross St (Jasmine).	82116.767	36521.419	114.6971
C435-LB13970	90 Cowcross St (Jasmine).	82122.8763	36526.4818	114.8097
C435-LB13971	90 Cowcross St (Jasmine).	82119.9763	36524.3241	114.7827
C435-LB13972	94 Cowcross St (The Hope).	82129.4680	36524.7660	114.5814
C435-LB13973	94 Cowcross St (The Hope).	82130.6811	36522.411	114.6403
C435-LB13974	94 Cowcross St (The Hope).	82131.9243	36520.8406	114.6046
C435-LB13975	94 Cowcross St (The Hope).	82129.7623	36523.4082	114.678
C435-LB13976	94 Cowcross St (The Hope).	82133.0578	36519.4163	114.6574
C435-LB13977	94 Cowcross St (The Hope).	82127.2076	36522.1918	114.6964
C435-LB13978	94 Cowcross St (The Hope).	82130.3763	36517.5196	114.7164
C435-LB13979	94 Cowcross St (The Hope).	82122.0156	36518.2842	114.7792
C435-LB13980	94 Cowcross St (The Hope).	82123.2222	36515.2165	114.757
C435-LB13981	94 Cowcross St (The Hope).	82125.0869	36513.5365	114.7626
C435-LB13926	16 St John St.	82160.2080	36565.0380	115.9441
C435-LB13927	16 St John St.	82165.7040	36563.6720	116.0753
C435-LB13928	16 St John St.	82170.9140	36562.4780	116.0181
C435-LB13929	16 St John St.	82176.1250	36562.3070	116.2207
C435-LB13930	16 St John St.	82179.1430	36559.6040	115.8408
C435-LB13931	16 St John St.	82172.3380	36560.4860	116.1974
C435-LB13932	105 Charterhouse St.	82220.0790	36567.6670	115.2421
C435-LB13933	105 Charterhouse St.	82216.0320	36563.8220	115.1662
C435-LB13934	105 Charterhouse St.	82216.0070	36570.3260	115.2734
C435-LB13935	105 Charterhouse St.	82211.8710	36573.0660	115.23
C435-LB13936	105 Charterhouse St.	82207.3310	36576.5490	115.2745
C435-LB13937	105 Charterhouse St.	82204.2120	36578.8030	115.4065
C435-LB13938	105 Charterhouse St.	82201.7350	36574.9360	115.4606
C435-LB13982	107 Charterhouse St.	82220.4983	36569.8188	115.385

Sensor	Location	Easting (m)	Northing (m)	Elevation (mATD)
C435-LB13983	107 Charterhouse St.	82217.0855	36572.2193	115.3513
C435-LB13984	107 Charterhouse St.	82213.1440	36574.8599	115.3568
C435-LB13985	107 Charterhouse St.	82208.4334	36577.9325	115.4297
C435-LB13986	107 Charterhouse St.	82205.0687	36580.0450	115.4333
C435-LB13987	23-28 Charterhouse Sq.	82276.2408	36572.0974	114.407
C435-LB13988	23-28 Charterhouse Sq.	82272.1812	36575.8071	114.4116
C435-LB13989	23-28 Charterhouse Sq.	82278.3907	36581.7012	114.3963
C435-LB13990	23-28 Charterhouse Sq.	82275.8146	36584.3622	114.3893
C435-LB13991	23-28 Charterhouse Sq.	82269.3909	36578.9896	114.3985
C435-LB13992	23-28 Charterhouse Sq.	82266.6748	36582.0978	114.4039
C435-LB13993	23-28 Charterhouse Sq.	82261.2552	36577.4850	114.405
C435-LB13994	23-28 Charterhouse Sq.	82264.4669	36585.2841	114.4032
C435-LB13995	23-28 Charterhouse Sq.	82266.0286	36586.5496	114.4073
C435-LB13996	23-28 Charterhouse Sq.	82270.2024	36590.7661	114.6804
C435-LB13997	23-28 Charterhouse Sq.	82272.6616	36588.0042	114.6981
C435-LB13998	23-28 Charterhouse Sq.	82268.3844	36568.8661	114.4128
C435-LB13999	23-28 Charterhouse Sq.	82266.5644	36570.9346	114.4104
C435-LB14000	23-28 Charterhouse Sq.	82263.8331	36573.9929	114.4083
C435-LB14050	Smithfield Market East	82267.6143	36522.4444	110.1151
C435-LB14051	Smithfield Market East	82274.4691	36523.1372	110.0362
C435-LB14052	Smithfield Market East	82281.9437	36525.3978	109.9959
C435-LB14053	Smithfield Market East	82273.9222	36510.8132	110.0296
C435-LB14054	Smithfield Market East	82281.8344	36514.4958	110.0166
C435-LB14055	Smithfield Market East	82285.1159	36507.1670	110.1765
C435-LB14056	Smithfield Market East	82283.1834	36504.6512	110.1307
C435-LB14057	Smithfield Market East	82287.3036	36502.4635	110.2098
C435-LB14058	Smithfield Market East	82289.3819	36497.5776	110.1453
C435-LB14059	Smithfield Market East	82290.0382	36483.2482	110.0373
C435-LB14060	Smithfield Market East	82294.3407	36487.4777	110.1266

Table 1: Details of the Internal Sockets

Sensor	Location
C435-CK00141A	25-27 Farringdon Rd.
C435-CK00141B	25-27 Farringdon Rd.
C435-CK00142A	25-27 Farringdon Rd.
C435-CK00142B	25-27 Farringdon Rd.
C435-CK00143A	25-27 Farringdon Rd.
C435-CK00143B	25-27 Farringdon Rd.
C435-CK00144A	25-27 Farringdon Rd.
C435-CK00144B	25-27 Farringdon Rd.
C435-CK00145A	25-27 Farringdon Rd.
C435-CK00145B	25-27 Farringdon Rd.
C435-CK00146A	25-27 Farringdon Rd.
C435-CK00146B	25-27 Farringdon Rd.
C430-CK00151A	2-3 Hayne St.
C430-CK00151B	2-3 Hayne St.
C430-CK00152A	2-3 Hayne St.
C430-CK00152B	2-3 Hayne St.
C430-CK00153A	2-3 Hayne St.
C430-CK00153B	2-3 Hayne St.
C435-CK00161A	55 Charterhouse St.
C435-CK00161B	55 Charterhouse St.
C435-CK00162A	55 Charterhouse St.
C435-CK00162B	55 Charterhouse St.
C435-CK00163A	55 Charterhouse St.
C435-CK00163B	55 Charterhouse St.
C435-CK00164A	55 Charterhouse St.
C435-CK00164B	55 Charterhouse St.
C435-CK00165A	55 Charterhouse St.
C435-CK00165B	55 Charterhouse St.
C435-CK00166A	55 Charterhouse St.
C435-CK00166B	55 Charterhouse St.
C435-CK00167A	55 Charterhouse St.
C435-CK00167B	55 Charterhouse St.
C430-CK00171A	57 Charterhouse St.
C430-CK00171B	57 Charterhouse St.
C430-CK00172A	57 Charterhouse St.
C430-CK00172B	57 Charterhouse St.

Table 2: Details of the Crackmeters

Installation and as-built-details are available in the following documents:

Drawings:

- C435-BFK-C2-DWG-M123-50043. Sockets Installed for Farringdon Station. Attached in Appendix A

Installation Report:

- C435-BFK-C2-RGN-M123-50999. Installation Report-Manual Precise Levelling Points. Studs, sockets and invar scale.
- C435-BFK-C-RGN-M123-50943. Handover Report- West Ticket Hall.
- C435-BFK-C-RGN-M123-50247. Handover Report- East Ticket Hall.

B.2 Location of the Instruments

Sockets and crackmeters are located on the plan below highlighted in yellow.

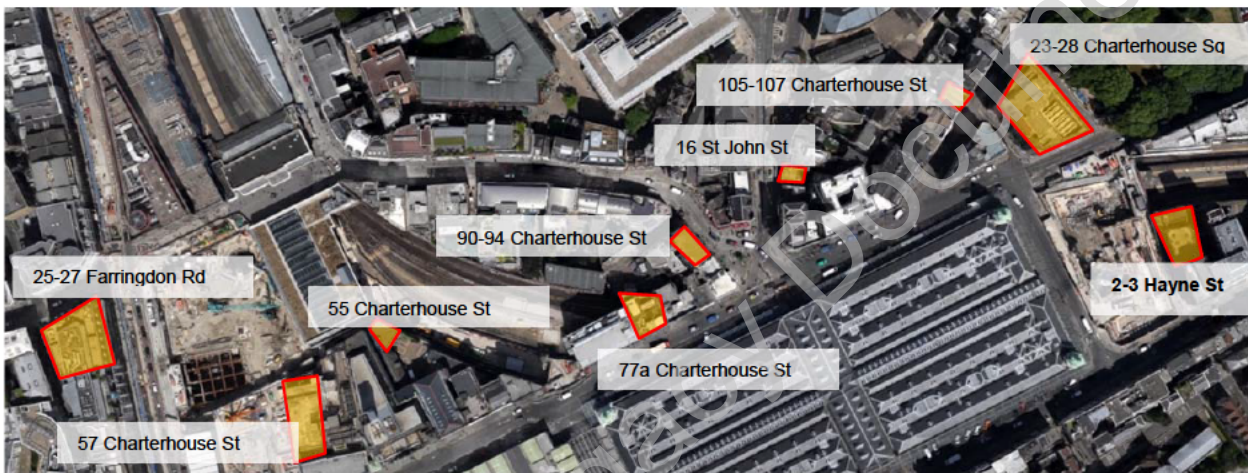


Figure 1 – Plan showing the Location of the sockets and crackmeters.

C. MOVEMENTS

C.1 Movements Resulting from Construction Activities

C.1.1 Relevant Crossrail (BFK) Works

The construction activities affecting these instruments are outlined in the Table 3 below:

Activity	Start Date	End Date
ETH Excavation	26-04-2013	28-10-2014
WB TBM	27-09-2013	07-10-2013
EB TBM	14-12-2013	23-01-2014
PTW Enlargement	12-06-2014	16-08-2014
PTE Enlargement	02-08-2014	27-01-2015
RTE2	26-10-2014	12-11-2014
CP4	17-09-2014	12-10-2014
CP2b	23-09-2014	28-08-2014
CP6	12-11-2014	22-11-2014
STE1	13-02-2015	02-03-2015
PL2	07-07-2014	24-05-2015

Table 3 – Construction Activities associated to the instruments.

C.1.2 Resulting Movements

To analyse the result for the sockets buildings will be looked at individually:

- 25-27 Farringdon Rd.
- 77a Charterhouse St.
- 90 Cowcross St. (Nicolas)
- 90 Cowcross St. (Jasmine)
- 94 Cowcross St. (The Hope)
- 16 St John St.
- 105 Charterhouse St.
- 107 Charterhouse St.
- 23-28 Charterhouse Sq.
- Smithfield Market.

1 25-27 Farringdon Rd.

The monitoring data for the sockets located at this building are shown in Appendix B.

- WB TBM caused 2mm maximum of settlement from 09-09-2013 to 11-09-2013.
- EB TBM caused 5mm maximum of settlement between 14-12-2013 and 17-12-2013.
- No movement caused by STW1 construction.
- Maximum settlement at the end of the works 7mm

2 77a Charterhouse St.

The monitoring data for the sockets located at this building are shown in Appendix B.

- WB TBM caused maximum 6mm of settlement from 27-09-2013 to 30-09-2013.
- Compensation grouting from Moorgate Spur Shaft 3 caused maximum 4mm of heave on 04-07-2014.
- PTW enlargement works caused 8mm of settlement from 12-06-2014 to 04-08-2014.
- Residual settlement caused 2mm.
- CP4 caused maximum 2mm of settlement from 17-09-2014 to 16-10-2014.
- Residual settlement caused 5mm.
- Maximum settlement at the end of the works 21mm.

3 90 Cowcross St (Nicolas).

The monitoring data for the sockets located at this building are shown in Appendix B.

- TAM's drilling for Moorgate Shaft 1 caused 4mm of heave from 06-08-2013 to 09-01-2014.
- EB TBM caused 3mm of settlement from 15-01-2014 to 16-01-2014.
- Residual settlement caused 2mm.
- PTE enlargement works caused 16mm maximum of settlement from 02-08-2014 to 18-08-2014.
- Compensation grouting from Moorgate Shaft 1 caused 4mm of heave from 03-09-2014 to 17-09-2014.
- CP4 construction caused maximum 10mm of settlement between 17-09-2014 and 16-10-2014.
- Maximum settlement at the end of the works 28mm

4 90 Cowcross St (Jasmine)

The monitoring data for the sockets located at this building are shown in Appendix B.

- TAM's drilling for Moorgate Shaft 1 caused 6mm of heave on 30-09-2013.
- EB TBM caused maximum 5mm of settlement from 15-01-2014 to 16-01-2014.
- Residual settlement caused 3mm of settlement.
- Maximum settlement at the end of the works 7mm

5 94 Cowcross St.

The monitoring data for the sockets located at this building are shown in Appendix B.

- TAM's drilling for Moorgate Shaft 1 caused 6mm of heave on 25-09-2013.
- Westbound TBM caused maximum 5mm of settlement from 30-09-2013 to 01-10-2013.
- Residual settlement caused 4mm of settlement.
- PTW works caused 18mm maximum of settlement between 20-07-2014 to 16-08-2014.
- Compensation grouting caused 2mm of heave from 04-09-2014 to 23-09-2014.
- CP4 construction caused 12mm of settlement from 17-09-2014 to 16-10-2014.
- Maximum settlement at the end of the works 30mm.

6 16 St John St.

The monitoring data for the sockets located at this building are shown in Appendix B.

- EB TBM caused maximum 9mm of settlement from 16-01-2014 to 17-01-2014.
- PTE enlargement works caused 15mm of settlement between 03-09-2014 to 25-10-2014.
- Maximum settlement at the end of the works 26mm

7 105 Charterhouse St.

The monitoring data for the sockets located at this building are shown in Appendix B.

- TAM's drilling from Moorgate Shaft 2 caused 3mm of heave on 23-08-2013.
- Compensation grouting caused 4mm maximum of heave on 21-11-2013.
- EB TBM caused maximum 7mm of settlement from 19-01-2014 to 20-01-2014.
- Residual settlement caused 2mm.
- Ground treatment caused 15mm of heave from 10-07-2014 to 27-10-2014.
- PTE enlargement works caused 16mm of settlement between 22-10-2014 to 10-11-2014.
- CP6 construction caused 3mm of settlement from 20-11-2014 to 22-11-2014.
- Maximum settlement at the end of the works 11mm

8 107 Charterhouse St.

The monitoring data for the sockets located at this building are shown in Appendix B.

- Compensation grouting from Moorgate Shaft 2 caused maximum 3mm of heave on 22-11-2013.
- EB TBM caused maximum 6mm of settlement from 19-01-2014 to 20-01-2014.
- Residual settlement caused 3mm.
- Ground treatment caused 14mm of heave from 02-07-2014 to 30-10-2014.
- PTE construction caused 15mm of settlement maximum from 22-10-2014 to 10-11-2014.
- CP6 works caused 3mm of settlement from 20-11-2014 to 22-11-2014.
- Maximum settlement at the end of the works 11mm

9 23-28 Charterhouse Sq.

The monitoring data for the sockets located at this building are shown in Appendix B.

- EB TBM caused maximum 10mm of settlement from 21-01-2014 to 23-01-2014.
- Ground treatment caused maximum 16mm of heave between 29-09-2014 to 07-11-2014.
- PTE construction works caused 20mm of settlement between 14-12-2014 to 27-01-2015.
- Residual settlement caused 2mm.
- CP8 and CP9 combination caused maximum 4mm of settlement from 10-06-2015 to 22-06-2015
- Maximum settlement at the end of the works 22mm

10 East Market.

The monitoring data for the sockets located at this building are shown in Appendix B.

- ETH excavation caused maximum 9mm of settlement from 26-04-2013 to 28-10-2014.
- RTE2 tunnel caused maximum 3mm of settlement between 26-10-2014 to 12-11-2014.
- Maximum settlement at the end of the works 14mm

To analyse the result for the crackmeters buildings will be looked at individually:

- 25-27 Farringdon Rd.
- 2-3 Hayne St.
- 55 Charterhouse St.
- 57 Charterhouse St. (CitiGen)

1 25-27 Farringdon Rd

The monitoring data for the crackmeters located at this building are shown in Appendix B.

- The maximum movement captured by the crackmeters installed in this building was -2mm during the STW1 construction, from 12-04-2014 to 24-04-2014.
- No movements caused by the rest of the Crossrail works.

2 2-3 Hayne St.

The monitoring data for the crackmeters located at this building are shown in Appendix B.

- Maximum movement captured by these crackmeters was 1.5mm during ETH excavation works.
- No significant movements for the rest of Crossrail works.

3 55 Charterhouse St.

The monitoring data for the crackmeters located at this building are shown in Appendix B.

- PTW works caused maximum 2mm of movement from 14-12-2014 to 02-04-2014.
- CP2b construction caused 1mm of movement from 28-08-2014 to 23-09-2014.

4 57 Charterhouse St.

The monitoring data for the crackmeters located at this building are shown in Appendix B.

- WB TBM caused maximum 2mm of movement from 18-09-2013 to 22-09-2013.
- No movement caused by the PL2 tunnel.

C.2 Trigger Breaches

The Instrumentation and Monitoring Plan: Farringdon Station Ground Movement and Asset Protection C122-OVE-C2-RGN-M123-50013 outlines the triggers associated with the works.

No triggers breached. The Table 4 below shows the 10mm default alerts breached:

MONITORING GROUP (Location)	POINT ID	TYPE	DIRECTION	DATE OF LAST READING	LAST READING VALUE	WORST HISTORICAL STATUS	CURRENT STATUS	
25-27 Farringdon Rd	C435-LB14013	BRE SOCKETS	Settlement	27/03/2015 14:00	-5.4	Clear	Clear	
	C435-LB14014	BRE SOCKETS	Settlement	27/03/2015 14:00	-13.6	Default Atert	Default Atert	
	C435-LB14015	BRE SOCKETS	Settlement	27/03/2015 14:00	-4.8	Clear	Clear	
	C435-LB14016	BRE SOCKETS	Settlement	27/03/2015 14:00	-5	Clear	Clear	
	C435-LB14017	BRE SOCKETS	Settlement	27/03/2015 14:00	-4.6	Clear	Clear	
	C435-LB14018	BRE SOCKETS	Settlement	27/03/2015 14:00	-5	Clear	Clear	
	C435-LB14019	BRE SOCKETS	Settlement	27/03/2015 14:00	-4.3	Clear	Clear	
	C435-LB14020	BRE SOCKETS	Settlement	27/03/2015 14:00	-5.6	Clear	Clear	
	C435-LB14021	BRE SOCKETS	Settlement	27/03/2015 14:00	-4.4	Clear	Clear	
	C435-LB14022	BRE SOCKETS	Settlement	27/03/2015 14:00	-5.6	Clear	Clear	
	C435-LB14023	BRE SOCKETS	Settlement	27/03/2015 14:00	-3.3	Clear	Clear	
	C435-LB14024	BRE SOCKETS	Settlement	27/03/2015 14:00	-4.1	Clear	Clear	
	C435-LB14062	BRE SOCKETS	Settlement	24/02/2015 14:00	-4.4	Clear	Clear	
	C435-LB14063	BRE SOCKETS	Settlement	24/02/2015 14:00	-4.1	Clear	Clear	
	77a Charterhouse St	C435-LB13939	BRE SOCKETS	Settlement	25/09/2015 10:00	-12.6	Default Atert	Default Atert
		C435-LB13940	BRE SOCKETS	Settlement	25/09/2015 10:00	-13.6	Default Atert	Default Atert
C435-LB13941		BRE SOCKETS	Settlement	25/09/2015 10:00	-11.5	Default Atert	Default Atert	
C435-LB13942		BRE SOCKETS	Settlement	03/06/2015 14:00	-10.3	Default Atert	Default Atert	
C435-LB13943		BRE SOCKETS	Settlement	25/09/2015 10:00	-8.8	Clear	Clear	
C435-LB13944		BRE SOCKETS	Settlement	25/09/2015 10:00	-9.8	Default Atert	Clear	
C435-LB13945		BRE SOCKETS	Settlement	25/09/2015 10:00	-10.7	Default Atert	Default Atert	
C435-LB13946		BRE SOCKETS	Settlement	25/09/2015 10:00	-14.2	Default Atert	Default Atert	
C435-LB13947		BRE SOCKETS	Settlement	25/09/2015 10:00	-10.9	Default Atert	Default Atert	
C435-LB13948		BRE SOCKETS	Settlement	25/09/2015 10:00	-13.6	Default Atert	Default Atert	
C435-LB13949		BRE SOCKETS	Settlement	25/09/2015 10:00	-20.4	Default Atert	Default Atert	
C435-LB13950		BRE SOCKETS	Settlement	25/09/2015 10:00	-11.1	Default Atert	Default Atert	
C435-LB13951		BRE SOCKETS	Settlement	25/09/2015 10:00	-16.6	Default Atert	Default Atert	
C435-LB13952		BRE SOCKETS	Settlement	25/09/2015 10:00	-13.9	Default Atert	Default Atert	
C435-LB13953	BRE SOCKETS	Settlement	25/09/2015 10:00	-15.6	Default Atert	Default Atert		
90 Cowcross St (Nicolas)	C435-LB13954	BRE SOCKETS	Settlement	28/09/2015 10:00	-29	Default Atert	Default Atert	
	C435-LB13955	BRE SOCKETS	Settlement	28/09/2015 10:00	-27.1	Default Atert	Default Atert	
	C435-LB13956	BRE SOCKETS	Settlement	28/09/2015 10:00	-26.6	Default Atert	Default Atert	
	C435-LB13957	BRE SOCKETS	Settlement	28/09/2015 10:00	-27.3	Default Atert	Default Atert	
	C435-LB13958	BRE SOCKETS	Settlement	28/09/2015 10:00	-27.4	Default Atert	Default Atert	
	C435-LB13959	BRE SOCKETS	Settlement	28/09/2015 10:00	-30	Default Atert	Default Atert	

Table 4- Default Alerts breached by the sockets

MONITORING GROUP (Location)	POINT ID	TYPE	DIRECTION	DATE OF LAST READING	LAST READING VALUE	WORST HISTORICAL STATUS	CURRENT STATUS
90 Cowcross St (Nicolas)	C435-LB13954	BRE SOCKETS	Settlement	28/09/2015 10:00	-29	Default Alert	Default Alert
	C435-LB13955	BRE SOCKETS	Settlement	28/09/2015 10:00	-27.1	Default Alert	Default Alert
	C435-LB13956	BRE SOCKETS	Settlement	28/09/2015 10:00	-26.6	Default Alert	Default Alert
	C435-LB13957	BRE SOCKETS	Settlement	28/09/2015 10:00	-27.3	Default Alert	Default Alert
	C435-LB13958	BRE SOCKETS	Settlement	28/09/2015 10:00	-27.4	Default Alert	Default Alert
90 Cowcross St (Jasmine)	C435-LB13959	BRE SOCKETS	Settlement	28/09/2015 10:00	-30	Default Alert	Default Alert
	C435-LB13960	BRE SOCKETS	Settlement	05/07/2014 11:00	-3.6	Clear	Clear
	C435-LB13970	BRE SOCKETS	Settlement	30/04/2014 12:00	-3.6	Clear	Clear
94 Cowcross St	C435-LB13971	BRE SOCKETS	Settlement	07/05/2014 15:00	-5.6	Clear	Clear
	C435-LB13961	BRE SOCKETS	Settlement	05/07/2014 11:00	-4.1	Clear	Clear
	C435-LB13972	BRE SOCKETS	Settlement	28/09/2015 10:00	-26.5	Default Alert	Default Alert
	C435-LB13973	BRE SOCKETS	Settlement	28/09/2015 10:00	-24.5	Default Alert	Default Alert
	C435-LB13974	BRE SOCKETS	Settlement	28/09/2015 10:00	-24.7	Default Alert	Default Alert
	C435-LB13975	BRE SOCKETS	Settlement	28/09/2015 10:00	-24.5	Default Alert	Default Alert
	C435-LB13976	BRE SOCKETS	Settlement	28/09/2015 10:00	-28.1	Default Alert	Default Alert
	C435-LB13977	BRE SOCKETS	Settlement	28/09/2015 10:00	-23.5	Default Alert	Default Alert
	C435-LB13978	BRE SOCKETS	Settlement	28/09/2015 10:00	-27.6	Default Alert	Default Alert
	C435-LB13979	BRE SOCKETS	Settlement	28/09/2015 10:00	-25	Default Alert	Default Alert
	C435-LB13980	BRE SOCKETS	Settlement	10/06/2015 14:00	-28.8	Default Alert	Default Alert
16 St John St	C435-LB13981	BRE SOCKETS	Settlement	28/09/2015 10:00	-30.2	Default Alert	Default Alert
	C435-LB13926	BRE SOCKETS	Settlement	04/12/2015 11:00	-16.7	Default Alert	Default Alert
	C435-LB13927	BRE SOCKETS	Settlement	04/12/2015 11:00	-21.1	Default Alert	Default Alert
	C435-LB13928	BRE SOCKETS	Settlement	04/12/2015 11:00	-22.8	Default Alert	Default Alert
	C435-LB13929	BRE SOCKETS	Settlement	04/12/2015 11:00	-25.2	Default Alert	Default Alert
105 Charterhouse St	C435-LB13930	BRE SOCKETS	Settlement	04/12/2015 11:00	-28	Default Alert	Default Alert
	C435-LB13931	BRE SOCKETS	Settlement	04/12/2015 11:00	-24	Default Alert	Default Alert
	C435-LB13932	BRE SOCKETS	Settlement	19/03/2015 14:00	-4.4	Clear	Clear
	C435-LB13933	BRE SOCKETS	Settlement	19/03/2015 14:00	-8.4	Clear	Clear
	C435-LB13934	BRE SOCKETS	Settlement	19/03/2015 14:00	-3.5	Clear	Clear
	C435-LB13935	BRE SOCKETS	Settlement	19/03/2015 14:00	-2.6	Clear	Clear
	C435-LB13936	BRE SOCKETS	Settlement	19/03/2015 14:00	-5.1	Clear	Clear
	C435-LB13937	BRE SOCKETS	Settlement	19/03/2015 14:00	-1.3	Clear	Clear
107 Charterhouse St	C435-LB13938	BRE SOCKETS	Settlement	19/03/2015 14:00	-6.4	Clear	Clear
	C435-LB13982	BRE SOCKETS	Settlement	07/10/2015 10:00	-11.3	Default Alert	Default Alert
	C435-LB13983	BRE SOCKETS	Settlement	07/10/2015 10:00	-13.2	Default Alert	Default Alert
	C435-LB13984	BRE SOCKETS	Settlement	07/10/2015 10:00	-9.3	Default Alert	Clear
	C435-LB13985	BRE SOCKETS	Settlement	21/08/2015 15:00	-3.7	Clear	Clear
23-28 Charterhouse Sq	C435-LB13986	BRE SOCKETS	Settlement	21/08/2015 15:00	-2.9	Clear	Clear
	C435-LB13987	BRE SOCKETS	Settlement	26/10/2015 12:00	-20.1	Default Alert	Default Alert
	C435-LB13988	BRE SOCKETS	Settlement	26/10/2015 12:00	-17.7	Default Alert	Default Alert
	C435-LB13989	BRE SOCKETS	Settlement	26/10/2015 12:00	-11.7	Default Alert	Default Alert
	C435-LB13990	BRE SOCKETS	Settlement	26/10/2015 12:00	-12.9	Default Alert	Default Alert
	C435-LB13991	BRE SOCKETS	Settlement	26/10/2015 12:00	-16.4	Default Alert	Default Alert
	C435-LB13992	BRE SOCKETS	Settlement	26/10/2015 12:00	-15.3	Default Alert	Default Alert
	C435-LB13993	BRE SOCKETS	Settlement	26/10/2015 12:00	-20	Default Alert	Default Alert
	C435-LB13994	BRE SOCKETS	Settlement	26/10/2015 12:00	-13.2	Default Alert	Default Alert
	C435-LB13995	BRE SOCKETS	Settlement	26/10/2015 12:00	-12.4	Default Alert	Default Alert
	C435-LB13996	BRE SOCKETS	Settlement	26/10/2015 12:00	-9.6	Clear	Clear
	C435-LB13997	BRE SOCKETS	Settlement	26/10/2015 12:00	-11.9	Default Alert	Default Alert
	C435-LB13998	BRE SOCKETS	Settlement	26/10/2015 12:00	-2.6	Default Alert	Default Alert
C435-LB13999	BRE SOCKETS	Settlement	26/10/2015 12:00	-23.8	Default Alert	Default Alert	
C435-LB14000	BRE SOCKETS	Settlement	26/10/2015 12:00	-22.6	Default Alert	Default Alert	

Table 4- Default Alerts breached by the sockets.

C.3 Significant Issues with the Instrumentation

No issues with these devices.

C.4 Residual Risks

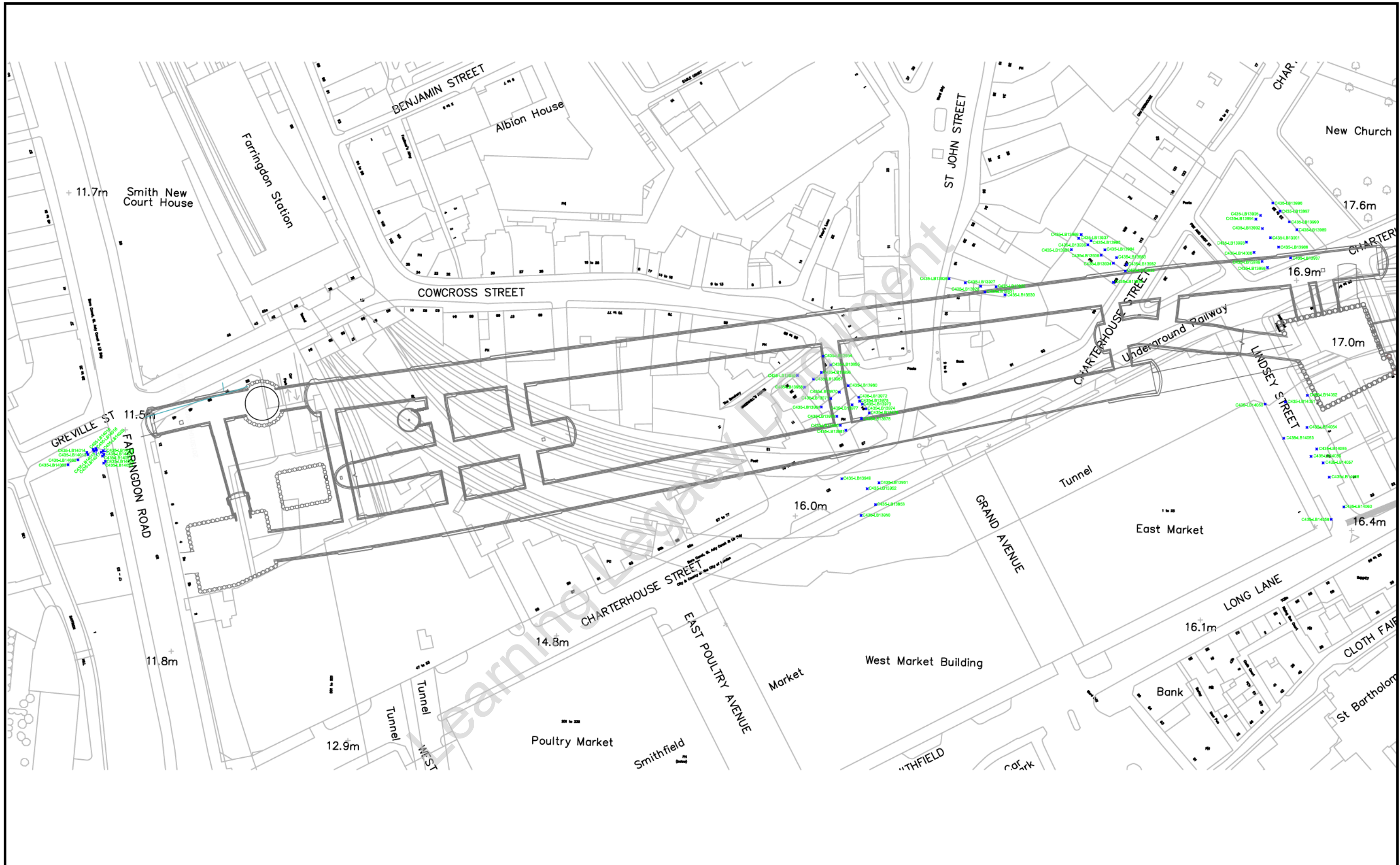
As per C435-PMI-00549 the Long Term Monitoring has been ceased by Contract C435 in this area. The last measurement carried out by C435 for these instruments was undertaken on 19-01-2016. Long Term Monitoring will be continued by Crossrail to review long term stability.

D. CONCLUSIONS

No triggers breached, monitoring stable. No residual risks remain. Long term monitoring to be completed by Crossrail.

APPENDIX A: DRAWINGS

Learning Legacy Document



Notes:

Rev.	Date	Description	By	Chkd	App	Auth



C/ Los Llanos de Jerez 10-12
28823- MADRID
www.geocisa.com



Scale : @ A3

Contract : BORED TUNNELS (ALIGNMENT AND TRACK)
 Originator : OVE ARUP & PARTNERS LIMITED
 Location : CROSSRAIL GENERAL
 Title : C435 I&M PRECISE LEVELLING SOCKETS IN BUILDINGS

Drg No : C435-BFK-C2-M123-50043

By :
 Chk :
 App :

Auth :

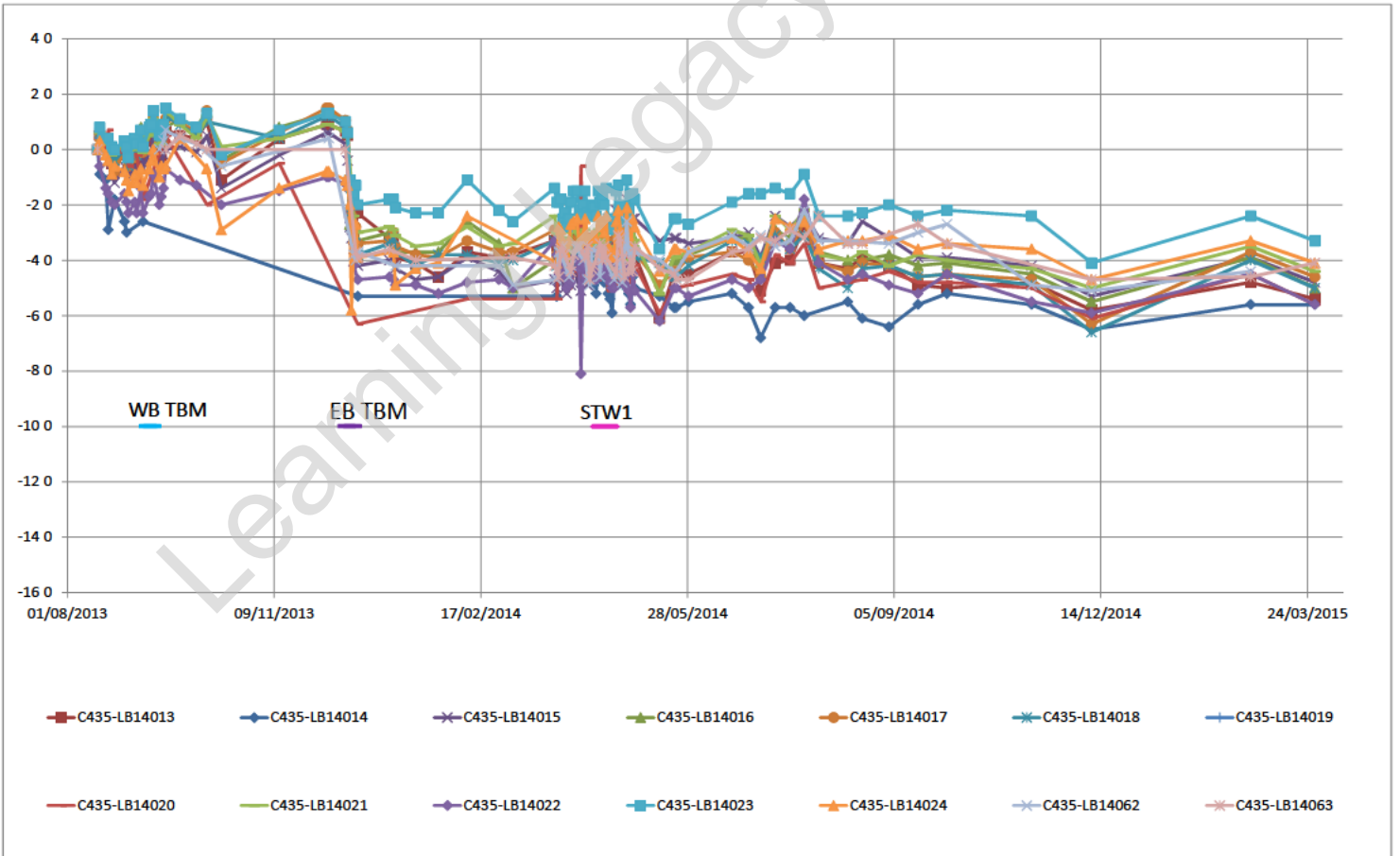
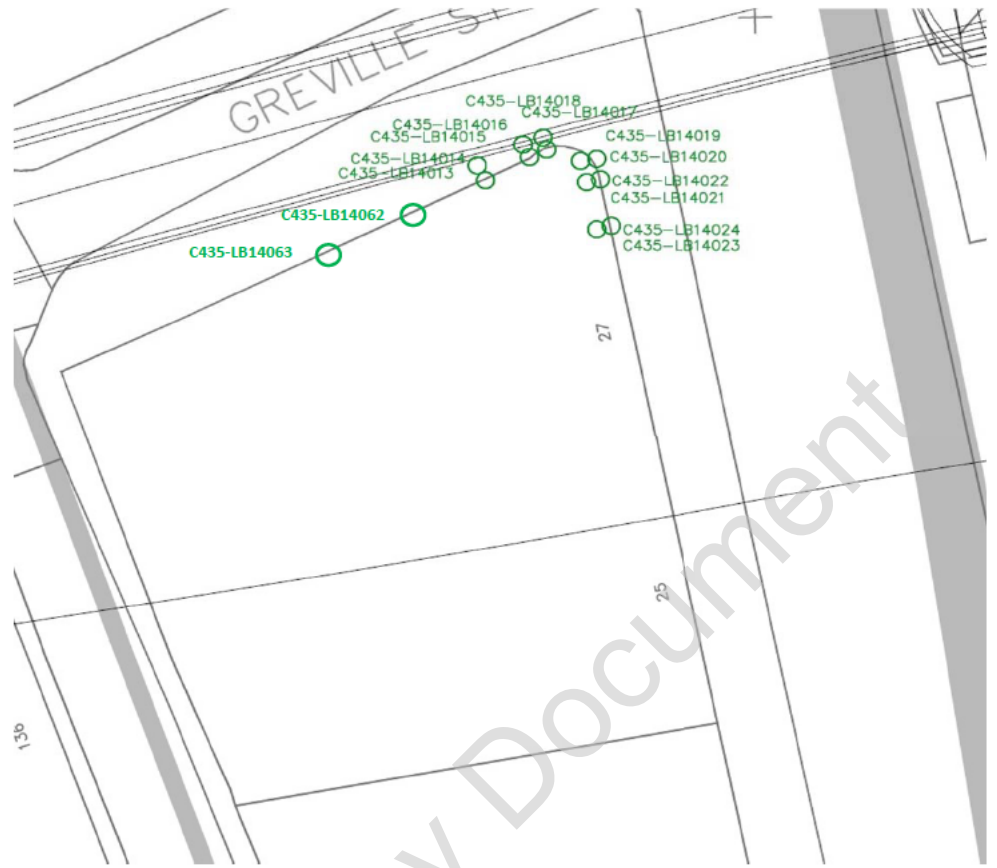
\$Pby\$

APPENDIX B: GRAPHS

Learning Legacy Document



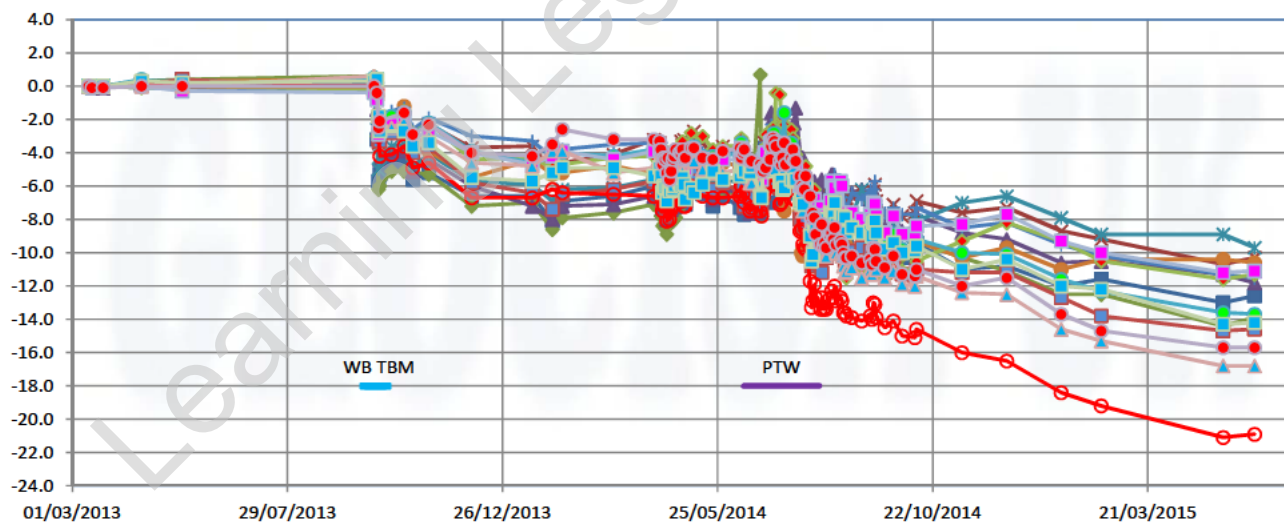
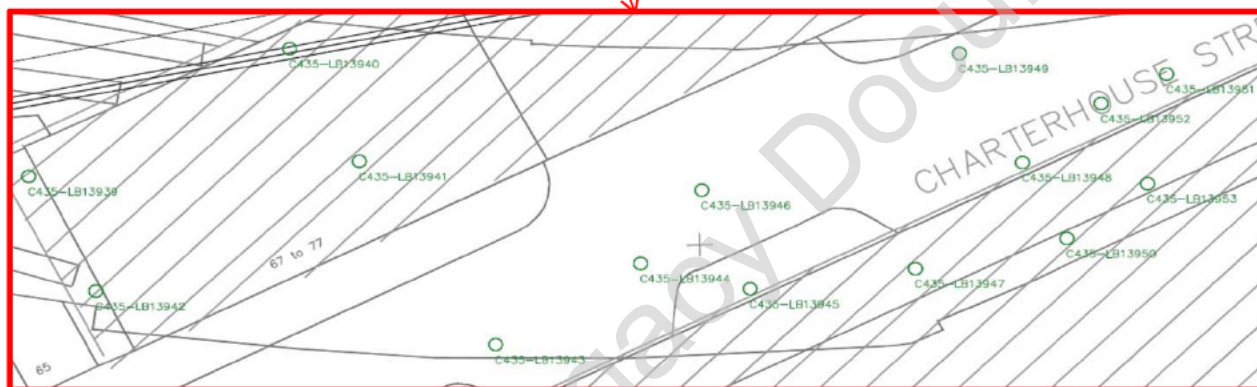
REPORT: LEVELLING
AREA: 25-27 Farringdon Rd
DEVICE: Precise Levelling Points



REMARKS:

Empty box for remarks.

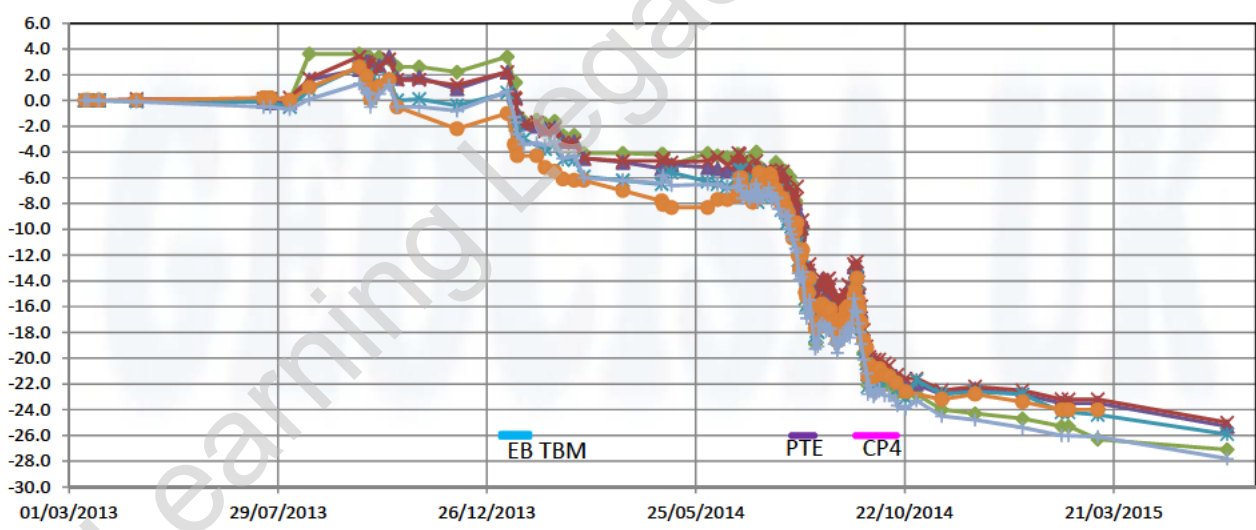
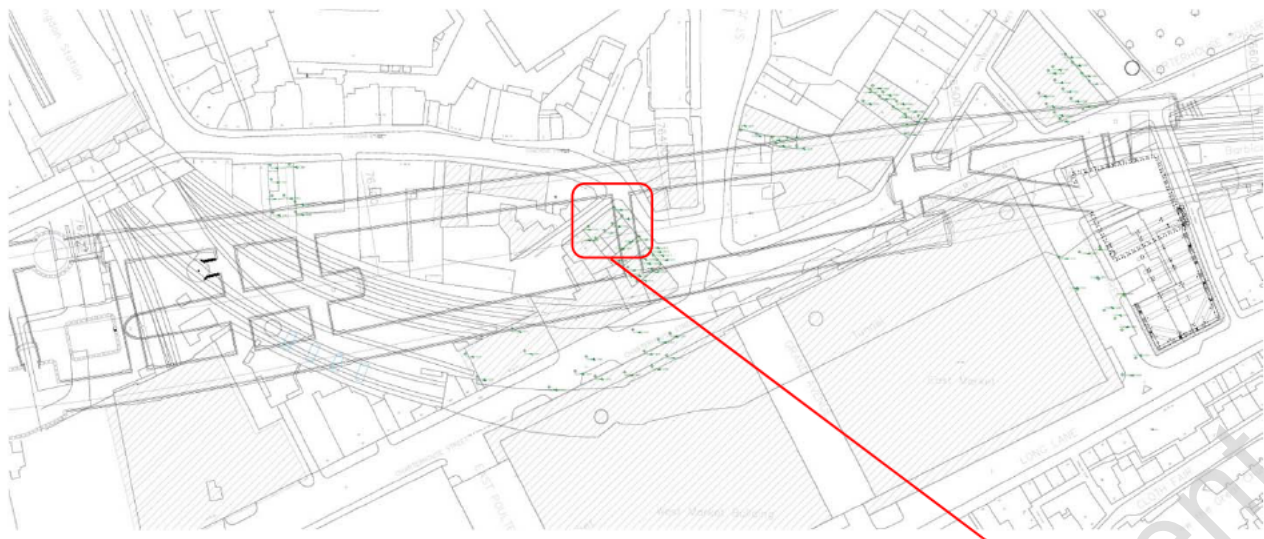
REPORT: LEVELLING
AREA: 77A Charterhouse St (Fabric)
DEVICE: Precise Levelling Point (Sockets)



- | | | | | |
|----------------|----------------|----------------|----------------|----------------|
| ■ C435-LB13939 | ◆ C435-LB13940 | ▲ C435-LB13941 | × C435-LB13942 | ✱ C435-LB13943 |
| ● C435-LB13944 | ⊕ C435-LB13945 | ■ C435-LB13946 | ◆ C435-LB13947 | ● C435-LB13948 |
| ○ C435-LB13949 | ■ C435-LB13950 | ▲ C435-LB13951 | ■ C435-LB13952 | ● C435-LB13953 |

REMARKS:

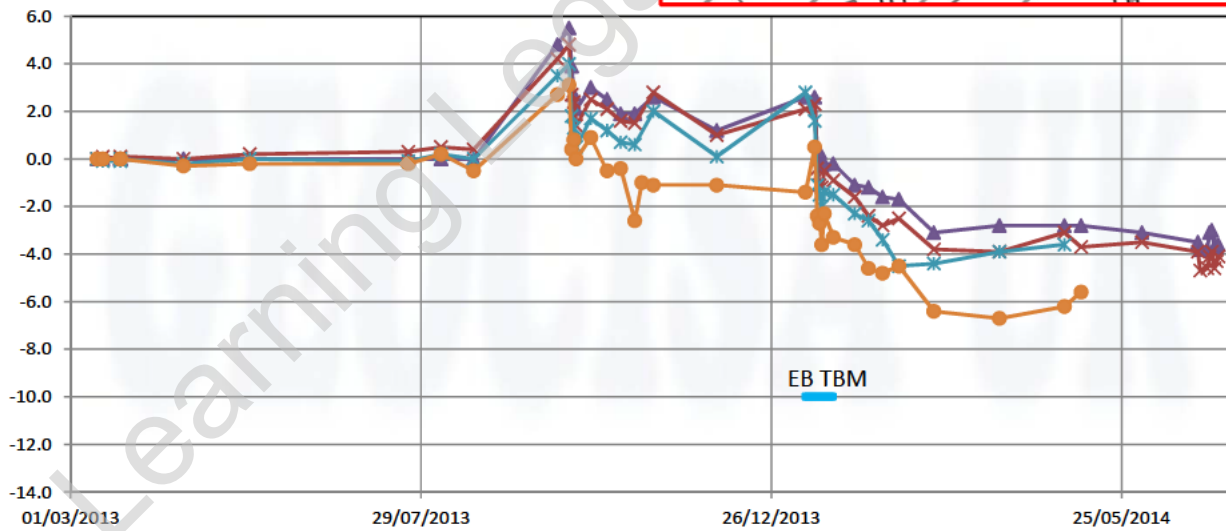
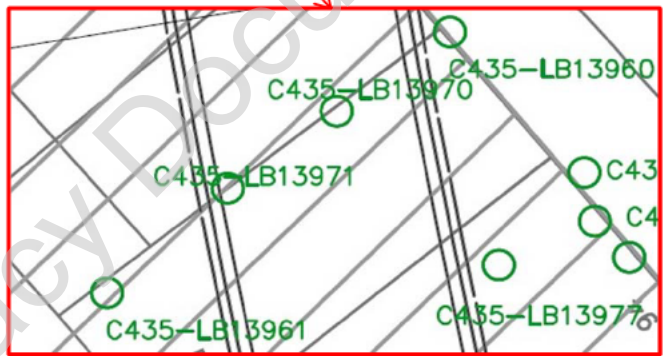
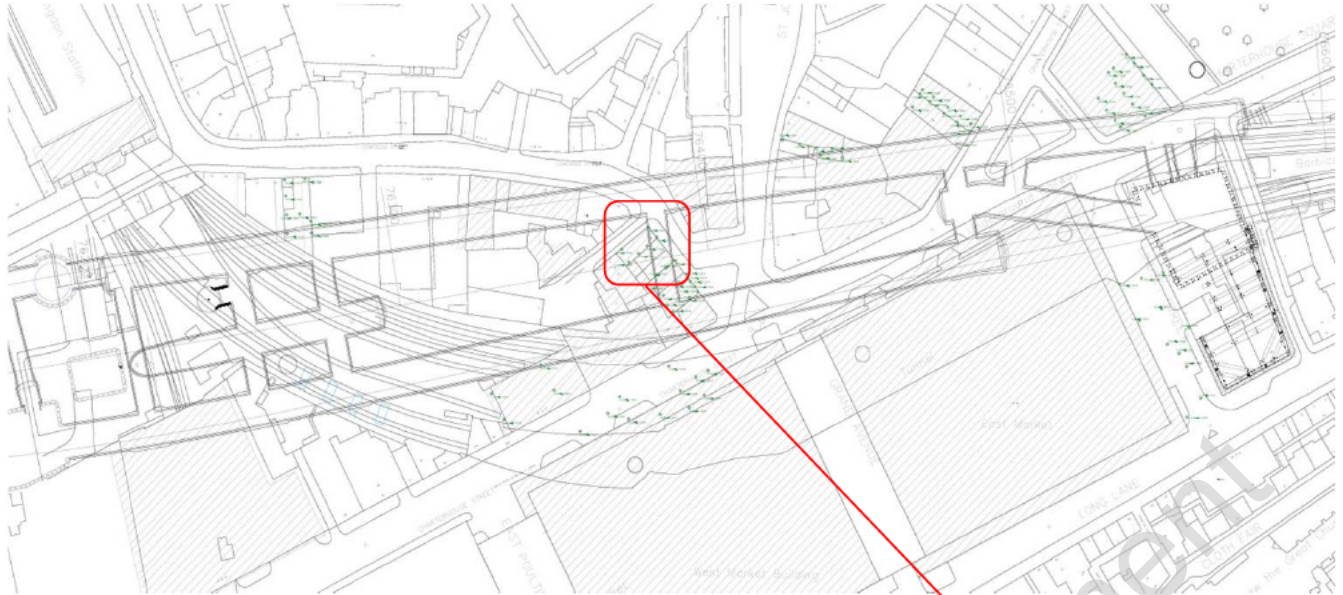
REPORT: LEVELLING
AREA: 90 COWCROSS (Nicolas)
DEVICE: Precise Levelling Point (Sockets)



◆ C435-LB13954
 ▲ C435-LB13955
 ✕ C435-LB13956
 ✱ C435-LB13957
 ● C435-LB13958
 + C435-LB13959

REMARKS:

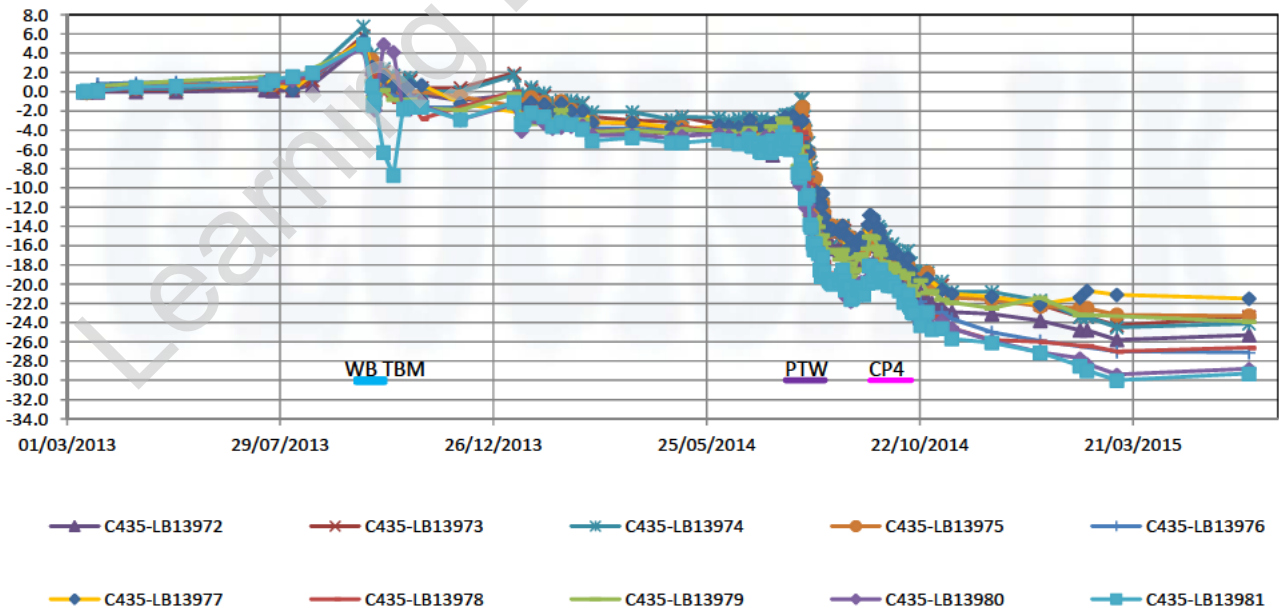
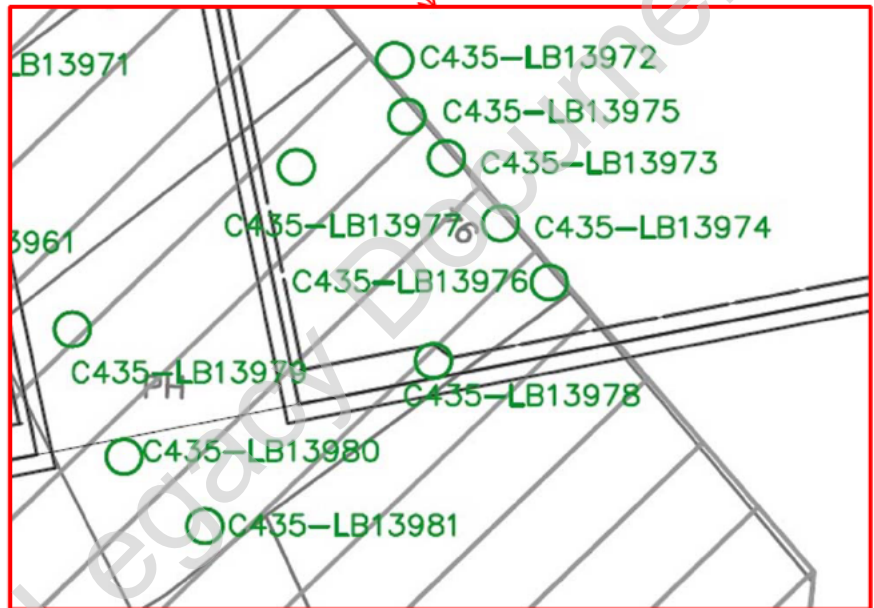
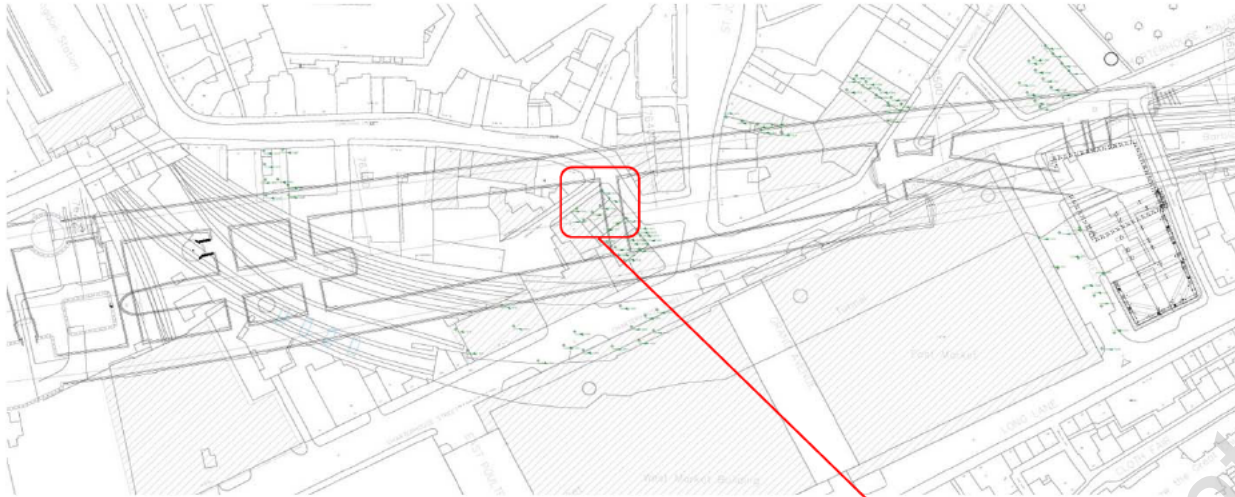
REPORT: LEVELLING
AREA: 90 COWCROSS (Jasmine)
DEVICE: Precise Levelling Point (Sockets)



▲ C435-LB13960 × C435-LB13961 * C435-LB13970 ● C435-LB13971

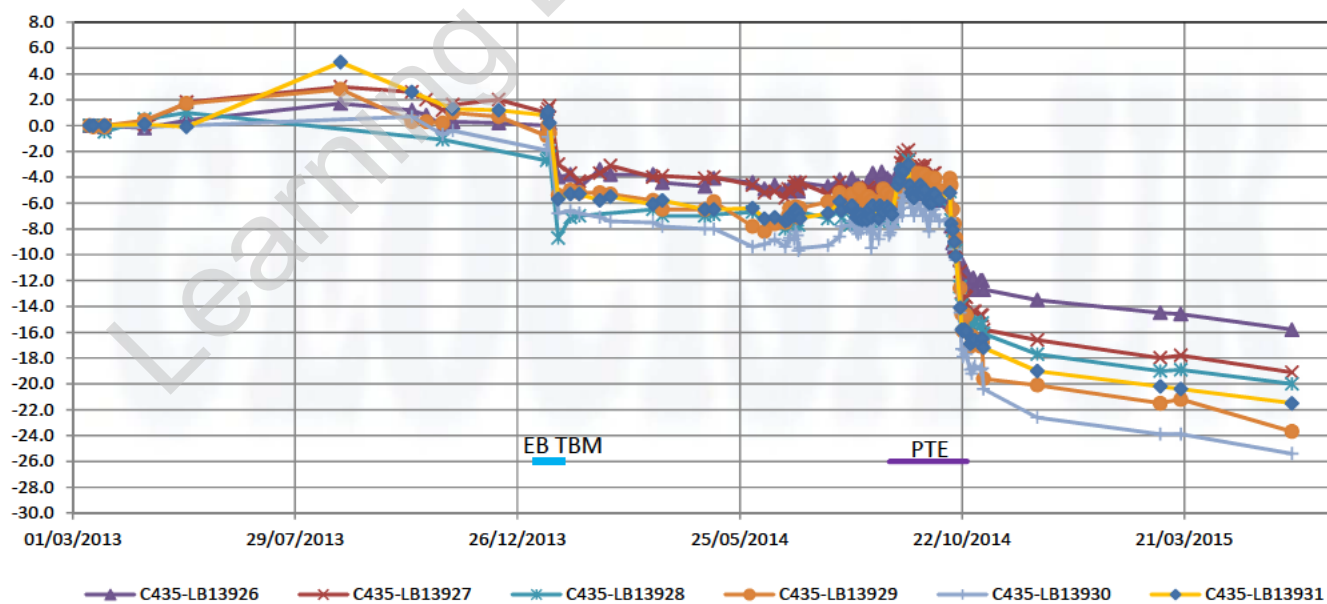
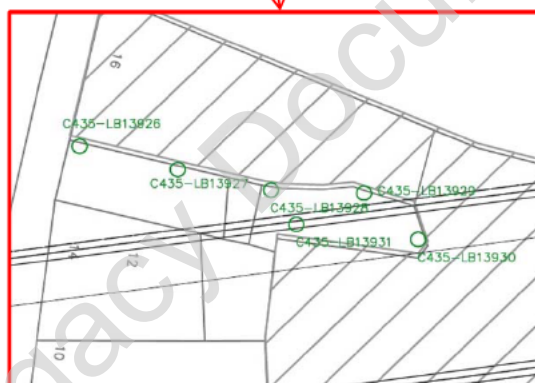
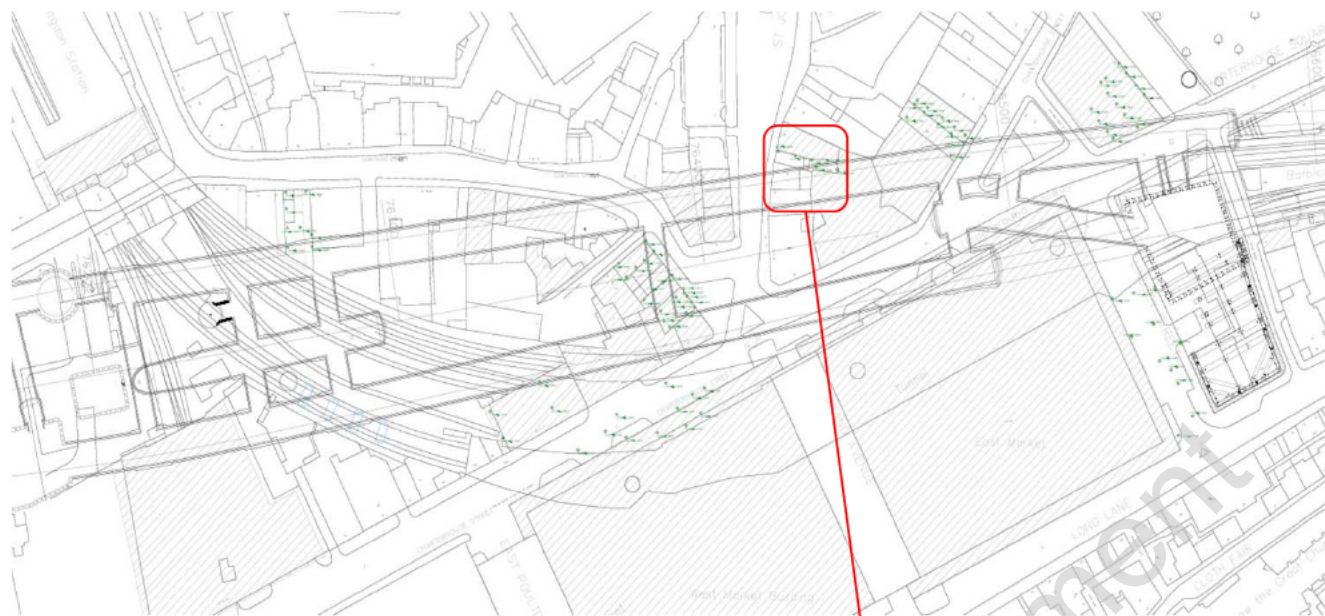
REMARKS:

REPORT: LEVELLING
 AREA: 94 Cowcross St (The Hope)
 DEVICE: Precise Levelling Point (Sockets)



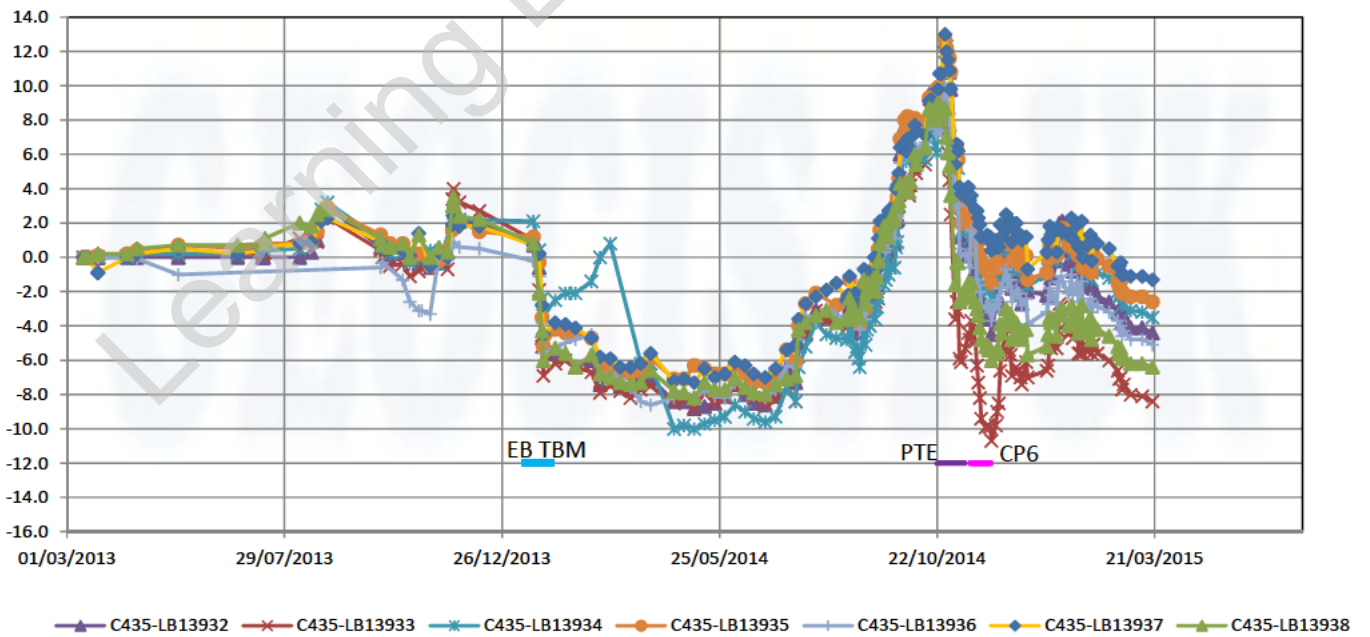
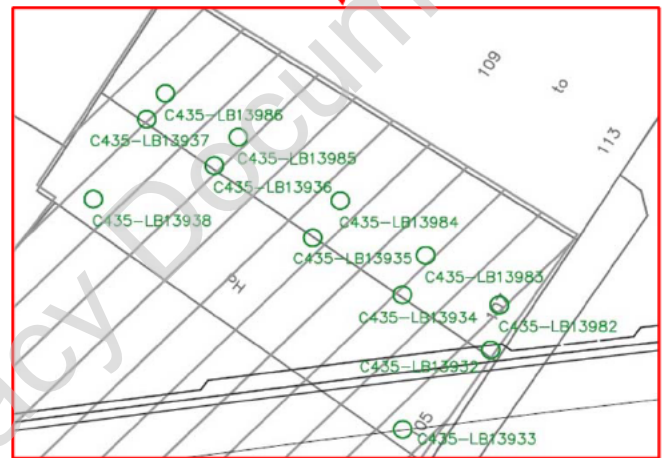
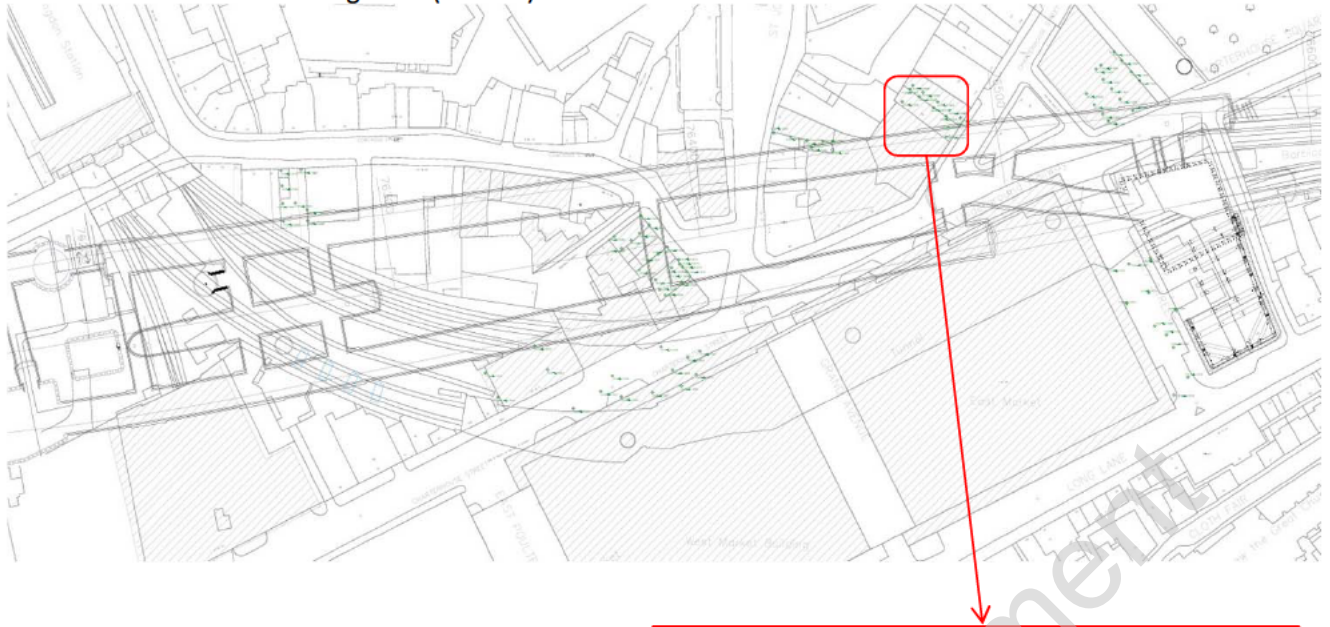
REMARKS:
 30-08-14. Bad readings

REPORT: LEVELLING
 AREA: 16 St John St (Clinic)
 DEVICE: Precise Levelling Point (Sockets)



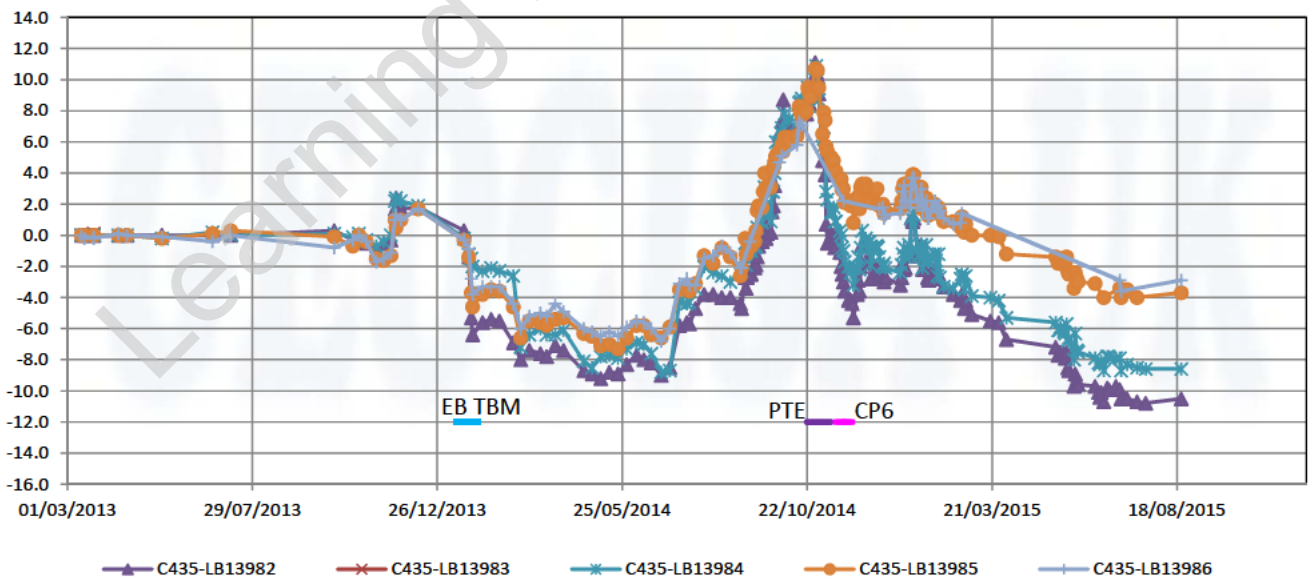
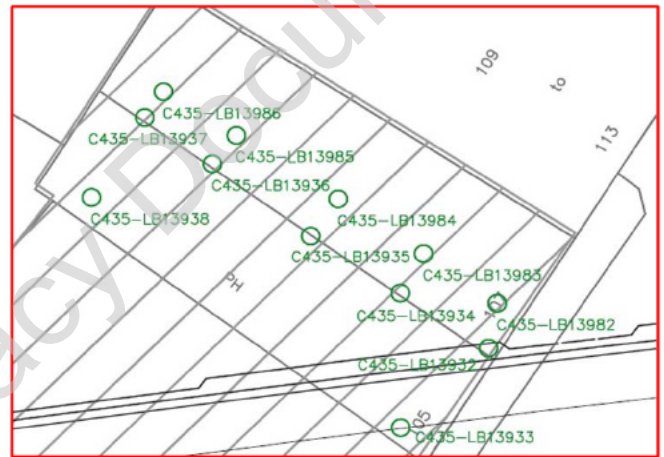
REMARKS:

REPORT: LEVELLING
 AREA: 105 Charterhouse St (Smithfield Tavern)
 DEVICE: Precise Levelling Point (Sockets)



REMARKS:

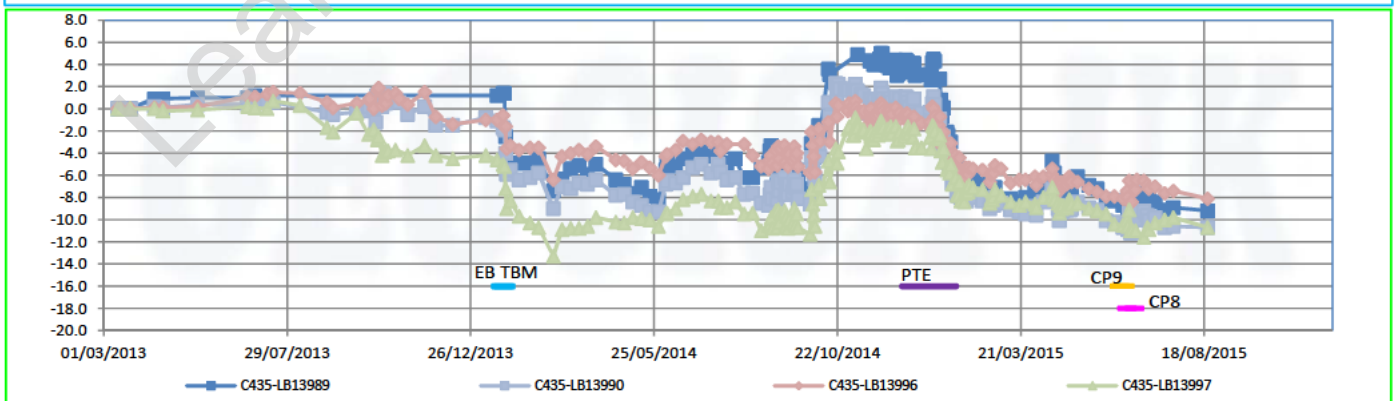
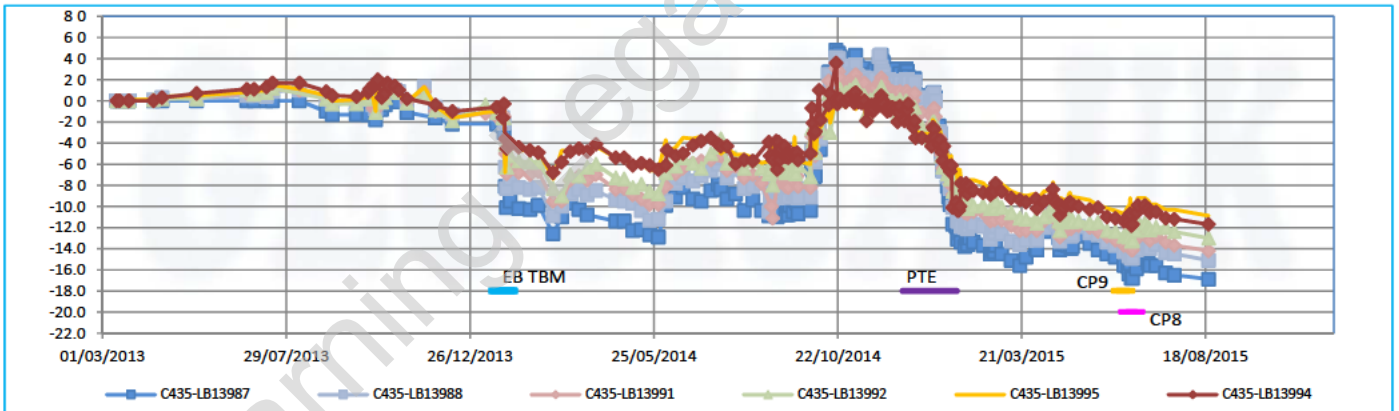
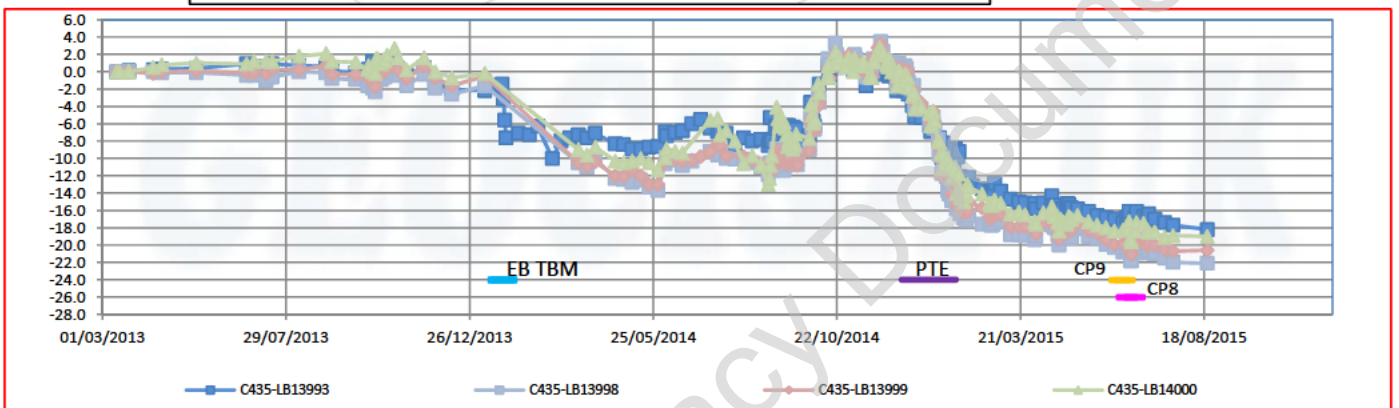
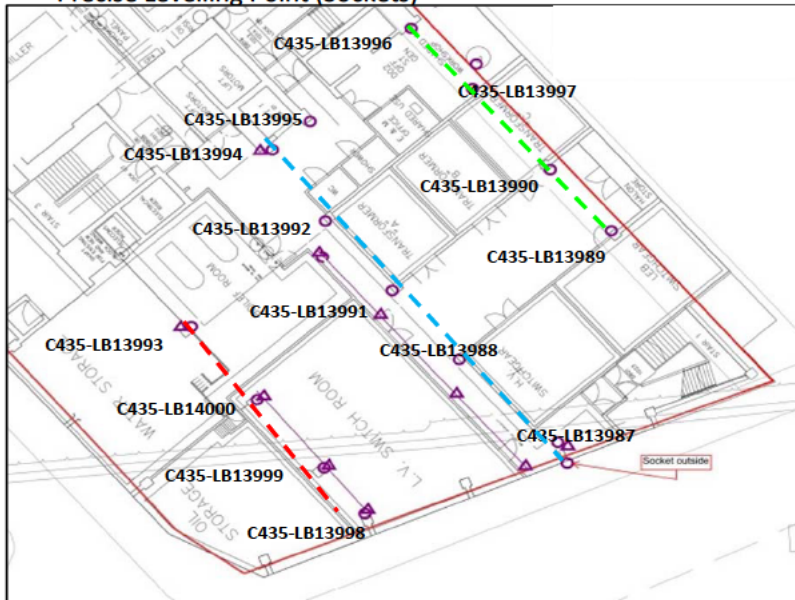
REPORT: **LEVELLING**
AREA: **107 CHARTERHOUSE**
DEVICE: **Precise Levelling Point (Sockets)**



REMARKS:

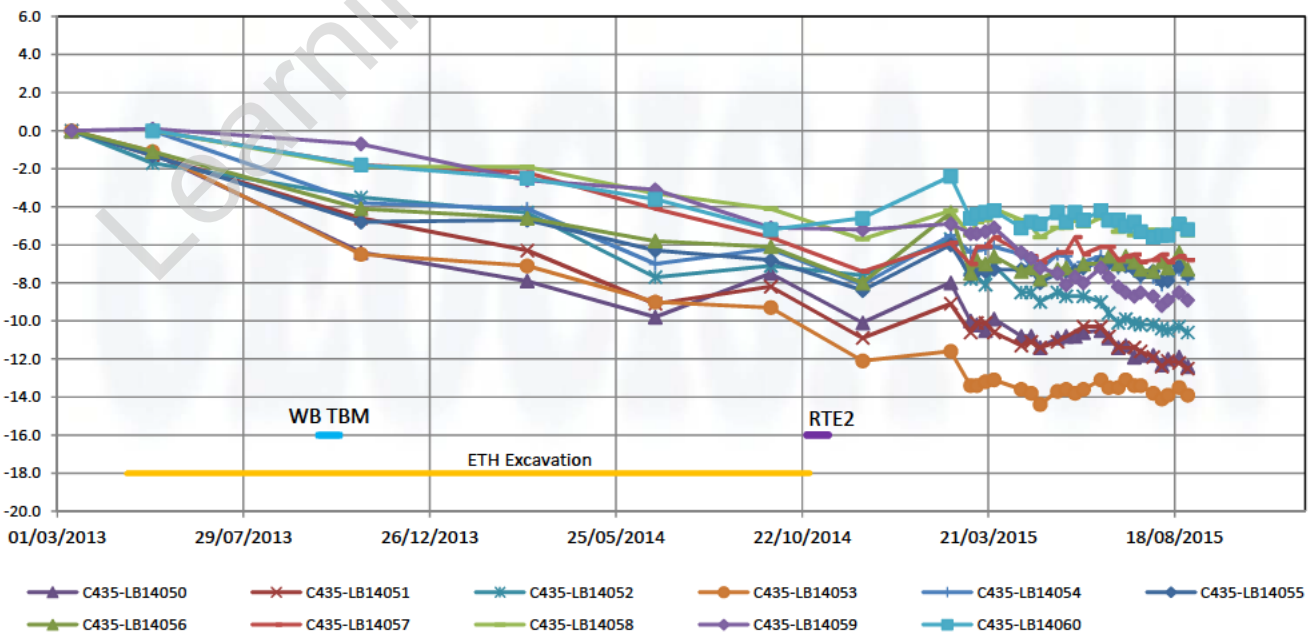
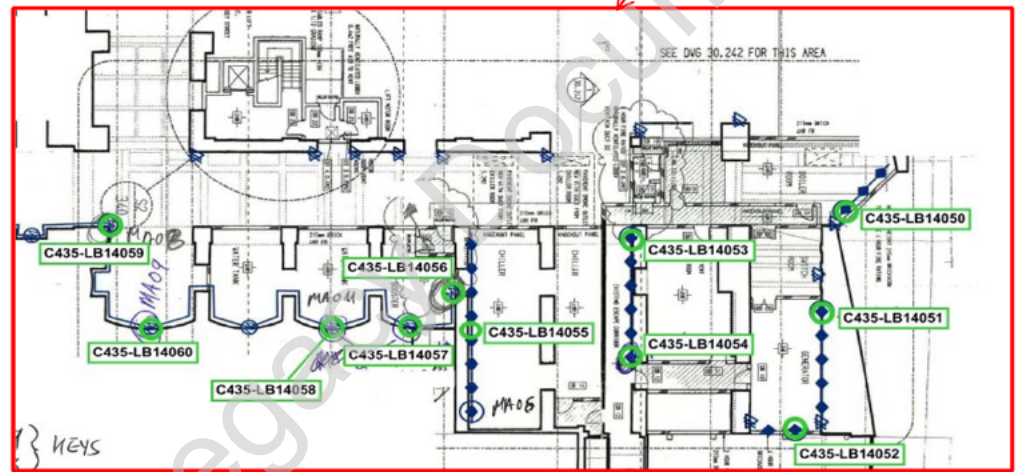
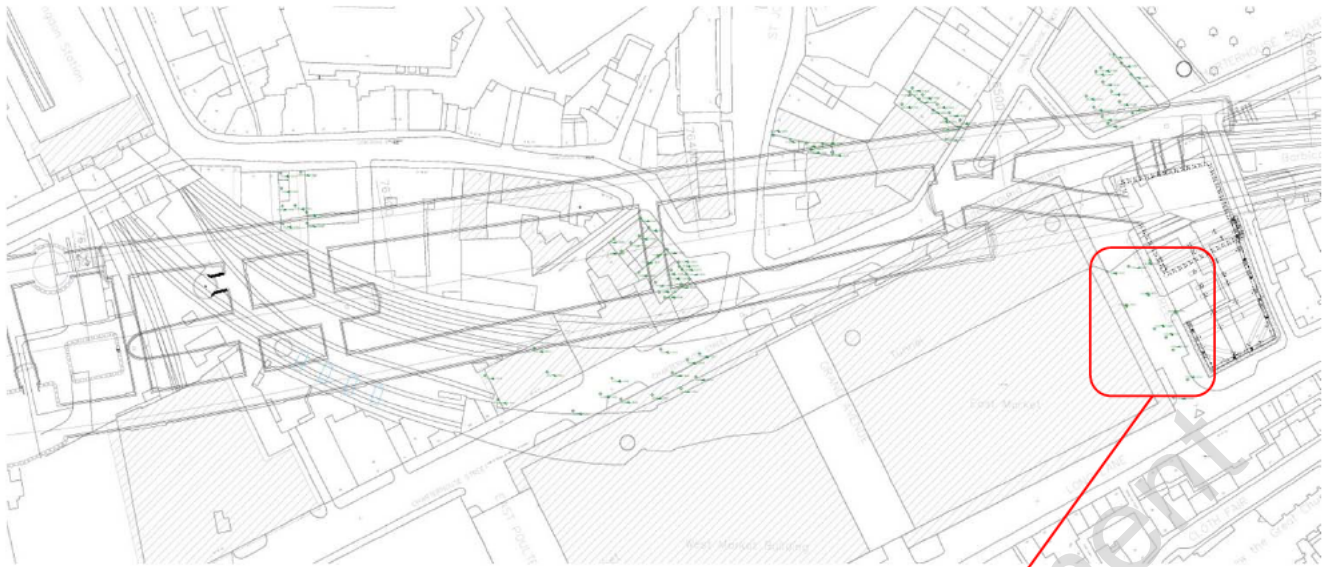
REPORT:
AREA:
DEVICE:

LEVELLING
23-28 Charterhouse Sq (Bank of Scotland)
Precise Levelling Point (Sockets)

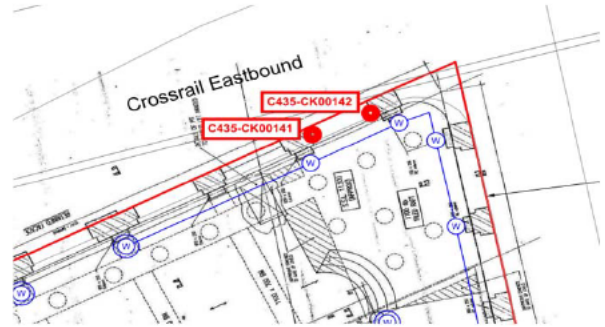
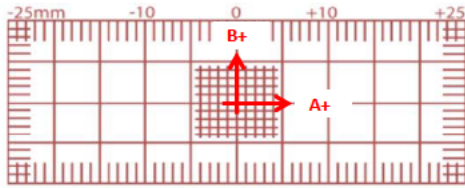


REMARKS:

REPORT: LEVELLING
 AREA: Smithfield Market (east)
 DEVICE: Precise Levelling Point (Sockets)



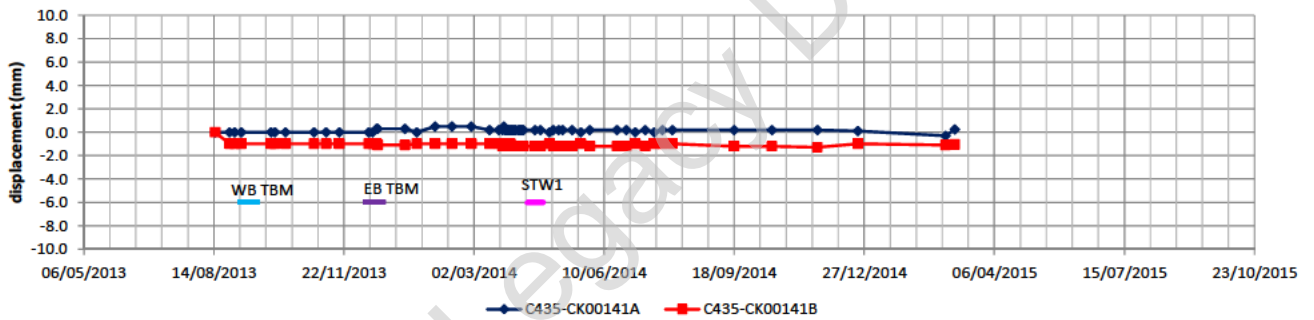
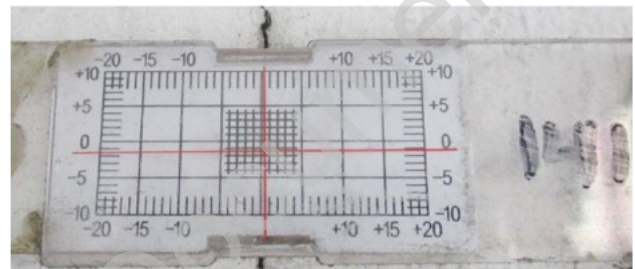
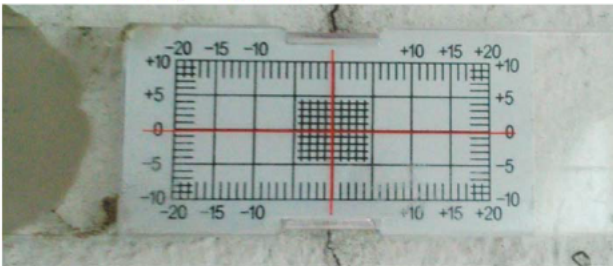
REPORT: Manual Crack monitor
AREA: 25-27 Farringdon Road
DEVICE: Calibrated Tell-Tales.



C435-CK00141

First Reading: 15-08-2013

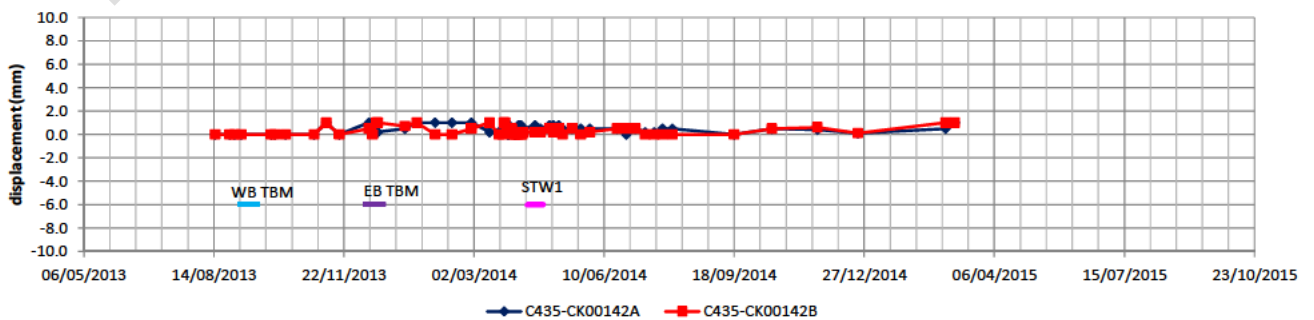
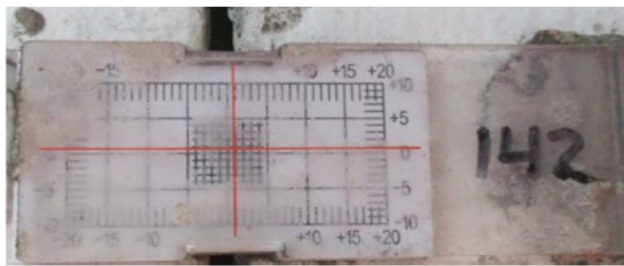
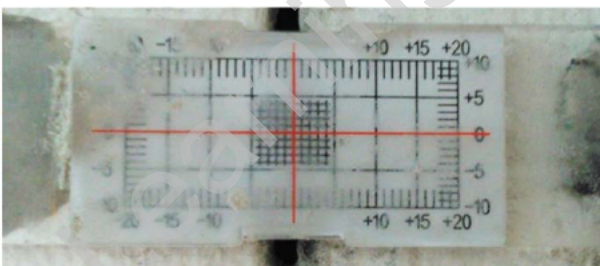
Last Reading: 06-03-2015



C435-CK00142

First Reading: 15-08-2013

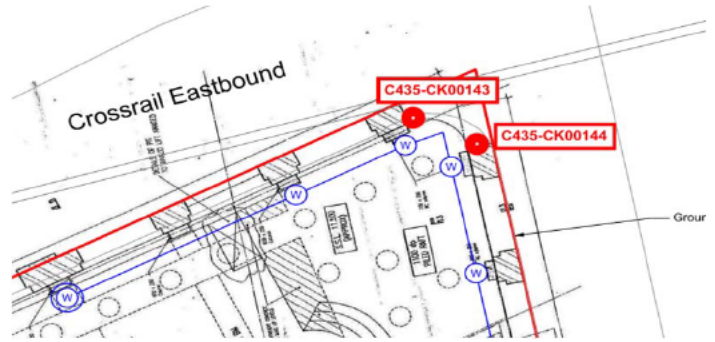
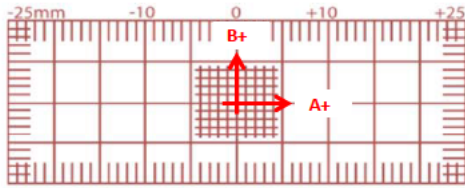
Last Reading: 06-03-2015



Remarks:

15-8-2013: Tell-tales installed.

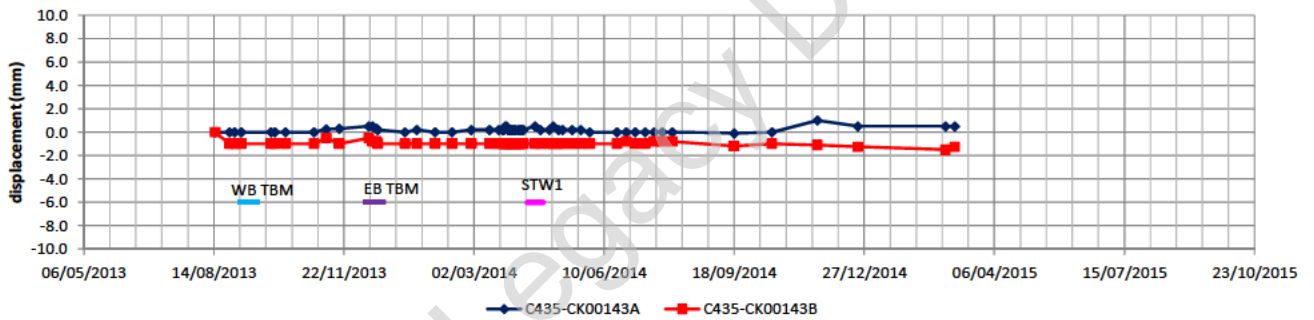
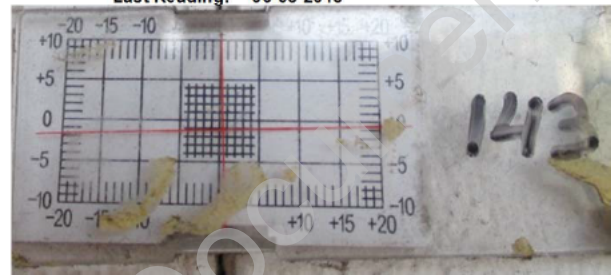
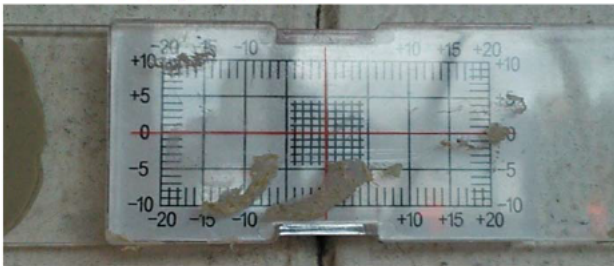
REPORT: Manual Crack monitor
AREA: 25-27 Farringdon Road
DEVICE: Calibrated Tell-Tales.



C435-CK00143

First Reading: 15-08-2013

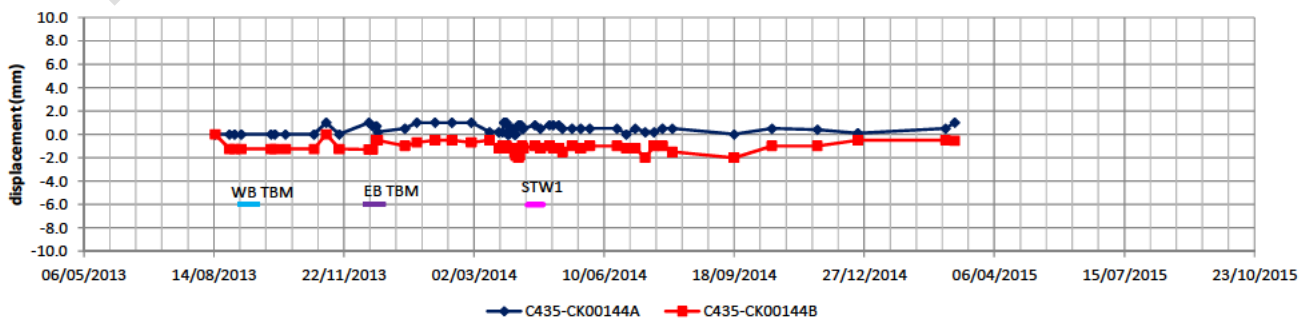
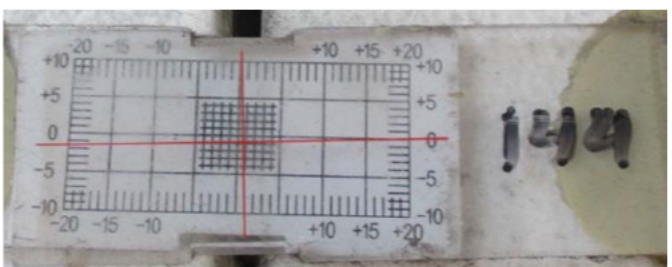
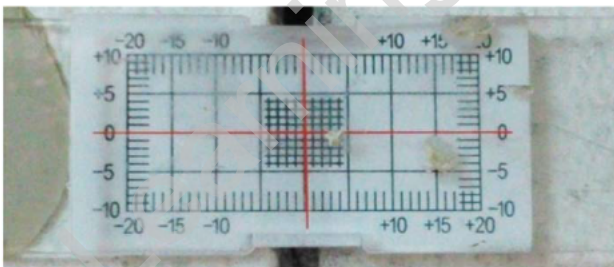
Last Reading: 06-03-2015



C435-CK00144

First Reading: 15-08-2013

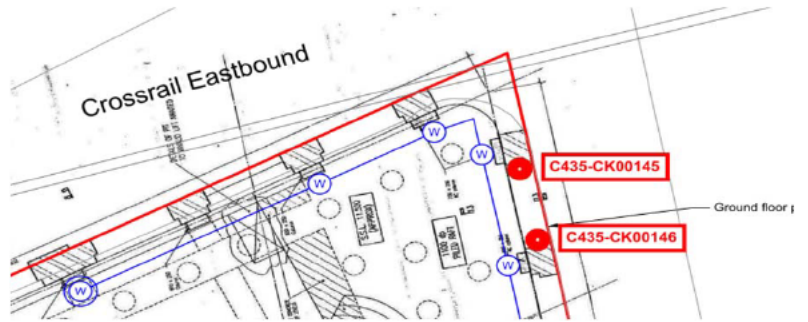
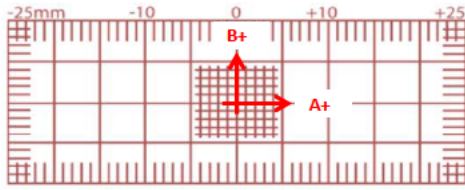
Last Reading: 06-03-2015



Remarks:

15-8-2013: Tell-tales installed.

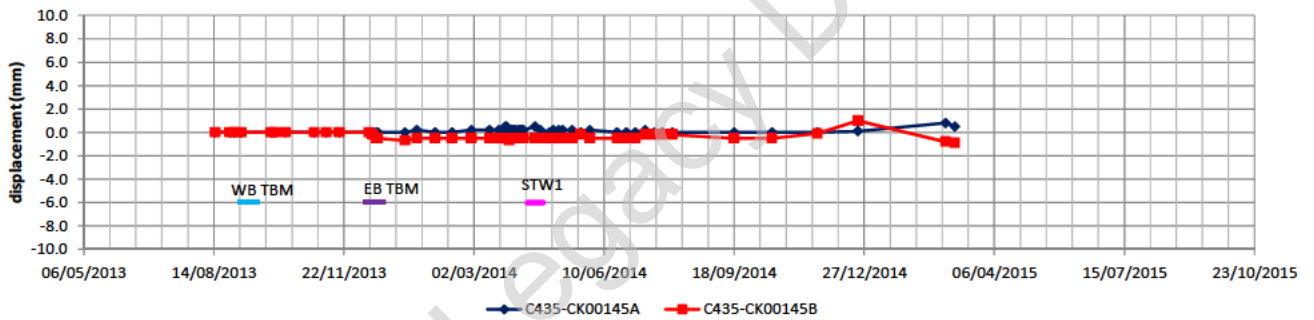
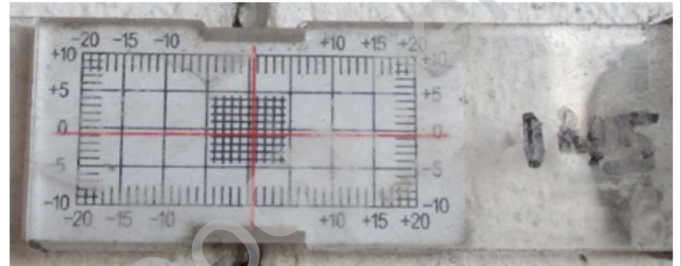
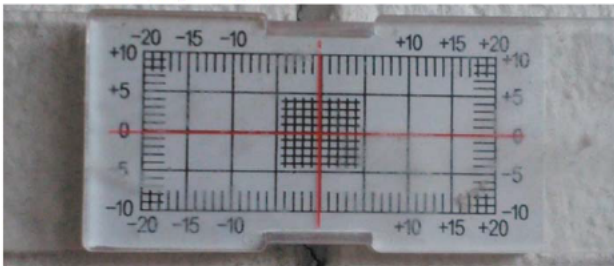
REPORT: Manual Crack monitor
AREA: 25-27 Farringdon Road
DEVICE: Calibrated Tell-Tales.



C435-CK00145

First Reading: 15-08-2013

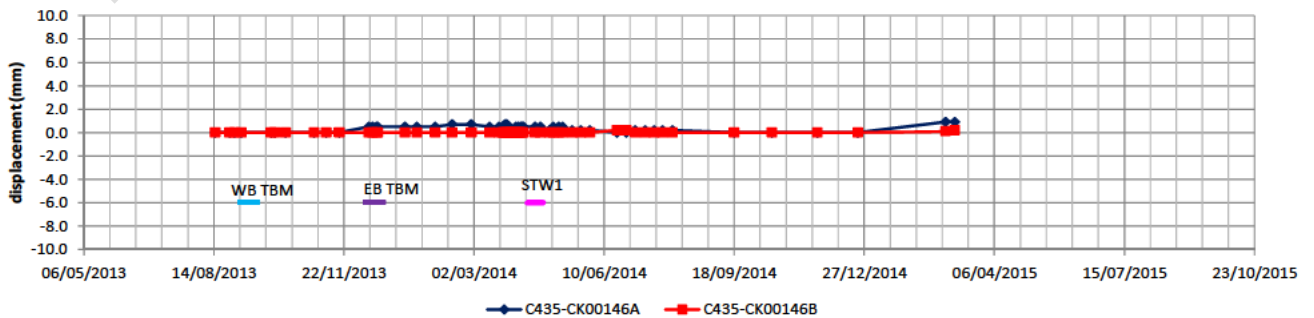
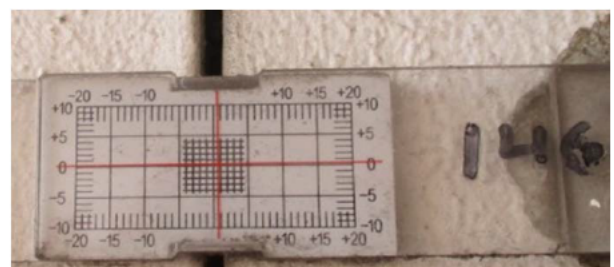
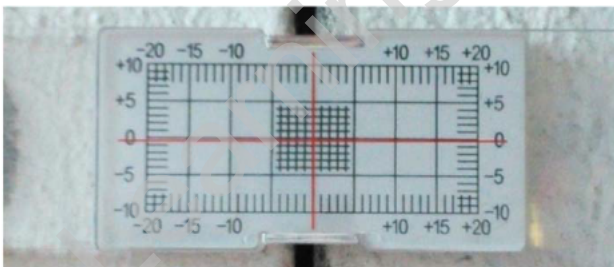
Last Reading: 06-03-2015



C435-CK00146

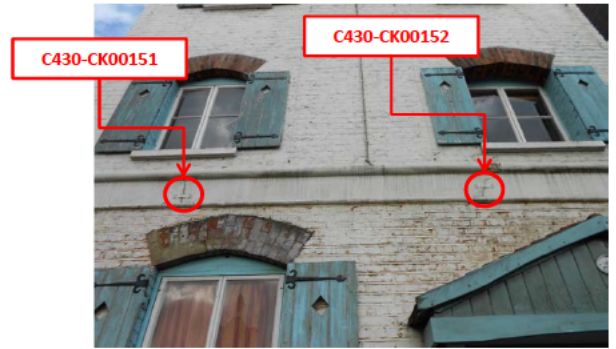
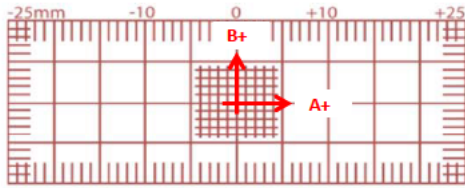
First Reading: 15-08-2013

Last Reading: 06-03-2015



Remarks:
 15-8-2013: Tell-tales installed.

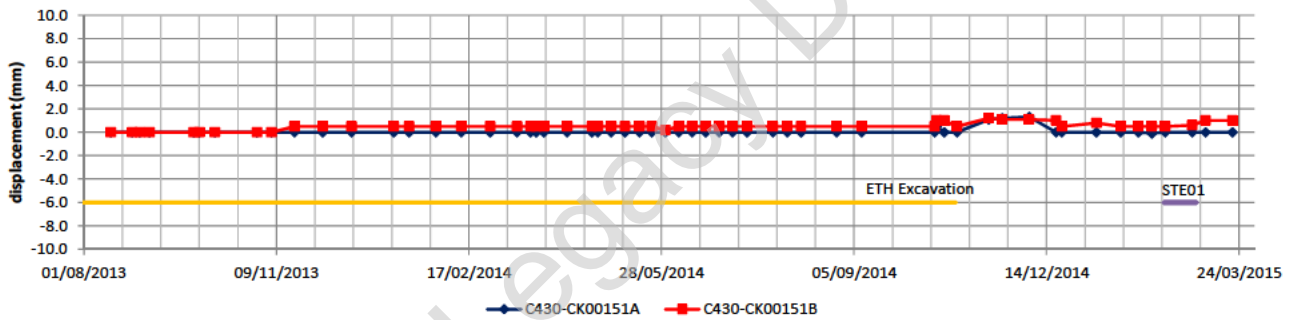
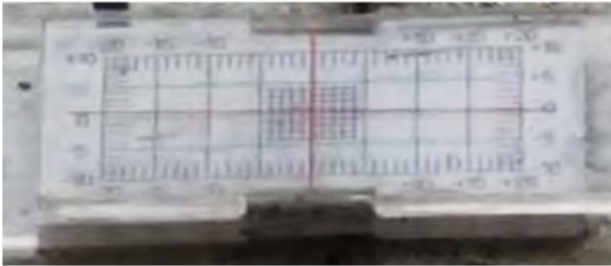
REPORT: Manual Crack monitor
AREA: 2-3 Hayne Street.
DEVICE: Calibrated Tell-Tales.



C430-CK00151

First Reading (C430): 08-08-2012

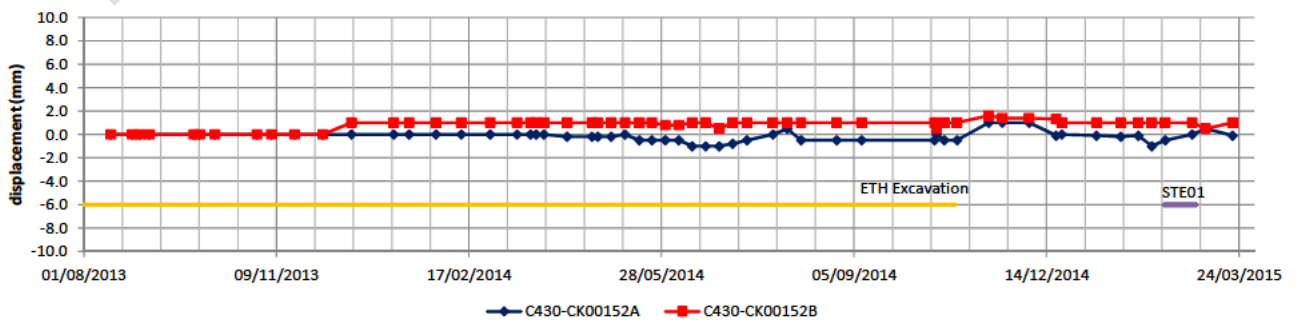
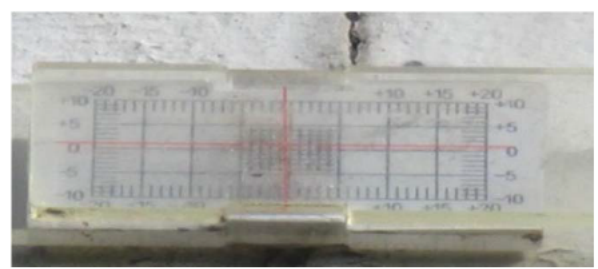
Last Reading: 20-03-2015



C430-CK00152

First Reading (C430): 08-08-2012

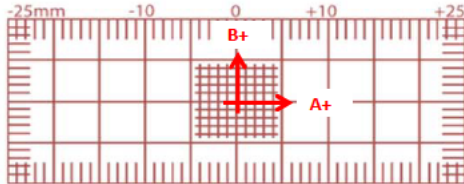
Last Reading: 20-03-2015



Remarks:

08-08-2012: Tell-tales installed by C430.

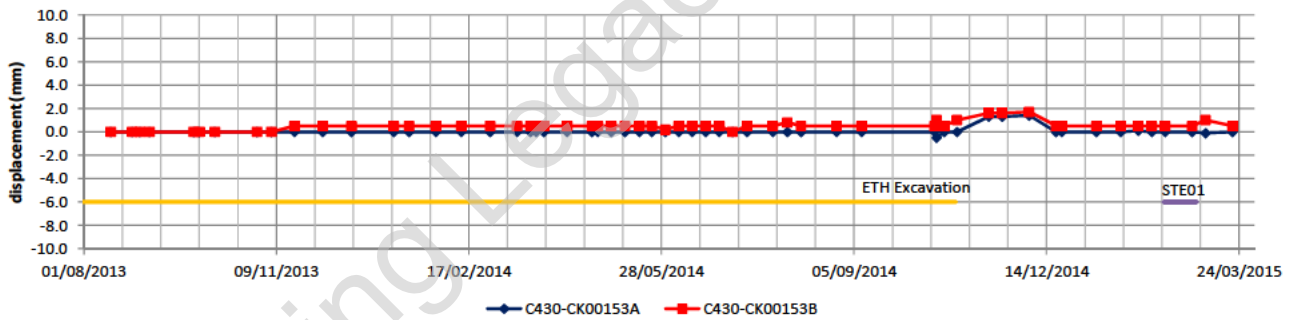
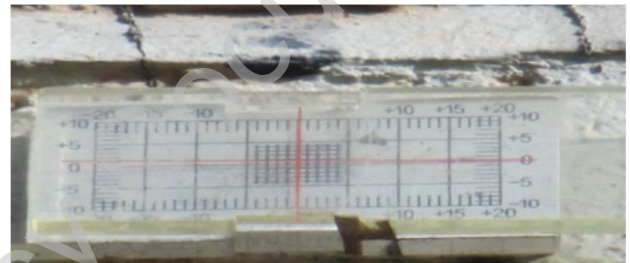
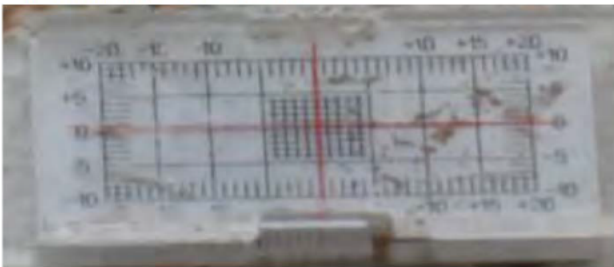
REPORT: Manual Crack monitor
AREA: 2-3 Hayne Street.
DEVICE: Calibrated Tell-Tales.



C430-CK00153

First Reading (C430): 08-08-2012

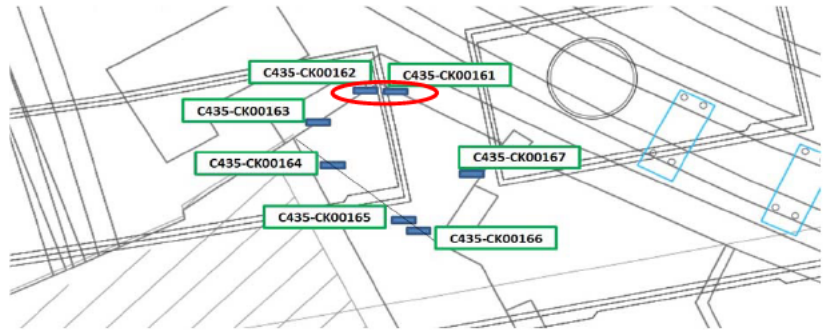
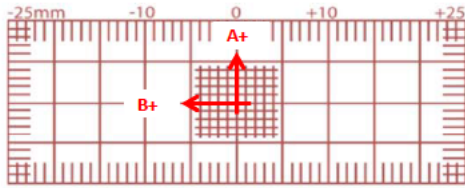
Last Reading: 20-03-2015



Remarks:

08-08-2012: Tell-tales installed by C430.

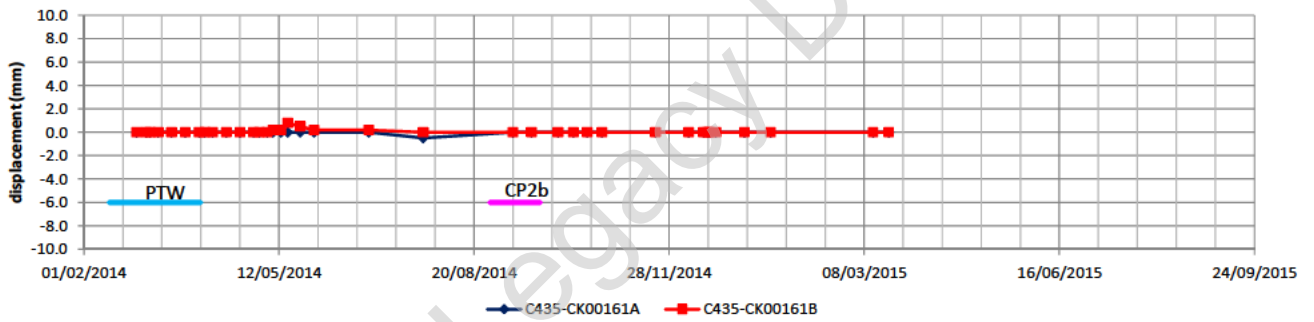
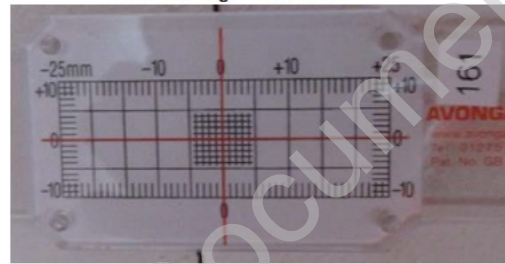
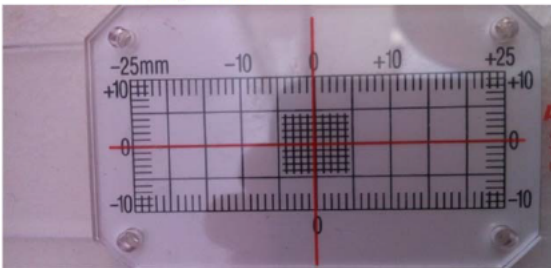
REPORT: Manual Crack monitor
AREA: 55 Charterhouse Street
DEVICE: Calibrated Tell-Tales.



C435-CK00161

First Reading: 28-02-2014

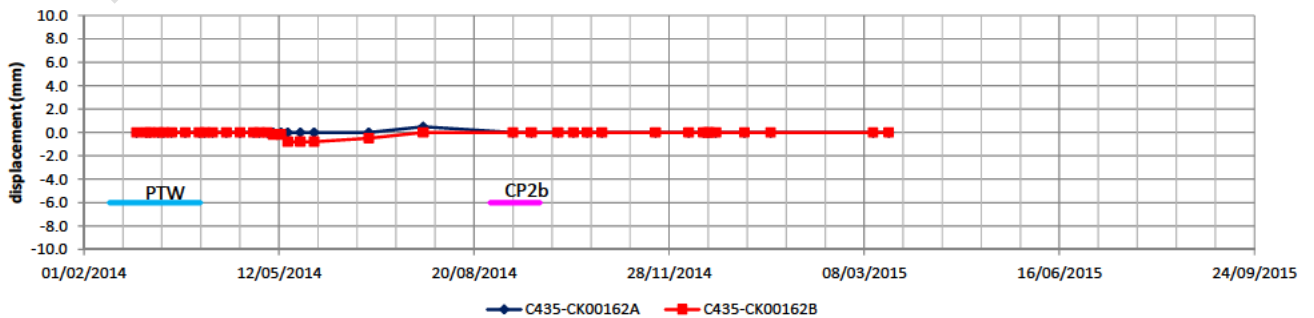
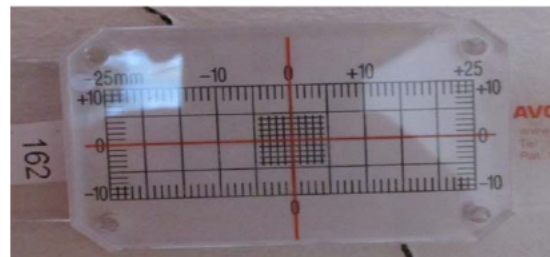
Last Reading: 12-03-2015



C435-CK00162

First Reading: 28-02-2014

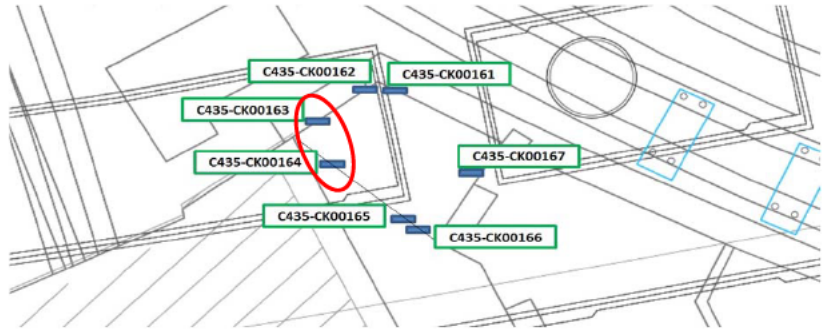
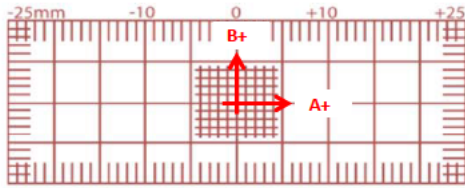
Last Reading: 12-03-2015



Remarks:

28-2-2014: These Crackmeters have been installed in vertical position.

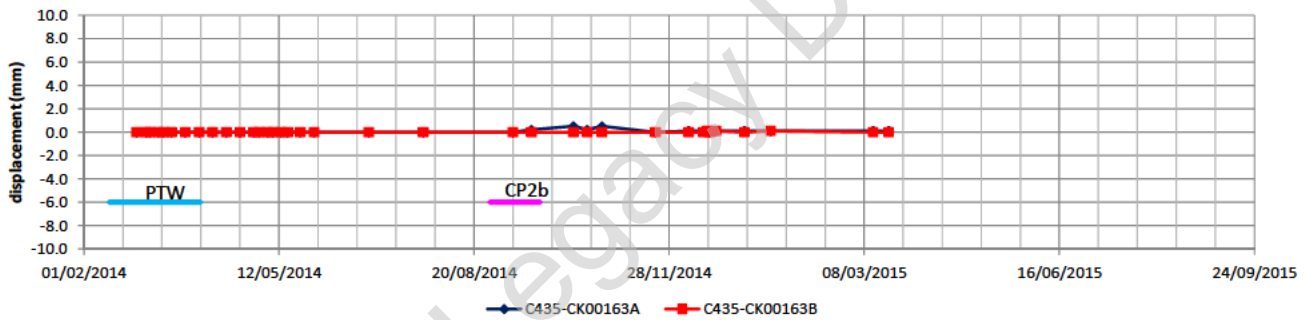
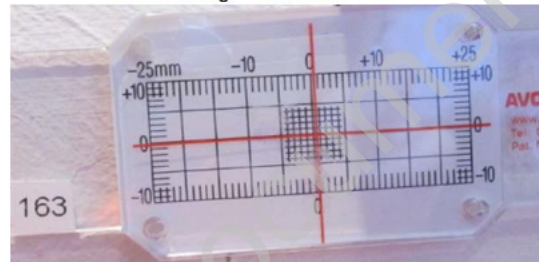
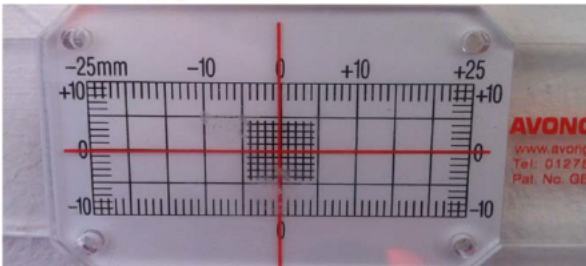
REPORT: Manual Crack monitor
AREA: 55 Charterhouse Street
DEVICE: Calibrated Tell-Tales.



C435-CK00163

First Reading: 28-02-2014

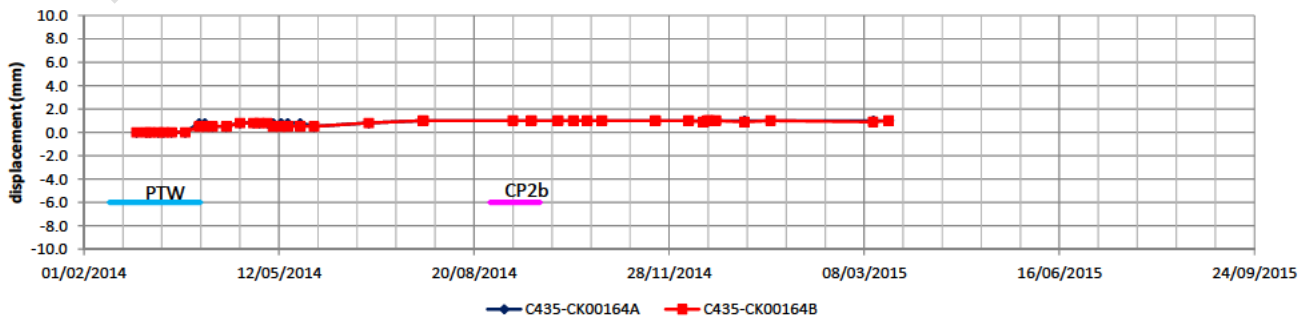
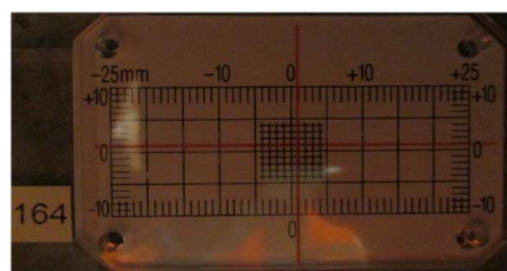
Last Reading: 12-03-2015



C435-CK00164

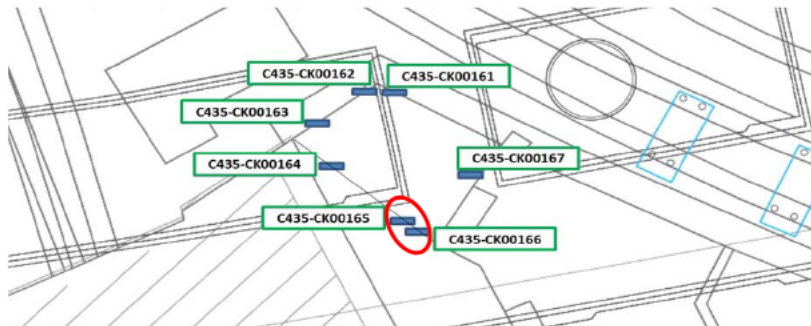
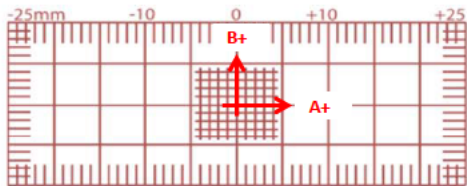
First Reading: 28-02-2014

Last Reading: 12-03-2015



Remarks:

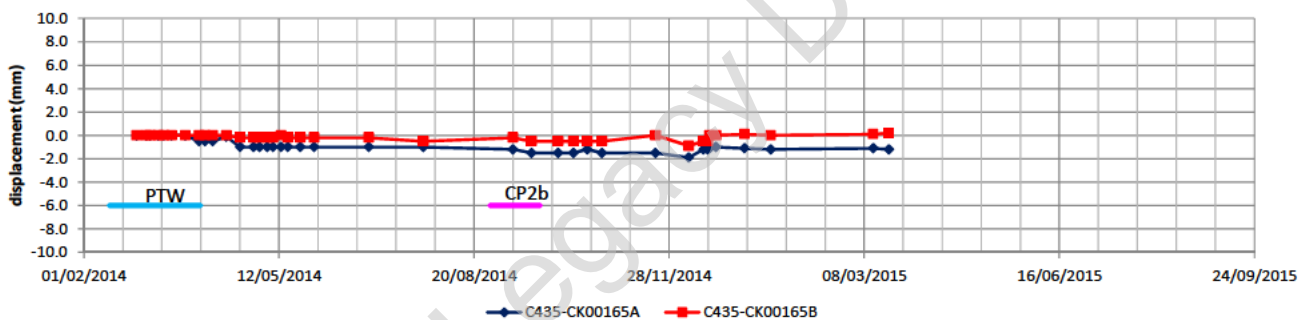
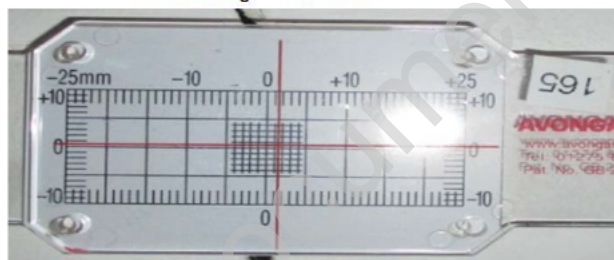
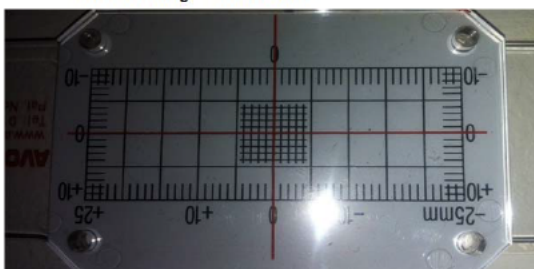
REPORT: Manual Crack monitor
AREA: 55 Charterhouse Street
DEVICE: Calibrated Tell-Tales.



C435-CK00165

First Reading: 28-02-2014

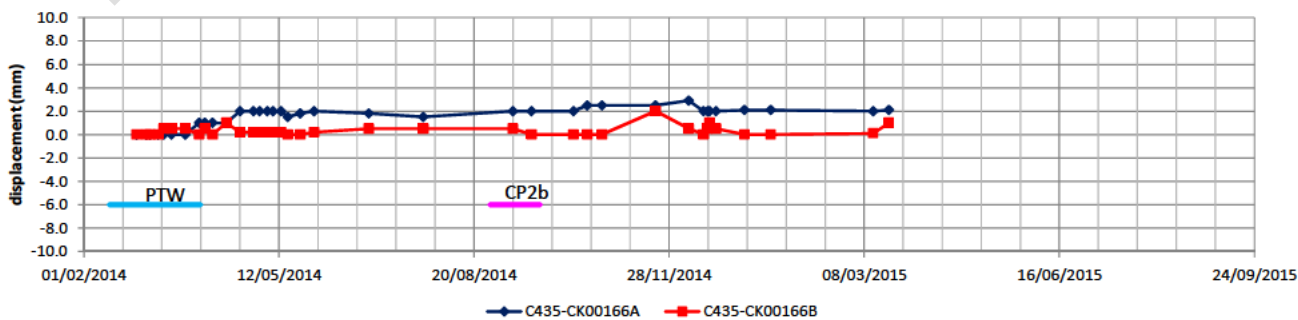
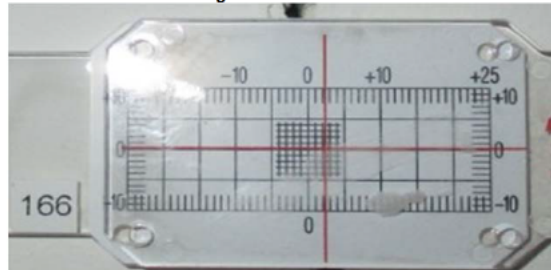
Last Reading: 12-03-2015



C435-CK00166

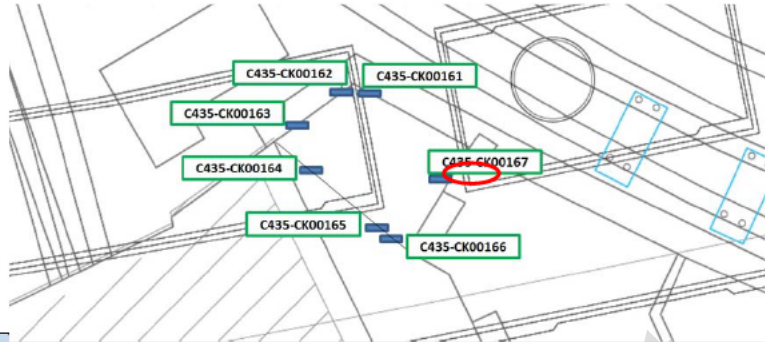
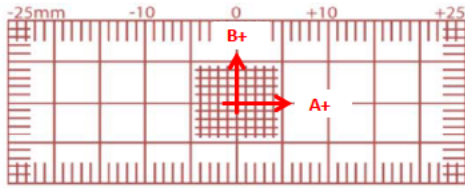
First Reading: 28-02-2014

Last Reading: 12-03-2015



Remarks:

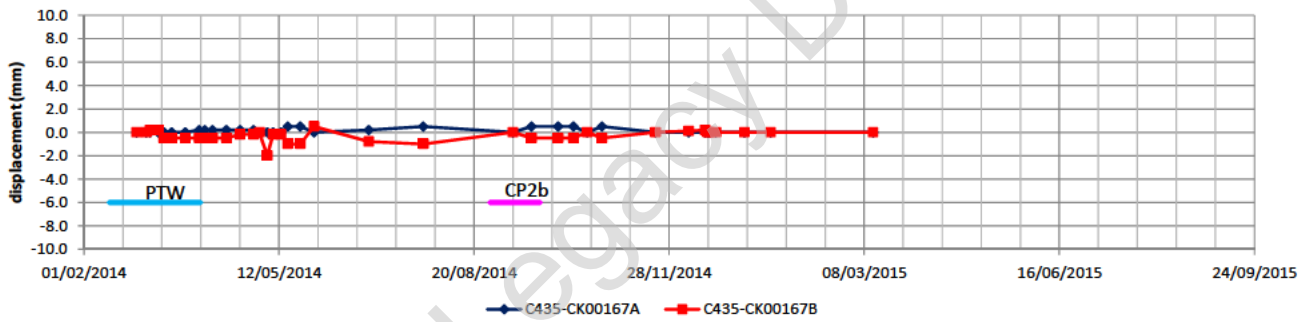
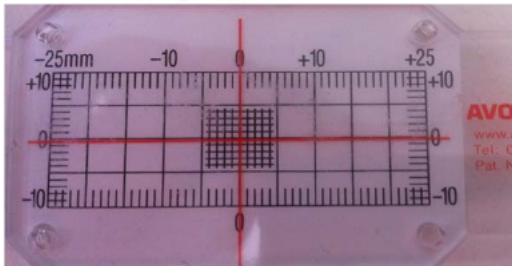
REPORT: Manual Crack monitor
AREA: 55 Charterhouse Street
DEVICE: Calibrated Tell-Tales.



C435-CK00167

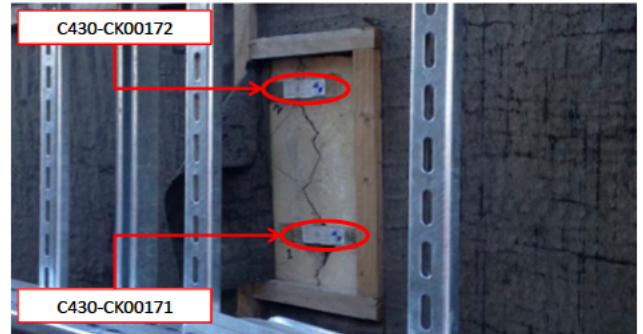
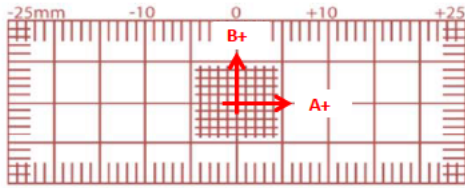
First Reading: 28-02-2014

Last Reading: 12-03-2015



Remarks:

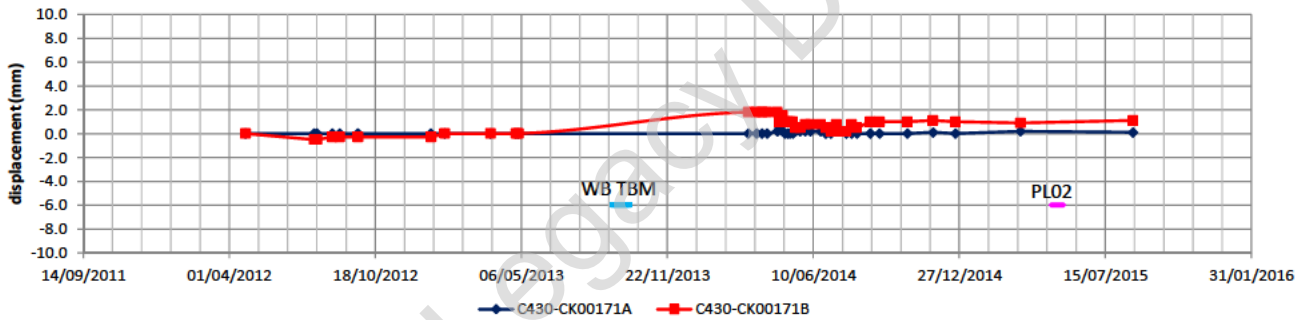
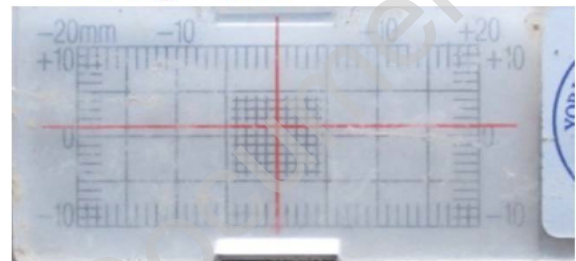
REPORT: Manual Crack monitor
AREA: 57 Charterhouse St
DEVICE: Calibrated Tell-Tales.



C430-CK00171

First Reading (C430): 23-04-2012

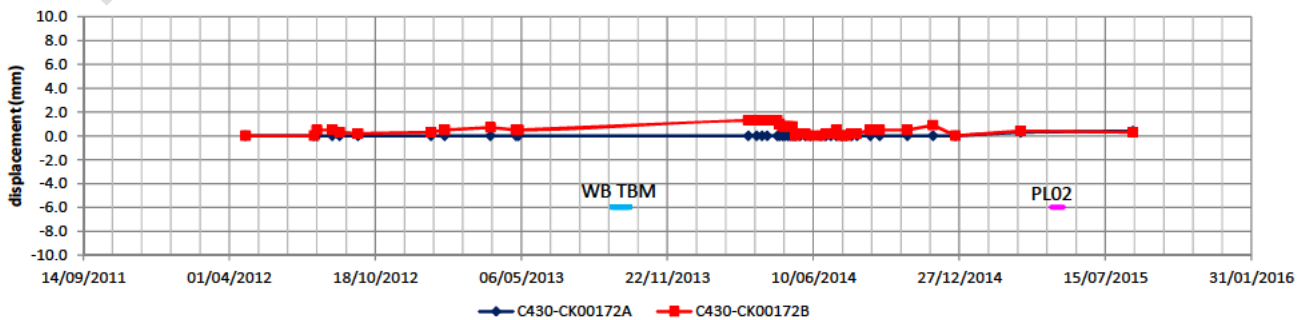
Last Reading: 21-08-2015



C430-CK00172

First Reading (C430): 23-04-2012

Last Reading: 21-08-2015



Remarks:

23-04-2012: Tell-tales installed by C430.
 02-05-2013: Handover exercises from C430 to C435

APPENDIX C: GLOSSARY

1- ATS	Automatic Total Station.
2- ETH	Eastern Ticket Hall.
3- WB	Westbound.
4- TBM	Tunnel Boring Machine.
5- EB	Eastbound.
6- PTW	Platform Tunnel West.
7- PTE	Platform Tunnel East
8- CP	Cross Passage.
9- CH	Concourse Hall.
10- VA	Ventilation Adit.
11- STE	Stub Tunnel East
12- STW	Stub Tunnel West.
13- RTE	Running Tunnel East.
14- ES	Escalator Shaft.
15- TAM	Tube a Manchette.
16- PL	Platform Link.

Learning Legacy Document