Dunedin City Council

DCC LANDSLIDE MONITORING REPORT

11 FEBRUARY 2025

CONFIDENTIAL

DCC LANDSLIDE MONITORING REPORT

Dunedin City Council

WSP
Dunedin
197 Rattray Street
Dunedin 9016
New Zealand
+64 3 471 5500
wsp.com/

REV	DATE	DETAILS
1	13/12/2024	WIP
2	16/12/2024	Draft for review
4	11/02/2025	Final

	NAME	DATE	SIGNATURE
Prepared by:	Caitlin Hall and Ben Winmill	11/02/2025	
Reviewed by:	Latasha Templeton	11/02/2025	
Approved by:	Kevin Wood	12/02/2025	

WSP
Dunedin
197 Rattray Street
Dunedin 9016
New Zealand
+64 3 471 5500
wsp.com/

DISCLAIMER AND LIMITATIONS

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1 INTRODUCTION

WSP New Zealand Limited (WSP) have been commissioned by Dunedin City Council (DCC) to undertake monitoring of 10 landslide sites around Dunedin. The following locations are the 10 landslide sites, which will be referred to as 'the sites' in this report;

1. Puketeraki
2. Greenacres Street
3. Howard Street
4. Brighton Road
5. Church Hill Road
6. Brockville Road
7. Dickson Street
8. West Abbotsford
9. Albany Street
10. Sidey Street

Previously, Motu Street and Cargill Street landslides were included; however, due to project constraints, they were excluded from this years' monitoring round. The purpose of this annual monitoring is to identify the trend and magnitude of movements and provide recommendations for future monitoring. Please note that these results are based on information gathered during the monitoring rounds and are compared to the year that the survey for that particular site began, which will have an influence on the data reported (i.e. monitoring started in 2021 compared to 1998).

This report presents a summary of the observed outcomes from the factual survey conducted at various sites in 2024, along with recommendations for future monitoring and reporting.

2 SURVEY MONITORING

2.1 MONITORING HISTORY

Survey monitoring of each site has been undertaken at various intervals since the respective base surveys (i.e., the year that the monitoring began). The surveys are typically carried out on a yearly or biennial basis, the frequency is dependent on the recent rates of movement. Historically, some sites of increased instability have been surveyed on a more frequent basis, particularly following major storm events or increased ground movement.

In previous years, the total number of sites surveyed was 12. Based on priority and criticality, 9 sites were surveyed in 2023, and 10 for 2024's survey iteration.

2.2 SURVEY EQUIPMENT

All the sites monitored in 2024, except Albany Street, utilised Global Navigation Satellite System (GNSS) observations collected using a variety of methods (i.e., a combination of static and post-processed kinematic observations). The Albany Street site is monitored using a total station to observe a closed loop traverse network around the George Street-Pitt Street-Queen Street-Albany Street block.

2.3 SURVEY METHODOLOGY

The quality and redundancy of survey measurements made in the field has been improved at selected sites in the 2024 round of landslide monitoring surveys. While we continue seeking to improve both survey field methodologies and office processing procedures, our approach to each site remains as consistent as possible to ensure that the data collected is comparable between years.

The most notable change in 2024 was to the office processing methodology, with the incorporation of GNSS data from the Continuously Operating Reference Station (CORS) GSMG, located in Mosgiel.

Data collected at GSMG increases the number of measurements included in our networks, increasing the redundancy (the number of measurements above the minimum required to compute coordinates) of the network adjustment. The inclusion of GSMG has positively impacted some sites, with improvements to the vertical accuracy of the survey observed. At most other sites that have incorporated data from GSMG, a negligible impact on survey results has been observed.

2.4 SURVEY ACCURACIES

The survey processing in 2024 has incorporated GNSS data from the CORS GSMG, as mentioned in Section 2.3 above. This improvement to the survey methodology for the Brighton Road Landslide, the Church Hill Road Landslide and the West Abbotsford Landslide has enabled the inclusion of additional measurements to these survey networks. The accuracy of the West Abbotsford survey remains consistent with 2023's results. The vertical accuracy of the Brighton Road and Church Hill

Road surveys has improved. The reported survey accuracies at each site, for the previous survey as well as the 2024 survey, are presented in Table 2-1 below.

Table 2-1: Reported Survey Accuracies for previous surveys and 2023 surveys.

Site	2023	2024
Puketeraki	H ±15 mm V ±30 mm	H ±15 mm V ±30 mm
Greenacres St	H ±10 mm V ±15 mm	H ±10 mm V ±15 mm
Howard St	H ±15 mm V ±25 mm	H ±15 mm V ±25 mm
Brighton Rd	H ±15 mm V ±25 mm	H ±15 mm V ±20 mm
Church Hill Rd	H ±15 mm V ±20 mm	H ±15 mm V ±15 mm
Brockville Rd	H ±10 mm V ±15 mm	H ±10 mm V ±15 mm
Dickson St	H ±15 mm V ±25 mm	H ±15 mm V ±25 mm
West Abbotsford	H ±10 mm V ±20 mm	H ±10 mm V ±20 mm
Albany St	H ±10 mm V ±10 mm	H ±10 mm V ±10 mm
Sidey St	Not surveyed in 2023	H ±5 mm V ±2 mm

3 LANDSLIDE TYPES

Providing the landslide types[1] can inform the rate of movement and allude to the plane of weakness, or failure surface(s), between the overlying material that is in motion and the underlying material. The following table outlines the types of landslide movements observed during the survey and their corresponding underlying geological conditions. Understanding the relationship between movement types and geology is crucial for assessing the stability of the slope and anticipating future behaviour.

In order to provide a background into interpreting the survey results, a summary of the landslide types have been incorporated in Table 3-1 below. Data has been derived from GNS Geology Webmap portal and Otago Regional Council's Hazard Database[2].

Table 3-1: Surveyed sites and the respective landslide types and underlying geology

Site name	Landslide movement type[3]	Dominant underlying Geology[4]
Puketeraki	Complex	Otakou Group sandstone and limestone
Greenacres St	Earthflow, mass movement	Dunedin Volcanic Group first main phase extrusives and pyroclastics
Howard St	Complex	Dunedin Volcanic Group first and second main phase extrusives
Brighton Rd	Complex	Onekara Group sandstone and siltstone
Church Hill Rd	Complex, flow	Otakou Group sandstone
Brockville Rd	Complex	Otakou Group sandstone
Dickson St	Complex	Dunedin Volcanic Group first main phase extrusives and pyroclastics
West Abbotsford	Complex, translational	Onekara Group sandstone and siltstone
Albany St	Flow	Dunedin Volcanic Group second main phase extrusives
Cargill St	Translational slide	Dunedin Volcanic Group second main phase extrusives
Motu St	Unknown	Dunedin Volcanic Group first main phase extrusives
Sidey St	Complex	Otakou Group sandstone and Dunedin Volcanic Group first main phase extrusives

[1] MS-144-Landslide-Planning-Guidance_2024-UPDATE
[2] Otago Natural Hazards Portal
[3] Otago Natural Hazards Portal
[4] Geology 2.0.0

4 MONITORING RESULTS

4.1 MONITORING DISPLACEMENTS SINCE PREVIOUS SURVEY

A summary of the maximum and average vertical and horizontal displacements since the previous survey are presented in Table 4-1. Refer to Appendix A for vector displacement plans, Appendix B for factual survey data results and Appendix C for vertical and horizontal movement graphs.

This data highlights the extent of terrain movement, with maximum vertical displacements reaching and horizontal displacements for each surveyed site. Average displacements are provided to show an overview of general trends.

Notable observations when comparing 2023 survey data to 2024 survey data are:

- Increase in horizontal movement for Puketeraki
- Increase in horizontal movement for Greenacres St, and decrease in vertical movement
- Decrease in vertical movement for Brockville Rd
- Decrease in vertical and horizontal for Dickson St

Table 4-1: Displacements since previous survey

Site name	Vertical Movement (mm)		Horizontal Movement (mm)		Date of Latest Survey
	Max	Ave	Max	Ave	
Puketeraki	54	18	293	208	09/12/2024
Greenacres St	14	2	72	5	08/11/2024
Howard St	23	13	27	10	14/11/2024
Brighton Rd	15	5	14	6	11/10/2024
Church Hill Rd	8	4	12	7	30/09/2024
Brockville Rd	19	9	17	12	16/09/2024
Dickson St	9	3	10	5	11/11/2024
West Abbotsford	10	5	11	6	09/09/2024
Albany St	7	1	9	6	13/11/2024
Sidey St	5	4	8	4	25/09/2024

4.2 MONITORING DISPLACEMENT SINCE BASE SURVEY

Survey monitoring of displacement since the base survey provides an opportunity to compare with prior results and identify slope movement patterns or structural shifts of the site.

It should be noted that some sites (e.g. Puketeraki) have a large dataset over a long period of time, whereas others (e.g. West Abbotsford) have only a select amount of data to compare to base surveys. It is important to take into account both the date range of the collected survey data and the intervals at which the data has been collected when viewing this data.

A summary of the maximum and average vertical and horizontal displacements since the base survey has been presented below in Table 4-2.

Table 4-2: Displacements Since Base Survey

Site name	Vertical Movement (mm)		Horizontal Movement (mm)		Date of Base Survey
	Max	Ave	Max	Ave	
Puketeraki	1089	332	4321	2462	1992
Greenacres St	697	427	1719	1145	Jul-15
Howard St	54	46	245	92	1998
Brighton Rd	433	60	1311	264	1998
Church Hill Rd	253	79	600	303	1997
Brockville Rd	41	11	14	8	Jul-20
Dickson St	53	17	59	17	1997
West Abbotsford	6	1	10	5	Jun-21
Albany St	42	19	40	27	2008, Re-established in 2010
Sidey St	12	5	10	4	1997, Re-established in 2010

5 RAINFALL DATA

A summary of the rainfall data since the initial 2020 survey is presented in Figure 5-1. The rainfall data was retrieved from the NIWA (National Institute of Water and Atmospheric Research) National Climate Database website[5] using the Musselburgh Station (Agent ID #15752). Mean monthly rainfall was calculated for the Musselburgh Station using data between 1997 and November 2023. A change in licensing for NIWA's Cliflo meant this year's (2024) annual rainfall data was obtained via the ORC's Data portal[6], using the Station ID Pine Hill.

A significant rainfall event during July 2022 is evident in Figure 5-1 whereby 234 mm was recorded in the calendar month. March 2023 had the highest monthly rainfall of 105.8 mm, however there were no significant rainfall events in 2023. October 2024 recorded the highest monthly rainfall event for 2024, with 198 mm of rainfall recorded over the month.

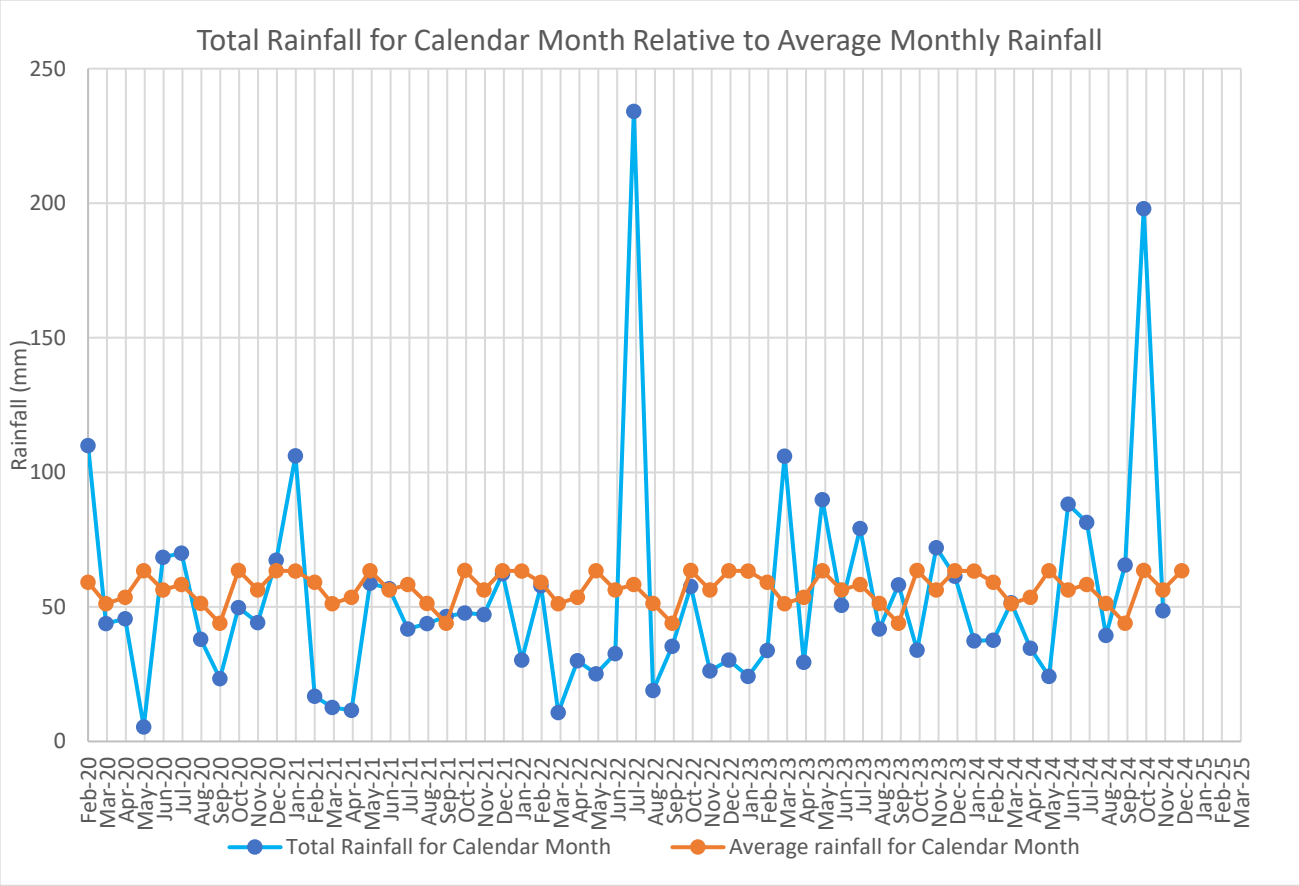

Figure 5-1 Measured monthly rainfall compared with average monthly rainfall (CliFlo.niwa.co.nz).

[5] https://cliflo.niwa.co.nz/

[6] ORC's Data portal ID Pine Hill

6 RECOMMENDATIONS

Although most sites surveyed this year have reported measurements less than survey accuracy when compared to the previous survey, care should be taken when interpreting these results. Landslide movement is difficult to determine without real-time constant monitoring, and as majority of the landslides surveyed are complex landslides (meaning two or more types of landslide movement at that site).

A summary of each site and its monitoring displacement are summarized in Table 6-1, with recommendations for each site summarized in Table 6-2 below.

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Table 6-1: Summary of monitoring displacement for each site

Site name	Summary of information
Puketeraki	Maximum displacement since base survey: 1089 mm vertical, 4321 mm horizontal. The average rate of horizontal movement has continued to increase (123 mm in 2023 compared to 293 mm in 2024). The landslide appears to have moved horizontally since the monitoring began. An increase in the average vertical deformations have exceeded the accepted survey accuracy this year. It should be noted this landslide was surveyed following the October 2024 Otago Rainfall event. Consequence of damage to the services, roads and utilities present in the vicinity of the landslip, should continue to be monitored for damage.
Greenacres Street	Maximum horizontal displacement since previous survey: 72 mm, slightly increased from the previous report. Vertical deformation remains less than survey accuracy. It should be noted this landslide was surveyed following the October 2024 Otago Rainfall event. Consequence is damage to residential dwellings and farmland.
Howard Street	Maximum displacement since base survey: 54 mm vertical, 245 mm horizontal. Minor vertical movement since previous survey, with a maximum horizontal movement of 27 mm. Average vertical and horizontal movements are both less than accepted survey accuracy. Continued movement of landslide towards harbour since base survey. Consequence is damage to residential dwellings.
Brighton Road	Maximum displacement since base survey: 433 mm vertical, 1311 mm horizontal. Average horizontal and vertical movements less than the accepted survey accuracy since previous survey. Semi-rural location of slip, with consequence of damage to residential dwellings.
Church Hill Road	600 mm maximum horizontal and 23 mm vertical deformation since the base survey. Measurements since the previous survey are less than the accepted survey accuracy of 15 mm (Hz and Vt).
Brockville Road	Horizontal and vertical deformation has increased since previous survey. Maximum displacement since base survey: 42 mm vertical, 14 mm horizontal. Average horizontal and vertical movements less than accepted survey accuracy. Consequence of damage to residential dwellings and a school.

Dickson Street	Maximum displacement since base survey: 53 mm vertical, 59 mm horizontal. Minimal/negligible displacements since previous survey. Positive vertical deformation is being reported which is atypical for landslides.
West Abbotsford	Maximum displacement since base survey: 10 mm vertical, 13 mm horizontal. Minimal/negligible maximum movements since previous survey (<10 mm vertical, <10 mm horizontal). Both average and maximum movements are less than accepted survey accuracy.
Albany Street	Maximum displacement since base survey: 42 mm vertical, 40 mm horizontal. Displacements since previous survey have been minimal (<10 mm maximum vertical and horizontal). 3 survey marks were removed due to the George St upgrades, will be reinstalled.
Sidey Street	Displacements since previous survey have been minimal (<10 mm maximum vertical and horizontal). Pavement failure noted previously in uphill area (marks 6-8) is worsening, kerb breaking into road at Nail 6. Nail 2 mark destroyed. Survey accuracy improved.

Table 6-2: Recommendations for each site

Reporting Level	Minimum Criteria	Sites[1]	Recommendations
1	Sites with displacements greater than the survey accuracy since previous survey.	• Puketeraki • Greenacres St	Site walkover, UAV survey, and a site-specific report every 2 years for Puketeraki and every 5 years for Greenacres St. Continued survey monitoring.
2	Sites with average displacements greater than the survey accuracy since base survey	• Howard St • Brighton Rd • Brockville Rd	Site walkover and high-level assessment of observable deformation. Brief description of observations and discussion of the survey network to be presented in a combined report. Continued survey monitoring.
3	Sites with negligible/no displacements	• Church Hill Rd • Dickson St • West Abbotsford • Sidey St • Albany St • Motu Street • Cargill Street	Continued survey monitoring and/or visual monitoring.

[1] Presented in descending order of criticality

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APPENDICES

Appendix A: Monitoring Displacement Vector Plans

Appendix B: Factual Survey Data

Appendix C: Vertical and Horizontal Cumulative Movement Graphs

Appendix A
Monitoring Displacement Vector Plans

LEGEND

LANDSLIDE - OTAGO REGION (CERTAINTY)

- DEFINITE
- LIKELY
- POSSIBLE
- NOT ASSESSED
- NO INFORMATION

INDICATIVE LANDSLIDE EXTENTS ARE BASED ON "REVISED LANDSLIDE DATABASE FOR THE COASTAL SECTOR OF THE DUNEDIN CITY DISTRICT" BY BARRELL, D.J.A., SMITH LITTLE, B., GLASSEY, P.J. GNS SCIENCE CONSULTANCY REPORT 2017/41, JULY 2017, SOURCED FROM THE OTAGO REGIONAL COUNCIL (ORC) NATURAL HAZARDS PORTAL.

OTHER

+/- Xmm = CUMULATIVE VERTICAL DISPLACEMENT SINCE THE BASE SURVEY

CUMULATIVE HORIZONTAL DISPLACEMENT SINCE THE BASE SURVEY

SURVEY MARKER

1:2000 @ A1
1:4000 @ A3
0 20 40 60 80 100 120 140 160 180 200 m

REVISION	AMENDMENT	APPROVED	DATE
A	2024 DEFORMATION MONITORING DATA	D.M.	10/12/2024

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wsp
Dunedin Office
+64 3 471 5500
Private Bag 1913
Dunedin 9016
New Zealand

CIVIL

SCALES: 1:2000 @A1, 1:4000 @A3
ORIGINAL SIZE: A1
DRAWN: J.W.
APPROVED: D.M.
DRAWING VERIFIED: C.H
APPROVED DATE: 10/12/2024

CUMULATIVE SURVEY RESULTS 2024

PROJECT
DUNEDIN CITY COUNCIL
PUKETERAKI
LONG TERM LANDSLIDE MONITORING

TITLE
CUMULATIVE LANDSLIDE DISPLACEMENT
PUKETERAKI

WSP PROJECT NO. (SUB-PROJECT): 6-CD109.55
SHEET NO.: C01
REVISION: A

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LEGEND

LANDSLIDE - OTAGO REGION (CERTAINTY)

- DEFINITE
- LIKELY
- POSSIBLE
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- NO INFORMATION

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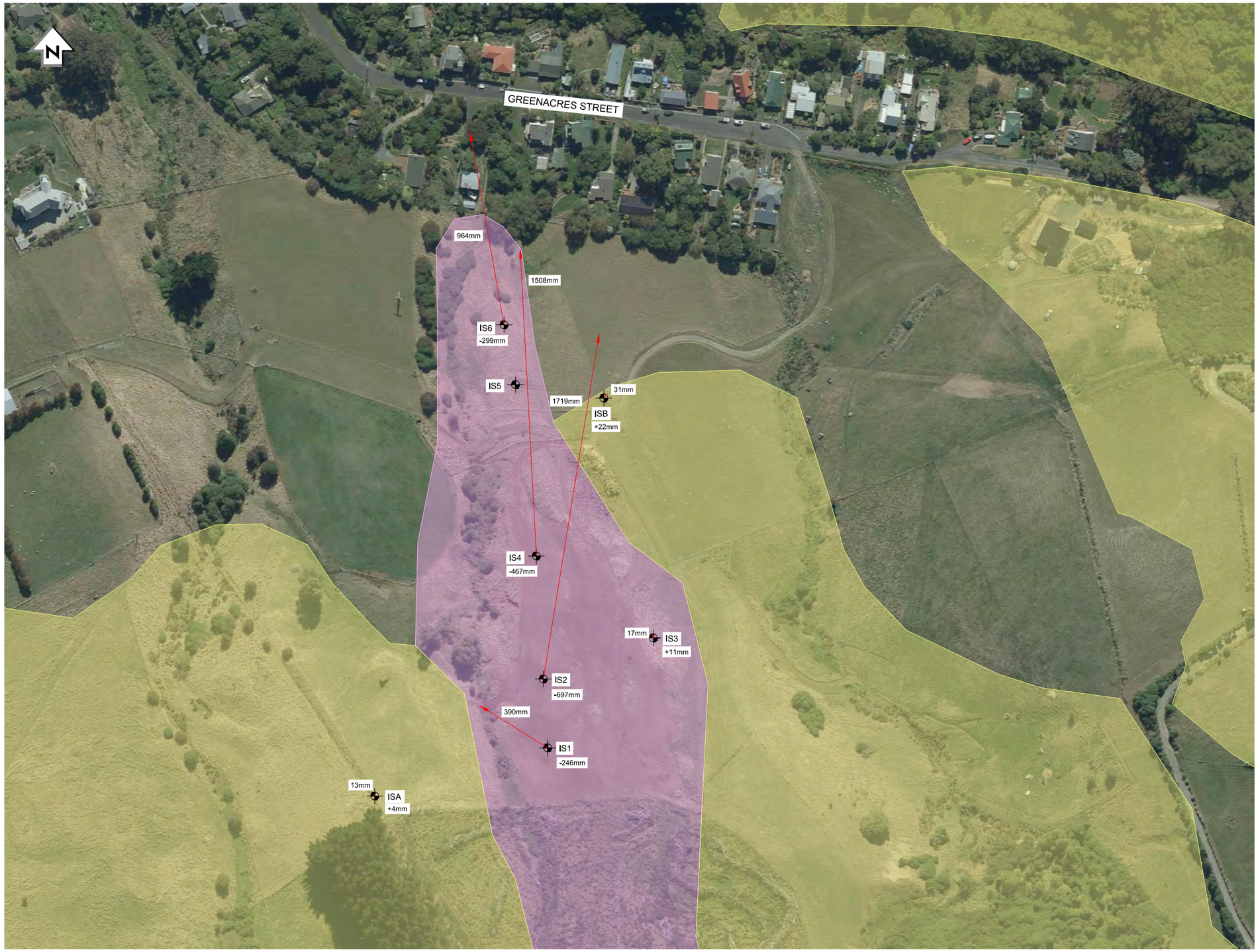
CUMULATIVE HORIZONTAL DISPLACEMENT SINCE THE BASE SURVEY

SURVEY MARKER



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1:1000 @ A1
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REVISION	AMENDMENT	APPROVED	DATE
A	2024 DEFORMATION MONITORING DATA	D.M.	10/12/2024

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Dunedin Office
+64 3 471 5500

Private Bag 1913
Dunedin 9016
New Zealand

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ORIGINAL SIZE: A1
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APPROVED: D.M
DRAWING VERIFIED: C.H
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CUMULATIVE SURVEY RESULTS 2024

PROJECT
DUNEDIN CITY COUNCIL
GREENACRES STREET
LONG-TERM LANDSLIDE MONITORING

TITLE
CUMULATIVE LANDSLIDE DISPLACEMENTS
GREENACRES STREET

WSP PROJECT NO.	PROJ-ORIG-VOL-LOC-TYPE	SHEET NO.	REVISION
6-CD109.55	6-CD109.55	C01	A

LEGEND

LANDSLIDE - OTAGO REGION (CERTAINTY)

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OTHER

+/- Xmm = CUMULATIVE VERTICAL DISPLACEMENT SINCE THE BASE SURVEY

CUMULATIVE HORIZONTAL DISPLACEMENT SINCE THE BASE SURVEY

SURVEY MARKER

1:2000 @ A1
1:4000 @ A3
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REVISION	AMENDMENT	APPROVED	DATE
A	2024 DEFORMATION MONITORING DATA	D.M	10/12/2024

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+64 3 471 5500

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ORIGINAL SIZE: A1
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APPROVED: D.M
DRAWING VERIFIED: C.H
APPROVED DATE: 10/12/2024

CUMULATIVE SURVEY RESULTS 2024

PROJECT
DUNEDIN CITY COUNCIL
HOWARD STREET
LONG-TERM LANDSLIDE MONITORING

TITLE
CUMULATIVE LANDSLIDE DISPLACEMENTS
HOWARD STREET

WSP PROJECT NO.	PROJ-ORIG-VOL-LOC-TYPE	SHEET NO.	REVISION
6-CD109.55	6-CD109.55	C01	A

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LEGEND

LANDSLIDE - OTAGO REGION (CERTAINTY)

- DEFINITE
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—— CUMULATIVE HORIZONTAL DISPLACEMENT SINCE THE BASE SURVEY

SURVEY MARKER

300 mm
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50
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1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

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Dunedin Office
+64 3 471 5500
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ORIGINAL SIZE: A1
DRAWN: J.W
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DRAWING VERIFIED: C.H
APPROVED DATE: 10/12/2024

CUMULATIVE SURVEY RESULTS 2024

PROJECT
DUNEDIN CITY COUNCIL
BRIGHTON ROAD
LONG-TERM LANDSLIDE MONITORING

TITLE
CUMULATIVE LANDSLIDE DISPLACEMENTS
BRIGHTON ROAD

WSP PROJECT NO.	PROJ-ORIG-VOL-LOC-TYPE	SHEET NO.	REVISION
6-CD109.55	6-CD109.55	C01	A

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CUMULATIVE HORIZONTAL DISPLACEMENT SINCE THE BASE SURVEY

SURVEY MARKER

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0 10 mm

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REVISION	AMENDMENT	APPROVED	DATE
A	2024 DEFORMATION MONITORING DATA	D.M	10/12/2024

DUNEDIN CITY COUNCIL | kaunihera a-rohe o Ōtepoti

Dunedin Office
+64 3 471 5500

Private Bag 1913
Dunedin 9016
New Zealand

CIVIL

SCALES: 1:3000 @A1, 1:6000 @A3
ORIGINAL SIZE: A1
DRAWN: J.W.
APPROVED: D.M
DRAWING VERIFIED: C.H.
APPROVED DATE: 10/12/2024

CUMULATIVE SURVEY RESULTS 2024

PROJECT
DUNEDIN CITY COUNCIL
CHURCH HILL ROAD
LONG-TERM LANDSLIDE MONITORING

TITLE
CUMULATIVE LANDSLIDE DISPLACEMENTS
CHURCH HILL ROAD

WSP PROJECT NO.	PROJ-ORIG-VOL-LOC-TYPE	SHEET NO.	REVISION
6-CD109.55	6-CD109.55	C01	A

Original sheet size A1 (841x594) Plot Date 2025-02-10 at 11:18:29 am \\corp.pbwan.net\ANZ\ProjectsNZ\6c\6-CD109.55 LTES Long-term Landslide Monitoring\Home\03_Delivery\Site Plans - DWG\6-CD109.55_Church hill.dwg Layout1

LEGEND

LANDSLIDE - OTAGO REGION (CERTAINTY)

- DEFINITE
- LIKELY
- POSSIBLE
- NOT ASSESSED
- NO INFORMATION

INDICATIVE LANDSLIDE EXTENTS ARE BASED ON "REVISED LANDSLIDE DATABASE FOR THE COASTAL SECTOR OF THE DUNEDIN CITY DISTRICT" BY BARRELL, D.J.A., SMITH LITTLE, B., GLASSEY, P.J. GNS SCIENCE CONSULTANCY REPORT 2017/41, JULY 2017, SOURCED FROM THE OTAGO REGIONAL COUNCIL (ORC) NATURAL HAZARDS PORTAL.

OTHER

+/- Xmm = CUMULATIVE VERTICAL DISPLACEMENT SINCE THE BASE SURVEY

CUMULATIVE HORIZONTAL DISPLACEMENT SINCE THE BASE SURVEY

SURVEY MARKER

1:1250 @ A1
1:2500 @ A3
0 20 40 60 80 100 120 m

REVISION	AMENDMENT	APPROVED	DATE
A	2024 DEFORMATION MONITORING DATA	D.M	10/12/2024

DUNEDIN CITY COUNCIL | kaunihera a-rohe o Ōtepoti

wsp
Dunedin Office
+64 3 471 5500
Private Bag 1913
Dunedin 9016
New Zealand

CIVIL

SCALES: 1:1250 @A1, 1:2500 @A3
ORIGINAL SIZE: A1

DRAWN	SURVEYED	APPROVED
J.W		D.M

DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
C.H		10/12/2024

CUMULATIVE SURVEY RESULTS 2024

PROJECT
DUNEDIN CITY COUNCIL
BROCKVILLE ROAD
LONG TERM LANDSLIDE MONITORING

TITLE
CUMULATIVE LANDSLIDE DISPLACEMENTS
BROCKVILLE ROAD

WSP PROJECT NO.	PROJ-ORIG-VOL-LOC-TYPE	SHEET NO.	REVISION
6-CD109.55	6-CD109.55	C01	A

Original sheet size A1 (841x594) Plot Date 2025-02-10 at 11:13:59 am \\corp.pbwan.net\ANZ\ProjectsNZ\6c\6-CD109.55 LTES Long-term Landslide Monitoring\Home\03_Delivery\Site Plans - DWG\6-CD109.55_Brockville.dwg Layout2

LEGEND

LANDSLIDE - OTAGO REGION (CERTAINTY)

- DEFINITE
- LIKELY
- POSSIBLE
- NOT ASSESSED
- NO INFORMATION

INDICATIVE LANDSLIDE EXTENTS ARE BASED ON "REVISED LANDSLIDE DATABASE FOR THE COASTAL SECTOR OF THE DUNEDIN CITY DISTRICT" BY BARRELL, D.J.A., SMITH LITTLE, B., GLASSEY, P.J. GNS SCIENCE CONSULTANCY REPORT 2017/41, JULY 2017, SOURCED FROM THE OTAGO REGIONAL COUNCIL (ORC) NATURAL HAZARDS PORTAL.

OTHER

+/- Xmm = CUMULATIVE VERTICAL DISPLACEMENT SINCE THE BASE SURVEY

CUMULATIVE HORIZONTAL DISPLACEMENT SINCE THE BASE SURVEY

SURVEY MARKER

300 mm
200
100
50
0 10 mm

1:1250 @ A1
1:2500 @ A3
0 20 40 60 80 100 120 m

REVISION	AMENDMENT	APPROVED	DATE
A	2024 DEFORMATION MONITORING DATA	D.M.	10/12/2024

DUNEDIN CITY COUNCIL | kaunihera a-rohe o Ōtepoti

wsp
Dunedin Office
+64 3 471 5500
Private Bag 1913
Dunedin 9016
New Zealand

CIVIL

SCALES: 1:1250 @A1, 1:2500 @A3
ORIGINAL SIZE: A1
DRAWN: J.W
APPROVED: D.M.
DRAWING VERIFIED: C.H
APPROVED DATE: 10/12/2024

CUMULATIVE SURVEY RESULTS 2024

PROJECT
DUNEDIN CITY COUNCIL
DICKSON STREET
LONG-TERM LANDSLIDE MONITORING

TITLE
CUMULATIVE LANDSLIDE DISPLACEMENTS
DICKSON STREET

WSP PROJECT NO.	PROJ-ORIG-VOL-LOC-TYPE	SHEET NO.	REVISION
6-CD109.55	6-CD109.55	C01	A

Original sheet size A1 (841x594) Plot Date 2025-02-10 at 11:22:49 am \\corp.pbwan.net\ANZ\ProjectsNZ\6c\6-CD109.55 LTES Long-term Landslide Monitoring\Home\03_Delivery\Site Plans - DWG\6-CD109.55_Dickson Street.dwg Layout2

LEGEND

LANDSLIDE - OTAGO REGION (CERTAINTY)

- DEFINITE
- LIKELY
- POSSIBLE
- NOT ASSESSED
- NO INFORMATION

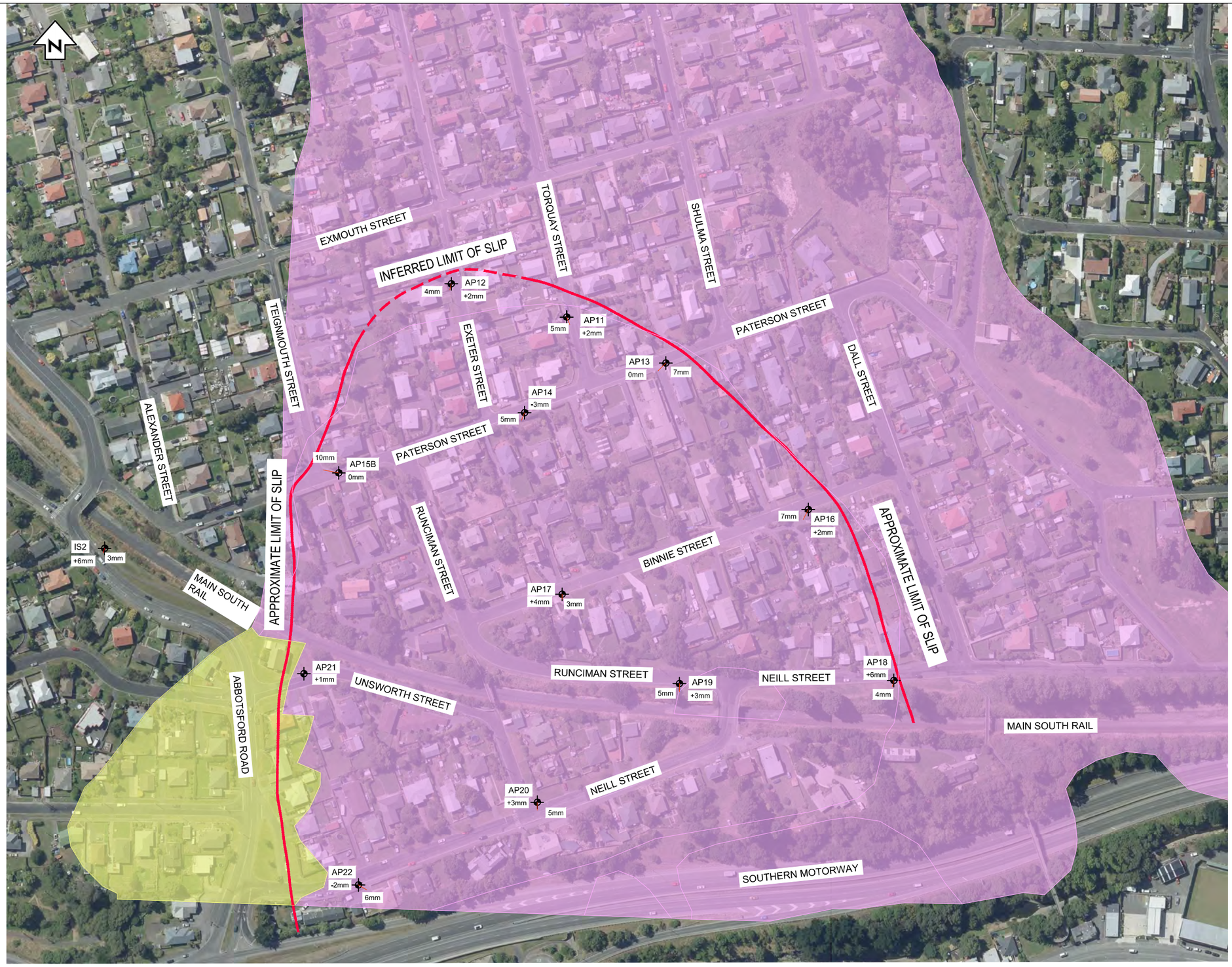
INDICATIVE LANDSLIDE EXTENTS ARE BASED ON "REVISED LANDSLIDE DATABASE FOR THE COASTAL SECTOR OF THE DUNEDIN CITY DISTRICT" BY BARRELL, D.J.A., SMITH LITTLE, B., GLASSEY, P.J. GNS SCIENCE CONSULTANCY REPORT 2017/41, JULY 2017, SOURCED FROM THE OTAGO REGIONAL COUNCIL (ORC) NATURAL HAZARDS PORTAL.

OTHER

+/- Xmm = CUMULATIVE VERTICAL DISPLACEMENT SINCE THE BASE SURVEY

CUMULATIVE HORIZONTAL DISPLACEMENT SINCE THE BASE SURVEY

SURVEY MARKER



1:1250 @ A1
1:2500 @ A3
0 20 40 60 80 100 120 m

REVISION	AMENDMENT	APPROVED	DATE
A	2024 DEFORMATION MONITORING DATA	D.M	10/12/2024

DUNEDIN CITY COUNCIL | kaunihera a-rohe o Ōtepoti

Dunedin Office
+64 3 471 5500
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Dunedin 9016
New Zealand

CIVIL

SCALES: 1:1250 @A1, 1:2500 @A3
ORIGINAL SIZE: A1
DRAWN: J.W.
APPROVED: D.M
DRAWING VERIFIED: C.H
APPROVED DATE: 10/12/2024

CUMULATIVE SURVEY RESULTS 2024

PROJECT
DUNEDIN CITY COUNCIL
WEST ABBOTSFORD
LONG-TERM LANDSLIDE MONITORING

TITLE
CUMULATIVE LANDSLIDE DISPLACEMENTS
WEST ABBOTSFORD

WSP PROJECT NO.	PROJ-ORIG-VOL-LOC-TYPE	SHEET NO.	REVISION
6-CD109.55	6-CD109.55	C01	A

Original sheet size A1 (841x594) Plot Date 2025-02-10 at 11:40:25 am \\corp.pbwan.net\ANZ\ProjectsNZ\6c\6-CD109.55 LTES Long-term Landslide Monitoring\Home\03_Delivery\Site Plans - DWG\6-CD109.55_West Abbortsford.dwg Layout1

LEGEND

LANDSLIDE - OTAGO REGION (CERTAINTY)

- DEFINITE
- LIKELY
- POSSIBLE
- NOT ASSESSED
- NO INFORMATION

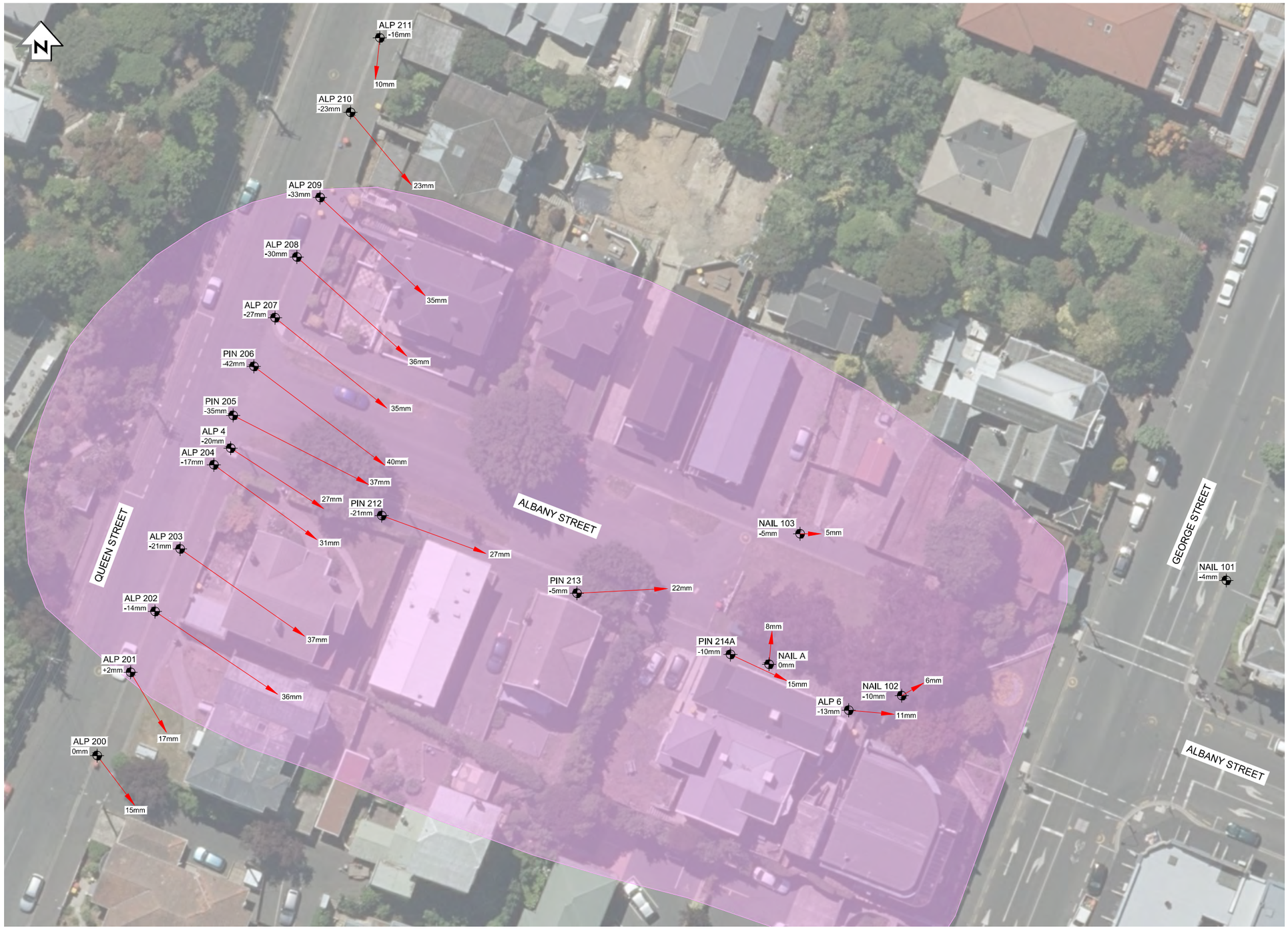
INDICATIVE LANDSLIDE EXTENTS ARE BASED ON "REVISED LANDSLIDE DATABASE FOR THE COASTAL SECTOR OF THE DUNEDIN CITY DISTRICT" BY BARRELL, D.J.A., SMITH LITTLE, B., GLASSEY, P.J. GNS SCIENCE CONSULTANCY REPORT 2017/41, JULY 2017, SOURCED FROM THE OTAGO REGIONAL COUNCIL (ORC) NATURAL HAZARDS PORTAL.

OTHER

+/- Xmm = CUMULATIVE VERTICAL DISPLACEMENT SINCE THE BASE SURVEY

CUMULATIVE HORIZONTAL DISPLACEMENT SINCE THE BASE SURVEY

SURVEY MARKER



1:250 @ A1
1:500 @ A3
0 4 8 12 16 20 24 m

REVISION	AMENDMENT	APPROVED	DATE
A	2024 ALBANY STREET LANDSLIDE MONITORING	D.M.	10/12/2024

DUNEDIN CITY COUNCIL | kaunihera a-rohe o Ōtepoti

Dunedin Office
+64 3 471 5500

Private Bag 1913
Dunedin 9016
New Zealand

CIVIL

SCALES: 1:250 @A1, 1:500 @A3
ORIGINAL SIZE: A1
DRAWN: J.W
APPROVED: D.M.
DRAWING VERIFIED: C.H
APPROVED DATE: 10/12/2024

CUMULATIVE SURVEY RESULTS 2024

PROJECT
DUNEDIN CITY COUNCIL
ALBANY STREET
LONG-TERM LANDSLIDE MONITORING

TITLE
LANDSLIDE MONITORING
ALBANY STREET

WSP PROJECT NO.	PROJ-ORIG-VOL-LOC-TYPE	SHEET NO.	REVISION
6-CD109.55	6-CD109.55	C01	A

Original sheet size A1 (841x594) Plot Date 2025-02-10 at 11:11:20 am \\corp.pbwan.net\ANZ\ProjectsNZ\6c\6-CD109.55 LTES Long-term Landslide Monitoring\Home\03_Delivery\Site Plans - DWG\6-CD109.55_Albany St.dwg Layout1

LEGEND

LANDSLIDE - OTAGO REGION (CERTAINTY)

- DEFINITE
- LIKELY
- POSSIBLE
- NOT ASSESSED
- NO INFORMATION

INDICATIVE LANDSLIDE EXTENTS ARE BASED ON "REVISED LANDSLIDE DATABASE FOR THE COASTAL SECTOR OF THE DUNEDIN CITY DISTRICT" BY BARRELL, D.J.A., SMITH LITTLE, B., GLASSEY, P.J. GNS SCIENCE CONSULTANCY REPORT 2017/41, JULY 2017, SOURCED FROM THE OTAGO REGIONAL COUNCIL (ORC) NATURAL HAZARDS PORTAL.

OTHER

+/- Xmm = CUMULATIVE VERTICAL DISPLACEMENT SINCE THE BASE SURVEY

CUMULATIVE HORIZONTAL DISPLACEMENT SINCE THE BASE SURVEY

SURVEY MARKER

1:250 @ A1
1:500 @ A3
0 4 8 12 16 20 24 m

REVISION	AMENDMENT	APPROVED	DATE
A	2024 DEFORMATION MONITORING DATA	D.M	10/12/2024
B	UPDATED ORIENTATION	D.M.	04/02/2025

DUNEDIN CITY COUNCIL | kaunihera a-rohe o Ōtepoti

wsp
Dunedin Office
+64 3 471 5500
Private Bag 1913
Dunedin 9016
New Zealand

CIVIL

SCALES: 1:250 @A1, 1:500 @A3
ORIGINAL SIZE: A1
DRAWN: J.W
APPROVED: D.M
DRAWING VERIFIED: C.H
APPROVED DATE: 04/02/2025

CUMULATIVE SURVEY RESULTS 2024

PROJECT
DUNEDIN CITY COUNCIL
SIDEY STREET
LONG TERM LANDSLIDE MONITORING

TITLE
CUMULATIVE LANDSLIDE DISPLACEMENTS
SIDEY STREET

WSP PROJECT NO.	PROJ-ORIG-VOL-LOC-TYPE	SHEET NO.	REVISION
6-CD109.55	6-CD109.55	C01	B

Appendix B
Factual Survey Data

Puketeraki Street Survey Data Dated: 9/12/2024														
Additional survey data				Present to Previous (30/10/2023)					Present to Control (08/03/2010)					
Pin #	Northing	Easting	Height	dN	dE	Bearing	Dist	dRL	dN	dE	Bearing	Dist	dRL	
103 - Iron Tube	823271.253	428653.839	35.139	0.000	0.000		0.000	0.000	0.000	0.000		0.000	0.000	0.000
105 - Iron Spike	823234.578	428647.600	36.281	0.004	0.000	0	0.004	0.001	-0.005	0.012	110.556	0.013	0.021	-0.005
106 - Iron Spike	823236.387	428641.766	36.831	0.000	0.001	90	0.001	0.003						
150 - EW5H	824788.53	428718.02	17.574	-0.001	-0.004	256	0.004	0.009	1552.138	0.004	0.009	1552.138	-0.018	1552.138
151 - EW5J	Not located in 2024													
201 - Iron Spike	824938.249	428913.028	10.258	-0.003	0.003	135	0.004	0.002	-0.001	0.002	0.002	0.002	-0.010	-0.001
DUND	797475.894	424425.428	387.018	0.009	-0.005	331	0.010	0.004						
OUSD	Data no longer available for processing													
SUTT	825243.803	388833.688	417.555	0.008	-0.010	309	0.013	0.030						
211a - Iron Spike	822439.452	428318.127	156.442	0.023	0.220	84	0.221	-0.020	0.034	0.351	84.467	0.353	-0.044	0.034
2	Not accessible													
3	822503.899	428677.092	112.450	-0.026	0.246	96	0.247	-0.054	-0.518	3.590	98.214	3.627	-1.030	-0.518
5	822355.665	428249.218	184.278	0.029	0.210	82	0.212	-0.014	0.404	2.685	81.443	2.715	-0.407	0.404
10a	822700.164	428292.568	111.369	0.087	0.254	71	0.268	-0.027	0.282	0.779	70.100	0.828	-0.086	0.282
11	822754.902	428502.497	86.464	0.027	0.136	79	0.139	0.005	0.587	2.666	77.579	2.730	-0.118	0.587
12	822637.133	428603.969	66.403	0.059	0.209	74	0.217	-0.017	0.879	3.477	75.817	3.586	-0.256	0.879
13	822655.105	428462.357	86.356	0.022	0.292	86	0.293	-0.011	0.320	4.309	85.750	4.321	-0.199	0.320
16	822501.912	428356.177	131.058	0.023	0.235	84	0.236	-0.053	0.433	3.435	82.811	3.463	-1.089	0.433
18	822760.081	428606.763	69.521	0.011	0.029	69	0.031	0.009	0.145	0.292	63.592	0.326	-0.019	0.145
19	822778.684	428451.426	88.218	0.068	0.206	72	0.217	0.005	0.765	2.559	73.349	2.671	-0.070	0.765
20	Not accessible													

Greenacres Street Survey Data Dated: 08/11/2024														
Survey Data					Present to Previous Survey (03/11/2023)					Present to Original				
Point ID	Easting	Northing	Elevation	Feature Code	mE	mN	Bearing	Dist	mZ	mE	mN	Bearing	Dist	mZ
DUND	424425.439	797475.867	386.925	Base Station										
IS1	424790.703	798547.607	94.358	IS1	-0.020	0.069	343.836	0.072	0.000	-0.330	0.207	302.099	0.390	-0.246
IS2	424789.194	798583.04	86.438	IS2	0.006	0.065	5.274	0.065	-0.010	0.275	1.697	9.205	1.719	-0.697
IS3	424843.107	798601.574	80.954	IS3	-0.001	0.003	341.565	0.003	0.009	-0.004	0.017	346.759	0.017	0.011
IS4	424785.357	798643.412	72.45	IS4	0.002	0.044	2.603	0.044	-0.001	-0.088	1.505	356.654	1.508	-0.467
IS5	Not observed in 2024 – Vegetation obscuring mark													
IS6	424769.427	798756.712	49.659	IS6	0.004	0.017	13.241	0.017	0.004	-0.166	0.950	350.088	0.964	-0.299
ISA	424705.91	798523.73	100.978	ISA	0.003	0.002	56.310	0.004	0.007	-0.009	0.010	318.013	0.013	0.004
ISB	424818.753	798719.707	59.374	ISB	0.006	0.001	80.538	0.006	0.014	0.019	0.024	38.367	0.031	0.022
X75	424540.14	800500.726	7.276	X75	0.003	0.004	36.870	0.005	0.005	0.005	0.001	78.690	0.005	0.006

Howard Street Survey Data
Dated: 14/11/2024

Additional survey data					Present to previous (06/11/2023)					Present to Control (Data derived from Previous Surveys)				
Point Number	Northing	Easting	Height	Code	dN	dE	Azim.	Dist	dRL	dN	dE	Azim.	Dist	dRL
A23K	698553.389	323584.281	8.414	I NO 3	0.003	0.002	34	0.004	0.015	0.006	0.001	9	0.006	0.01
DUND	697311.104	324412.321	386.734	DUND	0.000	0.000	FIXED		0.000	0.000	0.000	FIXED		0
OUSD	698908.139	317721.854	25.914	OUSD	0.000	0.000	#DIV/0!	0.000	0.000	-0.002	-0.006	252	0.006	0.002
IS 101	699022.349	324432.492	6.968	IS 101	0.003	0.000	0	0.003	0.010	0.001	-0.002	297	0.002	0.01
N 102	699035.008	324463.928	7.062	Nail 102	-0.003	0.003	135	0.004	0.015	-0.004	0.000	180	0.004	0.012
IS 106	700292.685	324573.459	7.524	IS 106	-0.006	0.005	140	0.008	0.009	-0.005	0.004	141	0.006	0.01
N 402	698762.744	324484.267	24.808	Nail 103	0.004	0.001	14	0.004	0.032					
IS4	698161.930	323756.594	88.194	ISIV	0.003	0.003	45	0.004	0.012	0.004	0.003	37	0.005	0.069
IS7A	698021.229	324014.464	168.592	IS7A	0.012	-0.005	337	0.013	0.005	0.029	-0.008	345	0.030	0.115
IT8B	698363.323	324109.626	97.333	IT8B	0.007	-0.018	291	0.019	-0.001	0.062	-0.209	287	0.218	0.025
IS9	698265.261	323937.591	87.576	IS9	0.012	-0.008	326	0.014	0.019	0.111	-0.112	315	0.158	0.050
IS12	698564.106	323849.766	21.233	IS12	-0.002	0.002	135	0.003	0.012	-0.002	0.005	112	0.005	0.043
IS14	698385.075	323947.435	60.599	IS14	0.025	-0.007	344	0.026	0.019	0.229	-0.086	339	0.245	0.030
IS18	698489.752	323898.090	35.425	IS18	0.005	0.004	39	0.006	0.010	0.027	0.003	6	0.027	0.068
IS 51	698396.337	323856.052	43.564	IS51	0.005	0.001	11	0.005	0.023	0.017	-0.024	305	0.030	0.058
IS 52	698388.200	323779.257	41.076	IS52	-0.008	0.002	166	0.008	0.017	0.020	-0.002	356	0.020	0.084
IS 53	698544.467	323694.702	8.710	IS53	-0.003	0.004	127	0.005	0.015	0.050	-0.004	355	0.051	0.046
IS 54	698497.786	323955.621	33.125	IS54	-0.007	0.008	131	0.011	0.010	0.004	-0.004	311	0.006	0.004
IS 55	698629.995	323833.209	11.469	IS55	0.006	0.001	9	0.006	0.019	0.008	-0.020	292	0.022	0.062
IS 60	698263.229	324011.779	88.861	IS60	0.026	-0.008	343	0.027	0.012	0.174	-0.109	328	0.205	-0.054
A23K	698553.389	323584.281	8.414	I NO 3	0.003	0.002	34	0.004	0.015	0.006	0.001	9	0.006	0.01

Brighton Street Survey Data Dated: 11/10/2024													
Additional survey data				Present to Previous (26/09/2023)					Present to Original				
Mark	mN	mE	Height	dN	dE	Azim.	Dist	dRL	dN	dE	Azim.	Dist	dRL
M2	791646.868	405758.442	18.364	-0.004	0.000	180	0.004	0.001	-0.353	-0.009	181	0.353	-0.028
M3	791699.348	405741.425	42.968	0.001	0.005	79	0.005	0.011	-0.598	0.096	171	0.624	0.037
M4	791698.060	405771.735	41.370	0.003	0.005	59	0.006	0.005	-0.949	0.267	164	1.016	-0.247
M5	791702.212	405806.521	38.439	-0.003	0.011	105	0.011	-0.002	-1.216	0.609	153	1.311	-0.433
M6	791722.519	405763.654	46.384	0.003	0.000	0	0.003	0.003	-0.805	0.254	162	0.755	-0.343
M7	791767.563	405767.383	62.418	0.002	0.001	27	0.002	0.012	-0.030	-0.001	182	0.030	0.008
M8	791516.993	405763.216	14.850	0.009	0.006	34	0.011	0.015	-0.015	0.018	130	0.023	-0.019
ISI - (FIXED)	791550.227	405748.121	13.675	0.000	0.000	-	0.000	0.000	0.000	0.000	-	0.000	0.000
ISII	791540.490	405693.774	13.752	0.003	0.005	59	0.006	0.003	-0.006	0.029	102	0.030	0.005
ISIII	791542.174	405779.193	13.537	-0.001	0.004	104	0.004	0.004	-0.024	-0.002	185	0.024	-0.017
ISA	791694.282	406325.528	14.791	0.005	0.008	58	0.009	0.006	-0.142	0.043	163	0.148	0.002
ISB	791667.100	405627.619	26.540	0.011	0.009	39	0.014	0.012	0.010	0.039	76	0.040	-0.002
ISC	791825.953	405811.480	73.067	-0.001	0.003	108	0.003	0.008	-0.029	0.087	108	0.092	0.001
OUSD	799071.946	417735.572	29.095	0.000	0.000	0	0.000	0.000	-0.024	-0.002	185	0.024	-0.008
BD5W	793063.315	409229.765	20.349	0.002	0.006	72	0.006	0.014	-0.003	0.002	146	0.004	0.024
DUND	797474.886	424425.980	389.869	0.011	0.005	24	0.012	0.000	-0.014	0.001	176	0.014	-0.005
GSMG	796940.969	405246.515	32.708	0.000	0.000	0	0.000	0.000	0.000	0.000	0	0.000	0.000

Church Hill Road Survey Data Dated:30/09/2024													
Additional survey data				Present to previous (16/10/2023)				Present to Control (Data derived from Base Survey) (June 1997)					
Point Number	Northing	Easting	Height	dN	dE	Bearing	Dist	dRL	dN	dE	Bearing	Dist	dRL
Trig A2	694110.908	311761.546	189.282	-0.007	-0.004	210	0.008	-0.009	-0.002	-0.006	252	0.006	-0.005
SS WEIR ST (BD5U)	694507.274	310627.827	21.319	0.000	0.002	90	0.002	0.007	0.007	0.001	8	0.007	0.007
IS 1	695294.190	311497.215	20.613	0.000	0.000	-	0.000	0.000	0.000	0.000	-	-	0.000
IS 2	694566.570	310599.975	15.818	0.000	0.000	-	0.000	0.011	0.000	0.000	-	-	-0.003
Mark 05	694943.901	311300.294	47.501	0.003	-0.001	342	0.003	-0.007	0.555	-0.198	340	0.589	-0.031
Mark 06	694803.854	311350.078	64.526	0.004	0.006	56	0.007	-0.006	0.572	-0.180	343	0.600	-0.073
Mark 07	694861.514	311393.694	60.865	0.011	-0.003	345	0.011	-0.003	0.406	-0.188	335	0.447	-0.253
Mark 11	694900.037	311520.728	56.440	-0.009	0.004	156	0.010	-0.002	0.022	0.012	29	0.025	0.043
Mark 12	694606.306	311682.494	125.685	-0.011	0.004	160	0.012	-0.005	0.014	-0.006	337	0.015	0.014
Mark 13	694510.854	311716.832	144.899	-0.004	0.007	120	0.008	-0.005	0.040	0.012	17	0.042	0.009
Mark 14	694678.086	311502.622	105.626	-0.004	0.000	180	0.004	-0.008	0.111	-0.025	347	0.114	0.012
Mark 15	695013.377	311491.013	40.882	-0.001	0.002	117	0.002	-0.002	-0.007	-0.001	188	0.007	-0.022
Mark 16	694986.957	311417.027	38.777	-0.003	0.001	162	0.003	0.004	-0.006	-0.002	198	0.006	-0.013

Brockville Street Survey Data Dated: 16/09/2024													
Survey data				Present to previous (08/08/2023)					Present to original				
Point id	Easting	Northing	Height	E	N	Horizontal	Bearing	Height	E	N	Horizontal	Bearing	Height
OUSD	Data not available												
IS Frasers G.	413294.389	799712.158	283.441	-0.007	0.005	0.009	87	-0.005	0.000	0.000	0.000	0	0.000
IS Dalziel Rd	413509.317	800234.218	291.874	-0.012	0.008	0.014	88	0.014	-0.003	0.006	0.007	333	0.014
IS Reservoir	412926.747	799127.947	308.737	-0.008	0.013	0.015	89	-0.002	-0.004	-0.001	0.004	256	-0.005
F36D	798307.963	414508.973	114.144										
GSMG	796941.958	405245.957	29.753										
MIS1	414105.539	799322.154	235.920	-0.013	0.005	0.014	90	-0.017	-0.007	0.005	0.009	90	-0.015
MIS2	414314.922	799430.222	199.030	-0.009	0.003	0.009	288	-0.019	-0.002	-0.001	0.002	243	-0.006
MIS3	414532.867	799551.179	174.718	-0.007	0.007	0.010	315	-0.010	-0.005	0.013	0.014	339	-0.002
MIS4	414692.795	799541.136	167.033	-0.011	0.008	0.014	306	-0.012	-0.004	0.012	0.013	342	-0.008
MIS5	414731.221	799443.722	157.162	-0.005	0.008	0.009	328	-0.005	0.000	0.002	0.002	0	-0.012
MIS6	414660.986	799411.250	171.834	-0.007	0.011	0.013	328	-0.012	-0.003	0.006	0.007	333	-0.006

Dickson Street Survey Data
Dated: 11/11/2024

Additional Survey Data					Present to Previous					Present to Control				
Point Number	Northing	Easting	Height	Code	dN	dE	Azim.	Dist	dRL	dN	dE	Azim.	Dist	dRL
	NZGD49	NZGD49	Intl1924											
106 and AFF3	NOT OBSERVED - UNRELIABLE, SUBJECT TO MOVEMENT													
A23K	698553.386	323584.280	8.398	I NO 3	-0.001	0.002	117	0.002	0.006	0.003	0.000	0	0.003	-0.006
DUND	697311.104	324412.321	386.734	DUND	0.000	0.000	0	0.000	0.000	0.000	0.000	0	0.000	0.000
GSMG	696777.055	305232.723	29.574	GSMG						0.000	0.000	0	0.000	0.000
101	699022.349	324432.490	6.955	IS101	0.003	-0.002	326	0.004	-0.004	0.001	-0.004	284	0.004	-0.003
102	699035.016	324463.927	7.052	NAIL 102	0.008	0.000	0	0.008	0.003	0.004	-0.001	346	0.004	0.002
1	698974.518	324733.975	33.650	ISI	0.002	0.006	72	0.006	0.001	-0.015	-0.008	208	0.017	0.053
2B	698762.737	324484.268	24.784	NAIL 2B	-0.002	0.002	135	0.003	0.009	-0.002	0.001	153	0.002	0.003
5	699088.871	325008.993	136.522	ISV	-0.008	-0.001	187	0.008	-0.003	0.003	-0.008	291	0.009	0.049
6	699121.109	324811.365	79.061	ISVI	-0.004	-0.002	207	0.004	-0.011	-0.042	-0.042	225	0.059	0.029
8	699034.433	324842.039	75.677	ISVIII	0.003	-0.002	326	0.004	-0.009	-0.027	-0.035	232	0.044	0.040
9B	699013.501	324570.351	20.986	ISIXB	0.003	0.006	63	0.007	-0.006	0.011	0.004	20	0.012	0.017
21	699121.889	324588.099	24.977	ISXXI	-0.002	0.003	124	0.004	-0.006	-0.008	-0.009	229	0.012	0.002
22	698870.898	324795.956	52.157	ISXXII	-0.007	0.002	164	0.007	-0.001	-0.015	-0.004	196	0.015	0.043
31	698991.121	324636.028	23.472	ISXXXI	0.001	0.004	76	0.004	0.001	0.001	0.005	79	0.005	0.000
32	698981.975	324681.417	28.273	ISXXXII	0.000	0.003	90	0.003	-0.002	0.002	0.002	45	0.003	-0.003
33	698954.323	324793.351	49.578	ISXXXIII	0.005	0.005	45	0.007	-0.005	0.024	0.007	16	0.025	0.003
34	699016.250	324787.798	48.639	ISXXXIV	0.007	-0.007	315	0.010	0.004	-0.001	0.002	117	0.002	-0.007
35	699067.826	324791.790	66.732	ISXXXV	0.001	-0.002	297	0.002	-0.006	0.008	0.005	32	0.009	-0.008

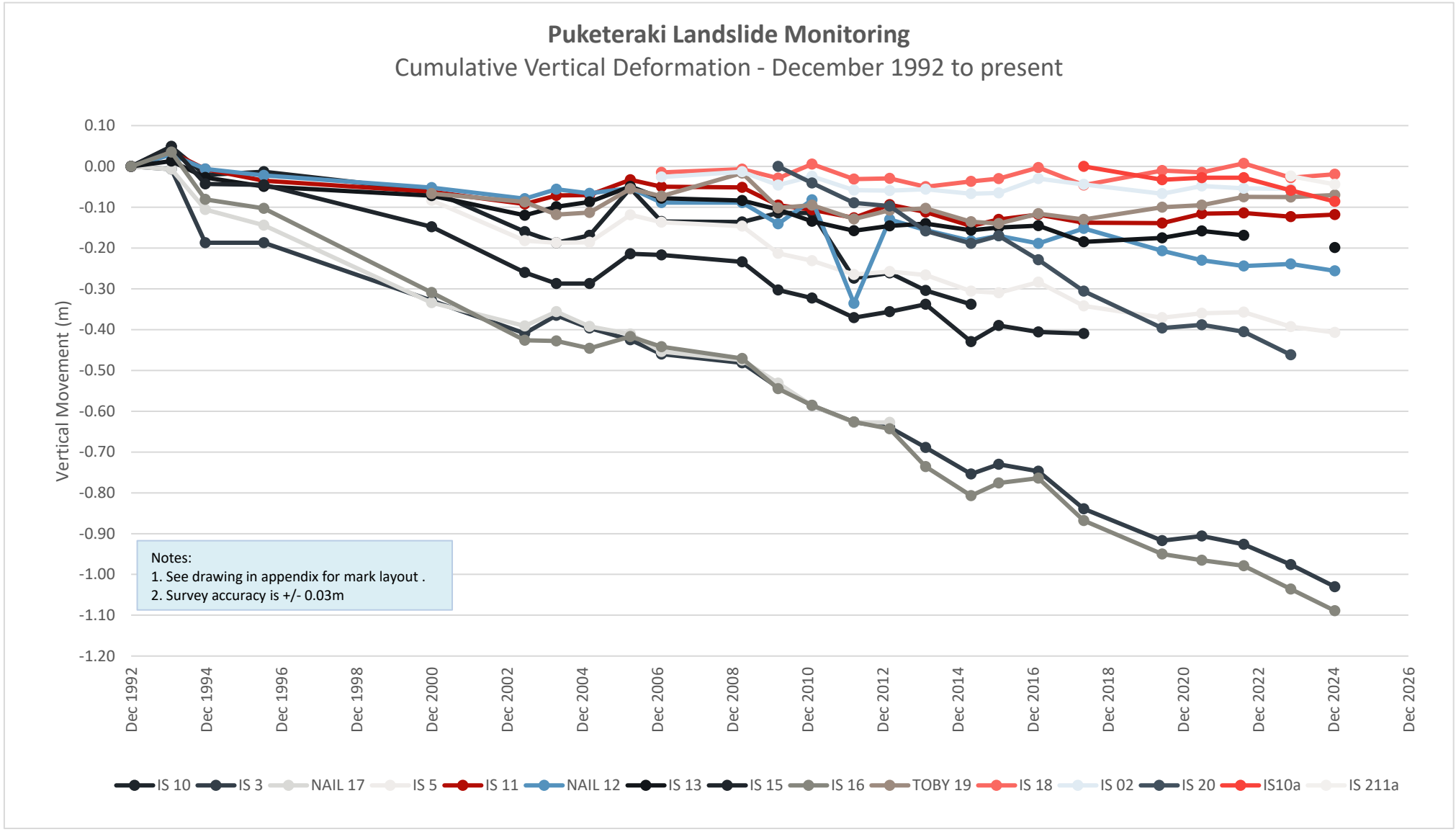
West Abbotsford Survey Data Dated: 09/09/2024													
Additional survey data				Present to previous (25/10/2023)					Present to control				
POINT	NORTHING	EASTING	HEIGHT	d N	d E	Δ Z	Dist	Azi	d N	D E	Δ Z	Dist	Azi
AG1C	FIXED Hz	795714.092	410340.258	13.502	0.000	0.000	0.019	-	0.000	0.000	0.000	0.003	-
OUSD	Primary Control												
GSMG	New Control	796941.958	405245.954	29.755									
C25W	Primary Control	795472.377	412098.463	29.588	-0.001	-0.008	-0.008	263	0.008	-0.003	-0.007	-0.013	247
IS 1	Fixed Vert.	795459.029	411510.387	20.851	0.001	-0.002	0.000	297	0.002	0.002	0.000	0.000	0
IS 2	Secondary Control	795778.257	410907.778	42.540	0.004	-0.003	0.002	323	0.005	-0.003	-0.001	0.006	198
IS 3	Secondary Control	795749.445	411890.869	28.806	0.003	-0.004	-0.006	307	0.005	-0.006	-0.005	0.001	220
IS 4	Secondary Control	796329.832	411648.226	95.135	0.000	-0.009	-0.001	270	0.009	-0.008	-0.005	-0.003	212
AP 11		795922.094	411195.488	55.025	0.002	0.000	-0.001	0	0.002	-0.005	0.002	0.002	158
AP 12		795942.770	411123.579	54.717	0.002	-0.004	-0.008	297	0.004	-0.004	-0.001	0.002	194
AP 13		795893.484	411257.173	51.047	-0.001	-0.006	0.008	261	0.006	-0.005	-0.005	0.000	225
AP 14		795862.599	411169.213	50.539	0.000	-0.008	-0.002	270	0.008	-0.005	-0.002	-0.003	202
AP 15B	AP 15 destroyed	795822.251	411053.225	46.263	0.002	-0.010	0.000	281	0.010	0.002	-0.010	0.000	281
AP 16		795802.355	411345.855	45.422	-0.001	-0.005	0.007	259	0.005	-0.006	-0.003	0.002	207
AP 17		795749.627	411192.586	39.218	0.004	-0.005	-0.003	309	0.006	-0.003	0.000	0.004	180
AP 18		795696.025	411399.093	37.552	0.002	-0.002	0.005	315	0.003	-0.004	-0.001	0.006	194
AP 19		795694.063	411265.633	38.646	0.010	-0.004	-0.003	338	0.011	-0.005	0.000	0.003	180
AP 20		795620.272	411177.109	30.945	0.004	-0.005	0.002	309	0.006	-0.005	0.000	0.003	180
AP 21		795700.244	411031.822	35.906	0.005	-0.008	0.000	302	0.009	0.000	0.000	0.001	0

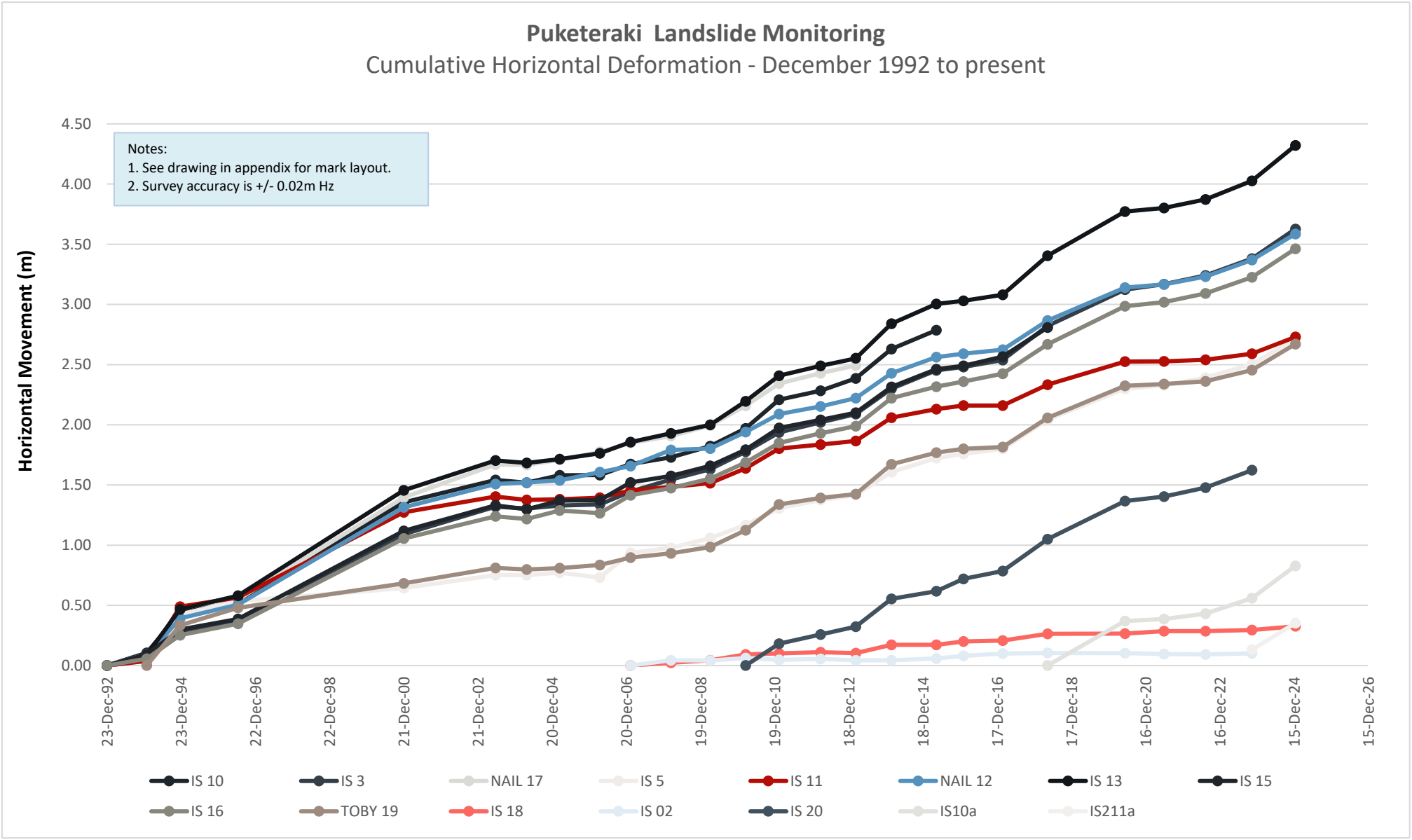
Albany Street Survey Data
Dated: 13/11/2024

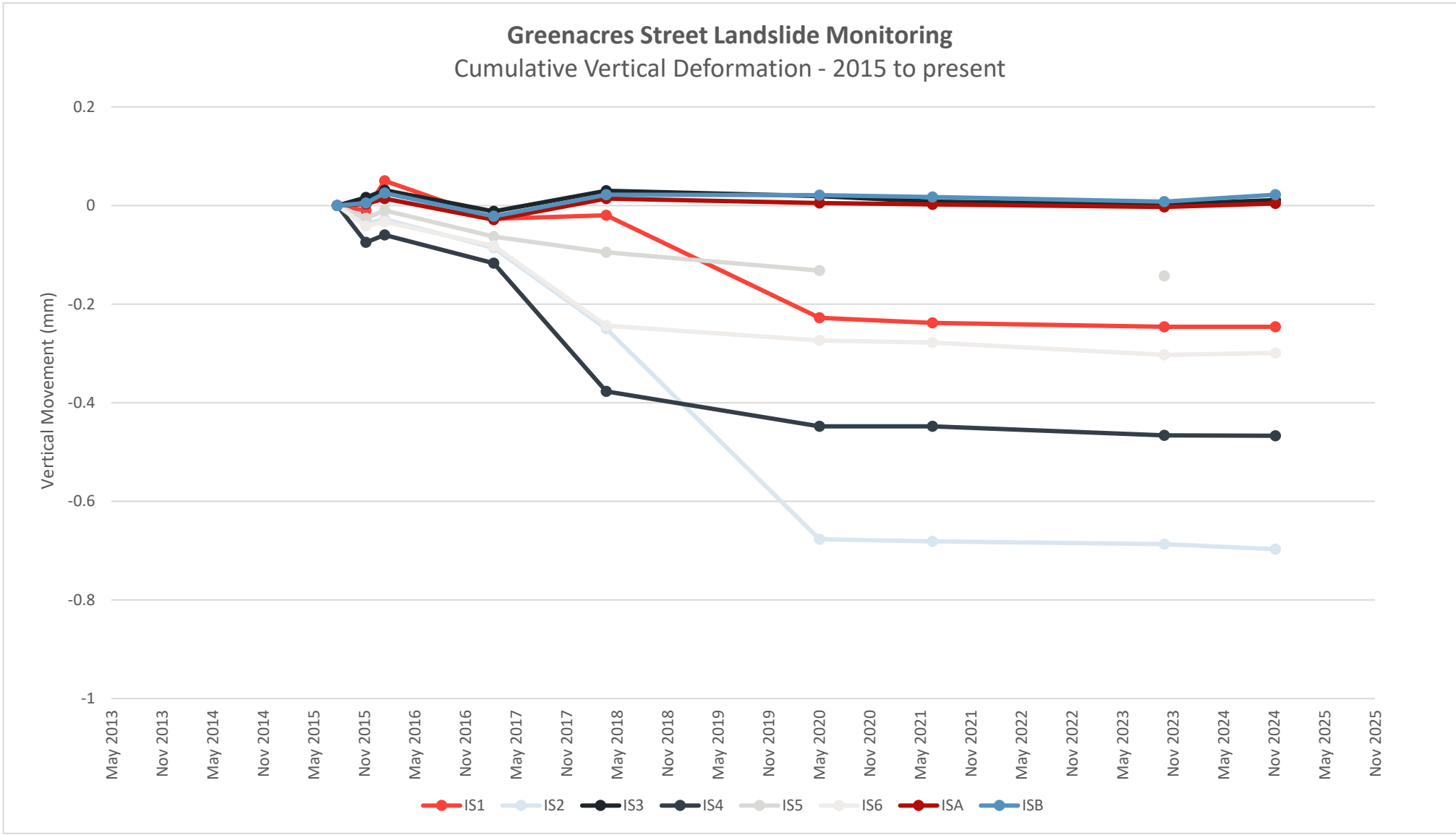
Additional survey data				Present to Previous (11/10/2023)					Present to Control (08/03/2010)				
Pin #	Northing	Easting	Height	dN	dE	Bearing	Dist	dRL	dN	dE	Bearing	Dist	dRL
	(NZGD2000 Nth Taieri)		(Otago Metric Datum)										
SS 13G		DESTROYED											
ALP 5		DESTROYED											
SS 9G		DESTROYED											
Nail 1	799381.730	417371.268	127.242	0.000	0.000	1	0.000	0.000	0.000	0.000	1	0.000	0.000
Nail 100	799267.870	417439.791	111.369					0.000					0.000
Nail 101	799472.943	417534.893	114.666					-0.004					-0.004
Nail A	799462.688	417479.017	125.232	0.007	-0.003	5	0.008	0.000	0.007	-0.003	5	0.008	0.000
BP 2 SO 590919	799527.301	417556.593	115.465										
Nail 102	799458.869	417495.225	120.698										
Nail 103	799479.219	417484.018	124.648										
ALP 4	799489.072	417413.253	136.898	-0.002	0.004	333	0.004	-0.004	-0.015	0.023	123	0.027	-0.020
ALP 6	799457.074	417488.765	122.904	-0.004	0.004	315	0.006	-0.007	-0.001	0.011	95	0.011	-0.013
ALP 200	799451.531	417396.936	134.493	-0.005	0.002	292	0.005	0.002	-0.012	0.009	143	0.015	0.000
ALP 201	799461.709	417401.005	135.302	-0.005	0.002	292	0.005	0.001	-0.015	0.009	149	0.017	0.002
ALP 202	799469.121	417404.010	135.717	-0.007	0.004	300	0.008	0.003	-0.020	0.030	124	0.036	-0.014
ALP 203	799476.759	417407.084	136.282	-0.006	0.003	297	0.007	0.000	-0.021	0.030	125	0.037	-0.021
ALP 204	799487.043	417411.202	136.969	0.000	0.003	0	0.003	-0.004	-0.018	0.025	126	0.031	-0.017
PIN 205	799493.069	417413.576	137.176	-0.001	0.004	346	0.004	-0.003	-0.017	0.033	117	0.037	-0.035
PIN 206	799499.054	417416.099	137.438	-0.003	0.007	337	0.008	-0.004	-0.024	0.032	127	0.040	-0.042
ALP 207	799505.009	417418.690	137.656	0.000	0.005	0	0.005	0.002	-0.022	0.027	129	0.035	-0.027
ALP 208	799512.418	417421.353	138.423	-0.001	0.006	351	0.006	-0.003	-0.024	0.027	132	0.036	-0.030
ALP 209	799519.685	417424.178	139.201	-0.001	0.007	352	0.007	-0.002	-0.024	0.026	133	0.035	-0.033
ALP 210	799530.098	417427.891	140.501	-0.003	0.009	342	0.009	0.000	-0.018	0.015	140	0.023	-0.023
ALP 211	799539.196	417431.449	141.264	0.000	0.006	0	0.006	0.007	-0.010	-0.001	186	0.010	-0.016
PIN 212	799480.852	417431.714	133.514	-0.004	0.004	315	0.006	0.000	-0.009	0.025	110	0.027	-0.021
PIN 213	799471.366	417455.560	129.525	-0.002	0.004	333	0.004	-0.001	0.001	0.022	87	0.022	-0.005
PIN 214A	799464.572	417472.638	126.600	-0.002	0.005	338	0.005	-0.002	-0.007	0.014	115	0.015	-0.010
216		DESTROYED											

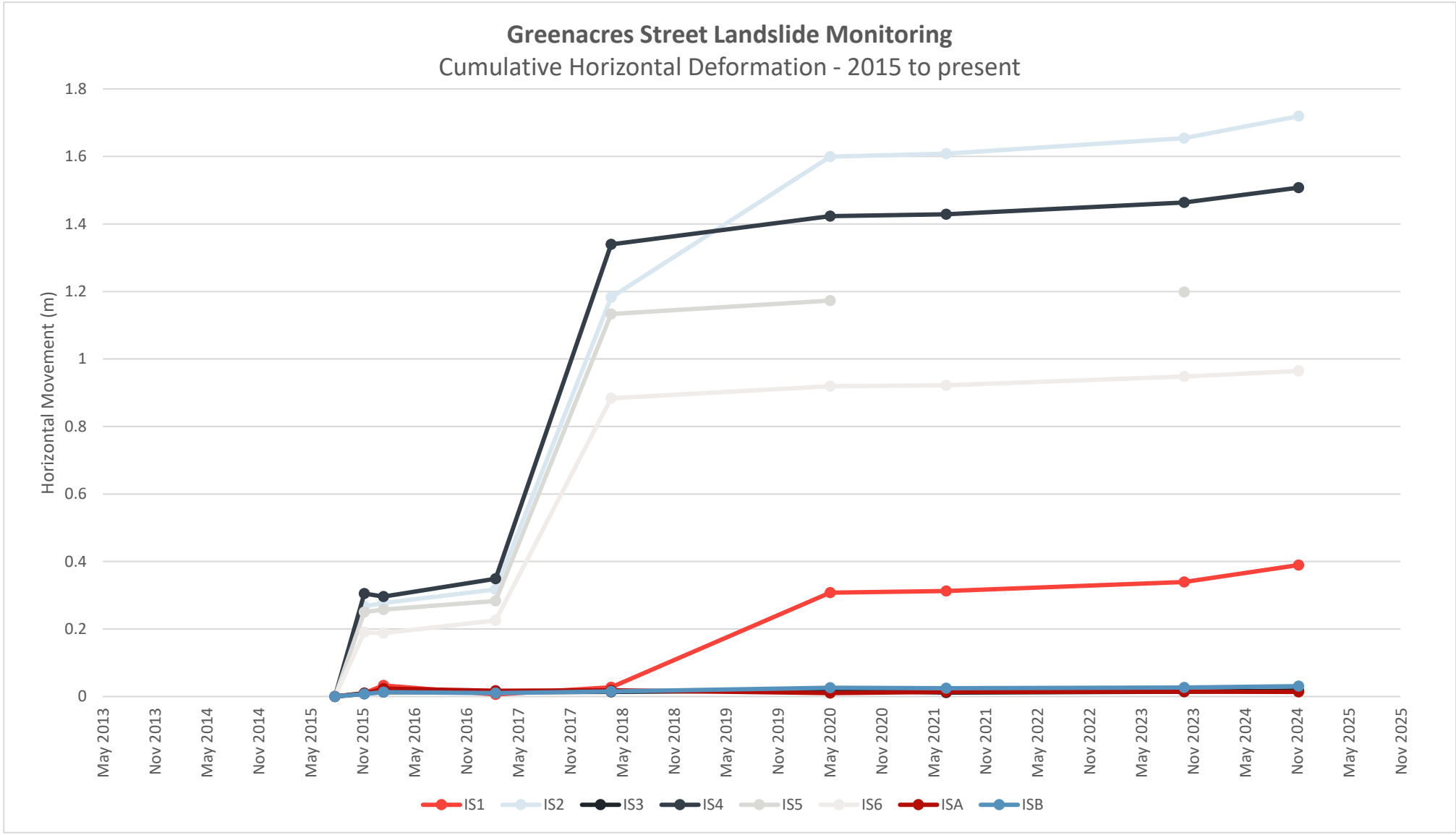
Sidey Street Survey Data Dated: 25/09/2024														
Additional survey data				Present to previous (02/12/2022)					Present to Control (Data derived from Previous Surveys)				
Point Number	Northing	Easting	Height	dN	dE	Azim.	Dist	dRL	dN	dE	Azim.	Dist	dRL
NL2	mark destroyed												
NL2b	8000.099	4900.148	89.577										
NL3	7991.974	4985.424	94.757	0.000	0.000	180	0.000	-0.006	0.000	0.000	-	0.000	0.000
NL4	7990.874	4997.836	95.519						-0.007	-0.005	215.538	0.009	0.003
NL5	7988.076	5018.999	96.992	0.000	0.000	270	0.000	-0.002	0.000	0.000	-	0.000	0.007
Pin 15	7996.425	4893.493	89.166										
RT 16	8000.960	4925.553	93.717										
NL6	7977.715	5075.749	100.539	-0.007	0.003	157	0.008	-0.003	-0.007	0.003	156.801	0.008	-0.012
NL1	8000.002	5000.001	95.595	0.002	0.001	27	0.002	-0.004	0.002	0.001	26.565	0.002	-0.004
NL7	7990.725	5054.317	99.070	-0.002	0.000	180	0.002	-0.001	0.005	0.000	0.000	0.005	-0.011
NL8	7995.638	5020.203	96.870	0.002	0.001	27	0.002	-0.005	0.010	-0.001	354.289	0.010	-0.012
NL9	7996.818	5011.110	96.286	0.003	0.000	0	0.003	-0.003	0.005	-0.001	348.690	0.005	-0.001
NL10	7997.753	5004.177	95.710	0.003	0.002	34	0.004	-0.004	0.000	0.000	-	0.000	-0.001
NL11	7998.655	4997.312	95.433	0.001	0.003	72	0.003	-0.003	-0.002	0.002	135.000	0.003	0.000
NL12	7999.516	4990.365	95.054	0.002	0.002	45	0.003	-0.004	0.000	0.000	-	0.000	-0.002
NL13	8000.141	4983.463	94.666	0.003	0.002	34	0.004	-0.004	0.003	0.001	18.435	0.003	-0.001
NL14	8000.700	4975.720	94.229	0.007	0.002	16	0.007	-0.004	0.005	0.002	21.801	0.005	-0.001

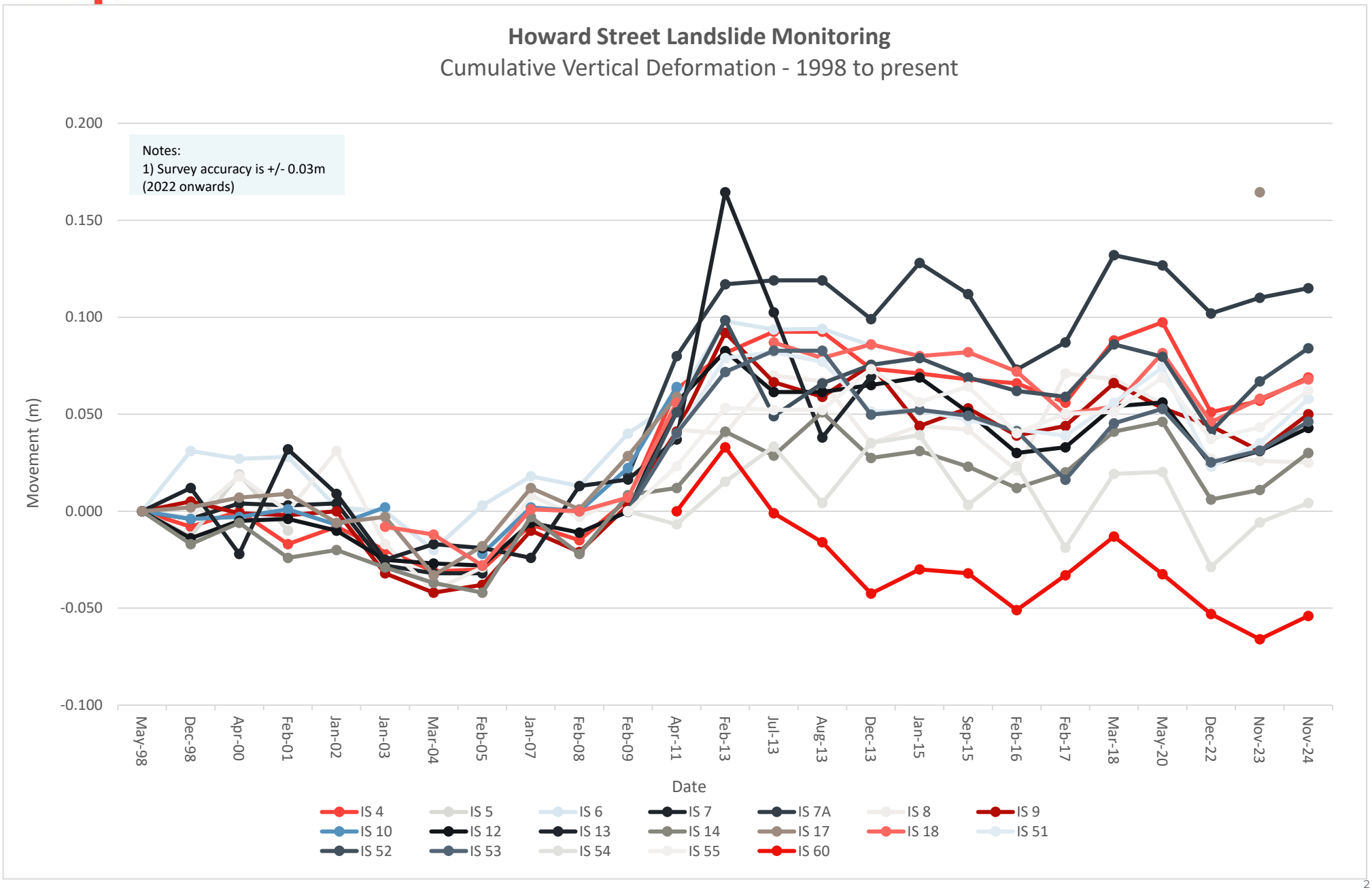
Appendix C
Vertical and Horizontal Cumulative Movement Graphs

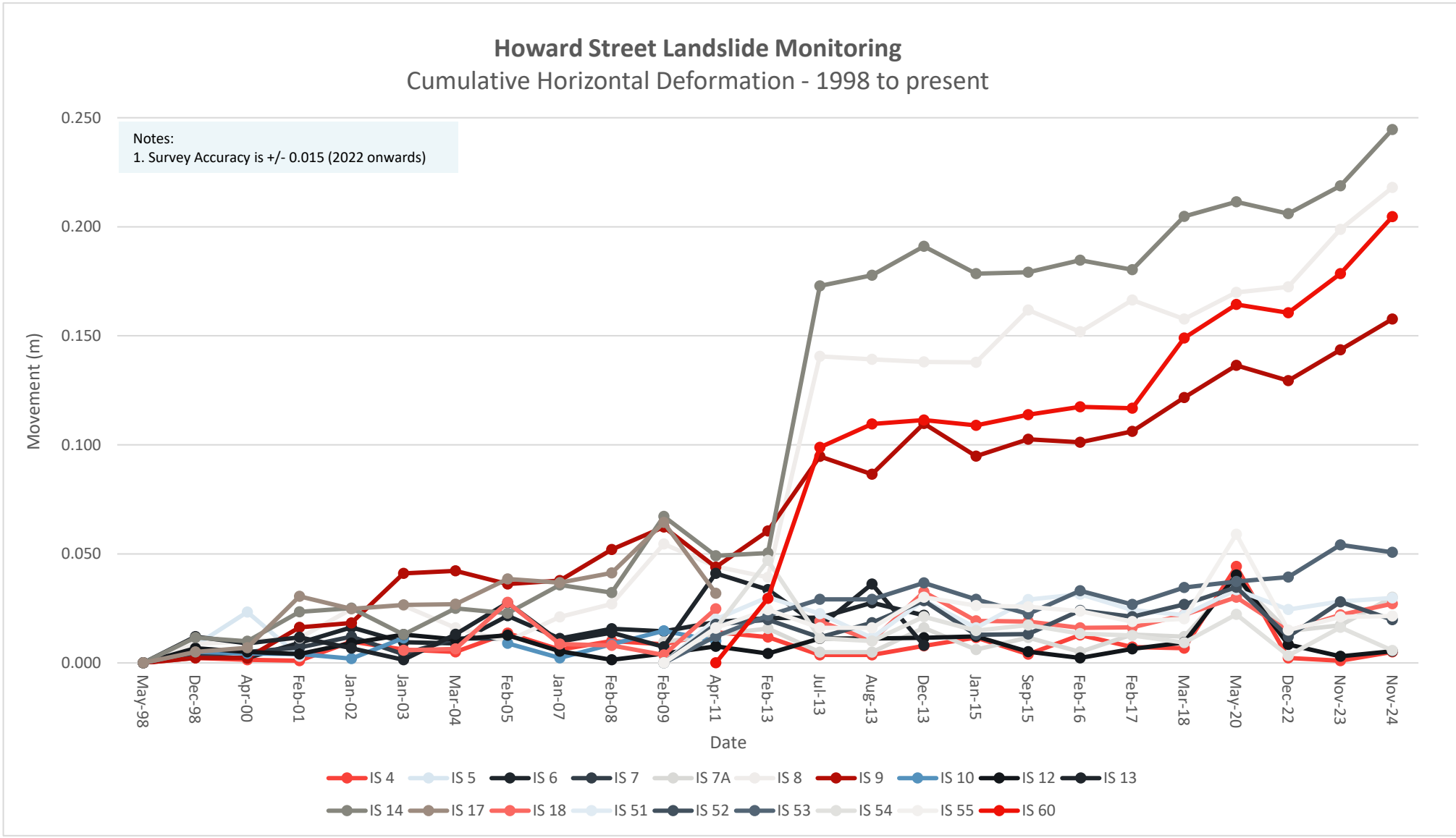

Puketeraki Landslide Monitoring
Cumulative Vertical Deformation - December 1992 to present
Vertical Movement (m)
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
-0.60
-0.70
-0.80
-0.90
-1.00
-1.10
-1.20
Dec 1992
Dec 1994
Dec 1996
Dec 1998
Dec 2000
Dec 2002
Dec 2004
Dec 2006
Dec 2008
Dec 2010
Dec 2012
Dec 2014
Dec 2016
Dec 2018
Dec 2020
Dec 2022
Dec 2024
Dec 2026
Notes:
1. See drawing in appendix for mark layout .
2. Survey accuracy is +/- 0.03m
IS 10
IS 3
NAIL 17
IS 5
IS 11
NAIL 12
IS 13
IS 15
IS 16
TOBY 19
IS 18
IS 02
IS 20
IS10a
IS 211a

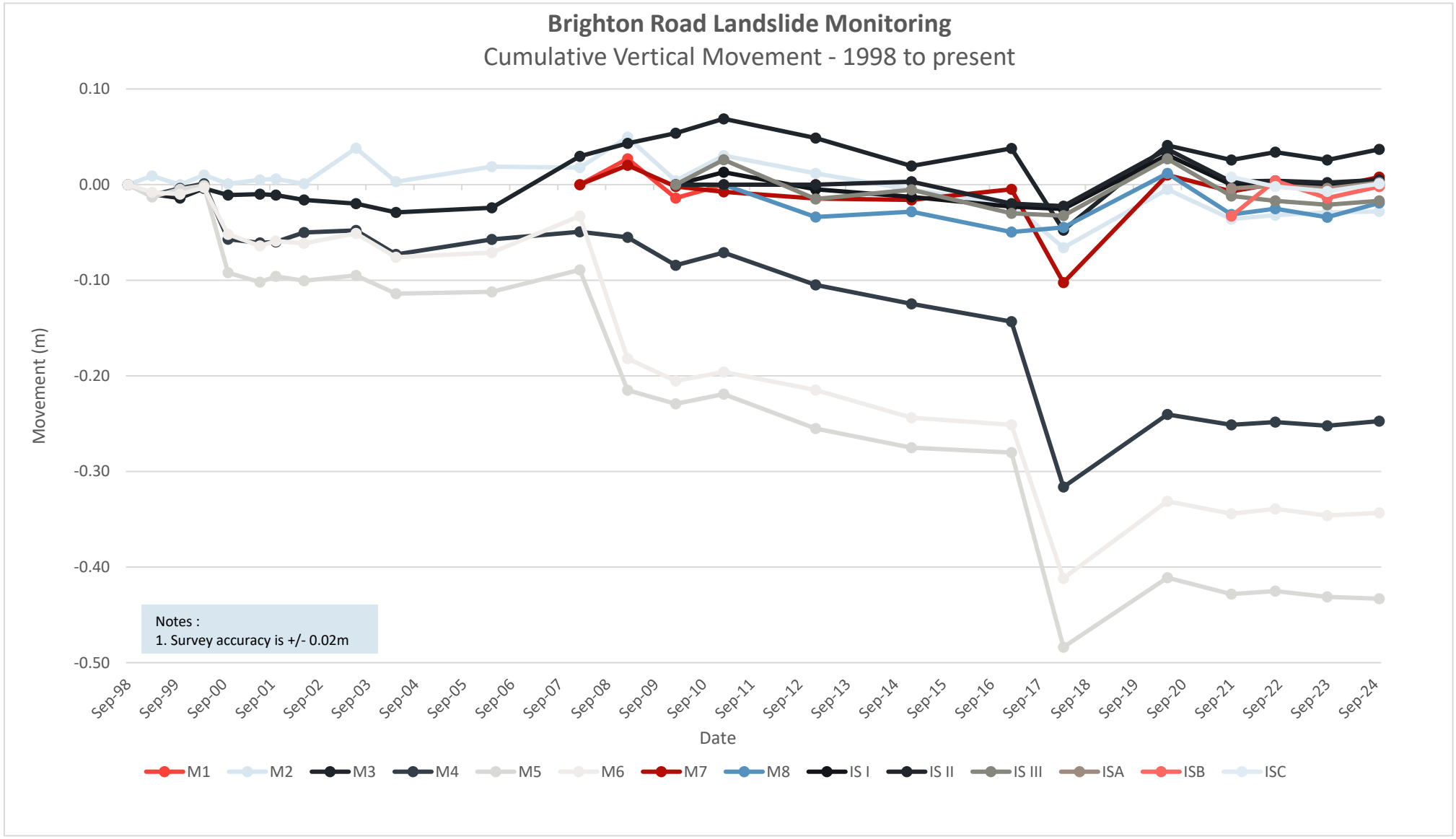

Puketeraki Landslide Monitoring
Cumulative Horizontal Deformation - December 1992 to present
Notes:
1. See drawing in appendix for mark layout.
2. Survey accuracy is +/- 0.02m Hz
Horizontal Movement (m)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
23-Dec-92
23-Dec-94
22-Dec-96
22-Dec-98
21-Dec-00
21-Dec-02
20-Dec-04
20-Dec-06
19-Dec-08
19-Dec-10
18-Dec-12
18-Dec-14
17-Dec-16
17-Dec-18
16-Dec-20
16-Dec-22
15-Dec-24
15-Dec-26
IS 10
IS 3
NAIL 17
IS 5
IS 11
NAIL 12
IS 13
IS 15
IS 16
TOBY 19
IS 18
IS 02
IS 20
IS10a
IS211a

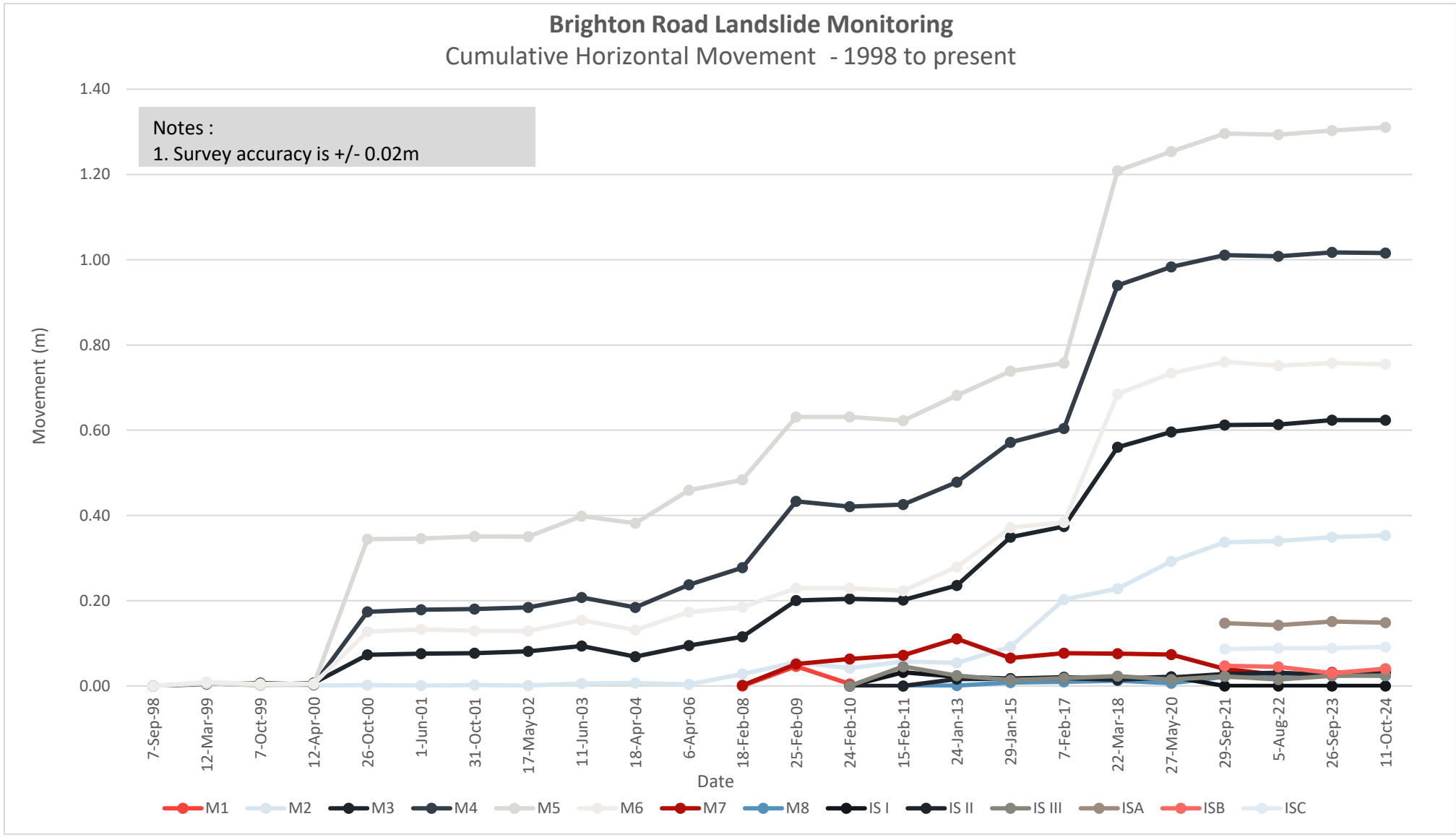

Greenacres Street Landslide Monitoring
Cumulative Vertical Deformation - 2015 to present
Vertical Movement (mm)
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
May 2013
Nov 2013
May 2014
Nov 2014
May 2015
Nov 2015
May 2016
Nov 2016
May 2017
Nov 2017
May 2018
Nov 2018
May 2019
Nov 2019
May 2020
Nov 2020
May 2021
Nov 2021
May 2022
Nov 2022
May 2023
Nov 2023
May 2024
Nov 2024
May 2025
Nov 2025
IS1
IS2
IS3
IS4
IS5
IS6
ISA
ISB

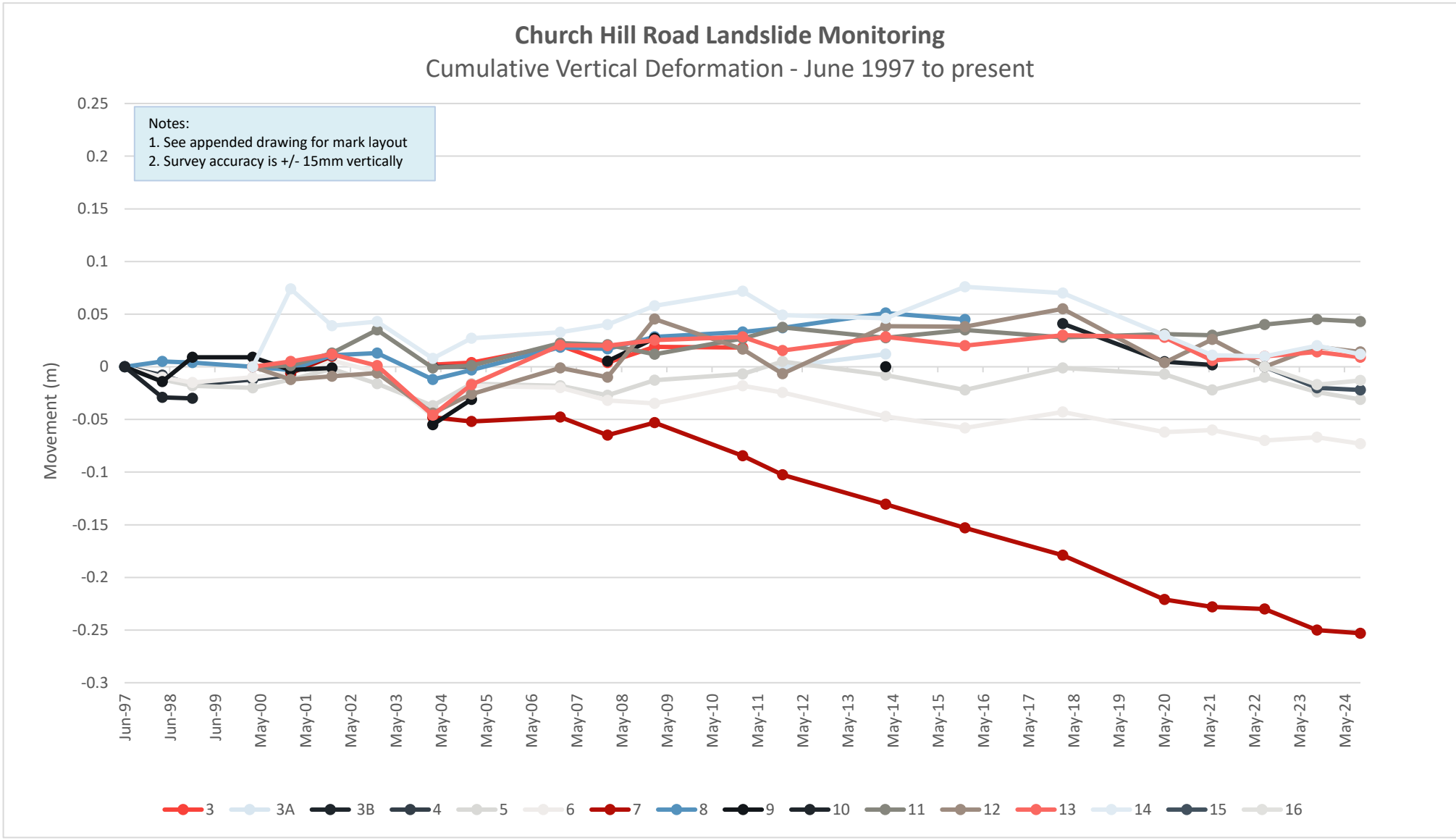

Greenacres Street Landslide Monitoring
Cumulative Horizontal Deformation - 2015 to present
Horizontal Movement (m)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
May 2013
Nov 2013
May 2014
Nov 2014
May 2015
Nov 2015
May 2016
Nov 2016
May 2017
Nov 2017
May 2018
Nov 2018
May 2019
Nov 2019
May 2020
Nov 2020
May 2021
Nov 2021
May 2022
Nov 2022
May 2023
Nov 2023
May 2024
Nov 2024
May 2025
Nov 2025
IS1
IS2
IS3
IS4
IS5
IS6
ISA
ISB

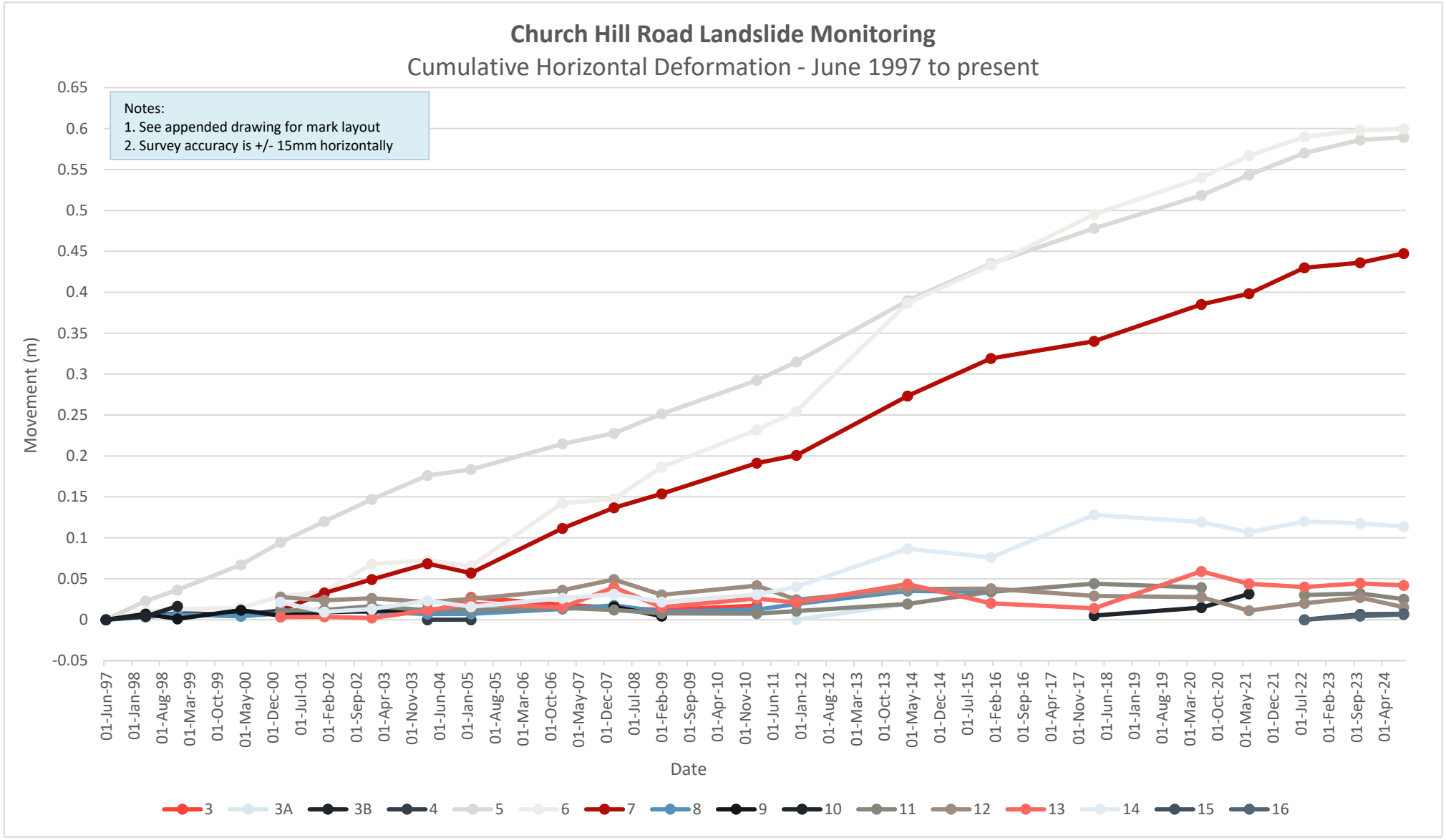

Howard Street Landslide Monitoring
Cumulative Vertical Deformation - 1998 to present
Notes:
1) Survey accuracy is +/- 0.03m
(2022 onwards)
Movement (m)
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
May-98
Dec-98
Apr-00
Feb-01
Jan-02
Jan-03
Mar-04
Feb-05
Jan-07
Feb-08
Feb-09
Apr-11
Feb-13
Jul-13
Aug-13
Dec-13
Jan-15
Sep-15
Feb-16
Feb-17
Mar-18
May-20
Dec-22
Nov-23
Nov-24
Date
IS 4
IS 5
IS 6
IS 7
IS 7A
IS 8
IS 9
IS 10
IS 12
IS 13
IS 14
IS 17
IS 18
IS 51
IS 52
IS 53
IS 54
IS 55
IS 60

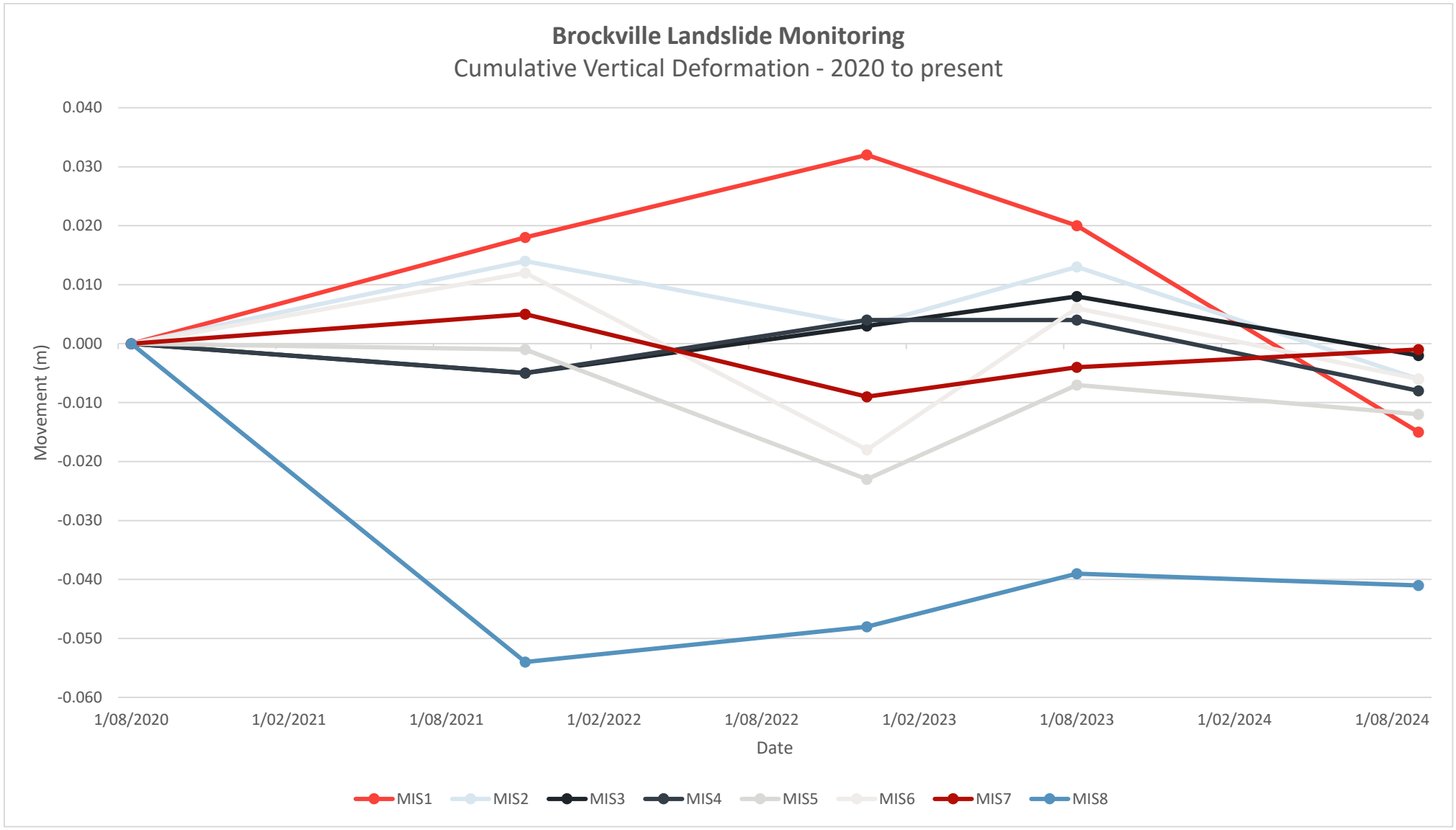

Howard Street Landslide Monitoring
Cumulative Horizontal Deformation - 1998 to present
Notes:
1. Survey Accuracy is +/- 0.015 (2022 onwards)
Movement (m)
0.250
0.200
0.150
0.100
0.050
0.000
May-98
Dec-98
Apr-00
Feb-01
Jan-02
Jan-03
Mar-04
Feb-05
Jan-07
Feb-08
Feb-09
Apr-11
Feb-13
Jul-13
Aug-13
Dec-13
Jan-15
Sep-15
Feb-16
Feb-17
Mar-18
May-20
Dec-22
Nov-23
Nov-24
Date
IS 4
IS 5
IS 6
IS 7
IS 7A
IS 8
IS 9
IS 10
IS 12
IS 13
IS 14
IS 17
IS 18
IS 51
IS 52
IS 53
IS 54
IS 55
IS 60

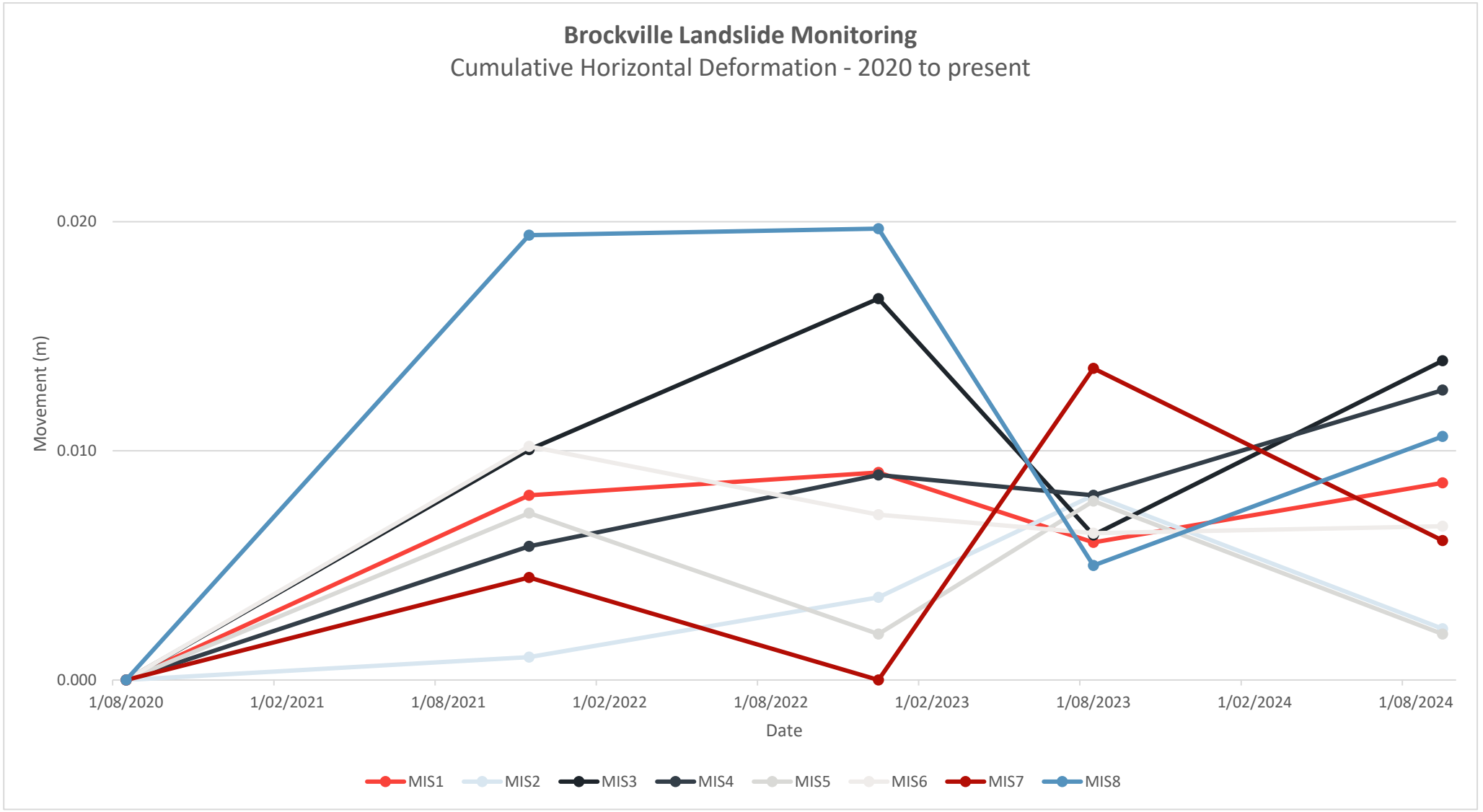

Brighton Road Landslide Monitoring
Cumulative Vertical Movement - 1998 to present
Movement (m)
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
Notes :
1. Survey accuracy is +/- 0.02m
Sep-98
Sep-99
Sep-00
Sep-01
Sep-02
Sep-03
Sep-04
Sep-05
Sep-06
Sep-07
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
Sep-16
Sep-17
Sep-18
Sep-19
Sep-20
Sep-21
Sep-22
Sep-23
Sep-24
Date
M1
M2
M3
M4
M5
M6
M7
M8
IS I
IS II
IS III
ISA
ISB
ISC

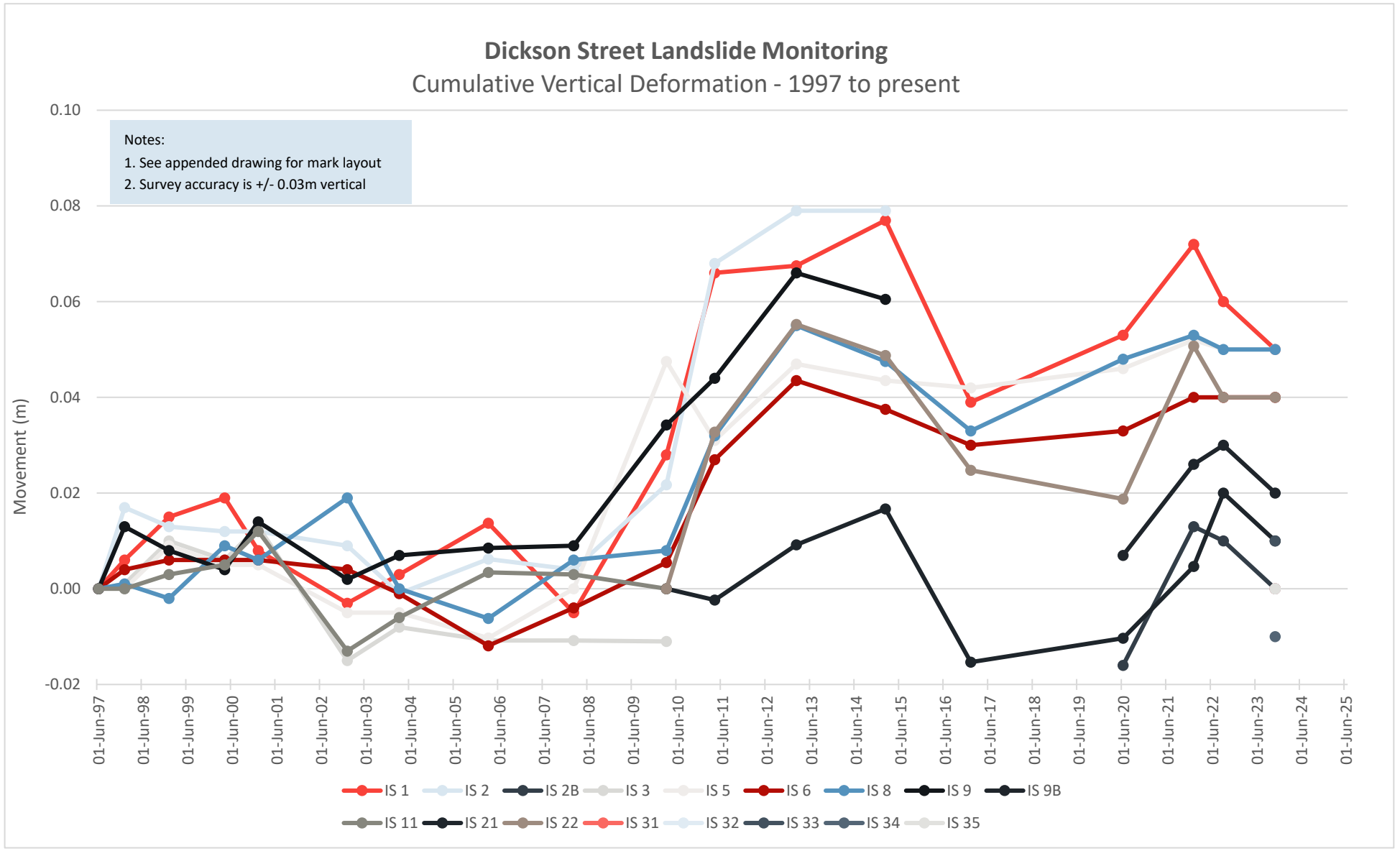

Brighton Road Landslide Monitoring
Cumulative Horizontal Movement - 1998 to present
Notes :
1. Survey accuracy is +/- 0.02m
Movement (m)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
7-Sep-98
12-Mar-99
7-Oct-99
12-Apr-00
26-Oct-00
1-Jun-01
31-Oct-01
17-May-02
11-Jun-03
18-Apr-04
6-Apr-06
18-Feb-08
25-Feb-09
24-Feb-10
15-Feb-11
24-Jan-13
29-Jan-15
7-Feb-17
22-Mar-18
27-May-20
29-Sep-21
5-Aug-22
26-Sep-23
11-Oct-24
Date
M1
M2
M3
M4
M5
M6
M7
M8
IS I
IS II
IS III
ISA
ISB
ISC

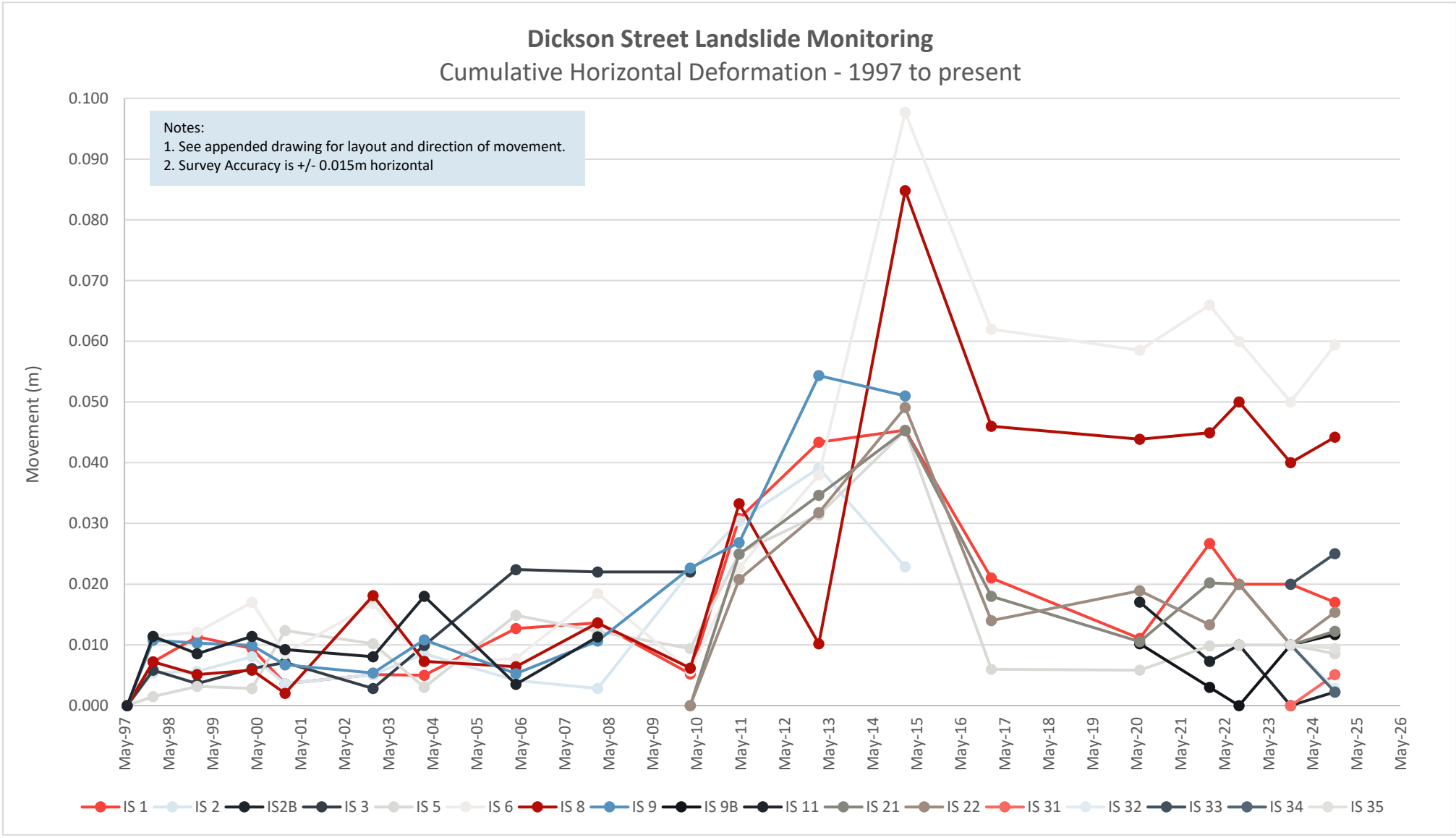

Church Hill Road Landslide Monitoring
Cumulative Vertical Deformation - June 1997 to present
Notes:
1. See appended drawing for mark layout
2. Survey accuracy is +/- 15mm vertically
Movement (m)
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
Jun-97
Jun-98
Jun-99
May-00
May-01
May-02
May-03
May-04
May-05
May-06
May-07
May-08
May-09
May-10
May-11
May-12
May-13
May-14
May-15
May-16
May-17
May-18
May-19
May-20
May-21
May-22
May-23
May-24
3
3A
3B
4
5
6
7
8
9
10
11
12
13
14
15
16

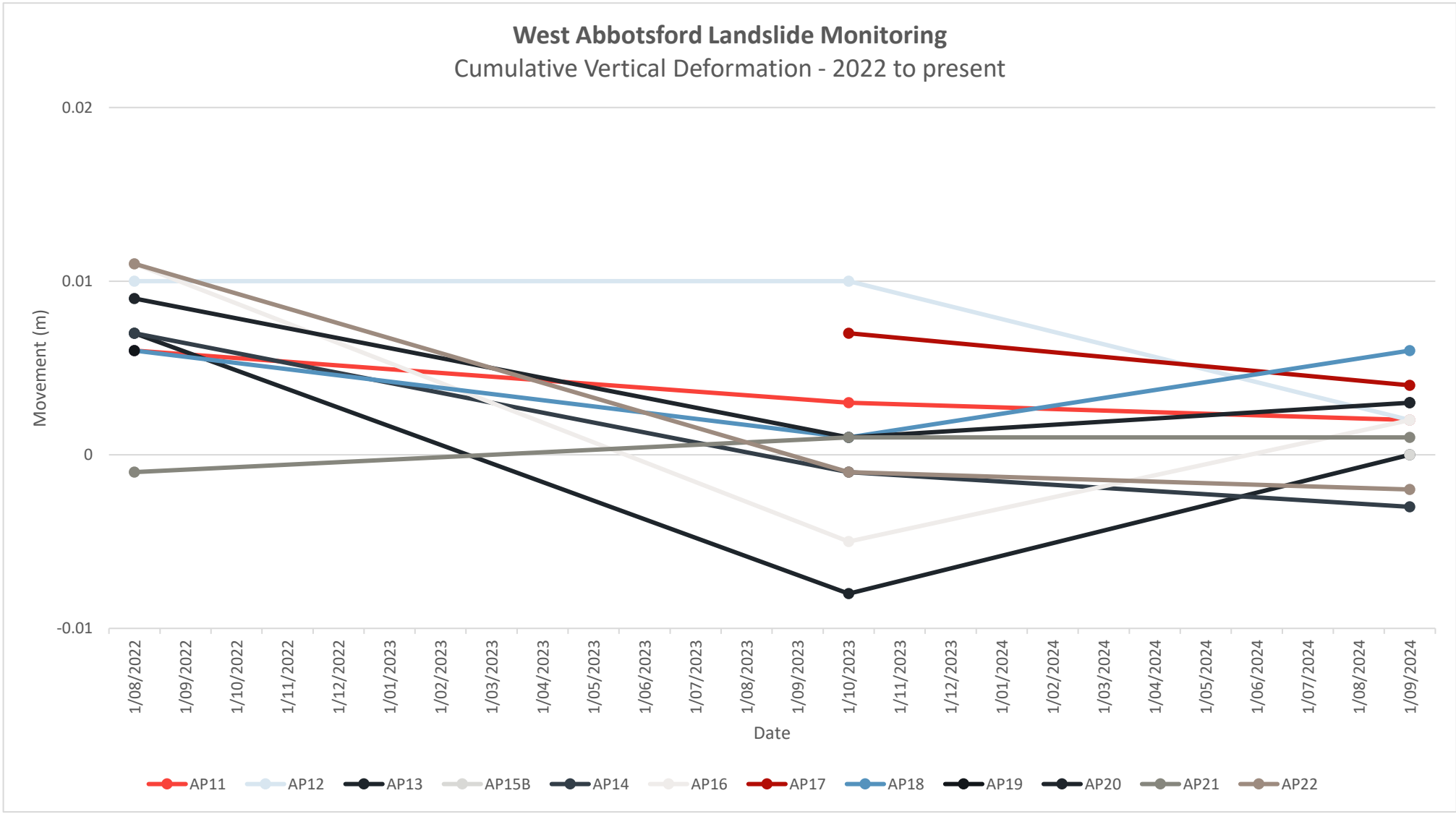

Church Hill Road Landslide Monitoring
Cumulative Horizontal Deformation - June 1997 to present
Notes:
1. See appended drawing for mark layout
2. Survey accuracy is +/- 15mm horizontally
Movement (m)
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
01-Jun-97
01-Jan-98
01-Aug-98
01-Mar-99
01-Oct-99
01-May-00
01-Dec-00
01-Jul-01
01-Feb-02
01-Sep-02
01-Apr-03
01-Nov-03
01-Jun-04
01-Jan-05
01-Aug-05
01-Mar-06
01-Oct-06
01-May-07
01-Dec-07
01-Jul-08
01-Feb-09
01-Sep-09
01-Apr-10
01-Nov-10
01-Jun-11
01-Jan-12
01-Aug-12
01-Mar-13
01-Oct-13
01-May-14
01-Dec-14
01-Jul-15
01-Feb-16
01-Sep-16
01-Apr-17
01-Nov-17
01-Jun-18
01-Jan-19
01-Aug-19
01-Mar-20
01-Oct-20
01-May-21
01-Dec-21
01-Jul-22
01-Feb-23
01-Sep-23
01-Apr-24
Date
3
3A
3B
4
5
6
7
8
9
10
11
12
13
14
15
16

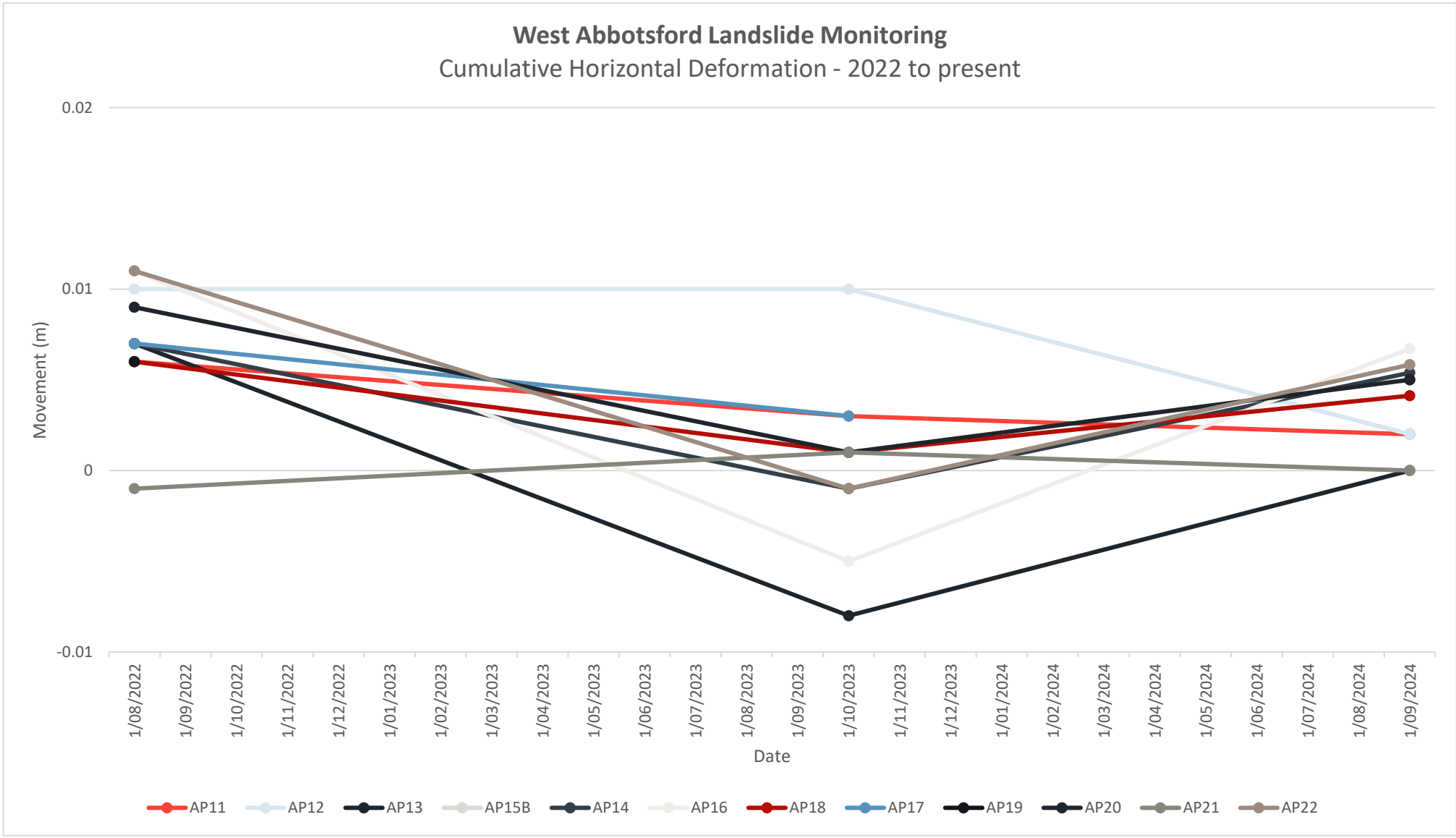

Brockville Landslide Monitoring
Cumulative Vertical Deformation - 2020 to present
0.040
0.030
0.020
0.010
0.000
-0.010
-0.020
-0.030
-0.040
-0.050
-0.060
Movement (m)
1/08/2020
1/02/2021
1/08/2021
1/02/2022
1/08/2022
1/02/2023
1/08/2023
1/02/2024
1/08/2024
Date
MIS1
MIS2
MIS3
MIS4
MIS5
MIS6
MIS7
MIS8

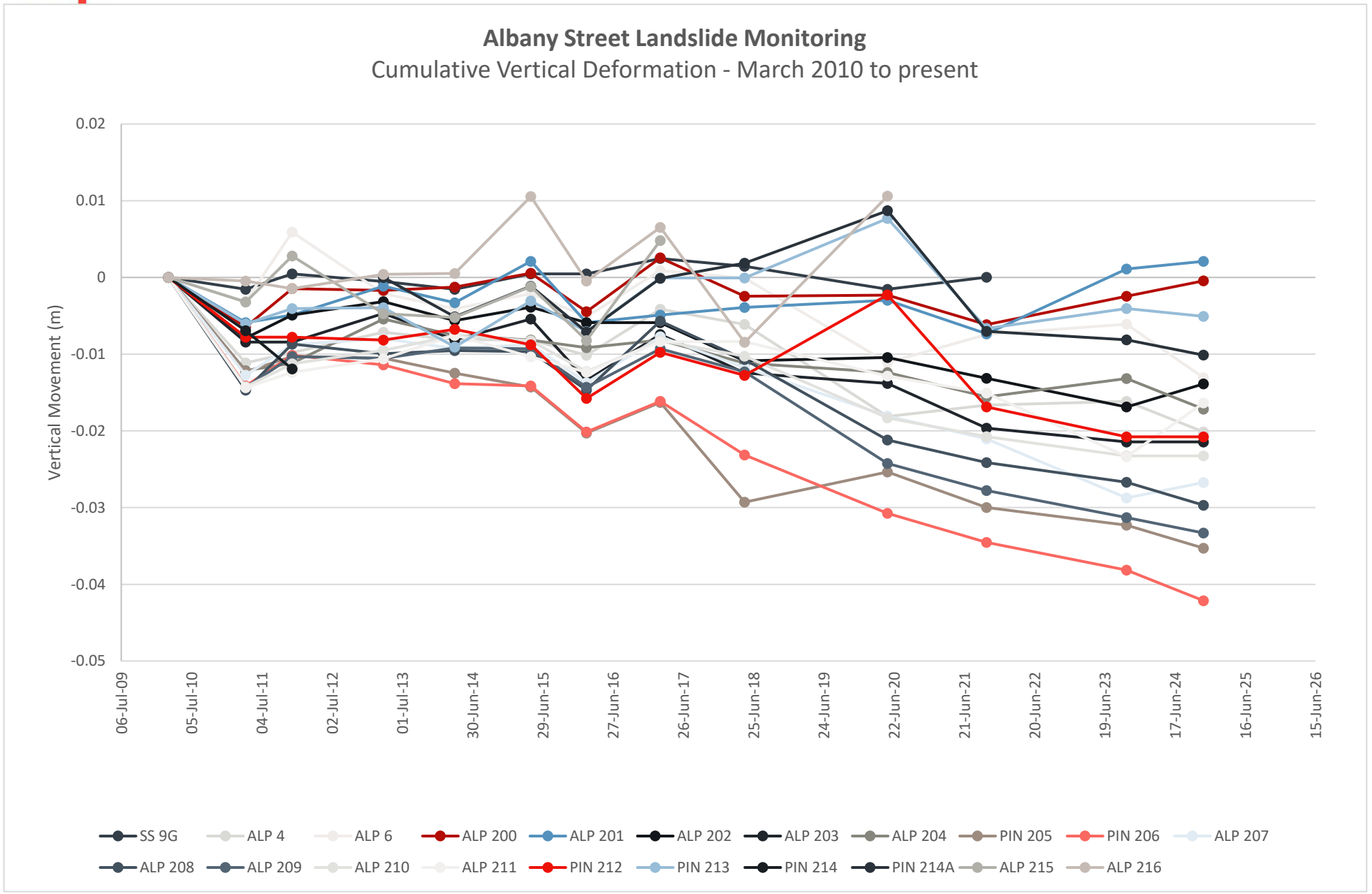

Brockville Landslide Monitoring
Cumulative Horizontal Deformation - 2020 to present
0.020
0.010
0.000
Movement (m)
1/08/2020
1/02/2021
1/08/2021
1/02/2022
1/08/2022
1/02/2023
1/08/2023
1/02/2024
1/08/2024
Date
MIS1
MIS2
MIS3
MIS4
MIS5
MIS6
MIS7
MIS8

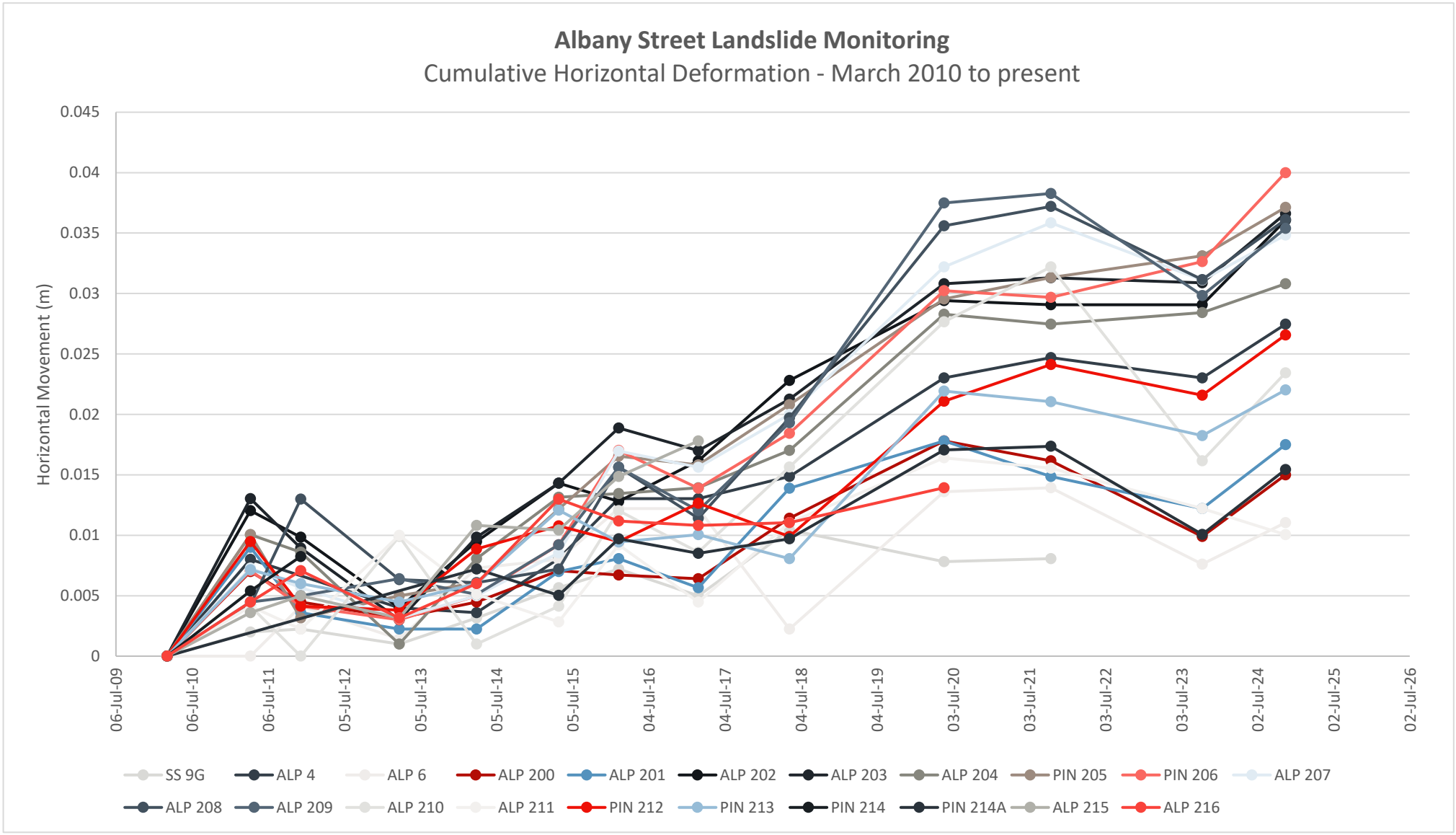

Dickson Street Landslide Monitoring
Cumulative Vertical Deformation - 1997 to present
Notes:
1. See appended drawing for mark layout
2. Survey accuracy is +/- 0.03m vertical
Movement (m)
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
01-Jun-97
01-Jun-98
01-Jun-99
01-Jun-00
01-Jun-01
01-Jun-02
01-Jun-03
01-Jun-04
01-Jun-05
01-Jun-06
01-Jun-07
01-Jun-08
01-Jun-09
01-Jun-10
01-Jun-11
01-Jun-12
01-Jun-13
01-Jun-14
01-Jun-15
01-Jun-16
01-Jun-17
01-Jun-18
01-Jun-19
01-Jun-20
01-Jun-21
01-Jun-22
01-Jun-23
01-Jun-24
01-Jun-25
IS 1
IS 2
IS 2B
IS 3
IS 5
IS 6
IS 8
IS 9
IS 9B
IS 11
IS 21
IS 22
IS 31
IS 32
IS 33
IS 34
IS 35

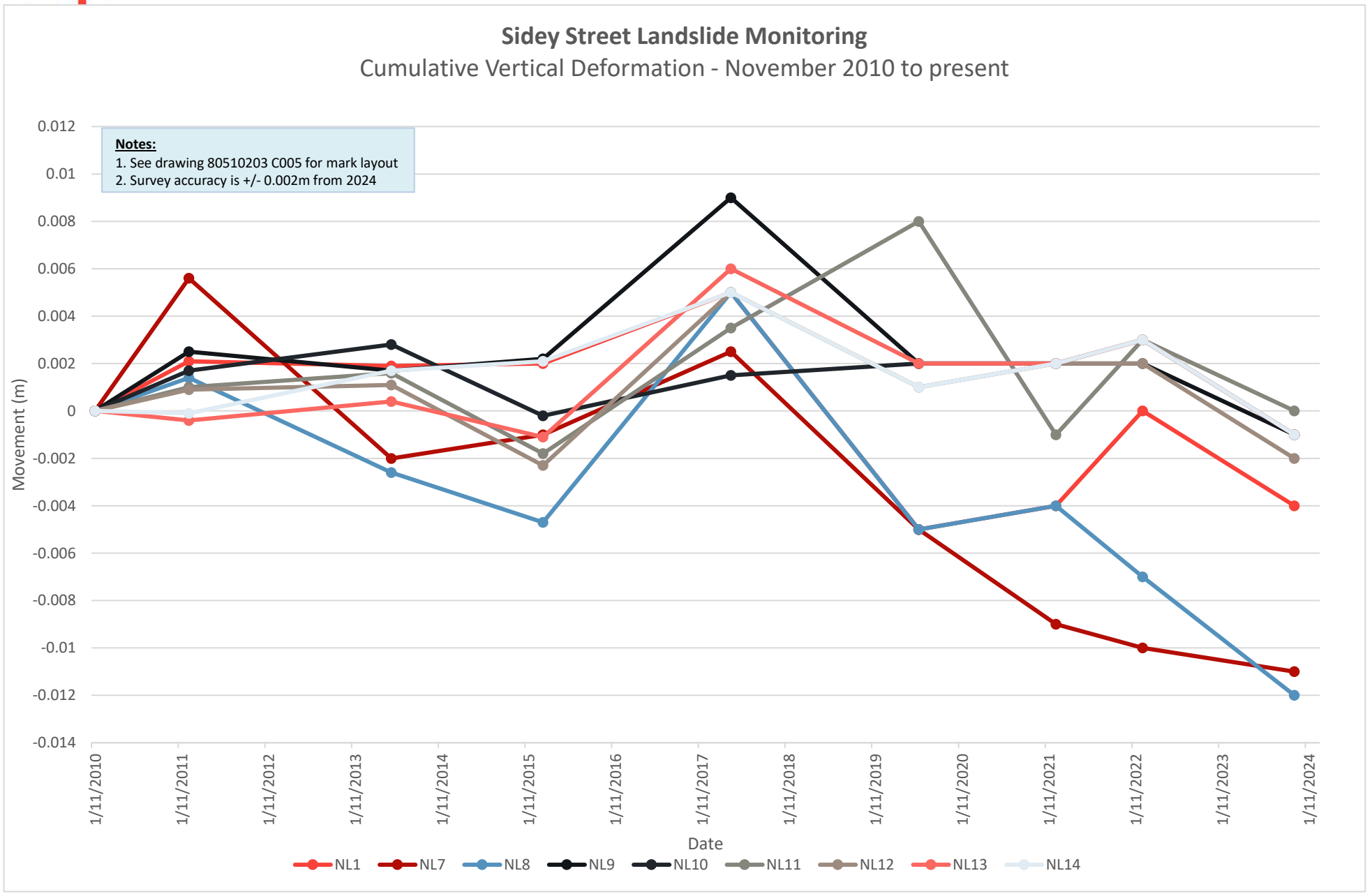

Dickson Street Landslide Monitoring
Cumulative Horizontal Deformation - 1997 to present
Notes:
1. See appended drawing for layout and direction of movement.
2. Survey Accuracy is +/- 0.015m horizontal
Movement (m)
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
May-97
May-98
May-99
May-00
May-01
May-02
May-03
May-04
May-05
May-06
May-07
May-08
May-09
May-10
May-11
May-12
May-13
May-14
May-15
May-16
May-17
May-18
May-19
May-20
May-21
May-22
May-23
May-24
May-25
May-26
IS 1
IS 2
IS2B
IS 3
IS 5
IS 6
IS 8
IS 9
IS 9B
IS 11
IS 21
IS 22
IS 31
IS 32
IS 33
IS 34
IS 35

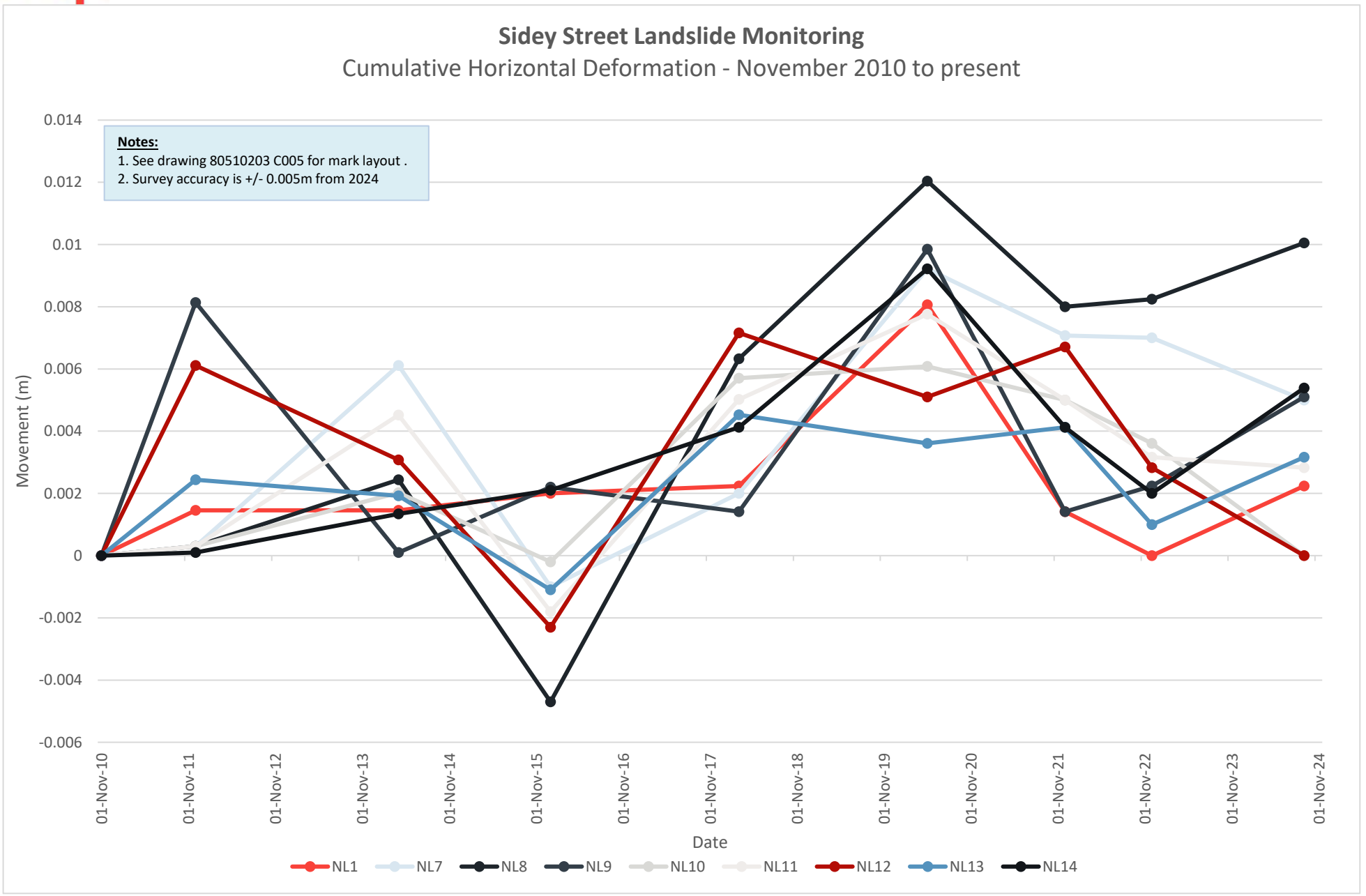

West Abbotsford Landslide Monitoring
Cumulative Vertical Deformation - 2022 to present
0.02
0.01
0
-0.01
Movement (m)
1/08/2022
1/09/2022
1/10/2022
1/11/2022
1/12/2022
1/01/2023
1/02/2023
1/03/2023
1/04/2023
1/05/2023
1/06/2023
1/07/2023
1/08/2023
1/09/2023
1/10/2023
1/11/2023
1/12/2023
1/01/2024
1/02/2024
1/03/2024
1/04/2024
1/05/2024
1/06/2024
1/07/2024
1/08/2024
1/09/2024
Date
AP11
AP12
AP13
AP15B
AP14
AP16
AP17
AP18
AP19
AP20
AP21
AP22


West Abbotsford Landslide Monitoring
Cumulative Horizontal Deformation - 2022 to present
0.02
0.01
0
-0.01
Movement (m)
1/08/2022
1/09/2022
1/10/2022
1/11/2022
1/12/2022
1/01/2023
1/02/2023
1/03/2023
1/04/2023
1/05/2023
1/06/2023
1/07/2023
1/08/2023
1/09/2023
1/10/2023
1/11/2023
1/12/2023
1/01/2024
1/02/2024
1/03/2024
1/04/2024
1/05/2024
1/06/2024
1/07/2024
1/08/2024
1/09/2024
Date
AP11
AP12
AP13
AP15B
AP14
AP16
AP18
AP17
AP19
AP20
AP21
AP22


Albany Street Landslide Monitoring
Cumulative Vertical Deformation - March 2010 to present
Vertical Movement (m)
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
-0.05
06-Jul-09
05-Jul-10
04-Jul-11
02-Jul-12
01-Jul-13
30-Jun-14
29-Jun-15
27-Jun-16
26-Jun-17
25-Jun-18
24-Jun-19
22-Jun-20
21-Jun-21
20-Jun-22
19-Jun-23
17-Jun-24
16-Jun-25
15-Jun-26
SS 9G
ALP 4
ALP 6
ALP 200
ALP 201
ALP 202
ALP 203
ALP 204
PIN 205
PIN 206
ALP 207
ALP 208
ALP 209
ALP 210
ALP 211
PIN 212
PIN 213
PIN 214
PIN 214A
ALP 215
ALP 216


Albany Street Landslide Monitoring
Cumulative Horizontal Deformation - March 2010 to present
Horizontal Movement (m)
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
06-Jul-09
06-Jul-10
06-Jul-11
05-Jul-12
05-Jul-13
05-Jul-14
05-Jul-15
04-Jul-16
04-Jul-17
04-Jul-18
04-Jul-19
03-Jul-20
03-Jul-21
03-Jul-22
03-Jul-23
02-Jul-24
02-Jul-25
02-Jul-26
SS 9G
ALP 4
ALP 6
ALP 200
ALP 201
ALP 202
ALP 203
ALP 204
PIN 205
PIN 206
ALP 207
ALP 208
ALP 209
ALP 210
ALP 211
PIN 212
PIN 213
PIN 214
PIN 214A
ALP 215
ALP 216


Sidey Street Landslide Monitoring
Cumulative Vertical Deformation - November 2010 to present
Notes:
1. See drawing 80510203 C005 for mark layout
2. Survey accuracy is +/- 0.002m from 2024
Movement (m)
0.012
0.01
0.008
0.006
0.004
0.002
0
-0.002
-0.004
-0.006
-0.008
-0.01
-0.012
-0.014
1/11/2010
1/11/2011
1/11/2012
1/11/2013
1/11/2014
1/11/2015
1/11/2016
1/11/2017
1/11/2018
1/11/2019
1/11/2020
1/11/2021
1/11/2022
1/11/2023
1/11/2024
Date
NL1
NL7
NL8
NL9
NL10
NL11
NL12
NL13
NL14


Sidey Street Landslide Monitoring
Cumulative Horizontal Deformation - November 2010 to present
Notes:
1. See drawing 80510203 C005 for mark layout .
2. Survey accuracy is +/- 0.005m from 2024
Movement (m)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
-0.002
-0.004
-0.006
01-Nov-10
01-Nov-11
01-Nov-12
01-Nov-13
01-Nov-14
01-Nov-15
01-Nov-16
01-Nov-17
01-Nov-18
01-Nov-19
01-Nov-20
01-Nov-21
01-Nov-22
01-Nov-23
01-Nov-24
Date
NL1
NL7
NL8
NL9
NL10
NL11
NL12
NL13
NL14