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Level 3, 4 Broadcast Way
Artarmon, NSW 2064

Project 86852.03
2 December 2021

R.004.Rev2
ZH/JH

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Geotechnical Monitoring Plan for Ground Surface Deformations
Student Housing Development
90-102 Regent Street, Redfern

1. Introduction

This Geotechnical Monitoring Plan (GMP) sets out the proposed geotechnical monitoring requirements during basement excavation and building construction works for the proposed Student Housing Development, 90-102 Regent Street, Redfern. This GMP is prepared in accordance with Sections 8.5 and 10 of "Sydney Metro Underground Corridor Protection Technical Guidelines (Ref: iCentral SM-20-00081444, Rev 2)", which sets out minimum requirements for developing GMPs for proposed developments near Sydney Metro assets. Reference is also made to TfNSW technical direction for excavation adjacent to Transport for NSW infrastructure (Ref: GTD 2020/001, Version No. 01 – 2 July 2020).

This GMP focuses on monitoring the basement retaining walls and the ground deformation in the vicinity of the site. It is understood that the Sydney Metro tunnels beneath the site are currently under construction. Based on our recent experience from similar sites adjacent to Sydney Metro City Line, tunnel access is unlikely to be granted by the tunnel construction contractors, therefore the monitoring activities that are required to be carried out inside the tunnels, such as tunnel convergence, stress and liner crack width monitoring, are not proposed in this GMP. However, tunnel monitoring would be of little benefit due to the small predicted movements in numerical modelling undertaken by Douglas Partners (Ref. DP 86852.03.R.003) and the nature of construction, with any induced movement being taken up in the gaskets between precast segments.

The vibration monitoring and management regime for Sydney Metro Tunnels was prepared by Acoustic Logic (Document Ref: 20201184.1/2402A/R1/AW). The vibration monitoring should be carried out in accordance with this document.

The proposed bulk excavation level is about RL 22.6 m, relative to Australian Height Datum (AHD) for the basement and RL 20.6 m AHD for the building core structure. The total required excavation depth varies between approximately 0.4 m on the southern part of the site where there is an existing basement and 6 m on the north-eastern part of the site, below the existing surface levels. It is understood that the existing basement retaining walls on the southern half of the site will be re-used as the perimeter walls

for the new basement. It is also understood that the existing basement retaining wall comprises 300 mm diameter contiguous shoring piles and will be temporarily propped for construction works.

It is also understood that the shoring or battering for the new retaining wall for expansion of existing basement and for building core is currently under design.

A geotechnical investigation has been undertaken for the project by Douglas Partners (Ref. DP 86852.00.R.001). This GMP has been based on the conditions encountered in this investigation.

Numerical modelling was also undertaken by Douglas Partners (Ref. DP 86852.03.R.003) to assess the potential impacts that the proposed Student Housing Development may have on the underlying Sydney Metro City and South West tunnel infrastructure.

2. Geotechnical Monitoring

Geotechnical monitoring is to include the following:

- Monitoring of survey targets at 10 m centres along the top of the shoring walls (refer attached Drawing GMP1);
- Monitoring of survey targets at 20 m centres on the eastern, northern, and western site boundary (refer attached Drawing GMP1).

Baseline readings will be established prior to the commencement of the bulk excavation. In addition, inspections of shoring walls during construction, prop installation (if props are to be used), and inspection of the base of the bulk excavation will be carried out as works progress.

As the existing Sydney Metro tunnels are located beneath the site and not adjacent to the proposed excavation works, no inclinometers are proposed in this GMP, as differential lateral movement of the ground beneath the site is not anticipated.

3. Geotechnical Monitoring Frequency and Hold Points

The frequency of geotechnical monitoring and Hold Points for the works are outlined in Table 1.

Table 1: Geotechnical Monitoring Frequency and Hold Points

Hold Point	Responsibility	Description
1	Geotechnical Engineer	Inspection of new shoring wall installation to confirm works have been constructed as per the design drawings.
2	Geotechnical Engineer	Inspection of prop installation to the existing retaining wall to confirm works have been constructed as per the design drawings.
3	Registered Surveyor	Installation of survey monitoring targets at 10 m centres at the top of the shoring walls, and on the eastern, northern and western site boundaries at 20 m intervals. Baseline survey of monitoring targets before commencement of any basement demolition and bulk excavation works.
4	Registered Surveyor	Survey of the relevant monitoring points during and after excavation: <ul style="list-style-type: none"> • After the existing ground and basement floor slabs are demolished; • after excavation to bulk excavation level; • once new basement and ground slabs have been constructed and props are removed; and • one month following completion of basement structure or after three consecutive measurements not less than a week apart showing no further movement, whichever is the later.
5	Geotechnical Engineer	Inspection of the base of the excavation at bulk excavation level by Geotechnical Engineer to assess the geotechnical conditions.
6	Geotechnical Engineer	Inspection of the foundation pile drilling to ensure required socket depths and material are achieved.
7	Geotechnical Engineer	Inspection of prop removal by Geotechnical Engineer to confirm that the props are removed from the structure.

Hold Points are released after verification by the design engineer.

4. Movement Trigger Levels

Based on TfNSW technical direction for excavation adjacent to Transport for NSW infrastructure (Ref: GTD 2020/001, Version No. 01 – 2 July 2020), the total serviceability horizontal movement of the wall in any one direction that is acceptable for non-sensitive TfNSW assets, is to be limited to 0.5% of the excavated height, or 30 mm, or the structural serviceability requirements of the retaining wall, whichever is the lesser. Considering some previous movements have occurred, the wall deflection trigger levels for the existing basement shoring wall are based on a nominal wall deflection of 10 mm. The threshold levels adopted are provided in Table 2.

Table 2: Deflection Trigger Levels for Existing Basement Retaining Wall

Threshold Level	% of Agreed Limit	Magnitude of Deflection	Required Action
Alert Level	Up to 80%	Up to 8 mm	No action. Excavation can continue
Action Level	81% to 100%	8 mm to 10 mm	Review monitoring data and increase monitoring frequency to an agreed level. Excavation can continue
Alarm Level	Over 100%	>10 mm	Excavation to stop and agreed contingency measures to be implemented

The wall deflection trigger levels for the new sheetpile wall are based on a nominal wall deflection of 15 mm that is based on 0.5% of excavation depth of 3 m on the western part of the site where the sheetpile wall is proposed. The threshold levels adopted are provided in Table 3.

Table 3: Deflection Trigger Levels for Sheetpile Wall

Threshold Level	% of Agreed Limit	Magnitude of Deflection	Required Action
Alert Level	Up to 80%	Up to 12 mm	No action. Excavation can continue
Action Level	81% to 100%	12 mm to 15 mm	Review monitoring data and increase monitoring frequency to an agreed level. Excavation can continue
Alarm Level	Over 100%	>15 mm	Excavation to stop and agreed contingency measures to be implemented

The ground movement trigger levels for the monitoring targets installed along site boundaries are provided in Table 4.

Table 4: Movement Trigger Levels for Site Boundaries

Threshold Level	% of Agreed Limit	Magnitude of Horizontal Movement	Magnitude of Vertical Settlement	Required Action
Alert Level	Up to 80%	Up to 8 mm	Up to 4 mm	No action. Excavation can continue
Action Level	81% to 100%	8 mm to 10 mm	4 mm to 5 mm	Review monitoring data and increase monitoring frequency to an agreed level. Excavation can continue
Alarm Level	Over 100%	>10 mm	>5 mm	Excavation to stop and agreed contingency measures to be implemented

5. Contingency Measures

Contingency measures will depend on the nature of the trigger level exceedance. Measures are likely to include backfilling against the retaining wall, installation of additional internal props/bracing etc.

Note that all monitoring devices should be kept in operating condition at all times. Construction works to be suspended where more than 30% of the devices are not operational.

6. Certification

Certification by a Chartered Professional Engineer (CPEng) will be required to confirm that the geotechnical conditions are in accordance with those described in the geotechnical report and that the works have been constructed in accordance with the design drawings.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully

Douglas Partners Pty Ltd



Zakieh Harif
Geotechnical Engineer



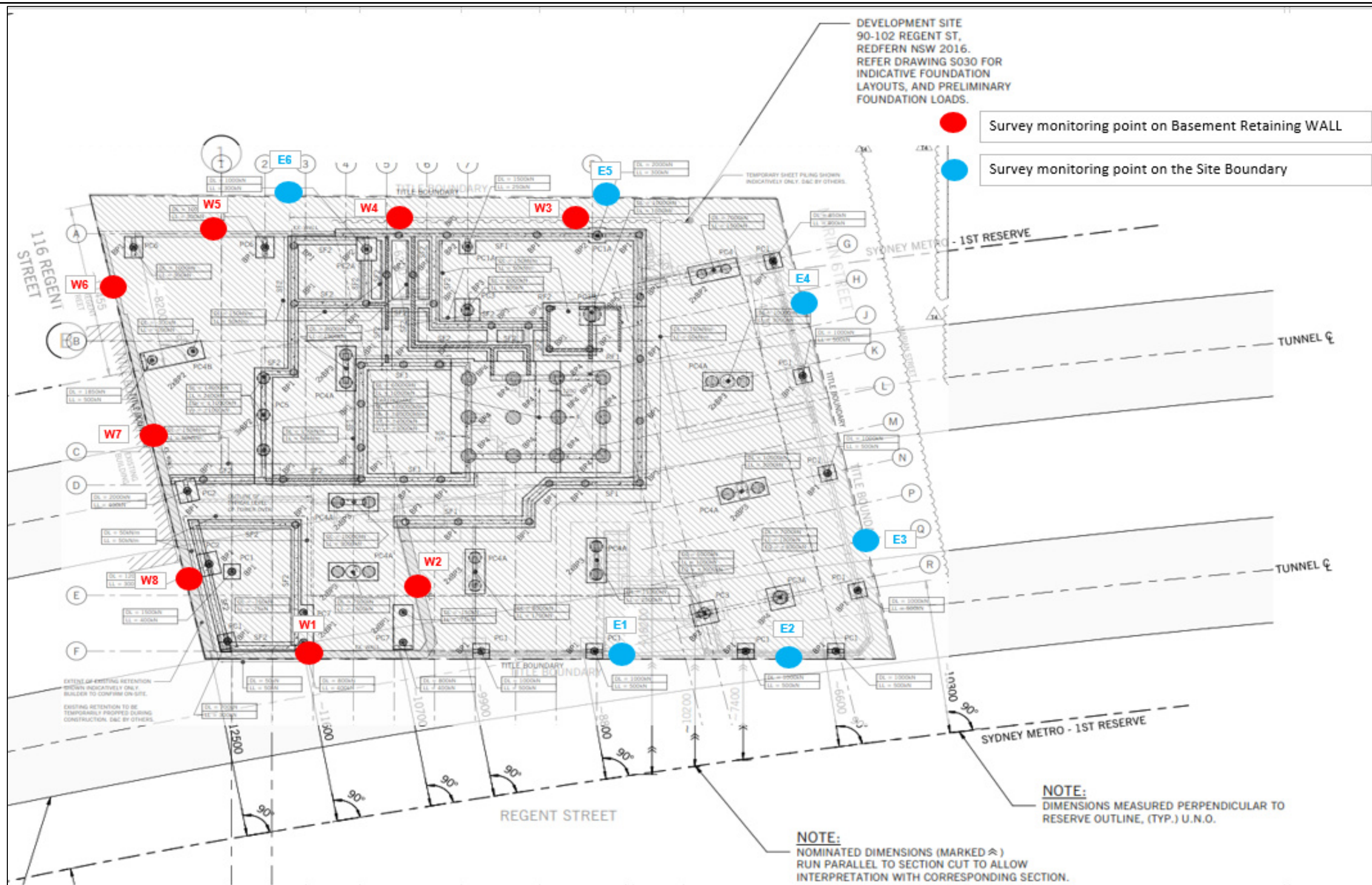
Joel Huang
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Reviewed by


John Braybrooke

Principal

Attachments: Drawing GMP1
 About this Report



About this Report

Douglas Partners



Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.