GEOTECHNICAL ASSESSMENT REPORT

FORTIFY
GEOTECH

Proposed Development – 23 to 31 Dover Road, Rose Bay

Preliminary Assessment of Potential Geotechnical Impacts on Neighbouring Properties

CLIENT

A Group of Wilberforce Avenue Residents

ADDRESS

23 to 31 Dover Road, Rose Bay

DATE

December 2025

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1 December 2025
Our ref: JM/C17038_Rev6

A Group of Wilberforce Avenue Residents

Via email: carmen@cjmcloughlinca.com.au

Attention: Carmen Mcloughlin

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We are pleased to present our a geotechnical desk-top study as part of a proposed development at 23 to 31 Dover Road, in Rose Bay, NSW.

Given the scale of the proposed development and the history in the area of detrimental impacts to neighbouring properties due to similar construction, the aim of the assessment is to provide details on potential geotechnical impacts on neighbouring properties should the proposed development proceed.

Should you require any further information regarding this report, please do not hesitate to contact our office.

Yours faithfully
Fortify Geotech

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About us

We work with our clients to provide practical advice and solutions tailored to each project. Our professional services are reliable, responsive and efficient.

Our highly capable Geotechnical Engineers and Geologists have a comprehensive understanding of the industry. We provide the best engineering solution for complicated geotechnical engineering issues. This has earned us a solid reputation with our Construction Industry, Municipal and Government clients.

INDUSTRIES WE WORK IN

- Residential
- Commercial
- Transport Infrastructure
- Industrial Developments of all sizes.

SERVICES

- Geotechnical Site Investigations and Reporting;
- Engineering Geology;
- Mining/Rock Geotechnics;
- Foundation Engineering;
- Dam Engineering; Embankment Design and Specification;
- Geotechnical Design Recommendations;
- Pavement Engineering and Design;
- Pavement Condition Surveys;
- Slope Stability and Risk Assessments;
- Geotechnical and Hydrological Instrumentation and Monitoring;
- Footing and Excavation Supervision and Certifications;
- Excavated soil/rock assessments and VENM assessments;
- Supervision and Certification of Earthworks and Controlled Fill, including Level 1 supervision;
- Geotechnical Construction Specifications;
- Deep Excavation Support; and
- Slope/Retaining Structure Analysis and Design

Table of Contents

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Geotechnical Assessment

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QUALITY INFORMATION

Revision history

Reference/ Revision	Description	Date	Author	Reviewer
JM/C17038 Rev6	For comment – Geotechnical Assessment	1/12/2025	JM	MD

Rose Bay Residents Action Group

Proposed Development – 23 to 31 Dover Road, Rose Bay

Preliminary Assessment of Potential Geotechnical Impacts on Neighbouring Properties

1 INTRODUCTION

1.1 PROPOSED DEVELOPMENT

We are pleased to present our geotechnical desk-top study as part of a proposed development at 23 to 31 Dover Road, in Rose Bay, NSW. It is understood that the proposed development comprises an eight-storey residential building with a two-level basement extending to ~6m depth (~RL2.8), however, there are proposals for additional adjacent developments totalling an area of ~18,500m^2 to 21,000m^2. A design groundwater level of ~RL4.6 within the DA documents, so the development could potentially require dewatering to temporarily lower the groundwater table by ~2m.

Given the scale of the proposed development and the history in the area of detrimental impacts to neighbouring properties due to similar construction, the aim of the assessment is to provide details on potential geotechnical impacts on neighbouring properties should the proposed development proceed. Potential geotechnical impacts could include:

- Settlement arising from dewatering or groundwater drawdown within the shallow aquifer,
- Cumulative impacts where multiple basements are constructed in close proximity – in this case, the development comprises six amalgamated sites sitting side by side,
- Foundation interaction and load transfer where new foundations are located close to (and within the zone of influence) existing load-bearing footings
- Changes in groundwater flow and drainage patterns, such as damming and shadowing, with redirected groundwater leading to seepage, damp issues, or flooding in adjoining properties.
- Vibrations from piling, compaction, excavation, and demolition could cause settlement in neighbouring loose granular soils if vibration induces densification, and
- Ground movement from excavation works, where deep or poorly supported excavations can cause lateral ground movement, footing distress, and disruption to infrastructure (roads and in-ground services).

Of particular concern is that the local planning controls appear to be inadequate in mitigating such damage and off-site effects could extend far beyond the subject properties. To date, the Councils planning controls fail to adequately require monitoring of dewatering activities on specific projects and cumulatively to ensure the 'safe' level of dewatering threshold is not breached.

Woollahra Municipal Council engaged GHD to assess hydrogeological and geotechnical conditions in the area to understand the impacts associated with deep excavations and dewatering (Report 12588469 of 31 July 2024 – Reference document #10 in Section 1.3). The aim of this document was to provide guidance to Woollahra Municipal Council when approving developments with deep excavations and dewatering. This Council commissioned document made the following observations, which were then incorporated into the Woollahra DCP 2015 via Amendments 18 and 30:

- Construction dewatering will extend far beyond the footprint of developments (up to 800m away).
- The lowering of groundwater levels through construction dewatering has a high risk of causing settlements to the groundsurface around the development, with consequential damage to properties.
- Developments must not cause “unacceptable lowering of groundwater levels” and cause “no adverse settlement or movement of surrounding land or structures”.
- To minimise the potential for damage to neighbouring properties, the recommendation was to **limit drawdown of groundwater levels to a maximum of 0.3m** outside of the site boundaries.

To minimise the impact of large-scale excavation from new developments, Woollahra Municipal Council has controls that limit excavation to 1,000m^3 per 1,000m^2 of property area. This development proposes to excavate ~15,000m^3 of soil for the property area of ~2,600m^2, which is about **six times the recommendation**.

1.2 EXECUTIVE SUMMARY

The proposed development will comprise the excavation of a ~6m deep basement, which will require construction dewatering to drawdown groundwater levels on site by up to 2m depth. Modelling by the proponent’s consultants shows that this construction dewatering will lower the groundwater table on adjacent land, extending to 75m from the development property boundaries. This will drawdown groundwater levels by between 0.3m and 1.3m depth on up to 40 adjacent properties.

The GHD report commissioned by Woollahra Municipal Council states that such drawdown can cause settlement and damage to properties, and therefore recommended that a limit of 0.3m of groundwater drawdown outside the development boundary be permissible. Given that the proponents modelling shows that groundwater drawdown will be greater than this affecting over 40 neighbouring properties, it is assessed that the proposed development does not comply with Council controls which are designed to protect surrounding residences.

There are numerous examples of construction dewatering causing damage to neighbouring properties in the Rose Bay and Double Bay areas (see Section 5.2). There is also the well-known case of the Mascot Towers, where construction dewatering on a neighbouring site caused extensive structural damage to the Mascot Towers apartment building. These examples highlight the risk and danger of excavating deep basements and dewatering next to existing structures.

In addition, the amount of proposed excavation (~15,000m^3 of soil for the property area of ~2,600m^2, or ~6,000m^3 per 1,000m^2) vastly exceeds the Council’s recommended limits.

1.3 BACKGROUND INFORMATION

To enable the assessment, the following documents (among others) were used to establish the project details, subsurface conditions, and potential adverse impacts:

1) MHNDUNION – "23 to 31 Dover Road, Rose Bay - Architectural Drawings", Project No. 25-020
2) Morrow Geotechnics – "Geotechnical Investigation Report – 23 to 31 Dover Road, Rose Bay", Report P3496_02 Rev1
3) Morrow Geotechnics – "Site Hydrogeology Report – 23 to 31 Dover Road, Rose Bay", Report P3496_03 Rev2
4) Morrow Geotechnics – "Dewatering Management Plan – 23 to 31 Dover Road, Rose Bay", Report P3496_04 Rev2
5) EI Australia – "Acid Sulfate Soil Management Plan – 23 to 31 Dover Road, Rose Bay", Report E26745.E14_Rev1
6) Pulse White Noise Acoustics – "SSD Noise and Vibration Impact Assessment – 23 to 31 Dover Road, Rose Bay", Project No. 250187
7) Ideal Geotech – "Report on Geotechnical Assessment – Wilberforce Avenue and Ian Street Carparks, Rose Bay", Jon No. 23921
8) Douglas Partners, "Report on Desktop Geotechnical and Hydrogeological Assessment - 488-492 Old South Head Rd & 30 Albermarle Ave, Rose Bay", Project No. 229319.00
9) Geo-Environmental Engineering, "Geotechnical & Hydrogeological Investigation Report – 66 to 68 Wilberforce Avenue, Rose Bay", Report ID G19075RB-R01F
10) GHD, "Rose Bay - Hydrogeological and Geotechnical Impacts – Groundwater and Geotechnical Assessment Report", for Woollahra Municipal Council, Report 12588469.

1.4 SCOPE OF WORKS

The aim of the report would be to summarise potential geotechnical risks and adverse impacts on neighbouring properties, and provide advice on how the Assessment Authority can implement Conditions to mitigate these risks. The preliminary geotechnical assessment report includes:

- A review of the documents provided as part of the State Significant Development application, including any potential shortcomings.
- Settlement arising from dewatering or groundwater drawdown within the shallow aquifer,
- whether the proposed 18,500m^2 to 21,000m^2 side-by-side development sites pose an additional significant risk given the known hydrogeological conditions indicate heightened settlement due to dewatering risk.
- whether development of this scale can be safely accommodated within such a groundwater system
- Provide examples of damage to properties in the area attributable to dewatering and excavation activities on other developments

- Provide recommendations for measures that must be implemented to reduce the risk of damage to neighboring properties, including mandatory requirements for monitoring dewatering activities, vibrations, and potential settlements.

2 SITE LOCATION & GEOLOGY

The site is located at 23 to 31 Dover Road in Rose Bay, in the eastern suburbs of Sydney. Plate 2-1 shows a recent aerial photo of the site, showing it to be currently occupied by five individual dwellings.

The MinView Seamless Geology Map documents the area to be underlain by Triassic age Hawkesbury Sandstone bedrock, comprising medium- to coarse-grained quartz sandstone displaying small- to large-scale, high-angle cross-bedding; minor shale and laminite lenses.

Topographically, the lower-lying areas of Rose Bay, such as this site, are covered by Holocene age coastal deposits (dune facies) and estuarine interbarrier creek deposits. The coastal deposit soils comprise marine-deposited and aeolian-reworked fine- to coarse-grained quartz-lithic sand with abundant carbonate, sporadic humic debris in stabilised dunes, and marine-deposited and aeolian-reworked coastal sand dunes, while the estuarine deposit soils comprise fine- to medium-grained lithic-carbonate-quartz sand (marine-deposited), silt, clay, organic mud, peat, gravel, shell material.

There are also large areas of the Double Bay ward that are covered by Quaternary age anthropogenic deposits (man-made fill), comprising anthropocene deposits varying from large man-made clasts (concrete blocks to building demolition rubble) to quarried natural boulders, with interstitial sand-sized to clay matrix.Plate 2-2 shows the geological map of the area.

Plate 2-1: Site Location Showing the Proposed Development

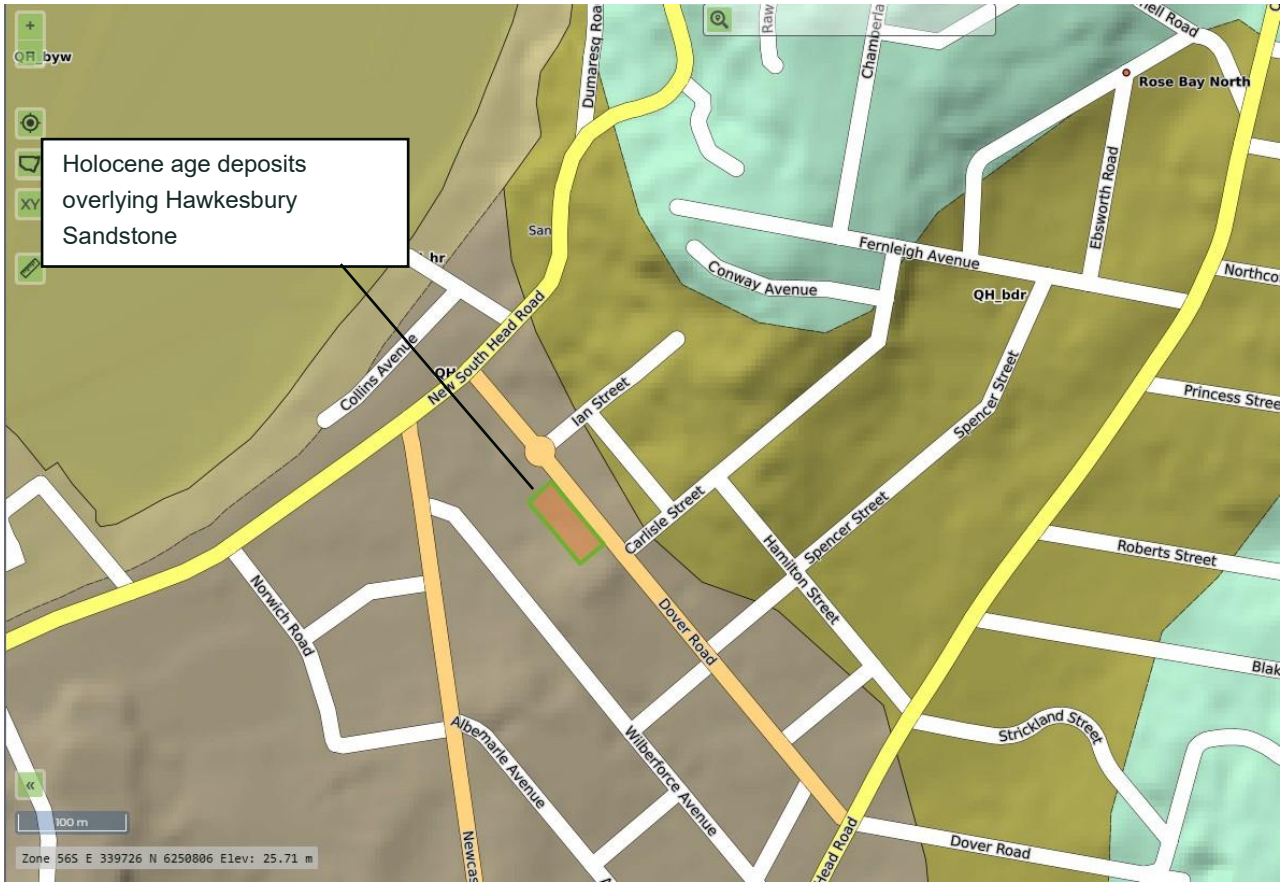

Plate 2-2: Extract of the Minview Seamless Geology Map Showing the site to be covered by Holocene age Coastal & Estuarine Deposits

3 ASSESSMENT METHODS

This report summarises expected geotechnical, groundwater, and geological conditions at the site based on research of available geological and topographical maps, past and recent aerial photographs, and available geotechnical and hydrogeological investigations conducted at the site and in the area (see Section 1.3).

4 ASSESSMENT RESULTS

4.1 SUBSURFACE CONDITIONS

Based on available previous geotechnical investigations, as well as reference to topographical maps and local soil and geology maps, Table 4-1 summarises the expected the subsurface profile expected at the site, primarily based on the boreholes drilled on the site by Morrow Geotechnics, but is consistent with our experience on nearby projects.

Table 4-1: Expected Subsurface Profile Summary

Geological Profile	Unit	Description
FILL	Unit 1: Silty & Gravelly SAND	**Silty to gravelly SAND**, loose, fine grained, fine to coarse sized gravel, with construction waste. Unit 1 is inferred to be uncontrolled and poorly compacted.
COASTAL & ESTUARINE DEPOSITS	Unit 2a: SAND Unit 2b: SAND Unit 2c: SAND	**SAND**, very loose, poorly graded, fine grained, pale grey, brown, dry to moist. **SAND**, loose, poorly graded, fine grained, with trace of low plasticity clays at some bands, pale grey, brown, pale orange, pale yellow, moist. **SAND**, medium dense, poorly graded, fine grained, with trace of low plasticity clays at some bands, pale grey, brown, pale orange, pale yellow, moist to wet.
WEATHERED BEDROCK	Unit 3: SANDSTONE	**SANDSTONE**, highly weathered, very low strength, fine to medium grained, inferred to grade stronger with depth.

The proposed development will have a two-level basement extending to ~6m depth (~RL2.8) which is expected to be through fill and into coastal and estuarine deposits of loose and medium dense sand. The depth to sandstone bedrock can be variable, and at this site it was encountered at 16.1m depth (in BH1 only). Documents supporting the proposed development at 17 Dover Street documented sandstone bedrock to be as deep as 27m, so there is some uncertainty regarding the actual depth to bedrock at the site. The expected depth intervals of fill, coastal & estuarine deposits, and sandstone bedrock are shown in Table 4-2.

Table 4-2: Typical Depth Interval of Each Soil/Rock Unit

Unit	Unit Description	Typical Depth Interval of Each Soil/Rock Layer
Unit 1	Fill	0m – 0.3m/0.4m
Unit 2a	Coastal & Estuarine Deposits	0.3m/0.4m – 1.5m
Unit 2b		1.5m – 2.5m/3.0m
Unit 2c		2.5m/3.0m – 16.1m
Unit 3	Sandstone Bedrock	Below 16.1m

It should be noted that weathered sandstone bedrock was only encountered in one borehole (BH1) in the Morrow Geotechnics investigation, and the other two boreholes were terminated in sands at ~10m depth. BH1 was only an auger hole (no rock coring was carried out), so the strength and weathering of the sandstone bedrock is inferred. **In our opinion, this investigation does not provide sufficient geotechnical data to adequately address the design and construction of the development or impacts on neighbouring properties. Further geotechnical investigations are recommended (additional boreholes that go deeper and obtain at least 3m of rock core).**

4.2 GROUNDWATER

Groundwater monitoring was undertaken by Morrow Geotechnics as part of the *Site Hydrogeology Report*, which states that permanent groundwater is expected at between 2.5m and 6m depth, which corresponds to RL3.0/3.5 mAHD. Data loggers were also installed to monitor fluctuations in the groundwater levels over a three-month period, which showed the groundwater level fluctuating by about 0.5m. The minimum groundwater level was RL2.85/RL3.11 mAHD, while the maximum groundwater level was RL3.22/RL3.53 mAHD. A design groundwater level for the site of RL4.6 mAHD was recommended.

Given that the proposed basement excavation will extend to RL2.8 mAHD (and possibly deeper for localised excavations such as footings, lift pits, crane pads, etc.), it is expected that the basement excavation will intersect the groundwater table and extend at least 0.7m (based on monitored groundwater levels) and up to 1.8m (based on the nominated design groundwater level from the proponent's consultant) below the groundwater table. Therefore, dewatering will be required for the proposed development, which will temporarily lower the groundwater table. **The proposed lowering of the groundwater table will also be greater than that recommended by the GHD report.**

In-situ permeability tests were conducted, and it was recommended that a coefficient of permeability of 9.5×10^{-5} m/s be used in dewatering calculations, which is a **very high inflow rate**.

4.3 PROPOSED DEWATERING METHODOLOGY

A dewatering management plan for the development has been provided by Morrow Geotechnics (*Dewatering Management Plan*), which recommends the following dewatering procedure:

In order to minimise the seepage volumes during construction it is understood that a sheet pile wall will be constructed. The sheet pile wall will embed 3m below bulk excavation level (BEL) to minimise groundwater flow. Dewatering wells will be installed within the excavation once the groundwater table is reached to drop the groundwater level within the sheet pile wall to below the proposed depth of excavation.

Water from the dewatering wells will be pumped to a holding tank before discharge to the stormwater system provided controls are put in place and contingency plans are initiated in the event the present water quality variation. The excavation program for the proposed basement is expected to take up to four months. Temporary construction dewatering is expected to occur for construction seepage inflows during this four-month period.

The dewatering management plan also included seepage modelling using Plaxis 2D, with the results summarised below:

- Short Term Flows for Temporary Dewatering During Construction = 148.82ML/year (or 49.6ML for a four-month period). This is well above the WaterNSW threshold of 3ML/year for an exemption from the requirement of a Water Access Licence. Therefore, a Water Access Licence is required for the development.

- The dewatering for the proposed development will also have to comply with Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023 (WSP 2023) that applies across Sydney's metropolitan groundwater sources (including the coastal sands in the Rose Bay / eastern-Sydney zone). Therefore, any significant groundwater take (e.g. dewatering) will be subject to the rules of the plan: licence requirements, metering, compliance with extraction limits. The plan's objectives reinforce the need to protect aquifer integrity, avoid excessive drawdown, prevent interference with neighbouring works, and protect ecosystems (including those near coastal sands). Large commercial/industrial/major dewatering/groundwater take must demonstrate compliance with the plan's limits (LTAAELs) and supply-works conditions.

- The results of the groundwater drawdown modelling show that drawdown of the groundwater table is not just limited to the site, but exceeds 0.2m of drawdown extending up to 80m away from the excavation boundaries (and exceeding the GHD recommended value of 0.3m of drawdown up to ~75m away from the site boundaries). Therefore, the area impacted by groundwater drawdown exceeding the GHD recommendation is shown in the aerial photo in Plate 4-1 below, and impacts up to 40 properties.

Plate 4-1: Aerial Photo Showing the Approximate Area That will be Impacted by Groundwater Drawdown During Dewatering

- There are existing structures within 5m to 10m of the proposed excavation, and the modelling indicates that drawdown of the water table could be up to 1.3m depth at this set back distance. The GHD report commissioned by Woollahra Municipal Council states that such drawdown can cause settlement and damage to properties, and therefore recommended that **a limit of 0.3m of groundwater drawdown outside the development boundary**

be permissible. Given that the proponents modelling shows that groundwater drawdown will be greater than this affecting over 40 neighbouring properties, it is assessed that the proposed development does not comply with Council advice.

- Plate 4-2 below is an extract of Table 2 from the dewatering management plan showing the expected groundwater table drawdown depths at varying set backs from the excavation, which is also graphically shown below. This data has come directly from the proponent's consultant report.

Table 2 Modelled Groundwater Drawdown

Analysis Case	Up Gradient Drawdown (m)				Down Gradient Drawdown (m)				Distance to Minimal Drawdown < (200 mm)
	Distance Behind Excavation Face				Distance Behind Excavation Face				
	0.5 m	5 m	10 m	20 m	0.5 m	5 m	10 m	20 m	
Section 1 Short Term	1.30	1.19	1.09	0.92	1.29	1.21	1.11	0.92	78.47
Section 2 Short Term	1.33	1.26	1.12	0.94	1.33	1.27	1.14	0.95	79.31

Plate 4-2: Depth of Expected Groundwater Drawdown at Various Distances From the Excavation Boundary

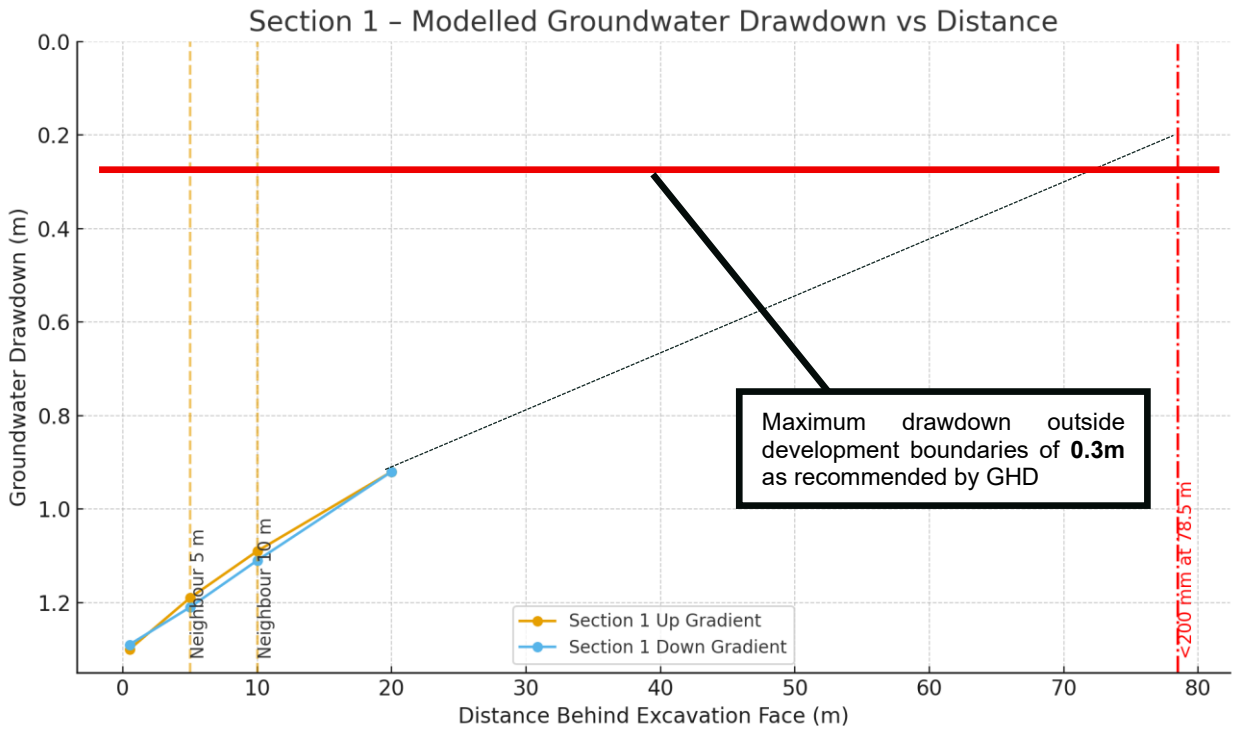

Plate 4-3: Graphical Representation of the Depth of Expected Groundwater Drawdown at Extending From the Excavation Boundary

- It has been indicated that there are proposals for additional adjacent developments totalling an area of ~21,000m^2. Cumulative impacts where multiple basements are constructed in close proximity will vastly increase the groundwater drawdown and extend the area of impacted properties. It is estimated that up to 130 neighbouring properties could be impacted if all proposed developments proceed. The approximate area which could potentially be impacted by groundwater drawdown if the additional development proceed is shown in the aerial photo in Plate 4-4 below, showing impact to up to 130 properties. It should be noted as this is approximate and would depend on what properties were being dewatered at particular times, and the exact level of groundwater drawdown. This is just to provide an indication of the significant area which could potentially be impacted.

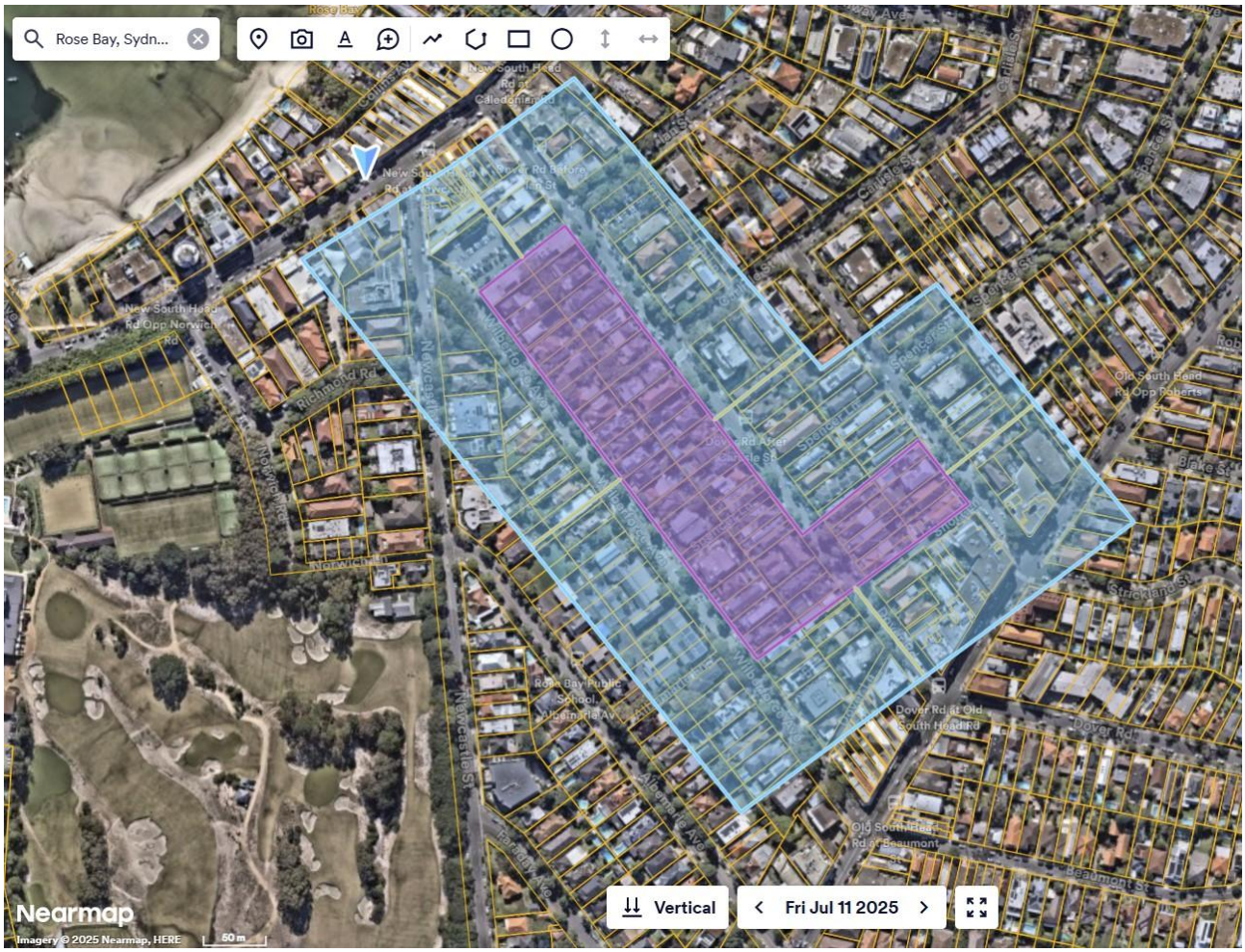

Plate 4-4: Aerial Photo Showing the Approximate Area That will be Impacted by Groundwater Drawdown During Dewatering if All Proposed Developments Were to Proceed

5 DISCUSSION & RECOMMENDATIONS

5.1 POTENTIAL GEOTECHNICAL IMPACTS OF THE PROPOSED DEVELOPMENT

The site is underlain by Holocene age coastal deposits (dune facies) and estuarine interbarrier creek deposits. The basement excavation for this development will extend to ~6.5m depth and will be through fill and into coastal and estuarine deposits of loose sand. The depth to sandstone bedrock can be variable, and is expected to be about 16m deep (**but could be up to 27m deep**, as found at the site owned by the Council which is directly adjacent).

The groundwater table is expected to be at RL4.6 mAHD, and given that the proposed basement excavation will extend to RL2.8 mAHD (and possibly deeper for localised excavations such as footings, lift pits, crane pads, etc.), it is expected that the basement excavation will intersect the groundwater table and extend at least 1.8m below the groundwater table. Therefore, dewatering will be required for the proposed development, which will temporarily lower the groundwater table. Modelling shows that the dewatering will also temporarily lower the groundwater table up to 75m away from the site, which will impact many neighbouring properties. Groundwater inflow rates are expected to be very high. **The proposed groundwater drawdown outside the property boundaries materially exceeds the 0.3m threshold recommended by the GHD report**.

Given the above geotechnical, groundwater, and geological conditions, the adverse impacts due to the proposed development (which will require a deep basement excavation and temporary dewatering) are listed below:

- The soil conditions are not favourable for supporting structures (existing and future) and typically have low bearing capacities and potential for large settlements.

- Excavations adjacent to existing structures have the potential to undermine and destabilise existing structures, causing settlement/subsidence of adjacent ground and damage to existing structures. There are at least nine structures within 10m of the proposed basement excavation, and up to 40 properties that will have groundwater table drawdown under their properties, and would most likely be founded on shallow footings.

- These sands are non-cohesive, with high permeability and little natural strength, meaning unsupported excavations could cause slippage or settlement. The proposed sheet pile shoring wall will help mitigate lateral soil movement, provided that it is designed and installed correctly.

- Excavations adjacent to existing infrastructure (particularly road and sewer network) have the potential to undermine and destabilise existing infrastructure, causing settlement/subsidence of adjacent ground and damage to existing road and sewer network.

- Construction activities that cause ground vibrations (such as large excavation equipment, vibratory rollers, sheet piling installation equipment) can result in settlement/subsidence of adjacent ground and damage to existing structures, road and sewer network. The installation of the proposed **sheet piling is expected to cause significant vibrations** which will have a detrimental effect on surface subsidence and structural damage to adjacent properties. Expected structural damage to neighbouring properties includes internal cracking of plaster, external cracking of masonry, cracking of floor slabs and tiles, cracking of pools, etc.

- The proposed development will comprise the excavation of a ~6m deep basement, which will require construction dewatering to drawdown groundwater levels on site by up to 2m depth. Modelling by the proponent's consultants shows that this construction dewatering will lower the groundwater table on adjacent land, extending to 75m from

the development property boundaries. This will drawdown groundwater levels by between 0.3m and 1.3m depth on up to 40 adjacent properties.

- The GHD report commissioned by Woollahra Municipal Council states that such drawdown can cause settlement and damage to properties, and therefore recommended that a limit of 0.3m of groundwater drawdown outside the development boundary be permissible. Given that the proponents modelling shows that groundwater drawdown will be greater than this affecting over 40 neighbouring properties, it is assessed that the proposed development does not comply with Council advice or local development planning controls.

- It has been indicated that there are proposals for additional adjacent developments totalling an area of ~18,500m^2 to 21,000m^2. Cumulative impacts where multiple basements are constructed in close proximity will vastly increase the groundwater drawdown and extend the area of impacted properties. It is estimated that up to 130 neighbouring properties could be impacted if all proposed developments proceed.

- It should also be noted that the documents provided as part of the State Significant Development application do not address any issues potentially arising from the cumulative effects of all future developments.

- There are existing structures within 5m to 10m of the proposed excavation, and the modelling indicates that drawdown of the water table could be up to 1.3m depth at this set back distance. This could potentially result in ground settlement/subsidence up to 10mm (or more if the shoring deflects excessively), and expected damage to neighbouring properties includes internal cracking of plaster, external structural cracking of masonry, cracking of floor slabs and tiles, cracking of pools, etc.. The proponent's consultant has stated that the impact is 'negligible', however, our experience (and other's experience including GHD) refute that assessment.

- There are numerous examples of construction dewatering causing damage to neighbouring properties in the Rose Bay and Double Bay areas (see Section 5.2). There is also the well-known case of the Mascot Towers, where construction dewatering on a neighbouring site caused extensive structural damage to the Mascot Towers apartment building. These examples highlight the risk and danger of excavating deep basements and dewatering next to existing structures.

- Construction dewatering will interrupt natural groundwater flow paths and gradients, as well changing water chemistry and salinity. By installing a sheet pile cut-off wall, groundwater flows can be held up or dammed. This can result in creating an upstream mound, reduce downstream recharge, change hydraulic gradients, and force groundwater to other aquifer zones. Consequences of this includes increasing pore pressures in the area of mounding, risk of hydraulic uplift, settlement of ground levels, and changing natural groundwater regimes.

- The amount of proposed excavation (~15,000m^3 of soil for the property area of ~2,600m^2, or ~6,000m^3 per 1,000m^2) vastly exceeds the Council's recommended limits.

- The modelling predicts that over the four-month dewatering period that 49.6ML of groundwater will be extracted. This is well above the WaterNSW threshold of 3ML/year for an exemption from the requirement of a Water Access Licence. Therefore, a Water Access Licence is required for the development.

- The dewatering for the proposed development will also have to comply with Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023 (WSP 2023) that applies across Sydney's metropolitan groundwater sources (including the coastal sands in the Rose Bay / eastern-Sydney zone). Therefore, any significant groundwater take (e.g., dewatering) will be subject to the rules of the plan: licence requirements, metering, compliance with extraction limits. The plan's objectives reinforce the need to protect aquifer integrity,

avoid excessive drawdown, prevent interference with neighbouring works, and protect ecosystems (including those near coastal sands). Large commercial/industrial/major dewatering/groundwater take must demonstrate compliance with the plan's limits (LTAAELs) and supply-works conditions.

- Given the high groundwater inflow rates, when dewatering, pump-out rates are also high. This can sometimes exceed the capacity of the stormwater network resulting in local flooding, with subsequent settlement/subsidence of adjacent ground and damage to existing structures, road and sewer network. This is not necessarily due to a single development but from the cumulative impact of multiple developments, which is also made worse by the higher frequency of rainfall and flooding events. Some of these impact are irreversible.

- Acid sulphate soils (ASS) are expected to be present within the soils in these area. If sulphide-bearing or pyritic soils are disturbed by excavation, thereby allowing ready access of the sulphides to oxygen in the air, a spontaneous or irreversible natural oxidation reaction takes place. This results in the generation of sulphuric acid or acid sulfates. Pyritic soils, which have begun to generate acid, are referred to as Actual Acid Sulfate Soils (AASS). The acid is transported by water, and if allowed to build up in sufficient concentration, poses a direct environmental threat to organisms that come in contact with such waters. While these issues can be managed to some extent, the risk posed by acid sulphate soils, particularly from unexpected flooding events, should be considered.

5.2 RECENT EXAMPLES OF ADVERSE IMPACTS

The adverse impacts for deep excavations for developments in these areas that are listed in Section 5.1 are not just hypothetical, and recent examples of adverse impacts are provided below:

- Numerous instances in Double Bay and Rose Bay of structural cracking and damage to existing houses and apartments which are located near or adjacent to building sites were deep excavations with dewatering are being undertaken. Specific instances where structural damage to neighbouring properties that have been attributed to shoring installation (both from vibrations due to installation of sheet piling and over-flighting for bored piles), excavation and dewatering works in Rose Bay are shown in Plate 5-1 and include:

    - Norwich Lane – back wall came away from the neighbouring house

    - Richmond Avenue – structural cracks appeared in block of neighbouring units (stop work issued).

    - Wilberforce Avenue – neighbouring house collapsed. The house was deemed unsafe for occupancy and it was subsequently sold and demolished.

    - Wilberforce Avenue – the same above development caused flooding into the basement of a neighbouring house.

    - O'Sullivan Road – sink holes appeared in the road

    - 4 to 8 Patterson Street (Double Bay) - as many as 25 homes up to 200 metres away from the development showed signs of plumbing de-lodgement, subsidence and walls needing extensive repairs due to aggressive dewatering to facilitate the double basement level. Woollahra Council have advised

the State Government that at least 25 homes were structurally damaged as a result of the dewatering required for this development's basement.

- 19 Bay Street (Double Bay) – structural cracks up to 100mm wide appeared in building next door, requiring the building to be evacuated. The building is currently being braced but it has been indicated that the extent of damage will require demolition.

- Forest Road (Double Bay) – a room of the neighbouring house was structurally damaged and had to be re-built. Another property on this street suffered where plumbing sank 1.4m, detaching itself from the house.

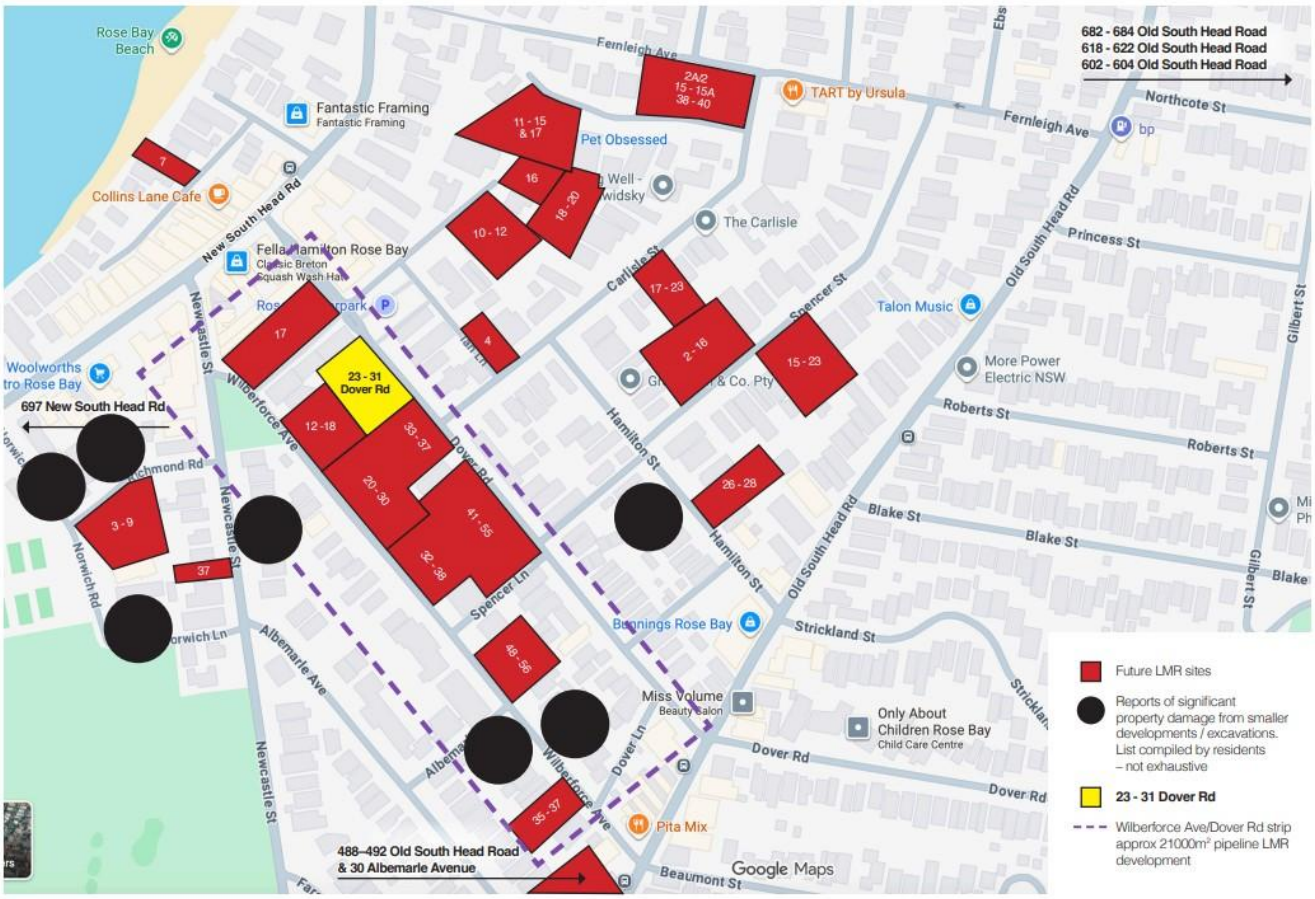

Plate 5-1 – Indicative markup provided by the client showing the development site (yellow), proposed LMR development sites (red), and known properties that have experience structural damage due to adjacent developments.

- The primary suspected cause of the major structural issues at Mascot Towers was due to dewatering activities on the site next door. Although not in the Rose Bay area, the geotechnical conditions are similar (deep aeolian sands and shallow groundwater).

  Many studies have been conducted which prove that lowering the groundwater table (dewatering) will result in groundsurface settlement. When the water table is lowered, the effective load on the subsoil is increased by an

amount equal to the difference between the drained and submerged weights of the entire soil mass between the original and lowered water. This increased overburden pressure causes additional compression and produces a settlement of the groundsurface. Generally, settlement occurs at a faster rate in sandy soils. Such settlements can cause structural damage to surrounding structures.

- We have conducted a general calculation based on typical soil and groundwater conditions using Geo 5 software, which has calculated a typical groundsurface settlement of about 10mm on properties adjacent to excavations that are being dewatered. This is based on a groundwater table drawdown of 2m, and the subsurface profile described in Section 4.1. If a settlement of 10mm were to occur under the foundation of most typical masonry houses/units, then structural damage to these structures would be expected. The likely structural damage to such structures includes cracks in walls, ceilings, and floors, walls leaning or bulging, distortion of window and door openings, and service pipes disrupted. Cracking and leaking of sewer pipes. Stormwater pipes, swimming pools, etc. is also expected.

- Recent flooding has been reported in many areas of Rose Bay and Double Bay, apparently associated with the over-loaded stormwater network. This has occurred along Bay Street (which has occurred about 4 or 5 times in less than a year), including large volumes of flood water and formation of sink holes and subsidence.

5.3 RECOMMENDED MITIGATION MEASURES

To reduce the risk of future adverse impacts, it is recommended that the following mitigation measures be implemented as conditions on new developments.

- Not allowing excavations to extend below the groundwater table.

- Not allowing dewatering that draws down the groundwater table.

- Not allowing deep excavations that undermine neighbouring structures without having adequate structural shoring support. This should consider the use of secant piles rather than sheet piles for basement shoring.

- Limiting construction activities that cause ground vibrations (such as large excavation equipment, vibratory rollers, sheet piling installation equipment), particularly the vibrations from sheet piling.

- Limit excavation volumes of soils in high risk acid sulphate soils areas.

5.4 GEOTECHNICAL INSPECTION & MONITORING

It is strongly recommended that the development be designed so that a maximum groundwater drawdown of 0.3m occurs outside the development boundaries. To monitor this (and all impacts) and to help prevent damage to existing neighbouring structures due to deep excavations, dewatering, and construction vibrations, it is recommended that geotechnical inspection and monitoring be carried out. It is imperative that these records be policed by Council (or an independently appointed geotechnical engineer or hydrogeologist) to ensure compliance.

5.4.1 Groundwater Monitoring

Because the site has high-permeability marine sands and groundwater drawdown of up to 1.3 m (although it is recommended that this be limited to 0.3m, as per the GHD report), groundwater control is critical to protect neighbouring properties from settlement.

- **Required Monitoring**
- **Install Perimeter Piezometers**
    - Minimum: **3–6 piezometers** located between excavation and neighbouring buildings
    - Screened at matching depths to excavation and foundation zones
    - Set to automatically log groundwater level at **hourly intervals**
- **Trigger Levels**
    - **Alert:** drawdown exceeds **0.3m** at the property boundary
    - **Action:** drawdown exceeds **0.3m** (or site-specific trigger per modelling)
    - **Stop Work:** rapid drawdown > **0.3 m/day**, or any excursion beyond model predictions
- **Dewatering Flow Monitoring**
    - Install **flow meters** on dewatering discharge lines
    - Log inflow volume → compare with modelled inflow (~2,860 kL/week)
    - Unexpected increases indicate:
        - wall leakage
        - sand piping

- formation instability

- **Water Quality Monitoring**

Important for detecting soil movement into pumps:

- Turbidity / suspended solids
- Presence of fines indicates internal erosion (“piping”) behind shoring.

5.4.2 Excavation Support Monitoring (Shoring / Retention Walls)

The geotechnical report requires *engineered retention* (soldier piles + anchors / sheet piles).

To protect nearby structures (75m away):

- **Inclinometers Installed Behind Shoring**
  - At least **two inclinometers per long wall**, spaced at ~20–25 m
  - Measurement frequency:
    - Daily during first 2–3 m of excavation
    - Twice weekly afterwards
  - Purpose: detect **lateral movement of shoring**
  - Acceptable movement guideline:
    - **< 10mm** for sensitive neighbouring structures
    - **< 0.2% of excavation height** (general practice)

- **Anchor Load Monitoring**

For ground anchors:

- Proof load testing
- Lock-off loads recorded and verified
- Periodic re-checking during excavation stages

- Automatic load cells for heavily loaded anchors

- **Shotcrete & Pile Wall Inspections**
  - Daily inspections during excavation
  - Ensure no voiding, no sand boils, no groundwater ingress pockets
  - Verify pile interlocks if secant wall used

- **Toe Stability Inspection**

Loose sands overlying sandstone require:

- Confirmation that piles or sheet piles are **embedded into Unit 5 sandstone**
- Verification via drilling logs and geotechnical sign-off

5.4.3 Surface Settlement Monitoring

Settlement monitoring protects buildings from long-term drawdown and excavation movement.

- **Settlement Markers / Survey Targets**
  - Install on ground surface and on neighbouring buildings
  - Recommended spacing:
    - Every **5–10 m** along boundary
  - Frequency:
    - Weekly before excavation
    - Daily during major excavation
    - Twice weekly during dewatering
  - Accuracy:
    - **≤ ±2 mm vertical**

- **Building Condition Surveys**

Before any site work:

- **Dilapidation survey** of all neighbouring buildings within 75m
- High-resolution photo and video record
- Structural condition documented (cracks, doors/windows distortion, foundations) After significant events (anchor stressing, major dewatering changes):
- Follow-up survey

5.4.4 Vibration Monitoring

The geotechnical report recommends to Limit vibration to 5 mm/s PPV for residential structures.

- **Vibration Monitors**
- Install one monitor along each boundary
  - And additional monitors near most sensitive buildings
- **Monitoring Requirements**
  - Real-time monitoring
  - Audible + visual alarms when approaching **3 mm/s**
  - Mandatory stop-work at **5 mm/s** exceedance
  - Trial excavation and trial pile installation required before full-scale works
- **Activities That Require Vibration Monitoring**
  - Sheet pile driving
  - Rock hammering in sandstone
  - Vibratory compaction
  - Excavator operations near boundary

5.4.5 Excavation Inspections During Construction

- **Geotechnical Engineer to Attend at Key Stages**
  - Excavation to each 1 m depth increment
  - Installation of each anchor level
  - Pile toe exposure
  - Dewatering commencement
  - Any unexpected conditions (boils, sloughing, voids)
- **Daily Contractor + Superintendent Inspections**

Checking for:

  - Sand running / ravelling
  - Groundwater inflow
  - Excessive shoring movement
  - Cracks or uplift in ground behind wall
  - Pump performance and sump integrity

5.4.6 Documentation and Reporting

- **Daily Logs**
  - Groundwater levels
  - Settlement data
  - Vibration readings
  - Shoring inspection notes
- **Weekly Engineering Review**
  - Compare readings to predicted movement and drawdown curves
  - Issue directions if any movement exceeds 50% of trigger levels

5.4.7 Emergency / Response Actions

If limits exceeded:

- Stop excavation/dewatering
- Reduce pumping rate
- Re-pressurise groundwater by reinjection if required
- Install additional anchors or struts
- Backfill section temporarily
- Notify structural engineer and geotechnical engineer

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