GEOTECHNIQUE® PTY LTD

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Thunderbirds Are Go Pty Ltd on behalf of the Gardeners Trust
c/- Pier Property Corporation
Suite 305, Level 3, 25 Lime Street
KING STREET WHARF NSW 2000
Email: Polly@pierproperty.com.au

Attention: Ms P Priday

Dear Madam

re: **Proposed Eden Garden Development**
307 Lane Cove Road, Macquarie Park
Desktop Study – Geotechnical Assessment

This report provides results of a geotechnical desktop study for a proposed development at 307 Lane Cove Road, Macquarie Park, hereafter referred to as the site. This report is based on the site inspection and review of geological and soil landscape maps relevant to the site.

We understand that the proposed development at the above site consists of the construction of a new 18 storey commercial tower and a new 4 storey car park structure all above ground. A new common podium structure at ground floor and a new single storey basement level below ground floor, integrated with existing car park, will also be constructed. Plan showing footprints of existing carpark was provided for preparation of this report.

A desktop geotechnical assessment was required to assess likely subsurface conditions across the site and provide preliminary geotechnical recommendations on design of the proposed buildings, including basement excavation, retaining structures, floors slabs and footings.

Anticipated Subsurface and Groundwater Conditions

Reference to the Geological Map of Sydney (scale 1:100,000) indicates that the bedrock across most portions of the site is Ashfield Shale, belonging to the Wianamatta Group of rocks and comprising dark grey to black shale and laminite. However, Hawkesbury sandstone, comprising medium to coarse grained quartz sandstone, very minor shale and laminite lenses, is likely to be encountered in the south eastern corner.

Reference to the Soil Landscape Map of Sydney (scale 1:100,000) indicates that the landscape across most portions of the site belong to Lucas Height Group, which is characterised by gently undulating crests and ridges on plateau surfaces of Mittagong Formation (alternating bands of shale and fine grained sandstone), with local relief to 30m and ground surface slopes of less than 10%. Rock outcrop is absent. The subsurface soil is likely to be moderately deep (0.5m to 1.5m) and stony. However, landscape in the south eastern portion of the site belongs to Gymea Group, which is characterised by undulating to rolling rises and low hills on Hawkesbury sandstone, with local relief of 20m to 80m and ground slopes of less than 25%, broad convex crests, moderately inclined side slopes with wide benches, and localised rock outcrops. The subsurface soil in this group is likely to be sandy, highly permeable and susceptible to erosion hazard.

No rock outcrops were observed within the site during site inspection. However, sandstone exposures were observed along the road cuttings for M2 Motorway.

Based on review of geological and soil landscape maps relevant to the site and site observation, it is our assessment that the subsurface profile across the site is likely to comprise a sequence of topsoil/fill and residual soils underlain by shale/sandstone bedrock. The predominant bedrock is likely to be sandstone encountered at depths of 1.0m to 2.0m from the existing ground surface.

Assessment of Excavation Conditions

Proposed development is understood to involve up to about 3.0m deep excavation for basement car park. The materials to be excavated are anticipated to include soils (including topsoil/fill and residual soils) as well as bedrock sandstone/shale.

We anticipate sandstone/shale up to depth of 3.0m will vary from low strength to high strength.

It is our assessment that the excavation of soils as well as low strength sandstone/shale can be achieved using conventional earthmoving equipment such as excavators and dozers. However, excavation into medium to high strength sandstone/shale will require larger equipment (such as rock saw, Caterpillar D10 or equivalent). Therefore, selection of rock cutting equipment should be based on strength of the sandstone/shale, site access, desired smoothness of the excavated rock surface and acceptable ground vibration during rock excavation.

Dilapidation survey should be carried out to ascertain possible impacts from ground vibration during rock excavations. However, a rock saw will be preferable for excavation into medium to high strength sandstone/shale to minimise ground vibration during rock excavation.

We do not anticipate significant groundwater inflow during proposed 3.0m deep excavations. Conventional sump and pump method is anticipated to be adequate to deal with minor groundwater inflow, if any.

Recommendations on Batter Slopes and Earth Pressure Coefficient

The proposed excavation faces should be battered for stability or retained by engineered retaining structures. For preliminary design of excavation faces for short and long term stability we recommend the following:

- Residual Soils;
  - 1 vertical to 1.5 of short term stability
  - 1 vertical to 2.5 horizontal for long term stability
- Sandstone/shale low strength;
  - Vertical for short term stability
  - 1 vertical to 1.5 horizontal for long term stability
- Sandstone/shale of medium to high strength = vertical

Vertical excavations in medium to high strength sandstone will have very low risk of instability. However, some localised rock bolting and shotcreting might be required, depending on the relative orientations of rock discontinuities (bedding partings, fractures and joint systems) and excavation faces.

If batter slopes steeper than those recommended above are required for whatever reason, the excavation faces would need to be retained by engineered retaining structures. It may also be the case that the excavation faces are retained to prevent undermining existing structures in the vicinity of the site.

Appropriate retaining structures for the proposed basement excavations would comprise bored pile walls installed prior to excavation works or cantilever or gravity walls installed after completion of excavations. For preliminary design of retaining structures, we recommend the following earth pressure parameters:

- Residual Soils;
  - Unit weight = 18.5kN/m^3
  - Active earth pressure coefficient = 0.40
  - At rest earth pressure coefficient = 0.55
- Sandstone/shale of low strength;
  - Unit weight = 20.0kN/m^3
  - Active earth pressure coefficient = 0.20
  - At rest earth pressure coefficient = 0.40

The above coefficients are based on the assumptions that the ground level behind the retaining structure is horizontal and the retained material is effectively drained. Additional earth pressures resulting from surcharge loads (buildings, infrastructures, etc) on retained materials and groundwater pressure, if any, should also be allowed for in design of retaining structures.

Recommendations for Design of Floor Slabs and Footings

The foundation material across the site is anticipated to comprise residual soils underlain by bedrock sandstone/shale. Some controlled fill placement may be required during foundation preparations, especially in the ground floor level. Therefore, foundation materials at various floor slab levels are anticipated to vary from controlled fill to residual soil to bedrock. Therefore, floor slabs for the proposed building may be constructed as ground bearing slabs or suspended slabs supported by footings designed in accordance with recommendations provided in this report. For design of ground bearing slabs, we recommend the following:

- A Modulus of Subgrade Reaction Value of 25kPa/mm is recommended for design of floor slabs bearing on controlled fill and/or residual soil.
- A Modulus of Subgrade Reaction Value of 40kPa/mm is recommended for design of floor slabs bearing on bedrock sandstone/shale.

Loading conditions from the proposed buildings are not known at this stage. However, we consider that the appropriate footings would comprise shallow footings (pad and strip) or deep footings (bored piers) socketed into sandstone bedrock. Deep footings might be desirable if footings are required to support significant lateral and/or uplift pressures. The recommended allowable bearing pressures for design of shallow and deep footings are presented in the following Table 1.

Table 1 – Recommended Allowable Bearing Pressures

Founding Material	Allowable Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)
Controlled Fill and Residual Soil	100.0	Ignore
Sandstone – Low strength	1000.0 to 1500.0	100.0 to 150.0
Sandstone – medium to high strength	3000.0 to 6000.0	300.0 to 600.0

If footings are founded above the 1 Horizontal to 1 Vertical line projected from the edge of excavation at the base, the recommended allowable bearing pressures presented in Table 1 are not applicable and appropriate allowable bearing pressure will have to be determined by reassessment of materials exposed in the excavation face.

General Comments

This report is prepared to provide preliminary geotechnical assessments and recommendations. In summary the desktop study indicates the following:

- The subsurface profile across the site is likely to comprise a sequence of topsoil/fill and residual soils underlain by bedrock sandstone/shale and bedrocks are anticipated at depths of 1.0m to 2.0m from existing ground surface. Therefore, it is our recommendations that the footings for the proposed buildings are founded and/socketed into bedrock sandstone/shale.
- Medium to high strength sandstone/shale may be encountered during proposed basement excavations. As rock excavations are likely to generate significant ground vibration, we recommend use a rock saw to achieve required excavations without excessive ground vibration.
- Proposed excavation faces will have “Low” risk of instability provided the excavation faces are battered and/or retained with retaining structures designed in accordance with recommendations provided in this report.
- Proposed excavations are unlikely to encounter groundwater level. Therefore, proposed development will not impact on the groundwater and vice versa. The design of proposed development will ensure that the surface water flow within and across the site is not impacted.

Therefore, it is our assessment that the site is suitable for the proposed development provided the assessments and recommendations provided in this desktop study report are verified by conducting detailed geotechnical investigation during final design and construction stage.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

INDRA JWORCHAN
Principal Geotechnical Engineer