FOUNDATION EARTH SCIENCES

GEOTECHNICAL DESKTOP STUDY REPORT

42 North Steyne and 75 The Corso, Manly NSW 2095

Prepared for

Iris Capital

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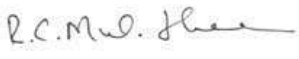
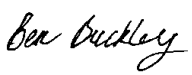
Author		Chandrasekaran Muralitharan	26/10/2021
Author		Ben Buckley	26/10/2021

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APPENDICES

1.0 INTRODUCTION

The purpose of this geotechnical desktop study is to infer the site's surface and subsurface conditions and then analyse the feasibility of construction of the proposed development summarised in Section 2. This report interprets and presents findings obtained during a site walkover inspection together with other information made available by the client and in the public domain. Details of the site are summarised in Table 1.

Table 1: Summary of Details of the Site

Site	Details
Location	42 North Steyne and part of 75 The Corso, Manly NSW 2095
Lot/DP	Lot 1 DP 1034722 and part of Lot 100, 101 & 102 DP 1069144
Local Council	Northern Beaches
Area	Approximately 410m^2 and 1960 m^2
Shape & Slope	Irregular shape and level
Existing Structures	Two and three storey commercial buildings with part basement floor levels and associated structures
Closest Watercourse	Manly Beach is located approximately 100m east to the site
Special Features	Development area has part existing basement and lower basement levels. The Steyne Hotel, located at 75 The Corso, is Heritage listed
Type of Neighbouring Properties	North Mixed used building East North Steyne carriageway South The Corso's walkway reserve West Henrietta Lane's road reserve and carriageway
Geology Map	Sydney 1: 1:100,000 Geological Series Sheet 9029-9130 Edition 1, 1983, from the Geological Survey of New South Wales
Primary Geology	Qhb – Alluvial soils, Quaternary age described as "Coarse quartz sand, varying amount of shell fragments"
Secondary Geology	Qhf – Marine Sand, Quaternary age described as "Medium to fine MARINE sand" is located approximately 40m west to the site

2.0 AVAILABLE INFORMATION

The following information was made available to Foundation Earth Sciences ("Foundation ES") during the preparation of this report:

- Architectural drawings project tilted "42 North Steyne Manly NSW 2095", prepared by Squillace Architects and dated October 2021.
- Pre-lodgement Meeting Notes addressed "75 The Corso (The Steyne Hotel) and 42 North Steyne, Manly", referenced application No. PLM2021/0173, prepared by Northern Beaches Council and dated 29/07/2021.
- Geotechnical investigation report addressed "19-23 The Corso, Manly", referenced No. JG18143-r1(rev), prepared by GeoEnviro Consultancy Pty Ltd and dated 30/04/2019 (Site 1).
- Preliminary geotechnical investigation report addressed "21 Whistler Street, Manly", referenced project No. 2018-141, prepared by Crozier Geotechnical Consultant and dated 4/10/2018 (Site 2).
- Preliminary geotechnical investigation report addressed "26 Whistler Street, Manly, NSW", referenced No. 32250SMlet2, prepared by JK Geotechnics and dated 30/08/2019 (Site 3).
- Preliminary geotechnical site investigation report addressed "Cnr Belgrave Street and Sydney Road, Manly", referenced project No. 85028.00, prepared by Douglas Partners Pty Ltd and dated 29/09/2015 (Site 4)
- Architectural drawings titled "Steyne Hotel, Manly, Plan of Rebuilding", referenced A.O. Plan 71109, 71110 and 71111prepared by Copeman Lemont and Keesing Architects and dated March 1935. This includes Cellar Plan, Ground Floor Plan and First Floor Plan.
- Architectural drawings titled "Steyne Hotel, Manly, Proposed Alterations", referenced A.O. Plan No. 71112, 71113, 71114 and 71115 prepared by Copeman Lemont and Keesing Architects and dated 5/08/1939.
- Architectural drawings addressed "42 North Steyne, Manly, NSW", prepared by Baka Organic Design and dated November – December 2000. This includes the drawing nos

NDA 1/10, 2/10, 3/10, 4/10, 5/10, 6/10, 7/10, 8/10, 9/10, 10/10 and C/D/1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22

- Architectural drawings addressed "42 North Steyne, Manly, NSW", prepared by Baka Organic Design and Assoc and dated 23/04/2001. This includes the drawing nos BC-1/5, 2/5, 3/5, 4/5 and 5/5.
- Architectural drawings project titled "42 North Steyne Manly", prepared by Baxter and Jacobson Architects Pty Ltd and dated December 1999. This includes the drawing nos 177.01 – 01, 02, 03, 05, 06, 07 and 08.
- Structural drawings project tilted "Proposed Development, 42 North Steyne, Manly", referenced project No 6515, prepared by Tierney and Partners Pty Ltd and dated October 2000. This includes the drawing nos S01, S02, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13,
- Architectural Drawing addressed "42 North Steyne, Manly", referenced No. 2027, prepared by Ken Powell Architects and dated January 2001.
- Construction Noise and Vibration Management Plan addressed "42 North Steyne, Manly", referenced No. TL912-03D01 CNVMP (r0), prepared by Renzo Tonin & Associates and dated 11/10/2021.

3.0 SCOPE OF WORK

The following scope of works were carried out for the geotechnical desktop study:

- Collected and reviewed publicly available information.
- Review of information provided by client listed in Section 2.
- Site walkover inspection.
- Assessment of the proposed development scheme and preparation of a geotechnical desktop study report (this report) in accordance with Northern Beaches Council's requirements.

The approximate locations of the subject site and other neighbouring sites with available geotechnical investigation information are shown on in the "Site Plan" and attached as Appendix A.

4.0 DEVELOPMENT DETAILS

Architectural drawings prepared by Squillace Architects dated October 2021 indicate that the proposed development area is split into three sections and they are identified as Site A, Site B and Site C. The key drawings providing these details are extracted from the provided set of drawings and attached as Appendix B. Reference should be made to the architectural drawings to get further details. Details of those sites are described below:

- **Site A** – The site is identified as Steyne Hotel, 75 The Corso, Manly NSW 2095. The site is Heritage listed. Heritage walls extends along the majority of the site boundaries and most of the site will remain as is during the development. Proposed improvements in this area include the introduction of a new passenger lift, alterations to an existing passenger lift, alterations to an existing goods lift and other minor improvements
- **Site B** – This is part of the property at 75 The Corso, Manly NSW 2095 and identified as Cafe Steyne. The site is proposed to be amalgamated with the site C during the development and will become part of the proposed new property, known as 42 North Steyne. The existing structure is a three-storey building with no basement level. The proposed development within the site will encompass demolition of existing building (including facades), excavation for a single basement level and the construction of a five-storey building above. The basement level will amalgamate with the existing upper basement level of the Site C.
- **Site C** - It is currently the property located at 42 North Steyne. The site is proposed to be amalgamated with Site B during the development and will become part of the new property 42 North Steyne. The existing structure is a five-storey building with two basement levels (lower basement being part basement only). The existing upper basement level extends to the site boundaries. However, the lower basement level extends only to a small portion of the site. The proposed development will include

alteration to the existing building to increase the floor plate areas by extending the upper basement level and floor above across into site B. There is no extension to the lower basement level.

Architectural drawings provided also indicate that structures within lower basement level of Site C will generally be retained (with modifications) without any extension. The upper basement level within Site C will be extended to the ground level of Site B and structures along the common boundary will be replaced with new structures. Existing foundation systems along the common boundary are inferred to be modified or replaced with new engineered systems. Reference should be made to the architectural drawings for further details.

5.0 REVIEW OF AVAILABLE INFORMATION

5.1 Site Walkover Inspection

During the site walkover inspection, the following significant features were observed:

- No major sign of settlement cracks on the walls of the existing buildings. However, it is noted that some renewal, repair and replacement work carried out to existing structures of the Styene Hotel in the past.
- No major sign of tilling or damage on the walls of the existing buildings.
- No major sign of settlement cracks on the concrete pavements.
- No sign of groundwater seeping on the ground surface.

5.2 Design Drawings of Exiting Structures

The following key information was obtained during the preliminary review of the design drawing of the existing structures within the site:

- Structures within the Steyne Hotel, 75 The Corso, Manly, are supported on a shallow type foundation. Some of the foundations are extended slightly deeper into the ground and supported on dwarf walls which were supported on shallow foundations.
- Structures at 42 North Steyne, Manly are supported by a shallow foundation system. Further, the lower basement level walls and floor slab are designed below the groundwater table and with applied waterproofing membrane to prevent groundwater seeping into the level. The historical plans prepared by Boka Architects denote that the groundwater level is expected to be range from RL +0.44m to RL +0.28m AHD.
- Site boundaries of 42 North Steyne, Manly are observed with a Geocast Wall along the boundaries and it is inferred to be constructed prior to the construction of the existing structure within 42 North Steyne.

5.3 Neighbouring Sites Ground Conditions

The following geotechnical investigation reports were provided by the client to inform our geotechnical desktop assessment.

Information provided in this section is summary information from the provided geotechnical investigation reports. The reports have been considered as information only. Reports should be read in full to understand the testing methodology and classification of the ground profiles. Foundation ES does not accept any liabilities for misinterpreting or misleading any provided information in this section.

Properties nos. 19-23 The Corso, Manly NSW (Site 1)

The property is located approximately 230m south-west to the subject site. Two (2) hand auger boreholes and two (2) Dynamic Cone Penetration ("DCP") tests were carried out during the geotechnical investigation. One of the boreholes was refused at a very shallow depth on fill layer. Another borehole was extended down to approximately 4.0m below natural ground level. Both of the DCP tests were extended down to practical refusal depth of 6.9m below natural ground level.

Encountered subsurface conditions during the geotechnical investigation are summarised in the Table 2 below.

Table 2: Summary of Subsurface Condition at 19-23 The Corso

Unit	Details	Depth (m)	
		BH1 DCP1	BH2 DCP2
	Existing Ground Level (RL m AHD)	5.5	5.5
Fill	Gravelly sand, fine to medium grained, grey-brown, with sandstone gravel and brick fragments, moist	0.1 – 0.9	0.1 – 0.7
Marine Sand	SAND, fine to medium grained, pale yellow, moist, very loose	0.9 – 2.2	0.7 – 2.9
	SAND, loose	2.2 – 4.8	2.9 – 4.2
	SAND, medium dense	4.8 – 5.1	4.2 – 4.8
	SAND, dense	5.1 – 6.9	4.8 – 6.9
Bedrock	Not encountered during the investigation	Expected to be deeper than 10.0m	
Groundwater	Not encountered during the investigation	Expected to in between 5.0m and 6.0m	

Property No. 21 Belgrave Street, Manly NSW (Site 2)

The property is located approximately 200m west of the subject site. Two (2) Cone Penetration Test ("CPT") and two (2) boreholes were drilled during the geotechnical investigation. The CPT tests, identified as CPT1 and CPT2, were extended down to depths of 38.9m and 36.2m respectively. However, the boreholes, identified as BH3 and BH4, were terminated at 8.5m and 10.5m respectively and then groundwater wells were installed for contamination investigation.

Encountered subsurface conditions during the geotechnical investigation are summarised in the Table 3 below.

Table 3: Summary of Subsurface Condition at 21 Belgrave Street

Unit	Details	Depth (m)			
		CPT1	CPT2	BH3	BH4
Existing Ground Level (RL m AHD)		5.8	5.7	5.7	5.7
Fill	Sand and gravel with igneous, sandstone, concrete and brick gravel and cobbles	0.0 – 2.0	0.0 – 1.1	0.1 – 0.5	0.1 – 1.5
Marine Sand	SAND, loose to medium dense, with peat layers	2.0 – 17.5	1.1 – 17.1	0.5 – 8.5	1.5 – 10.5
	SAND, dense to very dense	17.5 – 30.0	17.1 – 32.2	–	–
	Silty SAND, medium dense	30.0 – 38.9	32.2 – 36.2	–	–
Bedrock	Not encountered during the investigation	No information was provided about the bedrock			
Ground water	Not encountered during the investigation	4.8 (RL 1.0)	5.1 (RL 0.6)	5.1 (RL0.6)	5.0 (RL0.7)

Soil aggressivity testing finds the site is "non-aggressive" in accordance with Australian Standard AS1259-2009.

Property No. 26 Whistler Street, Manly NSW (Site 3)

The property is located approximately 160m north-west to the subject site. Three (3) hand auger boreholes and five (5) Dynamic Cone Penetration ("DCP") tests were carried out during the preliminary geotechnical investigation. One of the boreholes and the DCP test in the vicinity of the borehole identified as BH102 and DCP102 were refused at very shallow depth on fill layer. Other boreholes were extended down to depths of 3.2m and 2.2m below natural ground level. Both of the DCP tests within the vicinity of these boreholes and another two (2) DCP tests were extended down to depths of 4.0m, 4.2m, 4.7m and 4.2m.

Encountered subsurface conditions during the geotechnical investigation are summarised in the Table 4 below.

Table 4: Summary of Subsurface Condition at 26 Whistler Street

Unit	Details	Depth (m)			
		BH101 DCP101	BH103 DCP103	DCP1	DCP2
Existing Ground Level (RL m AHD)		5.8	5.8	6.2	5.9
Fill	Sandy gravel, with sandstone gravel, brick and concrete fragments, moist	0.0 – 0.5	0.15 – 0.8	Not Provided	Not Provided
Marine Sand	SAND, fine to medium grained, loose-medium dense	0.5 – 2.7	0.8 – 3.0	–	–
	SAND, medium dense	2.7 – 3.6	3.0 – 4.0	1.5 – 3.9	1.0 – 3.4
	SAND, dense	3.6 – 4.0	4.0 – 4.2	3.9 – 4.7	3.4 – 4.2
Bedrock	Not encountered during the investigation	No information was provided about the bedrock			
Ground water	Not encountered during the investigation	Expected to below 4.7m			

A constant head infiltration test was carried out within the boreholes and permeability of Natural Sand was assessed to be 1.7 x 10^{-4} m/s and 1.8 x 10^{-4} m/s.

Property No. 21 Whistler Street, Manly NSW (Site 4)

The property is located approximately 200m north-west of the subject site. Two (2) hand auger boreholes and two (2) Dynamic Cone Penetration ("DCP") tests were carried out during the geotechnical investigation. The boreholes were extended down to approximately 4.0m and 5.0m below natural ground level. Both of the DCP tests were carried out adjacent to boreholes.

Encountered subsurface conditions during the geotechnical investigation are summarised in the Table 5 below.

Table 5: Summary of Subsurface Condition at 19-23 The Corso

Unit	Details	Depth (m)	
		BH1 DCP1	BH2 DCP2
	Existing Ground Level (RL m AHD)	6.0	6.0
Fill	Sand, fine to medium grained, with gravel and brick fragments, moist	0.1 – 0.8	0.0 – 1.2
Marine Sand	SAND, fine to medium grained, moist, loose	0.8 – 3.3	1.2 – 3.6
	SAND, fine to medium grained, moist, medium dense	3.3 – 5.0	3.6 – 4.2
Bedrock	Not encountered during the investigation	Expected to be deeper than 10.0m	
Groundwater	Not encountered during the investigation	Expected to be below 5.0m	

5.4 Groundwater Well Search

A groundwater well search was carried out on the Water NSW website to identify any groundwater wells located within a 500m radius of the site. Ten (10) groundwater wells were identified and the details of these wells are summarised in Table 6.

Table 6: Summary of Groundwater Wells Details

Groundwater Well	Location	Distance	Standing Water level (m)
GW116138	Not Available	Not Available	Not Available
GW116140	Not Available	Not Available	Not Available
GW116139	Not Available	Not Available	Not Available
GW116659	Not Available	Not Available	Not Available
GW102856	33°47'56.9"S, 151°17'18.2"E	South, 280m	4.3
GW109304	33°47'54.8"S, 151°17'07.9"E	South West, 270m	4.83
GW109245	33°47'55.1"S, 151°17'05.3"E	South West, 310m	4.8
GW110294	33°47'52.8"S, 151°17'03.5"E	South West, 330m	4.0
GW105988	33°47'59.3"S, 151°17'20.7"E	South East, 370m	3.0
GW108552	33°47'59.9"S, 151°17'19.5"E	South East, 380m	4.0

6.0 INFERRED GROUND CONDITION

Based on the available geotechnical information for sites within the vicinity of the subject site, ground condition information in the public domain and past experience, inferred ground profiles at the site are summarised in Table 7.

Table 7: Summary of Ground Profile

Unit	Details	Estimated Depth (m)	
		Upper Side	Underside
Fill	Combination of sand, gravel, silt and clay	0.0 – 0.1	0.5 – 1.0
Marine Sand Upper	SAND with silt and clay, fine to medium grained, moist, loose to medium dense	0.5 – 1.0	5.0 – 6.0
Marine Sand with Peat	SAND, with peat layers, medium dense	5.0 – 6.0	17.0 – 18.0
Marine Sand Middle	SAND, dense to very dense	17.0 – 18.0	30.0 – 35.0
Marine Sand Lower	Silty SAND, medium dense	30.0 – 35.0	35.0 – 40.0
Bedrock	SANDSTONE, extremely to highly weathered, extremely low to low strength, with some clay bands	35.0 – 40.0	–

Based on the provided information, inferred standing groundwater is expected at a depth ranging from 4.5m (RL +0.5m AHD) to 5.0m (RL 0.0m AHD).

Standing groundwater levels are also subject to a piezometric head at the drilled locations. Therefore, levels may not be representative of the natural groundwater conditions of the site. Further, it should be noted that groundwater levels within the site may be subject to seasonal fluctuations, rainfall, prevailing weather conditions and also future developments of the areas and land forms.

7.0 GEOTECHNICAL APPRASIAL

7.1 Dilapidation Survey

A dilapidation survey report on all of neighbouring structures and road carriageways is recommended to be carried out by a qualified structural engineer prior to commencement of construction. Preparation of dilapidation survey report shall constitute as “Hold Point”.

7.2 Underpinning

The provided drawings listed in Section 2 indicate that the structures within Steyne Hotel, 75 The Corso, Manly, are supported by a shallow type foundation with some of them extending slightly deeper into the ground. The structures with shallow foundations supported on the marine sand geology have potential to settle due to any vibration and soil movement caused by demolition of existing structures, installation of piled/or other foundations and/or excavation activities. Therefore, it is recommended a more detailed investigation of the foundation system of the adjacent structures be undertaken to assess the requirement of the underpinning of their foundation systems or otherwise. The heritage listed Steyne Hotel is considered very sensitive to vibration and soil movement. Therefore, assessment of the requirement of underpinning to those structures should constitute as “Hold Point”.

7.3 Vibration Control

It is noted that a Vibration Management for the proposed development has been prepared as part of the Construction Noise and Vibration Management Plan (“CN&VMP”). The provided CN&VMP is referenced in Section 2 of this report.

The purpose of the vibration monitoring is to identify acceptable vibration limits and manage the potential vibration effects caused by demolition of existing structures, installation of piled/or other foundations and bulk excavation activities, on the heritage listed Steyne Hotel, neighbouring properties and road carriageways located along the site boundaries.

The monitoring can be carried out using suitable vibration monitoring equipment attached with alarm, and appropriate PPV selected based on the condition of the subject structure. If vibration on the subject structure is exceeded the selected PPV limit, construction activities shall cease and the project Geotechnical Engineer shall be contacted immediately for review of site conditions. Implementation of vibration monitoring constitute as “Hold Point”.

7.4 Ground Movement Monitoring

Due to the heritage listed Steyne Hotel building’s sensitivity to soil movement, it is advisable to carry out ground movement monitoring throughout the construction stage. Suitable inclinometers can be installed within the vicinity of the heritage structures and measurement of ground movement carried out. A Ground Movement Monitoring Plan is a requirement prior to the issuing of a construction certificate and should be prepared by suitably qualified engineer. Continual monitoring of the plan will require throughout the construction stage.

7.5 Excavation Conditions

Bulk excavation for the proposed development is likely to comprise of fill and marine sand. Excavation can be achieved using conventional earthmoving equipment such as backhoes or tracked excavators. Use of the rock breaking and ripping equipment is unlikely to be required.

Prior to commencement of excavation, the design and construction contractor shall refer to the detailed geotechnical investigation report to understand the geology. An assessment shall be carried out by a suitably qualified excavation contractor to identify a suitable excavation method for the encountered subsurface conditions as well as site constraints.

7.6 Retaining Walls

Temporary batter slopes are not considered suitable to the marine sand geology. Therefore, a shoring wall system is required to retain the proposed basement excavation boundaries.

Due to marine geology within the site, soldier pile systems may cause collapse of sandy materials in between the soldier piles during excavation. The geology can cause excessive foundation settlement to the existing structures located within the vicinity of the excavation. It is therefore considered that either contiguous piles wall, scant piles wall, sheet piles wall, Concrete-Soil-Mix ("CSM") wall or Geocast wall systems are more suitable options than a soldier pile wall system.

Design of the shoring wall should adopt a suitable surcharge load for the existing neighbouring structures on, and adjacent, the site. The project Structural Engineer shall provide the surcharge load of the existing neighbouring structure and design and construction of a shoring system should constitute as "Hold Point" to avoid or minimise potential ground movement. Detailed retaining wall analysis should be carried out to reduce earth movement and prevent collapse of excavation boundaries and excessive displacement of neighbouring structures, including the heritage listed Steyne Hotel. The toe of any retaining wall system shall be socketed into a suitable stratum, based on the detailed design and be at least 2.0m below the bulk excavation level.

It is recommended to conduct an analysis of site's groundwater condition before finalisation of the shoring wall system. Further, it is recommended that a suitable shoring wall system shall be adapted not only to support the excavation boundaries, but also to limit groundwater inflow into bulk excavation, where relevant.

7.7 Design of Retaining Walls

The proposed basement cut faces shall be supported temporarily during construction and in the longer-term using appropriate retaining structures. These retaining structures shall be designed to withstand the applied lateral pressures of the soil, the existing surcharges in their zone of influence, such as existing structures, construction related activities, and water pressures if it exists.

The pressure distribution on cantilever retaining structures may be assumed to be triangular and estimated as follows:

$$\boldsymbol{\rho_h = \gamma k H + q k}$$

Where,
ρ_h = Horizontal pressure (kN/m^2)
γ = Wet density (kN/m^3)
k = Coefficient of earth pressure (k_a or k_o)
H = Retained height (m)
q = Surcharge pressure behind retaining wall (kN/m^2)

For the design of flexible retaining structures, where some lateral movement is acceptable, an active earth pressure coefficient is recommended. Should it be critical to limit the horizontal deformation of a retaining structure, use of an earth pressure coefficient at rest should be considered. Recommended parameters for the design of retaining structures are presented in the Table 8.

Table 8: Retaining Walls Design Parameters

Ground Profile	Unit Weight (kN/m^3)	Effective Cohesion c' (kPa)	Angle of Friction ϕ'(°)	Modulus of Elasticity E_{sh} (MPa)
Fill	18	0	28	8
Marine Sand	18 - 20	0 - 5	28 - 34	10 - 15
Bedrock	22	50	32	75

Preliminary coefficients of lateral earth pressure for the encountered ground profile are provided in Table 9. The coefficients provided are based on horizontal ground surface and fully drained conditions.

Table 9: Coefficient of Lateral Earth Pressure

Ground Profile	Coefficient of Active Lateral Earth Pressure Ka	Coefficient of Active Lateral Earth Pressure at Rest Ko	Coefficient of Passive Lateral Earth Pressure Kp
Fill	0.36	0.53	2.77
Marine Sand	0.36 – 0.28	0.53 – 0.44	2.77 – 3.54
Bedrock	0.3	0.5	3.0

If cantilever retaining structures are considered impractical, then Rectangular or Trapezoidal Pressure Distribution may be considered for the tied-back retaining system, as recommended in related standards and technical literature. In this case, temporary anchors or suitable alternative systems should be designed and constructed. It is recommended to carry out geotechnical modelling to find out the required number of anchors or other lateral supporting arrangement, as well as ground defections.

Anchors shall be extended behind the active zone to allow an effective bonding with suitable stratum. The ground and basement floor slabs shall be designed and constructed to provide permanent lateral support to the retaining wall system, and anchoring shall be considered as a temporary option for the construction stage. If an anchoring system is impractical, consideration might be given to temporary support options, such as installation of struts or suitable alternative, approved by a suitably qualified Structural Engineer. Anchors shall be installed with bond length of at least 3.0m and proof tested with 1.3 times the design working load before they lock off at working load.

Inspection and monitoring of the construction of shoring pile walls and temporary anchoring system shall be carried out under supervision of a suitably qualified Geotechnical Engineer and shall constitute as “Hold Points”.

7.8 Groundwater Management

It should be noted that groundwater conditions of a site might change with climate and development variations. Based on the encountered ground conditions, it is anticipated that groundwater is unlikely to be encountered within the proposed earthwork.

The proposed basement floor slabs and walls with adequate drainage system shall be designed by a suitably qualified engineer and constructed in accordance with local council specification. Verification of the drainage system by a qualified geotechnical engineering is advisable.

7.9 Foundations

The foundation level of the proposed development is anticipated to be within the marine soils ground profile. It is therefore considered that the foundation system of the proposed development is likely to be reinforced concrete raft slab in conjunction with settlement reduction piles extending into suitable Marine Sand and socketing at least 2.0m. Table 10 provides design parameters recommended for shallow and pile foundations.

It is recommended to carry out detailed geotechnical modelling of the proposed foundation system to determine the magnitude and distribution of settlement occurring under working load. Where additional bearing pressure is required and/or excessive settlement has occurred, consideration should be given to adoption of pile foundation socking into stronger stratum.

Piles will also be used to increase the resistance against the lateral seismic and wind loads. Shallow and pile foundation can be designed in accordance with Australian Standards AS2870-2011 and AS2159-2009, respectively.

Table 10: Foundation Design Parameters

Ground Profile	Allowable End Bearing Capacity (kPa)	Allowable Shaft Adhesion Compression (kPa)
Fill	N/A	N/A
Marine Sand Upper	30	Referenced should be given to detailed geotechnical investigation report (CPT test results)
Marine Sand with Peat	N/A	
Marine Sand Middle	450	
Marine Soil Lower	300	
Bedrock	1,000	100

Note:

- With a minimum embedment depth of 0.5m for deep foundations and 0.4m for shallow foundations.
- Clean rock socket of roughness of at least grooves of depth 1mm to 4mm and width greater than 5mm at spacing of 50mm to 200mm.
- Shaft Adhesion in Tension is 50% of Compression, applicable to piles only.

Screw piles or Continuous Flight Auger (CFA) type piles would be more suitable options than bored and driven type piles as it is relatively quickly installable and causes less vibration. Due to the presence of marine soils, consideration might be given to CFA piles together with the grout injected method to prevent collapse of the marine sand during the pile installation. Installation of the CFA pile with grout injection method requires strict quality control procedures and should be installed by a qualified experienced contractor to avoid pile necking and honey-combing.

Consideration might be given to a floating pile option, where the skin friction alone provides requiring additional bearing pressure. If floating piles socket minimum five times the pile diameter into any geology layer, then piles can be designed as conventional piles with supporting through skin friction and end bearing pressure. Ensure a sufficient thickness of that geology layer (at least three times pile diameter) is available below toe of the pile if pile is designed as a conventional pile.

A qualified geotechnical engineer shall inspect the foundation excavations to confirm appropriate foundation materials, and to ensure that the serviceability bearing pressures can be met. Foundation excavations shall be cleaned; and wet and debris should be removed prior to the concrete placement. Verification of the capacity of the shallow and pile foundations by inspections would be required and inspections shall constitute as “Hold Points”.

7.10 Site Earthquake Classification

Based on the ground conditions and in accordance with Australian Standard AS 1170.4-2007, the proposed development is classified as “Deep or Soft Soil” (Class De) for design of foundations and retaining walls embedded in the underlying bedrock. The Hazard Factor (Z) is considered to be 0.08.

7.11 Aggressivity and Salinity

Soil and groundwater samples should be tested during the detailed geotechnical investigation for assessment of Aggressivity in accordance with Australian Standard AS219-2009. Assessment of the soil and groundwater electrical conductivity should be carried out to assess the salinity of the soil in accordance with the PA Regulation (1994) and Dryland Salinity (1993). Subsequently, the design and construction of the proposed foundation system should incorporate aggressivity and salinity of the soil assessed.

7.12 Earthwork and Subgrade Preparation

Earthwork and subgrade preparation should be carried out in accordance with local council specification and Australian Standard 3798-2007. However, a general procedure is provided below for the development areas:

- Fill materials or topsoils or unsuitable materials should be removed from the site.
- Excavated materials should be stockpiled separately before reuse as engineering fill or remove to spoil.
- Exposed surfaces, after excavation, should be treated to adjust its moisture condition to not to vary more than 2% from its Optimum Moisture Content ("OMC") and then compacted using at least 12 tonnes vibrating compacter to design the density ratio.
- Exposed surfaces should be tested with appropriate density testing and proof rolling with a smooth drum roller.
- Soft or loose areas should be excavated, treated with moisture and then recompacted or replaced with appropriate imported fill material.

Final surface of the cut areas and every layer of the fill areas should be treated with moisture and compacted to design parameters in order to achieve the adequate strength for the proposed development. The general recommendation for the compaction of fill layers is listed below:

- Moisture content of fill materials should be treated to ±2% of OMC of the material.
- Minimum density ratio of 98% of the maximum dry density for the proposed development area.
- Placement of loose thickness of fill layers should not exceed 200mm during the compaction.

General recommendation for suitability of imported materials for the fill layers are provided below:

- The materials should be clean (i.e. free of contaminants, deleterious or organic material), free of inclusions of >120mm in size.
- Material with excessive moisture content should not be used.
- The materials should satisfy the Australian Standard AS 3798-2007.

7.13 Detailed Geotechnical Investigation

Prior to detailed design, drilling of appropriate number of CPT test and boreholes together with installation of piezometers should be undertaken in order to confirm the preliminary recommendations presented in this report. The geotechnical investigation should be undertaken in accordance with Australian Standard AS 1726-1993 by a Geotechnical Engineer familiar with the contents of this report.

8.0 CONCLUSIONS

This report presents the findings of the geotechnical investigation and recommendations for the proposed development at 42 North Steyne and 75 The Corso, Manly NSW 2095. It considers that the proposed development is feasible on the site utilising what are industry standard Design and Construction techniques and where the recommendations provided in this report are considered.

For and on behalf of Foundation Earth Sciences

Prepared by

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Reviewed by

Ben Buckley
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9.0 LIMITATIONS

The assessment of the sub-surface profile within the proposed development area and the recommendations presented in this report are based on limited information available to date.

The recommendations and advice presented in this report on soil and rock condition is considered to be indicative only as only very limited areas were assessed on site to date. Site inspection by a consulting Geotechnical Engineer or Engineering Geologist are to be undertake when further investigation works are to be carried out to confirm the condition of founding materials in which this geotechnical assessment recommends.

Anecdotal evidence and Information provided by client is assumed to be relevant and to the best of knowledge be appropriate for its interpretation.

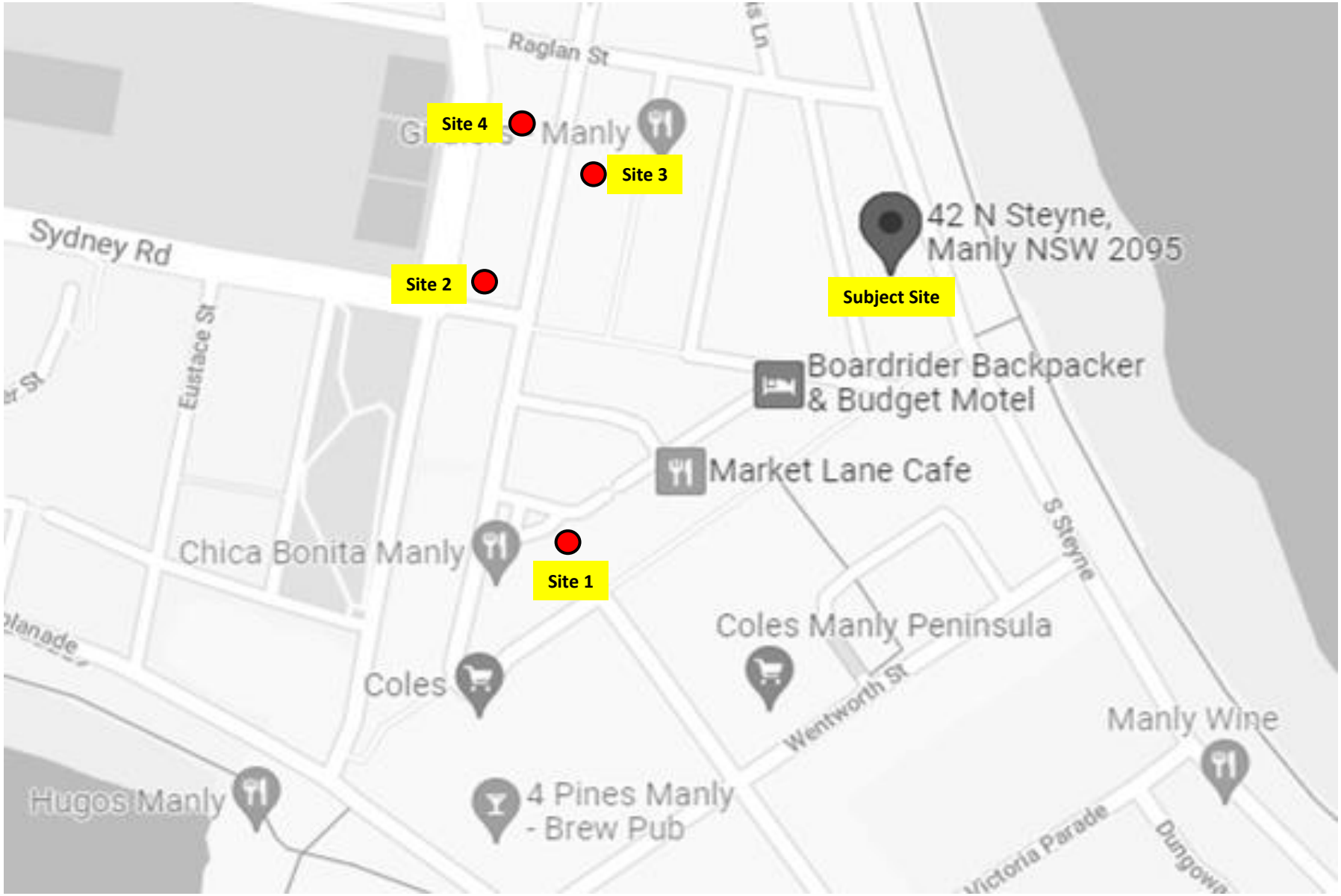
There is a possibility that the actual geotechnical and groundwater conditions across the site could differ from the inferred geotechnical assumptions and derivations on which our recommendations are presented in this report. In that case, Foundation Earth Sciences should be contacted for further advise and review of the information provided in this report. Foundation Earth Sciences does not accept any liabilities for the conditions not provided and/or accessible during the preparation of this report. Any ensuring liability resulting from use of this report by third parties cannot be transferred to Foundation Earth Sciences.

10.0 REFERENCES

1. Australian Standard – AS1726-1993 “Geotechnical Site Investigation”.
2. Australian Standard – AS 1170.4-2007 “Structural Design Actions – Part 4: Earthquake actions in Australia”.
3. Australian Standard – AS 2870-2011 “Residential slabs and footings”.
4. Australian Standard – AS 2159-2009 “Piling - Design and installation”.
5. Pells, P.J.N, Mostyn, E and Walker, B F – Foundations on Sandstone and Shale in the Sydney Region, Australian Geomechanics Journal, Dec 1998.
6. Pells, P.J.N, Douglas D.J, Rodway, B, Thorne C, McManon B.K – Design Loadings for Foundations on Shale and Sandstone in the Sydney Region. Australian Geomechanics Journal, 1978.
7. Site Investigation for Urban Salinity, Department of Land and Water Conservation 2002.
8. Water NSW, NSW government - https://realtimedata.waternsw.com.au/water.stm

Appendix A

Site Plan



Key

Approximate Sites Locations

Not to scale

FOUNDATION EARTH SCIENCES

Ref #	Site Plan
G521	Iris Capital
MM	42 North Steyne and 75 The Corso, Manly NSW 2095

Appendix B

Details of the Sites

Site Plan
Locality

Location - Manly

- Site Boundary
- Site A
- Site B
- Site C
- Site D - IN PROGRESS OF AMALGAMATING WITH SITE C (DA 2021/0532)

Site Analysis
Locality

Key

- Subject Site
- Through links
- Pedestrian walking paths
- Pedestrian Crossings
- Views
- Heritage Items
- Conservation Area
- Heritage Landscape Item
- Ⓟ Council Car Park
- Important Vistas - Manly Development Control Plan Schedule 2
- Important Corners - Manly Development Control Plan Schedule 2
- ① Image locations - refer to Pedestrian through link images