GEOTECHNICAL INVESTIGATION REPORT

PROPOSED RESIDENTIAL DEVELOPMENT
122 - 124 QUEENSCLIFF ROAD, QUEENSCLIFF NSW

PREPARED FOR GEMINI QUEENSCLIFF PTY LTD
AND KRISTOFFER HARVEY
REPORT ID: G22006QUE-R01F

Date: 22nd March 2022
Revision No.: 0

Client:
Gemini Queenscliff Pty Ltd and Kristoffer Harvey
C/- ESS Lifestyle
24/13-29 Nichols Street
Surry Hills NSW 2010

Author: S. McCormack (B.Eng Civil) – MIEAust, CEnvP, CPEng, NER (geotechnical, environmental)
Class 2 Buildings Professional Engineers Registration PRE0000623
Field Engineer / Scientist: Z. Ziesel (B.Eng Civil)

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1 PROJECT INFORMATION

1.1 INTRODUCTION AND OBJECTIVES

Geo-Environmental Engineering Pty Ltd (GEE) was commissioned by Gemini Queenscliff Pty Ltd and Kristoffer Harvey to complete a geotechnical investigation at 122 - 124 Queenscliff Road, Queenscliff New South Wales (herein referred to as 'the site'). A survey plan of the site is provided in **Appendix A**.

The investigation relates to the proposed construction of a multi-storey residential unit building including a basement for car parking and general storage and was required to support a Development Application with Council and to assist with the preliminary structural design and construction of the development.

The report presents the factual results of the field investigations and provides interpretation and recommendations regarding the ground conditions at the site in accordance with client requirements and the agreed scope of work.

1.2 PROPOSED DEVELOPMENT

According to the architectural plans, a copy of which is provided in **Appendix A**, it is proposed to construct a residential unit building with three levels of living space over a single level basement for parking and general storage. A mechanical car lift is also proposed at the northern end of the site to facilitate access to the basement, while two in-ground swimming pools are proposed at the rear of the site and adjacent to the rear of the basement.

The finished floor level of the basement is expected to be 22.05m above Australian Height Datum (AHD) and is expected to require excavation of between approximately 3.5m and 7.5m below existing ground surface (bgs), with deeper excavations locally to accommodate the mechanical car lift and lift shaft. According to the development plans, the basement will be setback 2.2m from the side boundaries and over 5m from the front and rear boundaries. The pools are expected to require excavation of up to 2.0m and will be approximately 1.0m from the rear and side boundaries.

1.3 SCOPE OF WORK

To satisfy the above objective, GEE completed the following scope of work:

◊ The drilling of boreholes in accessible locations across the site to assess the subsurface conditions across the site,

- Performance of Dynamic Cone Penetrometer (DCP) tests across the site to assess the consistency and/or relative density of the subsurface soils, and to assist with confirming the depth to bedrock,
- Collection of representative soil and rock samples from the boreholes,
- Analysis of selected soil samples for the preliminary assessment of soil salinity and aggressivity,
- Point load strength testing of selected rock samples, and
- Preparation of this geotechnical report.

2 SITE INFORMATION

2.1 SITE DESCRIPTION

The site is located on the southern side of Queenscliff Road and is bounded by residential dwellings to the east and west. To the south was a construction site which included an excavation into the existing slope of up to approximately 8m and exposing a vertical sandstone bedrock batter. The site covers an area of approximately 950m^2 and encompasses Lots 5 and 6 in Deposited Plan (DP) 16941.

At the time of this investigation, the eastern half of the site (Lot 6 and No. 122) was occupied by a one and two storey brick unit building and there was no vehicle access to this allotment. At the front and rear of the building were grassed yards with some concrete paths and a few garden beds. Some sandstone bedrock was exposed at the surface in the front yard.

The western half of the site (Lot 5 and No. 124) was occupied by a one, two and three level brick unit building with a concrete driveway along the eastern side of the allotment which led to a concrete paved rear yard and two single garages at the rear of the building. The front yard was predominately covered by grass while there was some exposed bedrock at the surface adjacent to the front, north-western corner of the unit building.

Of particular significance to the development is the presence of a Sydney Water sewer pipeline which crosses the rear of the site (refer to **Appendix B**). However, the site is located at the high end of the pipeline so it could be repositioned to suit the proposed development.

Site features and the proposed extent of the outline of the proposed development is provided as **Figure 1**. Photographs of the site, which were taken on the 21st February 2022, are provided for reference in **Plates 1 to 6** below.

Plate 1: View to the south showing the front of No. 124

Plate 2: View to the south-east across the front of No. 122

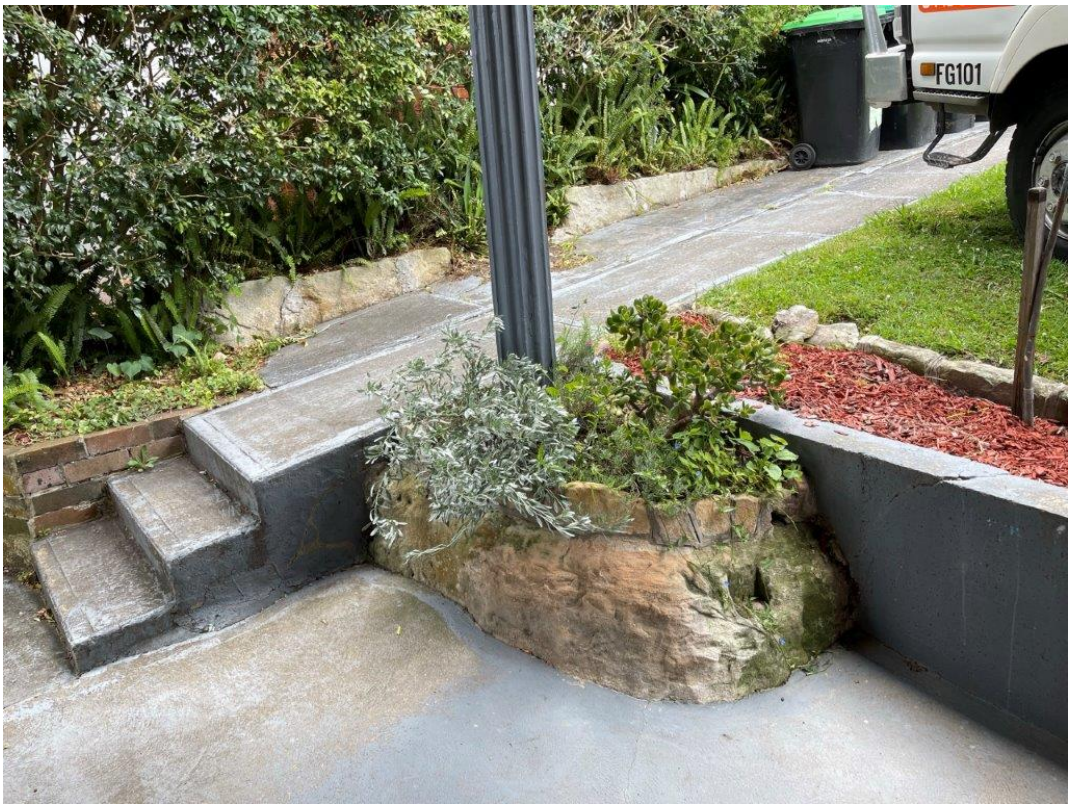


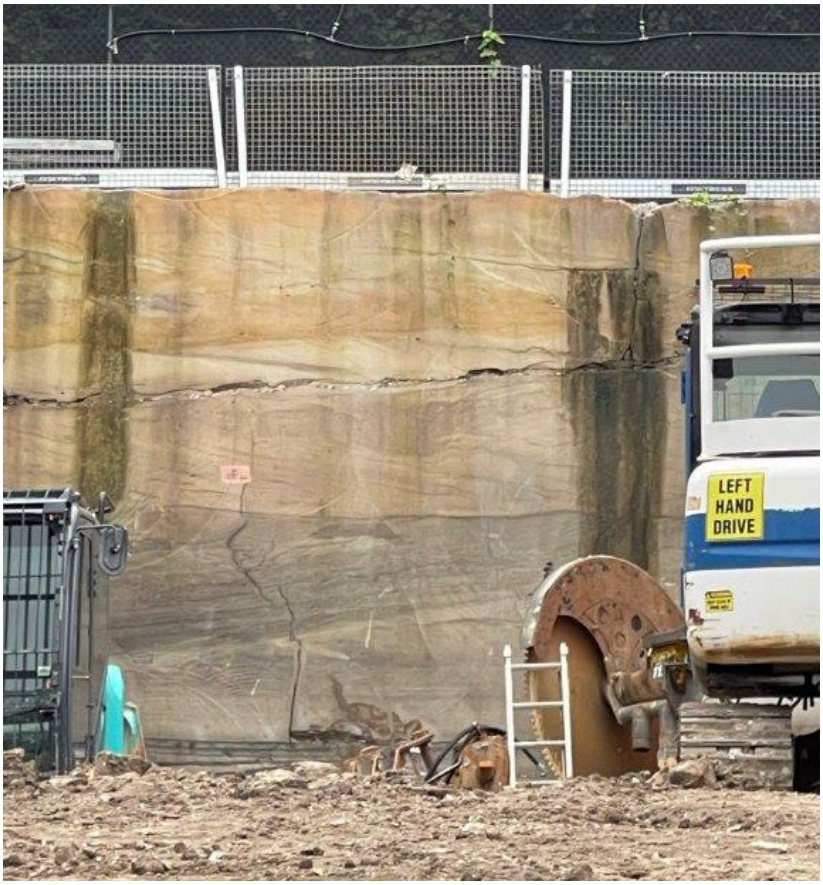
Plate 3: Exposed bedrock at the front of No. 124.

Plate 4: Exposed bedrock at the front of No. 122.

Plate 5: View north along the driveway between the two allotments.

Plate 6: View the south across the rear yard of No. 122.

Plate 7: View to the south showing the excavation immediately to the south of No. 124.



Pate 8: View of the vertical rock excavation face on the adjoining property to the south.

2.2 TOPOGRAPHY

The site is situated on a southerly dipping hillslope with slope an average grade of approximately 10 to 15%. The elevation at the front (northern end) of the site is approximately 31m AHD and is approximately 26m AHD at the rear (southern end).

2.3 GEOLOGY AND SOIL MAPPING

A review of the regional geological map (reference 1) indicates that the site is underlain by the Hawkesbury Sandstone formation, which typically comprises '*…medium to very coarse grained quartz sandstone, minor laminated mudstone and siltstone lenses'*.

A review of the regional soils map indicates that the site is located within the Warriewood Soil Landscape Group (reference 2). The landscape of the Warriewood group are characterised by level to gently undulating swales, depressions and infilled lagoons on Quaternary sands. Soils from this group are typically deep (>1.50m) well sorted sandy humus podsols and dark siliceous sands overlying buried acid peats in depressions and pale siliceous sands on sandy rises. GEE notes that the soil profile encountered during this investigation was not consistent with soils from the Warriewood group.

2.4 HYDROGEOLOGY

The regional water table in the vicinity of the site is likely to be confined or partly confined, discrete, water-bearing zones within the Hawkesbury sandstone, while intermittent perched water may exist between the soil / bedrock interface, at various times in particular following rainfall events.

Groundwater flow is dominated by water movement through fractures (or joints), where stress has caused partial loss of cohesion in the rock and evidence of potential water bearing fractures is usually the presence of clay or iron-staining along the face of the joints.

2.5 ACID SULFATE SOIL RISK

Acid Sulfate Soil is naturally occurring sediments and soils containing iron sulfides (principally iron sulfide, iron disulfide or their precursors). Oxidation of these soils through exposure to the atmosphere or through lowering of groundwater levels results in the generation of sulfuric acid.

Land that may contain potential acid sulfate soils was mapped by the NSW Department of Land and Water Conservation (DLWC) and based on these maps local Councils produced their own acid sulfate soil maps to be used for planning purposes.

The DLWC '*Sydney Heads'* Acid Sulfate Soil Risk Map (reference 3), indicates that the site lies within an area with no known occurrences of acid sulphate soil and land activities within this area are "...*not likely to be affected by acid sulphate soil materials*".

The Acid Sulfate Soils Map produced by the NSW Department of Planning and Environment, and available via interactive online mapping, indicates that the site lies outside areas defined as "Class 1" to "Class 5". In this regard, there is no need for an acid sulphate soil assessment or management plan.

3 FIELD INVESTIGATIONS

The site investigation was undertaken by Stephen McCormack from GEE on the 21st February 2022 and the work comprised:

- ◊ A site inspection,
- ◊ The drilling of four boreholes (BH1 to BH4) at accessible locations across the site to assess the subsurface conditions across the site including a preliminary assessment of the strength and quality of the bedrock formation,
- ◊ The performance of DCP tests adjacent to each borehole to assess the consistency and/or relative density of the soil profile and to assist with determining the depth to bedrock,
- ◊ The collection of representative soil samples for the preliminary analysis of soil salinity and aggressivity, and
- ◊ Collection of rock core from the boreholes for selective laboratory testing.

3.1 BOREHOLE DRILLING AND DCP TESTING

Prior to commencement of the bores, an inspection for potential underground services and utilities was completed and cross-checked with the results of a Dial Before you Dig (DBYD) search.

Boreholes BH1 and BH2 were positioned at the front and rear yards of No. 124 and drilled using a mechanical track mounted drill rig which was owned and operated by the Fico Group using a combination of solid flight augers (SFA) through the soil profile and into the weathered bedrock formation, while NMLC diamond coring was adopted within the deeper bedrock formation. Borehole BH1 terminated at a depth of 7.0m below ground surface (bgs) which equates to an elevation of approximately 19.15m AHD, while BH2 terminated at a depth of 9.0m depth which equates to an elevation of approximately 20.5m AHD.

The mechanical rig could not access No. 122 and so the remaining boreholes (BH3 and BH4) were drilled using an 85mm diameter stainless steel hand auger. Each of the boreholes terminated due to practical refusal on the surface of the bedrock and this occurred at 0.4m bgs at BH3 and 0.55m bgs at BH4.

During drilling, the encountered fill material and any natural soil were geologically logged, taking care to describe the presence and depth of any adverse aesthetics such as discolouration or odours.

The DCP tests were performed in accordance with Australian Standard Test Method AS1289.6.3.2-1997 (reference 4) and all terminated due to practical refusal at depths that were consistent with the top of the bedrock formation.

A summary of the subsurface conditions encountered is provided in Section 4.1, while the locations of the boreholes are shown on **Figure 1** along with a copy of the survey plan.

3.2 SOIL SAMPLING

Soil samples were collected at regular intervals from each of the boreholes and selected samples were submitted to Eurofins laboratory for the following NATA accredited testing as part of a preliminary assessment of soil salinity and soil aggressivity towards buried concrete and/or unprotected steel.

3.3 ROCK SAMPLING

Samples of recovered rock core were taken from regular intervals from boreholes BH1 and BH2 with selected samples undergoing point load strength testing to assist with classifying the rock.

4 INVESTIGATION RESULTS

4.1 SUBSURFACE CONDITIONS

The subsurface conditions, as observed in the boreholes, typically comprised relatively shallow fill and/or natural soil over sandstone bedrock. The depth to bedrock was between approximately 0.4m and 1.0m bgs, although as previously mentioned, sandstone bedrock was observed at the surface of the site at some locations at the front of the site (refer to Plates 3 and 4).

Detailed descriptions of the subsurface conditions on site are provided in the borehole logs in **Appendix C**, while a summary of the subsurface conditions across the site are provided in **Table 1**.

Table 1: Summary of Subsurface Conditions and Geological Model

Layer / Unit	Description	Depth to the Top of the Layer/Unit (m)[1]
		m BGS
1- FILL / TOPSOIL / NATURAL SOIL	Fill: Sandy GRAVEL: grey, red, brown, fine to coarse sand and fine to coarse gravel with sandstone cobbles noted in BH4 and some anthropogenic inclusions in BH1, moist, loose. Topsoil / Natural: Silty SAND: dark brown / dark grey, fine to medium grained, very loose to loose and moist to very moist.	0.0
2a - BEDROCK	SANDSTONE: grey, brown, fine to coarse grained, extremely to highly weathered and estimated to be very low strength. Assessed as Class V SANDSTONE – reference 5	0.0 – 1.0
2b - BEDROCK	SANDSTONE: grey, white, pink and black, fine to coarse grained, low to medium strength and variable weathering (distinctly to fresh). Assessed as Class IV SANDSTONE – reference 5	1.55 – 2.5

4.1.1 GROUNDWATER

During the borehole drilling for this investigation, and over the intervals where either a hand-auger or solid flight augers were used, groundwater was not encountered. However, perched seepage water that is directly recharged by rainfall will occur intermittently through defects within the bedrock formation, and along the soil-bedrock interface.

4.2 LABORATORY TEST RESULTS

A limited number of soil samples were collected during the fieldwork and submitted to Eurofins laboratory for the following tests:

- ◊ Electrical Conductivity (EC) to provide a detailed assessment of the salinity potential of the soil profile, and
- ◊ Resistivity, Sulphate, Chloride and pH to determine the exposure classification of the soil with respect to buried structural concrete or steel.

GEE also used a calibrated point load tester to assess the strength of the recovered rock core from boreholes BH1 and BH2. The laboratory and point load test results are presented in **Appendix D**, while a summary of the results is provided in the following sections.

4.2.1 SOIL SALINITY TESTING

A limited assessment of soil salinity conditions has been undertaken with reference to guidance published by the Department of Land and Water Conservation NSW (reference 6). In this regard, selected samples of natural soil were submitted to Eurofins for NATA accredited testing of Electrical Conductivity (EC), which is the primary indicator of salinity. The raw EC results and the EC_e results are provided in **Table 2**.

Table 2: Electrical Conductivity Results

Sample Location / Depth	**Sample Description**	**EC** (dS/m)	**Multiplication Factor[1]**	**EC_e** (dS/m)
BH1 / 0.5 – 0.6m	Silty SAND	0.016	14	0.22
BH2 / 0.1 – 0.3m	Silty SAND	0.042	14	0.59
BH3 / 0.1 – 0.3m	Silty SAND	0.092	14	1.29

According to the Department Land and Water Conservation NSW the soil salinity classes are as follows:

ECe (dS/m)	Class
<2	Non-Saline
2 – 4	Slightly Saline
4 – 8	Moderately Saline
8 – 16	Very Saline
>16	Highly Saline

The above test data indicate that the toposoil/natural soil profile is non-saline.

4.2.2 AGGRESSIVITY TESTING

Selected soil samples were submitted to Eurofins for NATA accredited testing of pH, sulfate, chloride and resistivity to provide a preliminary assessment of the exposure classification (or aggressiveness/corrosiveness potential) of the soil with respect to future buried steel and/or concrete (e.g. footings).

To determine the aggressiveness of the soil and water environment on concrete or steel, the chemical test results are compared to Tables 6.4.2(C) and 6.5.2(C) from Section 6 of the Australian Standard AS 2159 (reference 7). This section provides assessment criteria to assess the 'exposure classification' for a concrete or steel pile. The Standard has two classes of soil conditions:

(A) high permeability soils below groundwater; and
(B) low permeability soils and all soils above groundwater.

For this site, all the soil samples are considered to be condition 'B'. Based on the chemical testing results, the standard provides a range of 'exposure classifications' from non-aggressive to very severe. For the range of chemical conditions in the soil surrounding the structure, the condition leading to the most severe aggressive conditions is adopted.

A summary of the soil testing results is provided in **Table 3**.

Table 3: Exposure classification (aggressivity) test results

Sample Location / Depth	Material Type	Soil Condition	pH	Sulphate (SO_4) mg/kg	Chloride (Cl) mg/kg	Resistivity Ohm cm
BH1 / 0.5 – 0.6m	Silty SAND	B	7.3	<10	<10	63,000
BH2 / 0.1 – 0.3m	Silty SAND	B	6.9	<10	11	24,000
BH3 / 0.1 – 0.3m	Silty SAND	B	5.4	<10	<10	11,000

The aggressivity potential of the environment on concrete is dependent on the sulphate and pH levels of the soil and the chloride and sulfate concentration of the groundwater. Based on the limited number of test results and according to AS2159-2009 (reference 7) the subsurface profile is mildly aggressive towards concrete.

According to Australian Standard AS 3600-2009 (reference 8), specifically Table 4.3, this equates to an exposure classification of 'A2'.

The corrosive potential of an environment on unprotected steel is normally dependent on pH, chloride, and resistivity levels of the soil. Based on the limited number of test results above and with reference to AS2159-2009, the subsurface profile is considered to be non-aggressive/corrosive.

4.2.3 Rock Strength Testing

To assess the strength of the encountered bedrock, representative samples of recovered rock core were collected from BH1 and BH2 and were subjected to point load tests. Where possible, the point load tests were conducted at approximately 1.0m intervals. Point load tests are a simple and economical test for estimating the strength of a rock and the tests results are routinely multiplied by a factor of 15 - 20 to estimate an Ultimate Compressive Strength (UCS) value, although the correlation is known to vary significantly. For the purpose of this investigation a multiplication factor of 15 was adopted for estimating the UCS value from the point load tests.

A copy of the laboratory test results is presented in **Appendix D**, and the data is also recorded in the borehole logs.

5 DISCUSSION

5.1 SITE PREPARATION

Following demolition of the existing structures and prior to bulk excavation works and construction of the new development, all topsoil with organic matter and any pavement materials, should be removed from the proposed building and pavement areas. Stripped topsoil should be stockpiled for re-use as landscape material or disposed of off-site.

Material removed from site will need to be managed in accordance with the provisions of current legislation and may include segregation by material type classification in accordance with NSW EPA (2014) *Waste Classification Guidelines* (reference 9) and disposal at facilities appropriately licensed to receive the particular materials. GEE notes that the natural soil and bedrock may be classified as Virgin Excavated Natural Material (VENM) and re-used on other sites rather than disposed at a landfill, although it must be proven to be free of contamination.

5.2 DILAPIDATION SURVEY

Considering the proximity of adjoining structures, it is recommended that a dilapidation report is obtained prior to commencing demolition and construction work. The purpose of a dilapidation report is to confirm that demolition and construction works, are not causing damage to adjoining structures and therefore may prevent future claims of damage arising from the works. Preferably these surveys should be agreed to, and the report signed, by the owners of the adjacent building prior to work commencing.

5.3 EARTHWORKS

Based on the development plans provided in **Appendix A**, excavation of between approximately 3.5m and 7.5m depth will be required to construct the proposed basement level, with deeper excavations locally to accommodate the mechanical car lift and lift shaft. The basement is setback 2.2m from the side boundaries and over 5m from the front and rear boundaries. The pools at the rear of the site are expected to require excavation of up to 2.0m and will be approximately 1.0m from the rear and side boundaries.

5.3.1 Excepted Excavation Conditions

Based on the fieldwork undertaken as part of this investigation, the excavation for the basement will encounter shallow fill material and/or natural sandy soil before encountering weathered sandstone bedrock. Sandstone bedrock is also expected to be found at the surface in some parts of the site.

Based on the rock strength testing completed herein, the sandstone unit is predominately low to medium in strength from a relatively shallow depth and remains relatively consistent in strength throughout the depth of the proposed basement excavation. In this regard the majority of the excavation is expected to require the use of an impact hammer, particularly where unfavourable rock-defect geometry occurs. When using an impact hammer, the effects of vibration should be considered and are discussed further in Section 5.3.5.

GEE recommends that the earthworks contractor make their own determination of excavatability of the bedrock and base their assessment on the strength of the rock from inspection of the rock core and interpretation from the point load test results rather than the rock classification for foundations because rock classification for foundations include a factor of safety and therefore may underestimate the strength.

Finally, the combination of jointing and bedding where present, in particular the moderately to steeply inclined fractures within the rock, have the potential to cause wedge or block type failures during excavation and therefore allowance will need to be made for the support of the fractured rock and GEE recommends mapping of the rock during excavation by an experienced engineering geologist.

5.3.2 Groundwater Inflow

Permanent groundwater was not encountered during the drilling of the boreholes. However seepage slow seepage is expected to occur over time along the soil-bedrock interface and through defects within the bedrock formation. The seepage is expected to be recharged by rainfall events and will therefore be intermittent and vary in volume. Notwithstanding this, it is expected that the water inflow to the excavation will be sufficiently managed during the earthworks phase by pumping from a sump at the base of the excavation. In the long term, conventional techniques such as strip drains behind basement walls and ag-lines below the basement floor will need to be incorporated into the design of the basement to ensure that any seepage is directed to a sump where it can be pumped into the regional stormwater system.

The volume of groundwater required to be withdrawn during excavation works, and long term, is expected to be significantly less that the 3ML/year limit noted in the Water Management (General) Regulation 2018 and therefore exempt from needing a water access licence.

Finally, considering the lack of registered groundwater bores within proximity to the site, the basement is not expected to impact existing groundwater users.

5.3.3 BATTERS

The areas of proposed excavation may be temporarily battered as detailed below:

- ◊ Fill / Topsoil / Natural Soil: 2 Horizontal (H) to 1 Vertical (V).
- ◊ Bedrock: Vertical

All such batters should be inspected by a geotechnical professional to confirm their stability and they assume that the ground surface beyond the crest of the slope is horizontal and surcharge loads are not placed within a distance from the crest equal to the vertical height of the cut.

Considering the shallow depth to bedrock across the site and the basement position relative to the boundaries, these batter slopes are expected to be feasible on all sides. However, it is recommended that regular inspections by an experienced engineering geologist or geotechnical engineer be conducted during excavation works to ensure that the excavation stability is not affected by unsuitable defects or detached boulders. Where defects or detached boulders that affect the batter, stability are encountered conventional stabilisation techniques such as rock bolting, meshing or shotcrete may be required. The removal of some boulders may also be required where stabilisation is not considered safe.

If deeper soil profiles are encountered locally, then either temporary retaining structures or the early construction of permanent walls designed to shore up the soil profile will be required. Temporary retaining structures may also be required to support the soil profile for the pool excavations which are expected to be only 1.0m from the rear and side boundaries.

5.3.4 RETAINING STRUCTURES

Any retaining structures should be designed by a suitably experienced structural engineer in accordance with AS 4678-2002 *Earth Retaining Structures* (reference 10)

The design of any retaining structures should make allowance for all applicable surcharge loadings including construction activities around the perimeter of the excavation and adjacent buildings. Consideration should be given to the possibility of a hydrostatic pressure due to build-up of water behind the wall (*e.g.* from broken services), unless permanent subsurface drainage can be provided.

Finally, computer aided analysis may be carried out to assess potential ground movements based on different wall designs and construction sequence, to control deflections to within tolerable limits. It is also considered prudent to carry out surveys before and after installation to measure the actual movement of the wall or soil.

Preliminary geotechnical parameters for the soil and bedrock profile encountered at the site are provided in **Table 4** below. Although additional investigations are recommended to confirm the quality and strength of the bedrock formation across the entire site.

Table 4: Geotechnical Earth Pressure Design Parameters – Retaining Walls / Shoring

Material		**Unit 1 Fill / Natural Soil**	**Unit 3a Sandstone**	**Unit 3b Sandstone**
Bulk Unit Weight (kN/m^3)		17	22	24
Earth Pressure Coefficients	Active (Ka)	0.4	0.33	0.31
	At Rest (Ko)	0.57	0.5	0.47
	Passive (Kp)	2.5	3.0	3.2
Elastic Modulus (MPa)		10	100	150
Drained Cohesion c' (kPa)		0	35	70
Drained Friction Angle ϕ' (º)		26	30	32
Poisson's Ratio		0.35	0.3	0.3

Note 1: Unit weights are based on visual assessment only – order of accuracy approximately ±10%.
Note 2: The passive earth pressure are provided on the assumption that the ground behind the retaining wall is flat and drained.

5.3.5 Construction / Excavation Induced Vibration

The structures and utilities adjacent to the areas of excavation are sensitive to vibrations above certain threshold levels (regarding potential for cracking). This includes the shallow widened brick footings of the existing dwelling and in particular

where the footing system and walls have been previously damaged due to movements in the footing system.

When using a hydraulic hammer, vibrations will be transmitted through the ground and potentially impact on adjoining structures. Where possible, the use of other techniques not involving impact (*e.g.* rock saws), should be adopted as they would reduce or possibly eliminate risks of damage due to vibrations.

Where vibration intensive works such as hydraulic hammering of competent rock is proposed, contractors should assess the potential impact of their works based on the borehole logs and local knowledge of similar bedrock formations. Monitoring of construction induced vibration should be undertaken at the commencement of such activities at the nearest vibration receptor and in consultation with the project superintendent and geotechnical engineer so that excessive vibration effects are not generated.

Peak Particle Velocity (PPV) is usually the adopted measure of ground vibration, and the safe limits depend on the sensitivity of the adjoining structures. There are several Australian and overseas publications which provide vibration velocity guideline levels (or safe limits) including:

- Australian Standard AS2187.2-2006 Explosives - Storage and use - Use of explosives - Appendix J: Ground Vibrations and Airblast Overpressure (reference 11).
- Australian Standard AS2670.2-1990 Evaluation of human exposure to whole-body vibration - Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz) (reference 12).
- DIN 4150 – Part 3 – 1999. Effects if Vibration on Structures (reference 13).
- Department of Environment and Conservation NSW, 2006. Assessing Vibration: a technical guideline (reference 14).
- British Standard BS 7385-1:1990. Evaluation and measurement for vibration in buildings. Guide for measurement of vibrations and evaluation of their effects on buildings (reference 15).
- British Standard BS 7385-2:1993. Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration (reference 16).

Furthermore, the owners of adjoining assets/utilities sometimes have their own limits. In the absence of PPV guidelines from affected asset owners, GEE recommends the following limits be placed on vibrations:

◊ 5 mm/s for the adjoining developments and utilities.

This limit is somewhat conservative, although it can be raised by undertaking a vibration management plan to be prepared by a suitably qualified vibration consultant which can be completed prior to excavation works commencing.

If vibration levels are found to be unacceptable during the earthworks, it may be necessary to adopt vibration mitigation measures such as:

◊ The use of smaller excavation plant and hydraulic hammers,

◊ The use of a rock sawing or grinder adjacent to the site boundaries. GEE notes that this equipment also reduces the possibility of over-break and loosening of the rock mass.

◊ Hammering at 50% capacity in short bursts to prevent the buildup of resonant frequencies,

◊ The use of low vibration techniques such as rotary grinders or chemical rock splitting,

◊ Progressive breakage from open excavated faces,

◊ Selective breakage along open joints, where present, and

◊ Orientation of the rock hammer pick away from property boundaries and into the existing open excavation.

GEE notes human discomfort levels caused by vibration are typically less than the levels that are likely to cause cosmetic or structural damage to structures. Therefore, complaints may be lodged by neighbours before any cosmetic or structural damage occurs. In this regard, consideration may be given to adopting more stringent vibration limits recommended for human amenity or, as a minimum, ensuring that vibration monitoring is undertaken as reassurance to confirm that vibrations are within safe limits. Acceptable vibration limits for human comfort caused by construction and excavation equipment are provided in DEC (2006) (reference 19). Specifically, maximum acceleration limits as specified in Table 2.2 of the guideline should be adopted.

5.4 FOUNDATIONS

Following excavation of the basement, the bulk excavation level is expected to comprise the Unit 3b sandstone formation which is assessed as being at least Class IV sandstone (reference 5). The preliminary design parameters for this bedrock unit is provided in **Table 5** however, additional investigations are recommended to confirm the quality and strength of the bedrock formation across the entire site.

Table 5: Preliminary Foundation Design Parameters

Founding Stratum	Serviceability End Bearing Pressure (MPa)[1]	Ultimate Compressive Socket Side Shear (kPa)[2]	Elastic (Young's) Modulus (MPa)	Poisson Ratio (Y')
Unit 3b Sandstone	1.5	300	150	0.3

Note 1: Settlements for the serviceability bearing pressure are expected to be <1% of the minimum footing dimension.
Note 2: Assumes a rough socket of category R2 or better.

Footing systems should be designed by a suitably qualified and experienced structural engineer and GEE recommends that inspection by a geotechnical engineer is undertaken during the excavation stage to confirm that the design founding conditions have been achieved.

5.4.1 AGGRESSIVITY / EXPOSURE CLASSIFICATION

Based on the preliminary exposure classification test results (Section 4.2.2), and in accordance with AS 2159-2009 (reference 7), the subsurface concrete structures (*e.g.* footings) may be designed based on mildly aggressive soil conditions for concrete. According to Australian Standard AS 3600-2009 (reference 8) the exposure classification is 'A2'. For buried steel that is unprotected, the sub-surface profile is considered to be non-aggressive/corrosive.

5.5 SALINITY CONDITIONS

The testing carried out on the soil profile (refer to Section 4.2.1) indicate that non-saline soil conditions exist beneath the site. In this regard a salinity management plan is not warranted.

6 CONCLUSION AND RECOMMENDATIONS

GEE considers that sufficient information has been gained to be confident of the subsurface conditions across the site, to assist with design of the proposed development and to provide Council with assurances about the feasibility of the project.

Based on the results of the investigation, it is concluded that the proposed development is feasible. Additionally, GEE concludes that the existing rock formation is capable of withstanding the proposed loads to be imposed, and either standard shoring works (provided they are designed by a structural engineer), or temporary batters described herein, will ensure the stability of the excavation and provide protection and support of adjoining properties.

However, further investigation (post demolition) is recommended to better define the strength and quality of the bedrock formation more accurately across the entire site, which will minimise the uncertainty for earthworks contractors and structural design engineers when planning and designing the proposed excavation and foundations. Inspections by an experienced geotechnical professional are also recommended during the proposed excavation works to ensure that the excavation stability is not affected by unsuitable defects in the bedrock formation or detached boulders.

The geotechnical issues associated with the proposed development have been addressed by the investigation and are discussed in this report. If, during construction, any conditions are encountered that vary significantly from those described or inferred in the above report, it is a condition of the report that we be advised so that those conditions, and the conclusions discussed in the report, can be reviewed and alternative recommendations assessed, if appropriate.

GEE will be pleased to assist with any further advice or geotechnical services required in regard to the proposed development.

7 GENERAL LIMITATIONS

Soil and rock formations are variable. The logs or other information presented as part of this report indicate the approximate subsurface conditions only at the specific test locations. Boundaries between zones on the logs or stratigraphic sections are often not distinct, but rather are transitional and have been interpreted.

The precision with which subsurface conditions are indicated depends largely on the frequency and method of sampling, and on the uniformity of subsurface conditions. The spacing of test sites also usually reflects budget and schedule constraints. Groundwater conditions described in this report refer only to those observed at the place and under circumstances noted in the report. The conditions may vary seasonally or as a consequence of construction activities on the site or adjacent sites.

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEE be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of changed soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

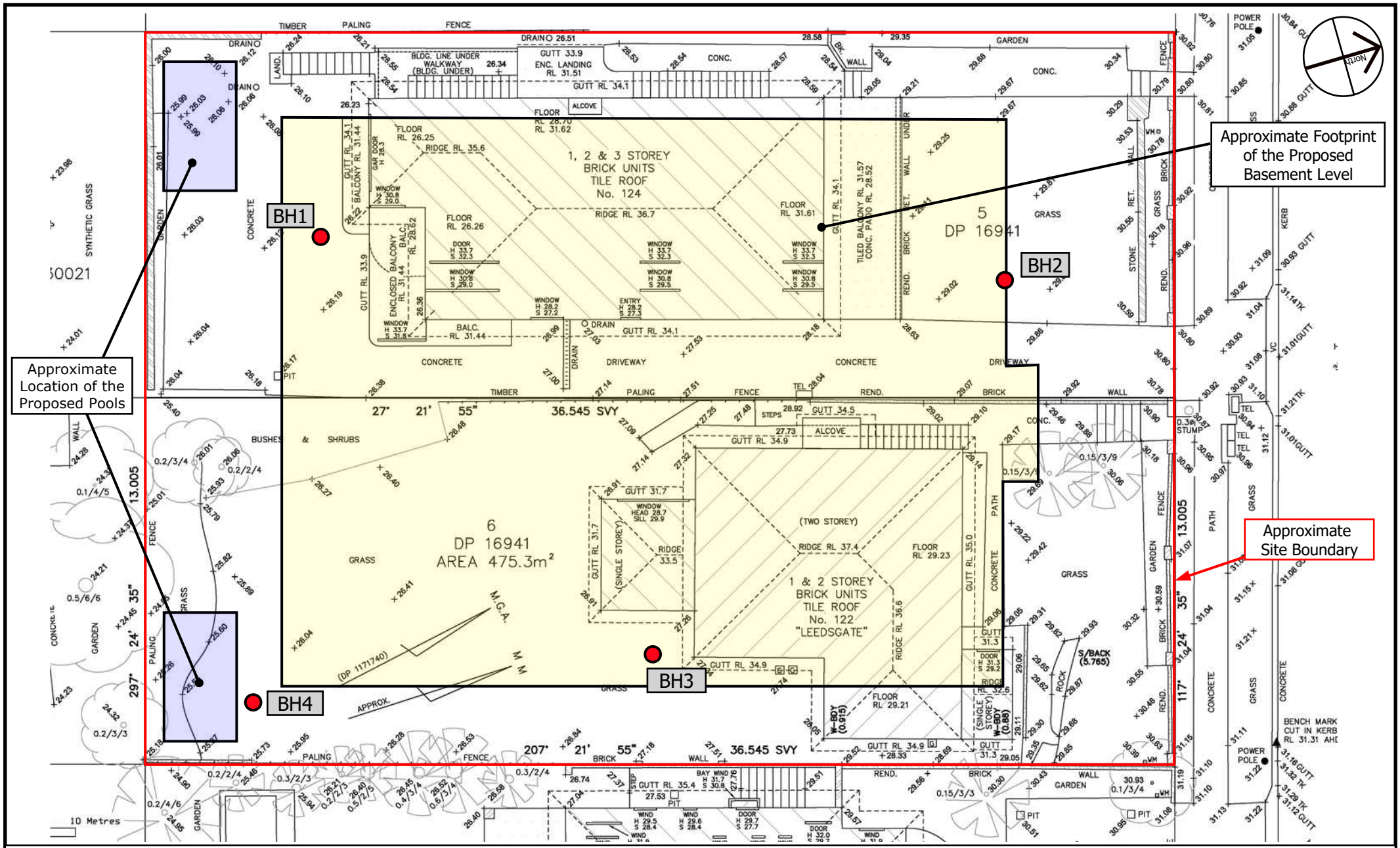
The comments given in this report are intended only for the guidance of the design engineer, or for other purposes specifically noted in the report. The number of boreholes or test excavations necessary to determine all relevant underground conditions which may affect construction costs, techniques and equipment choice, scheduling, and sequence of operations would normally be greater than has been carried out for design purposes. Contractors should therefore rely on their own additional investigations, as well as their own interpretations of the borehole data in this report, as to how subsurface conditions may affect their work.

8 REFERENCES

1. Department of Mineral Resources, 1983: Sydney 1:100,000 *Geological Series Map Sheet 9130 (Edition 1).*
2. Department of Land and Water Conservation (DLWC), 2004: Sydney 1:100 000 Soil Landscape Series Sheet 9130 (second edition).
3. DLWC, 1997: Department of Land and Water Conservation of NSW, 1997: *Sydney Heads Acid Sulfate Soil Risk Map – Edition Two.*
4. Australian Standards, 1997. *AS1289.6.3.2 Determination of the penetration resistance of a soil – 9kg dynamic cone penetrometer test*.
5. Pells et al, 2019: *Classification of Sandstones and Shale in the Sydney Region: A Forty Year Review.* Australian Geomechanics Society, 2019.
6. Department of Land and Water Conservation NSW, 2002: *Site investigations for urban salinity*.
7. Australian Standard (AS) 2159 -2009: *Piling Design and Installation*.
8. Australian Standard (AS) 3600 – 2009: *Concrete Structures.*
9. New South Wales Environmental Protection Authority (NSW EPA), 2014: *Waste classification guidelines – Part 1 classifying waste.* November 2014.
10. Australian Standard AS4678-2002: Australian Standard, 2002: *Earth Retaining Structures*.
11. Australian Standard AS2187.2-2006 *Explosives - Storage and use - Use of explosives* - Appendix J: *Ground Vibrations and Airblast Overpressure.*
12. Australian Standard AS2670.2-1990: *Evaluation of human exposure to whole-body vibration - Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)*.
13. DIN 4150 – Part 3 – 1999. *Effects if Vibration on Structures.*
14. Department of Environment and Conservation NSW, 2006. *Assessing Vibration: a technical guideline.*
15. British Standard BS 7385-1:1990. *Evaluation and measurement for vibration in buildings. Guide for measurement of vibrations and evaluation of their effects on buildings.*
16. British Standard BS 7385-2:1993. *Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration.*

FIGURES

1 – Site Plan



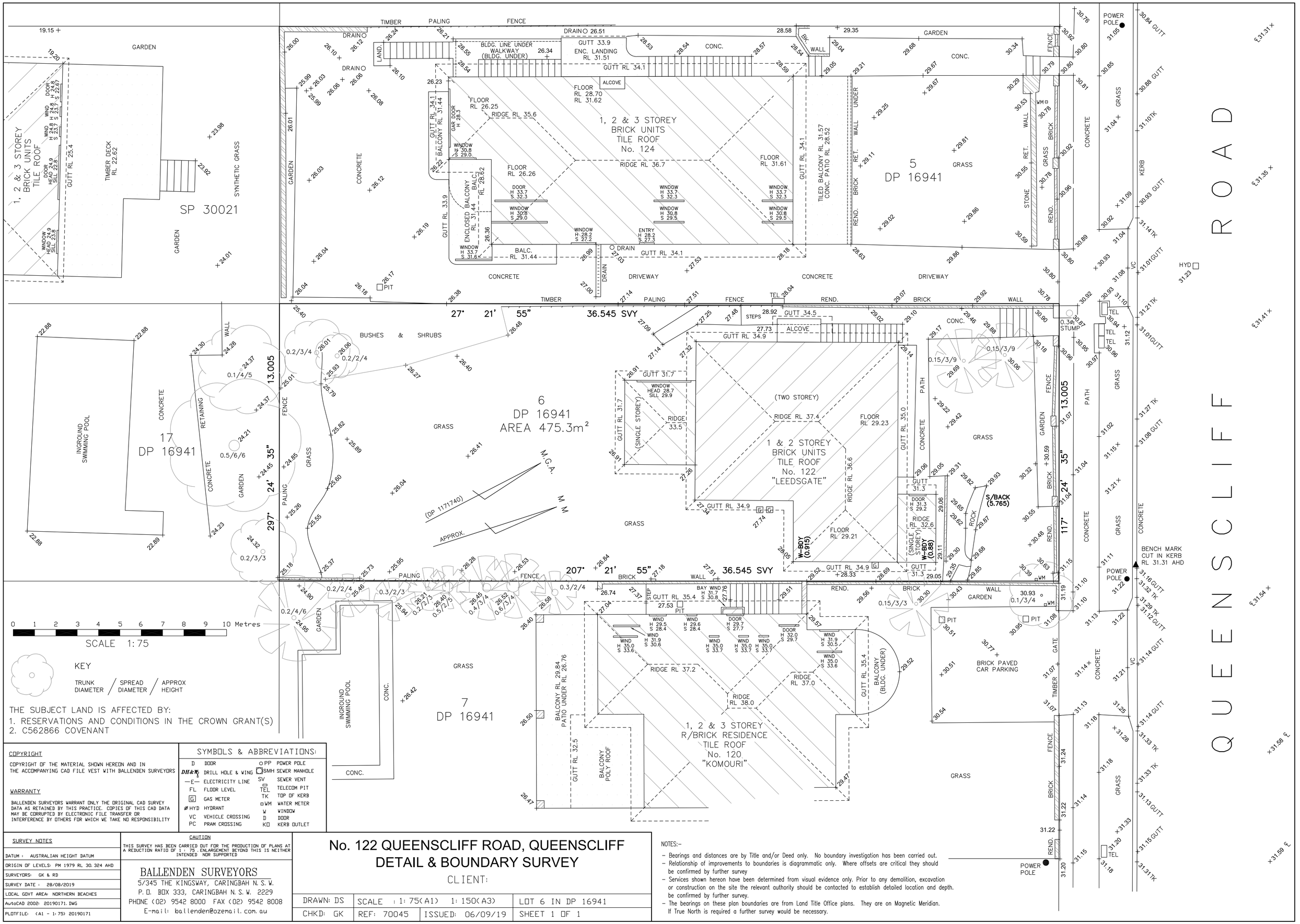
Source of Base Plan: Survey Plan prepared by Ballenden Surveyors - Dated 28/08/2019

geo-environmental ENGINEERING
82 BRIDGE STREET
LANE COVE NSW 2066
P - 61 (2) 9420 3361
E - info@geoenvironmental.com.au
www.geoenvironmental.com.au

TITLE:	SCALE:	DATE:	FIGURE No.:
SITE PLAN 122 - 124 Queenscliff Rd, Queenscliff NSW	N.T.S	2 March 2022	1
	DRAWN: S. McC	JOB No.: G22006QUE	REVISION: A

APPENDIX A

Survey and Architectural Plans (12 Sheets)



KEY

TRUNK DIAMETER / SPREAD DIAMETER / APPROX HEIGHT

THE SUBJECT LAND IS AFFECTED BY:
1. RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)
2. C562866 COVENANT

SYMBOLS & ABBREVIATIONS:

D	DOOR	PP	POWER POLE
DH&W	DRILL HOLE & WING	SMH	SEWER MANHOLE
—E—	ELECTRICITY LINE	SV	SEWER VENT
FL	FLOOR LEVEL	TEL	TELECOM PIT
G	GAS METER	TK	TOP OF KERB
HYD	HYDRANT	WM	WATER METER
VC	VEHICLE CROSSING	W	WINDOW
PC	PRAM CROSSING	D	DOOR
		KO	KERB OUTLET

SURVEY NOTES	
DATUM:	AUSTRALIAN HEIGHT DATUM
ORIGIN OF LEVELS:	PM 1979 RL 30.324 AHD
SURVEYORS:	GK & RD
SURVEY DATE:	28/08/2019
LOCAL GOVT AREA:	NORTHERN BEACHES
AutoCAD 2002:	20190171.DWG
PLOTFILE:	(A1 - 1:75) 20190171

CAUTION

THIS SURVEY HAS BEEN CARRIED OUT FOR THE PRODUCTION OF PLANS AT A REDUCTION RATIO OF 1 : 75. ENLARGEMENT BEYOND THIS IS NEITHER INTENDED NOR SUPPORTED

BALLENDEN SURVEYORS
5/345 THE KINGSWAY, CARINGBAH N.S.W.
P.O. BOX 333, CARINGBAH N.S.W. 2229
PHONE (02) 9542 8000 FAX (02) 9542 8008
E-mail: ballenden@ozemail.com.au

No. 122 QUEENSCLIFF ROAD, QUEENSCLIFF
DETAIL & BOUNDARY SURVEY

CLIENT:

DRAWN: DS	SCALE: 1:75(A1) 1:150(A3)		LOT 6 IN DP 16941
CHKD: GK	REF: 70045	ISSUED: 06/09/19	SHEET 1 OF 1

NOTES:–
- Bearings and distances are by Title and/or Deed only. No boundary investigation has been carried out.
- Relationship of improvements to boundaries is diagrammatic only. Where offsets are critical they should be confirmed by further survey
- Services shown hereon have been determined from visual evidence only. Prior to any demolition, excavation or construction on the site the relevant authority should be contacted to establish detailed location and depth. be confirmed by further survey.
- The bearings on these plan boundaries are from Land Title Office plans. They are on Magnetic Meridian. If True North is required a further survey would be necessary.

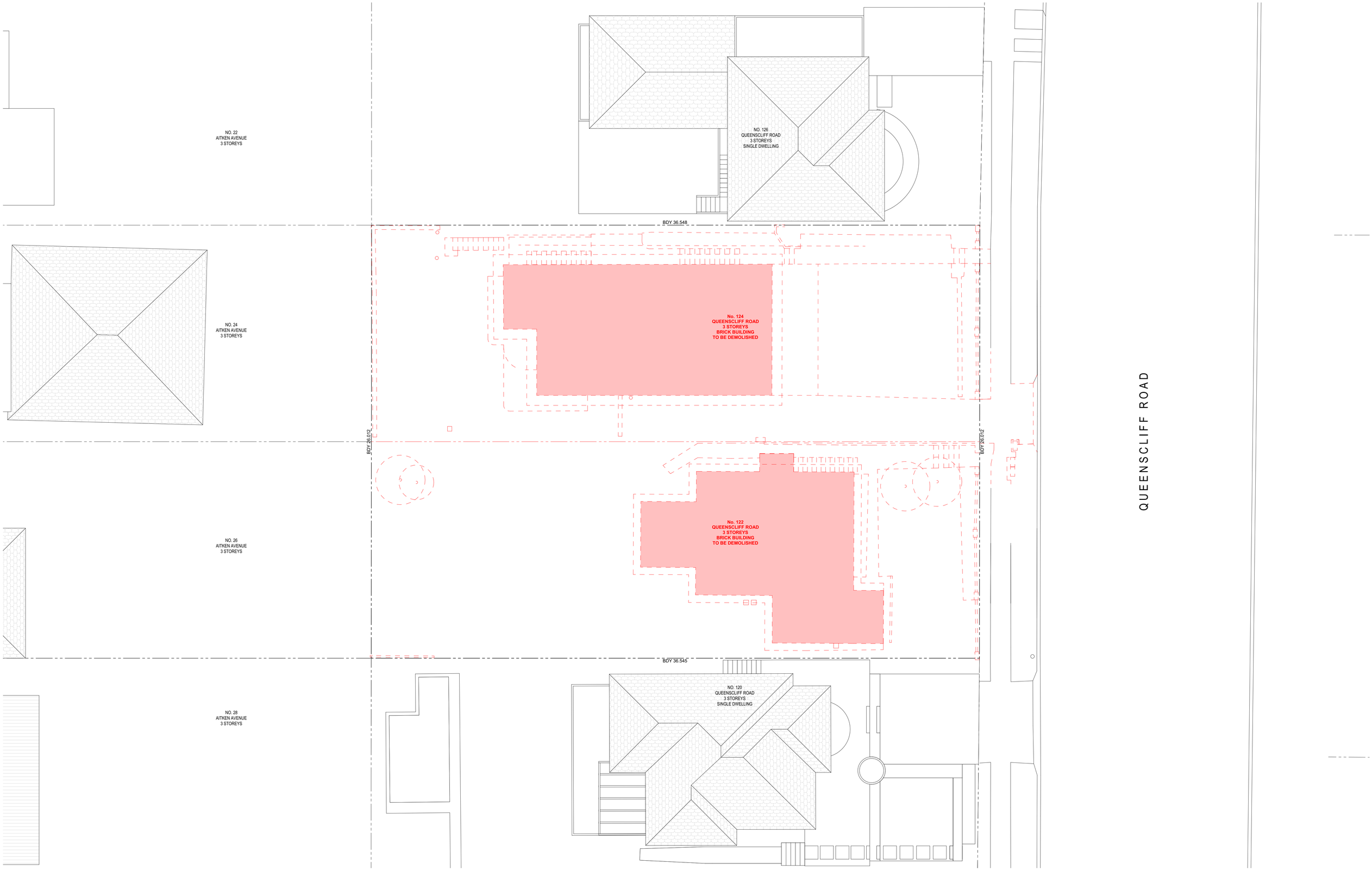
ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward
9383

COVER	A0000	DA01
PLAN: LOCATION	A1001	DA01
PLAN: SITE ANALYSIS	A1010	DA01
PLAN: DEMOLITION	A1050	DA01
PLAN: BASEMENT	A2201	DA01
PLAN: GROUND -1	A2202	DA01
PLAN: GROUND	A2203	DA01
PLAN: LEVEL 01	A2204	DA01
PLAN: ROOF	A2205	DA01
AREAS : GFA	A2401	DA01
AREAS : LANDSCAPE + DEEP SOIL	A2402	DA01
AREAS : NET SELLABLE AREA	A2403	DA01
AREAS : GROSS BUILDING AREA	A2404	DA01
SHADOWS: JUNE 21ST 9:00AM, 9:30AM 10:00AM	A2601	DA01
SHADOWS: JUNE 21ST 10:30AM, 11:00AM 11:30AM	A2602	DA01
SHADOWS: JUNE 21ST 12:00PM, 12:30PM 13:00PM	A2603	DA01
SHADOWS: JUNE 21ST 13:30PM, 14:00PM 14:30PM	A2604	DA01
SHADOWS: JUNE 21ST 15:00PM	A2605	DA01
SOLAR: VIEWS FROM THE SUN 9:00AM, 9:30AM 10:00AM	A2701	DA01
SOLAR: VIEWS FROM THE SUN 10:30AM, 11:00AM 11:30AM	A2702	DA01
SOLAR: VIEWS FROM THE SUN 12:00PM, 12:30PM 13:00PM	A2703	DA01
SOLAR: VIEWS FROM THE SUN 13:30PM, 14:00PM 14:30PM	A2704	DA01
SOLAR: VIEWS FROM THE SUN 15:00PM	A2705	DA01
ELEVATION: NORTH	A3101	DA01
ELEVATION: SOUTH	A3102	DA01
ELEVATION: EAST	A3103	DA01
ELEVATION: WEST	A3104	DA01
SECTION: A	A3201	DA01
SECTION: B	A3202	DA01
SCHEDULE: WINDOW & DOOR	A7101	DA01
PERSPECTIVE: STREET VIEW	A8101	DA01
FINISHES BOARD	A8201	DA01

DEVELOPMENT APPLICATION **22.03.2022**

122-124 Queenscliff Road, Queenscliff



ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward 9383

Client
Kristoffer Harvey

Project
122-124 Queenscliff Road
Queenscliff

Project Start Date
May 2020

Project Number
0228

Drawing Title
PLAN : SITE
DEMOLITION

Drawing No.
A1050

Drawing Stage
C03

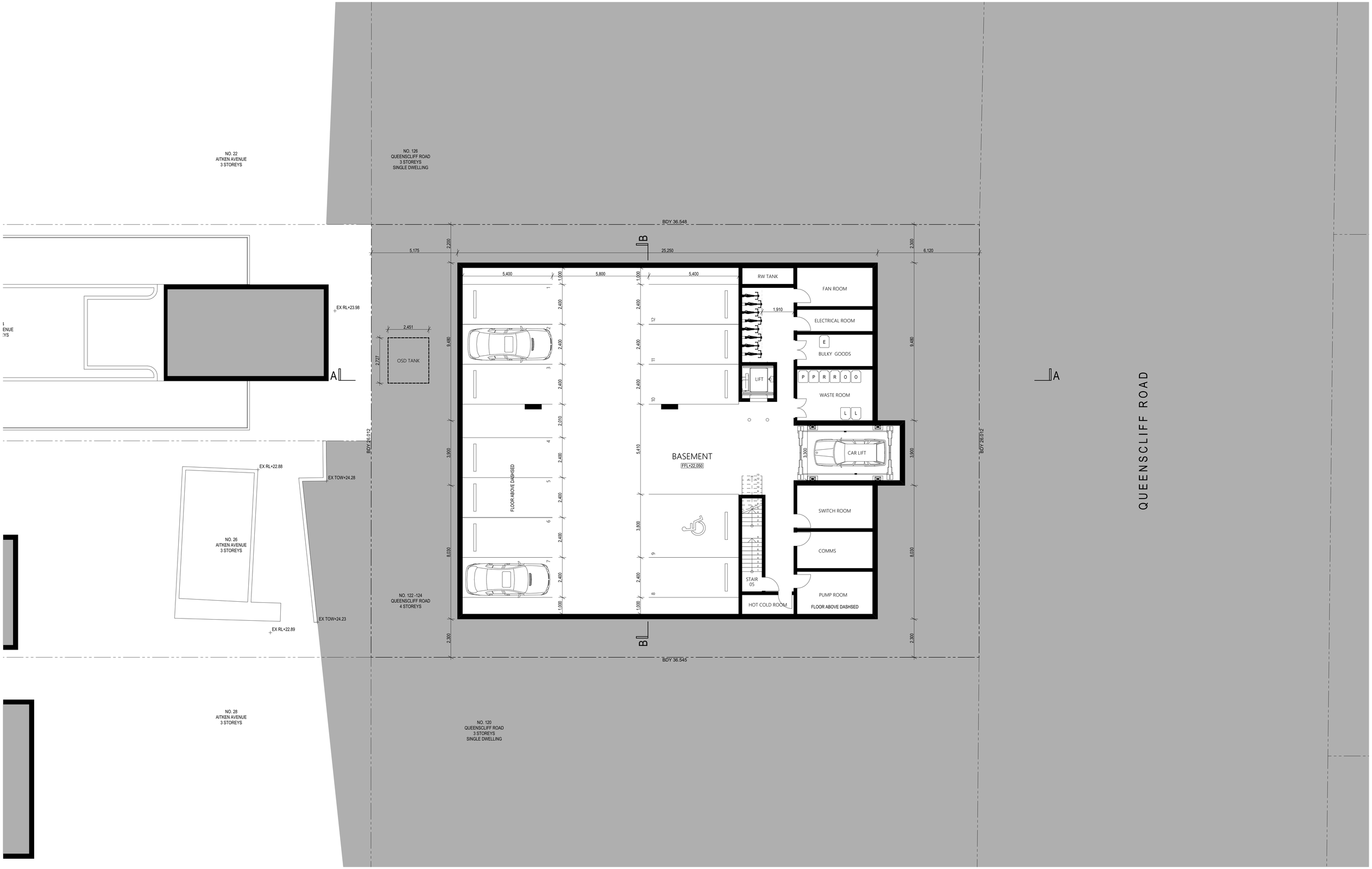
Drawing Scale
1:100@A1
1:200@A3

REV	DESCRIPTION	DATE
DA01	DEVELOPMENT APPLICATION	22/03/22

LEGEND

BA:01	Balustrade, Aluminium, charcoal finish.
CE:01	Concrete, off form, light finish.
DR:01	Sliding door, Aluminium frame, charcoal finish, clear glass.
FE:01	Batten fence, Aluminium, charcoal finish.
RN:01	Render, white
SF:01	External tile, Stone.
ST:01	Crushed granite.
WD:01	Sliding window, Aluminium frame, charcoal finish, clear glass.
WD:02	Fixed window, Aluminium frame, charcoal finish, clear glass.
WD:03	Double hung window, Aluminium frame, charcoal finish clear glass.
CD:01	Aluminium Batton, charcoal finish

- TO BE DEMOLISHED
- TO BE RETAINED



ess

ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward 9383

Client
Kristoffer Harvey

Project
122-124 Queenscliff Road
Queenscliff

Project Start Date
May 2020

Project Number
0228

Drawing Title
PLAN : GENERAL ARRANGMENT
BASEMENT

Drawing No.
A2201

Drawing Stage
C03

Drawing Scale
1:100@A1
1:200@A3

REV	DESCRIPTION	DATE
DA01	DEVELOPMENT APPLICATION	22/03/22

LEGEND

BA:01	Balustrade, Aluminium, charcoal finish.
CE:01	Concrete, off form, light finish.
DR:01	Sliding door, Aluminium frame, charcoal finish, clear glass.
FE:01	Batten fence, Aluminium, charcoal finish.
RN:01	Render, white
SF:01	External tile, Stone.
ST:01	Crushed granite.
WD:01	Sliding window, Aluminium frame, charcoal finish, clear glass.
WD:02	Fixed window, Aluminium frame, charcoal finish, clear glass.
WD:03	Double hung window, Aluminium frame, charcoal finish clear glass.
CD:01	Aluminium Batton, charcoal finish

ess

ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward 9383

Client
Kristoffer Harvey

Project
122-124 Queenscliff Road
Queenscliff

Project Start Date
May 2020

Project Number
0228

Drawing Title
PLAN : GENERAL ARRANGMENT
GROUND-1

Drawing No.
A2202

Drawing Stage
C03

Drawing Scale
1:100@A1
1:200@A3

REV	DESCRIPTION	DATE
DA01	DEVELOPMENT APPLICATION	22/03/22

LEGEND

BA:01	Balustrade, Aluminium, charcoal finish.
CE:01	Concrete, off form, light finish.
DR:01	Sliding door, Aluminium frame, charcoal finish, clear glass.
FE:01	Batten fence, Aluminium, charcoal finish.
RN:01	Render, white
SF:01	External tile, Stone.
ST:01	Crushed granite.
WD:01	Sliding window, Aluminium frame, charcoal finish, clear glass.
WD:02	Fixed window, Aluminium frame, charcoal finish, clear glass.
WD:03	Double hung window, Aluminium frame, charcoal finish clear glass.
CD:01	Aluminium Batton, charcoal finish

ess

ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward 9383

Client
Kristoffer Harvey

Project
122-124 Queenscliff Road
Queenscliff

Project Start Date
May 2020

Project Number
0228

Drawing Title
PLAN : GENERAL ARRANGMENT GROUND

Drawing No.
A2203

Drawing Stage
C03

Drawing Scale
1:100@A1
1:200@A3

REV	DESCRIPTION	DATE
DA01	DEVELOPMENT APPLICATION	22/03/22

LEGEND

- BA:01 Balustrade, Aluminium, charcoal finish.
- CE:01 Concrete, off form, light finish.
- DR:01 Sliding door, Aluminium frame, charcoal finish, clear glass.
- FE:01 Batten fence, Aluminium, charcoal finish.
- RN:01 Render, white
- SF:01 External tile, Stone.
- ST:01 Crushed granite.
- WD:01 Sliding window, Aluminium frame, charcoal finish, clear glass.
- WD:02 Fixed window, Aluminium frame, charcoal finish, clear glass.
- WD:03 Double hung window, Aluminium frame, charcoal finish clear glass.
- CD:01 Aluminium Batton, charcoal finish

ess

ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward 9383

Client
Kristoffer Harvey

Project
122-124 Queenscliff Road
Queenscliff

Project Start Date
May 2020

Project Number
0228

Drawing Title
PLAN : GENERAL ARRANGMENT
LEVEL 01

Drawing No.
A2204

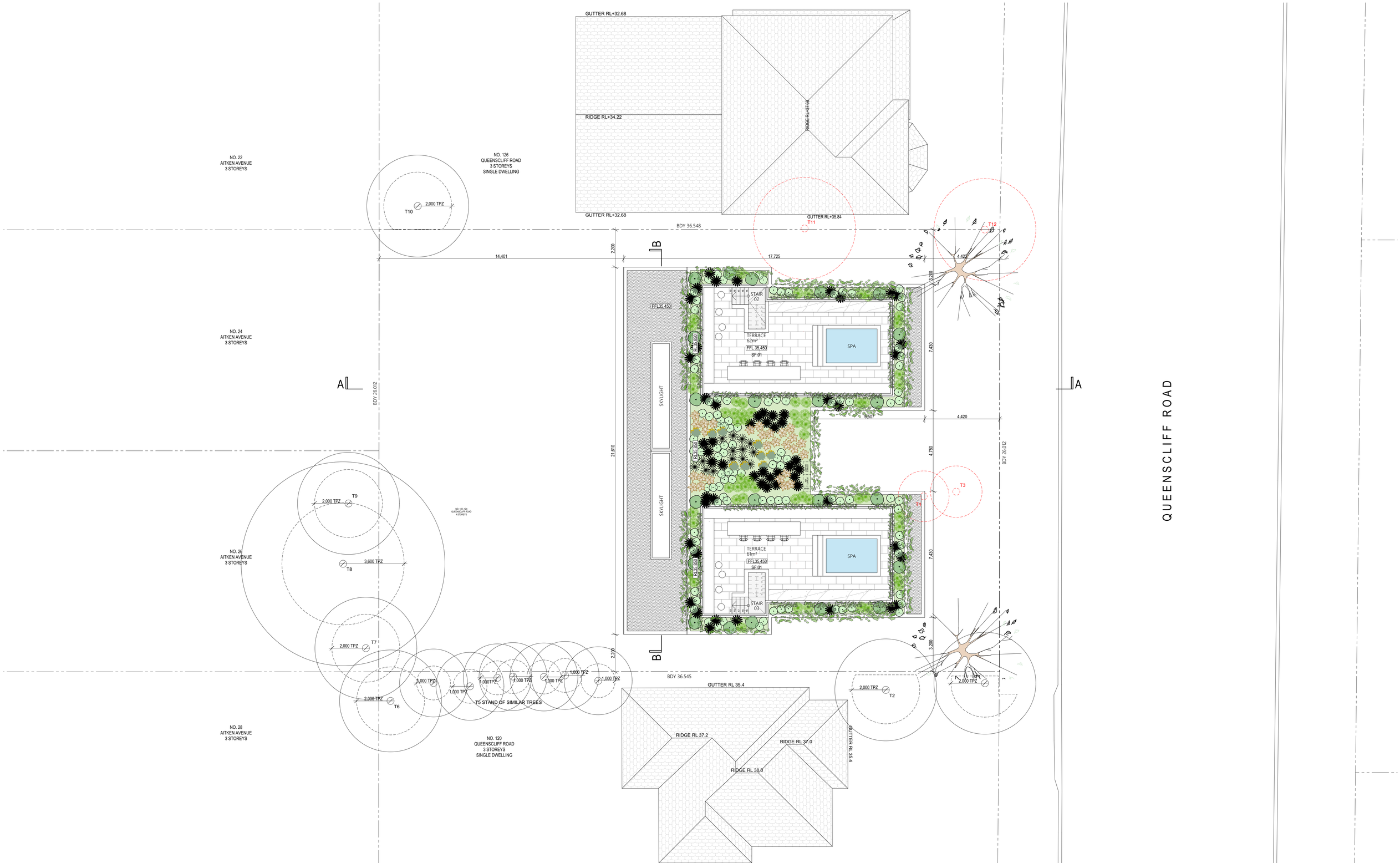
Drawing Stage
C03

Drawing Scale
1:100@A1
1:200@A3

REV	DESCRIPTION	DATE
DA01	DEVELOPMENT APPLICATION	22/03/22

LEGEND

BA:01	Balustrade, Aluminium, charcoal finish.
CE:01	Concrete, off form, light finish.
DR:01	Sliding door, Aluminium frame, charcoal finish, clear glass.
FE:01	Batten fence, Aluminium, charcoal finish.
RN:01	Render, white
SF:01	External tile, Stone.
ST:01	Crushed granite.
WD:01	Sliding window, Aluminium frame, charcoal finish, clear glass.
WD:02	Fixed window, Aluminium frame, charcoal finish, clear glass.
WD:03	Double hung window, Aluminium frame, charcoal finish clear glass.
CD:01	Aluminium Batton, charcoal finish



ess

ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward 9383

Client
Kristoffer Harvey

Project
122-124 Queenscliff Road
Queenscliff

Project Start Date
May 2020

Project Number
0228

Drawing Title
PLAN : GENERAL ARRANGMENT ROOF

Drawing No.
A2205

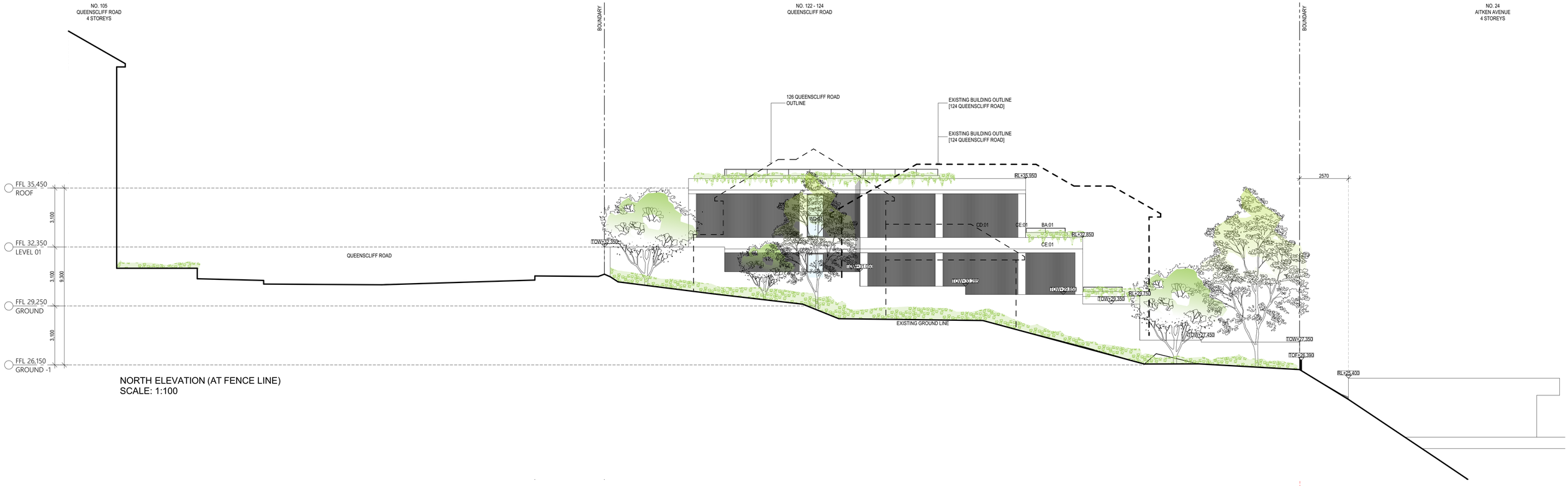
Drawing Stage
C03

Drawing Scale
1:100@A1
1:200@A3

REV	DESCRIPTION	DATE
DA01	DEVELOPMENT APPLICATION	22/03/22

LEGEND

BA:01	Balustrade, Aluminium, charcoal finish.
CE:01	Concrete, off form, light finish.
DR:01	Sliding door, Aluminium frame, charcoal finish, clear glass.
FE:01	Batten fence, Aluminium, charcoal finish.
RN:01	Render, white
SF:01	External tile, Stone.
ST:01	Crushed granite.
WD:01	Sliding window, Aluminium frame, charcoal finish, clear glass.
WD:02	Fixed window, Aluminium frame, charcoal finish, clear glass.
WD:03	Double hung window, Aluminium frame, charcoal finish clear glass.
CD:01	Aluminium Batton, charcoal finish



ess

ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward 9383

Client
Kristoffer Harvey

Project
122-124 Queenscliff Road
Queenscliff

Project Start Date
May 2020

Project Number
0228

Drawing Title
ELEVATION
NORTH

Drawing No.
A3103

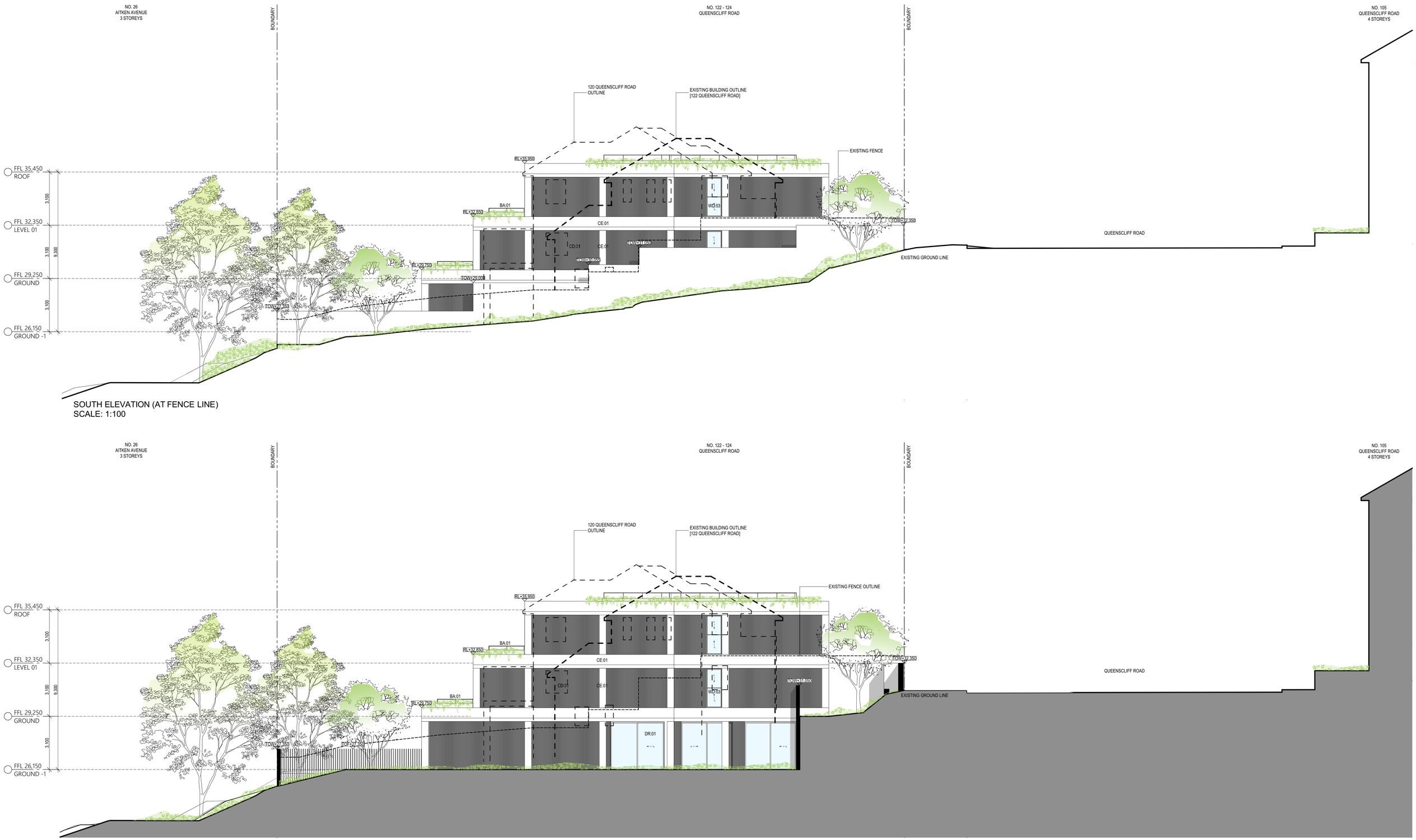
Drawing Stage
C03

Drawing Scale
1:100@A1
1:200@A3

REV	DESCRIPTION	DATE
DA01	DEVELOPMENT APPLICATION	22/03/22

LEGEND

BA:01	Balustrade, Aluminium, charcoal finish.
CE:01	Concrete, off form, light finish.
DR:01	Sliding door, Aluminium frame, charcoal finish, clear glass.
FE:01	Batten fence, Aluminium, charcoal finish.
RN:01	Render, white
SF:01	External tile, Stone.
ST:01	Crushed granite.
WD:01	Sliding window, Aluminium frame, charcoal finish, clear glass.
WD:02	Fixed window, Aluminium frame, charcoal finish, clear glass.
WD:03	Double hung window, Aluminium frame, charcoal finish clear glass.
CD:01	Aluminium Batton, charcoal finish



SOUTH ELEVATION (AT FENCE LINE)
SCALE: 1:100

SOUTH ELEVATION (AT BUILDING FACE)
SCALE: 1:100

ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward 9383

Client
Kristoffer Harvey

Project
122-124 Queenscliff Road
Queenscliff

Project Start Date
May 2020

Project Number
0228

Drawing Title
ELEVATION
SOUTH

Drawing No.
A3104

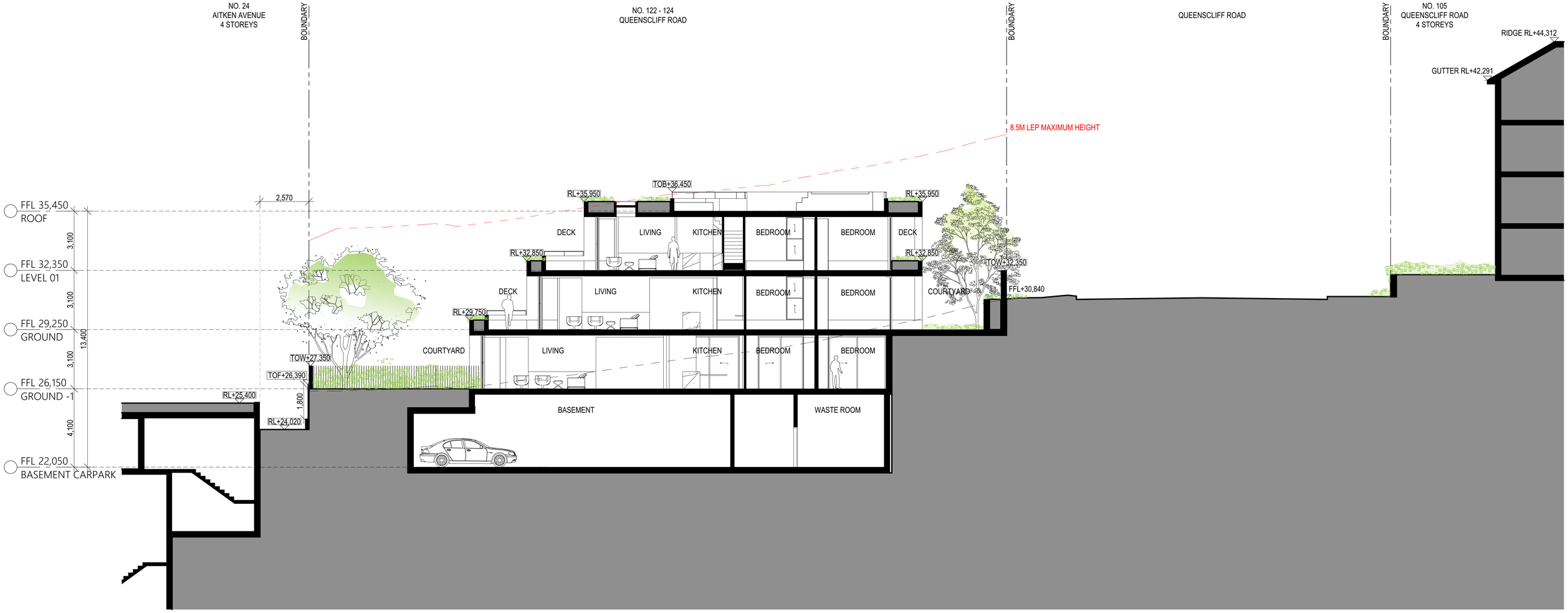
Drawing Stage
C03

Drawing Scale
1:100@A1
1:200@A3

REV	DESCRIPTION	DATE
DA01	DEVELOPMENT APPLICATION	22/03/22

LEGEND

BA:01	Balustrade, Aluminium, charcoal finish.
CE:01	Concrete, off form, light finish.
DR:01	Sliding door, Aluminium frame, charcoal finish, clear glass.
FE:01	Batten fence, Aluminium, charcoal finish.
RN:01	Render, white
SF:01	External tile, Stone.
ST:01	Crushed granite.
WD:01	Sliding window, Aluminium frame, charcoal finish, clear glass.
WD:02	Fixed window, Aluminium frame, charcoal finish, clear glass.
WD:03	Double hung window, Aluminium frame, charcoal finish clear glass.
CD:01	Aluminium Batton, charcoal finish



ess

ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward 9383

Client
Kristoffer Harvey

Project
122-124 Queenscliff Road
Queenscliff

Project Start Date
May 2020

Project Number
0228

Drawing Title
SECTION
SECTION A

Drawing No.
A3201

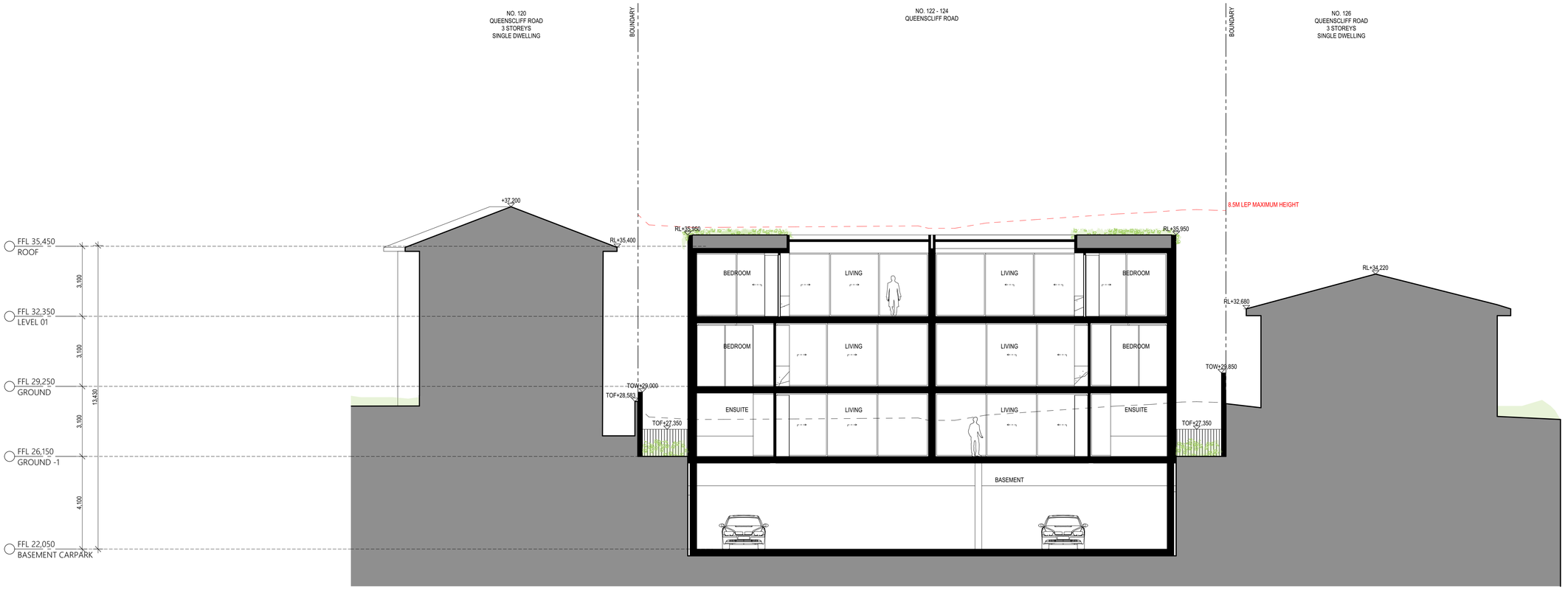
Drawing Stage
C03

Drawing Scale
1:100@A1
1:200@A3

REV	DESCRIPTION	DATE
DA01	DEVELOPMENT APPLICATION	22/03/22

LEGEND

BA:01	Balustrade, Aluminium, charcoal finish.
CE:01	Concrete, off form, light finish.
DR:01	Sliding door, Aluminium frame, charcoal finish, clear glass.
FE:01	Batten fence, Aluminium, charcoal finish.
RN:01	Render, white
SF:01	External tile, Stone.
ST:01	Crushed granite.
WD:01	Sliding window, Aluminium frame, charcoal finish, clear glass.
WD:02	Fixed window, Aluminium frame, charcoal finish, clear glass.
WD:03	Double hung window, Aluminium frame, charcoal finish clear glass.
CD:01	Aluminium Batton, charcoal finish



ess

ess lifestyle PTY LTD
ABN 52 144 951 119

E: alexp@esslifestyle.com
M: 0414085001
NSW registered architect
Robert Gordon Woodward 9383

Client
Kristoffer Harvey

Project
122-124 Queenscliff Road
Queenscliff

Project Start Date
May 2020

Project Number
0228

Drawing Title
SECTION
SECTION B

Drawing No.
A3202

Drawing Stage
C03

Drawing Scale
1:100@A1
1:200@A3

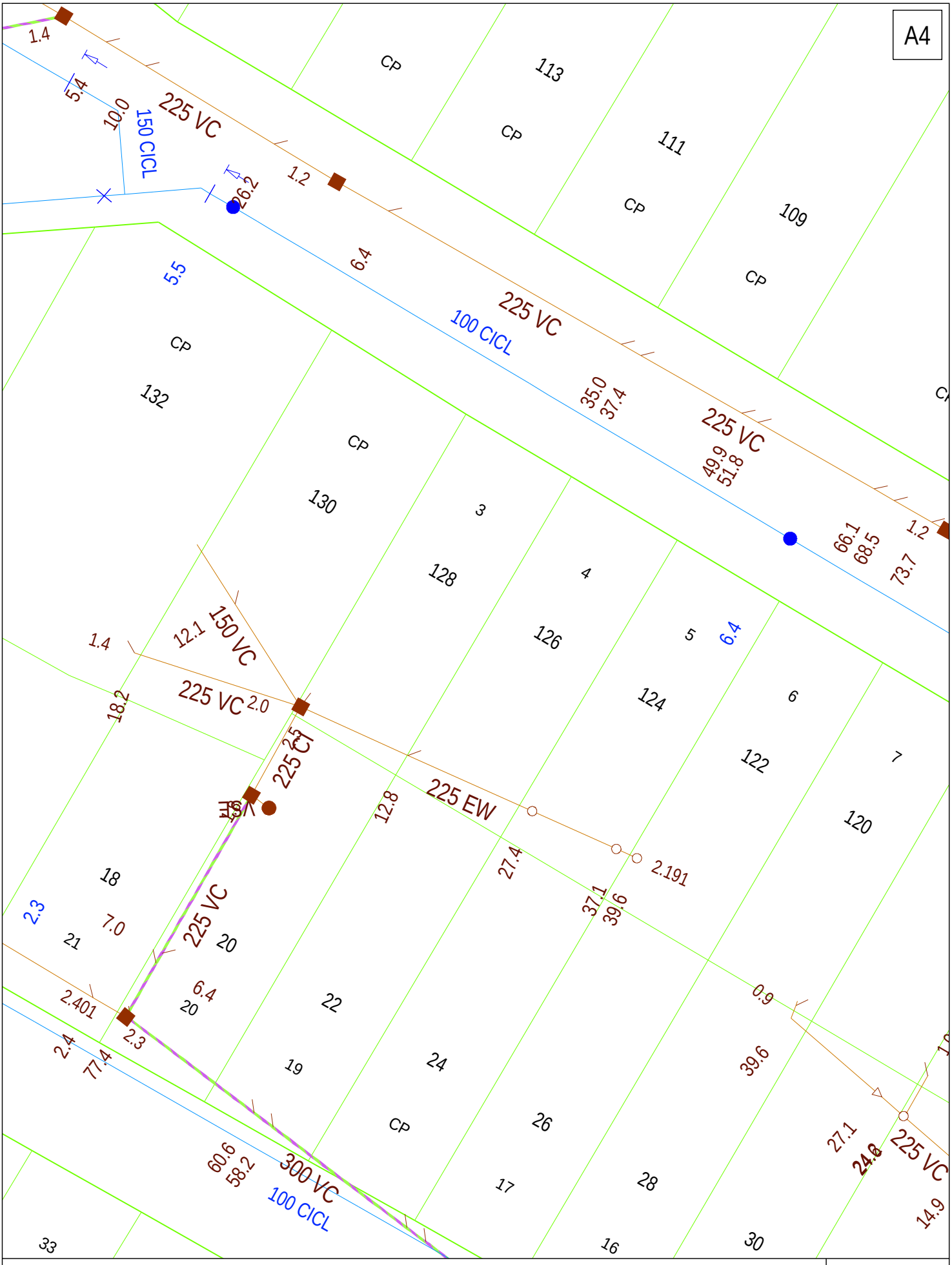
REV	DESCRIPTION	DATE
DA01	DEVELOPMENT APPLICATION	22/03/22

LEGEND

BA:01	Balustrade, Aluminium, charcoal finish.
CE:01	Concrete, off form, light finish.
DR:01	Sliding door, Aluminium frame, charcoal finish, clear glass.
FE:01	Batten fence, Aluminium, charcoal finish.
RN:01	Render, white
SF:01	External tile, Stone.
ST:01	Crushed granite.
WD:01	Sliding window, Aluminium frame, charcoal finish, clear glass.
WD:02	Fixed window, Aluminium frame, charcoal finish, clear glass.
WD:03	Double hung window, Aluminium frame, charcoal finish clear glass.
CD:01	Aluminium Batton, charcoal finish

APPENDIX B

Sydney Water DBYD Plan (1 Sheet)



DBYD Address:
128 QUEENSCLIFF ROAD
QUEENSCLIFF NSW 2096

DBYD Job No: 31430793
DBYD Sequence No: 208350077

No warranty is given that the information shown is complete or accurate.

SYDNEY WATER CORPORATION

Scale: 1:500

Date of Production: 21/02/2022

Plan 1 of 1

N

0m 2m 4m 6m 8m 10m

APPENDIX C

Borehole Logs and Core Photos (11 Sheets)

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

geo-environmental ENGINEERING

Hole ID. **BH1**
Hole Depth: **7.00 m**
Sheet: **1 of 3**

Project Name: **Geotechnical Investigation**
Project Number: **G22006QUE**
Location / Site: **122 - 124 Queenscliff Road, Queenscliff NSW**
Client: **Gemini Queenscliff Pty Ltd**

Drilling Company: **FICO Group**
Date Started: **21-FEB-22**
Ground Level: **RL26.15m** (approx)
Drill Method: **SFA / NMLC**
Date Completed: **21-FEB-22**
Latitude: **----------**
Equipment: **Track Mounted**
Longitude: **----------**

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests: ID No.	Samples / Tests: DCP blows/100mm	Observations / Comments
							Surface: Gravel Base				5 10 15	
SFA			26.0		GP	Fill	**CONCRETE**- grey.					
							FILL: Sandy GRAVEL- grey, red and brown, fine to coarse gravel and sand with some anthropogenic inclusions (brick, fibro and ceramic tile).	loose	m			
					SM	Natural	**Silty SAND**- dark grey, fine to medium grained.	loose	vm	BH1 0.5-0.6m		
		1.0	25.0		SP		**SAND**- brown, medium to coarse grained, with trace fine to coarse quartz gravel.	loose	vm			Bore dry upon completion and before coring
							SANDSTONE- grey-brown, medium to coarse grained, extremely weathered, estimated very low strength.					
							BH1 continued as cored hole from 1.15m					
		2.0	24.0									
		3.0	23.0									
		4.0	22.0									
		5.0										

Moisture	
D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

Logged By: **Stephen McCormack** Date: **21-Feb-22**
Checked By: **Stephen McCormack** Date: **01-MAR-22**

GEE DAVIES BH LOG G22006QUE.GPJ GEE.GDT 11-3-22 12:08:48 PM

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH1**
Hole Depth: **7.00 m**
Sheet: **2 of 3**

Project Name: **Geotechnical Investigation**
Project Number: **G22006QUE**
Location / Site: **122 - 124 Queenscliff Road, Queenscliff NSW**
Client: **Gemini Queenscliff Pty Ltd**

Drilling Company: **FICO Group**
Date Started: **21-FEB-22**
Ground Level: **RL26.15m** (approx)
Drill Method: **SFA / NMLC**
Date Completed: **21-FEB-22**
Easting: ----------
Equipment: **Track Mounted**
Northing: ----------

Depth (m)	RL (m)	Material Description	Weathering	Estimated Strength (MPa)	Is(50) MPa	U.C.S. (Mpa)	RQD %	Core Photo	Defect Spacing (mm)	Defect Description (type, inclination, thickness, shape, roughness, coating)	Depth (m)	Casing & Core Lifts
0.5	26.0										0.5	
1.0	25.5										1.0	
	25.0	*Continued from non-cored borehole from 1.15m*										
1.5	24.5	**CORE LOSS (Interpretted as extremely weathered Sandstone)**.									1.5	
2.0	24.0	**SANDSTONE** - cream pink, fine to coarse grained, trace fine rounded gravel, trace carbonaceous laminations, weakly iron stained.	SW		A=0.58 D=0.48					BP, 0	2.0	
2.5	23.5				A=0.97 D=0.9		85			HB	2.5	
3.0	23.0										3.0	
3.5	22.5				A=1.04 D=0.66					SM, 20, Clay 30mm	3.5	
4.0	22.0									DB	4.0	4
4.5	21.5	**SANDSTONE** - trace carbonaceous laminations, weakly iron stained.			A=0.93 D=0.61		84			HB JT (x2), 70, FE, RG	4.5	
5.0											5.0	

Method: NMLC
Water Level:
Graphic Log:
Material Type: Bedrock
Estimated Strength (MPa): EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH
Is(50) MPa: D=diametral A=axial
Rock Mass Defects
Defect Spacing (mm): 20, 60, 200, 600, 2000
Defect Description: Specific / General

Additional Comments

Logged By: **Stephen McCormack** Date: **21-Feb-22**
Checked By: **Stephen McCormack** Date: **01-MAR-22**

GEE DAVIES CH LOG G22006QUE.GPJ GEE.GDT 11-3-22 12:07:11 PM

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH1**
Hole Depth: **7.00 m**
Sheet: **3 of 3**

Project Name: **Geotechnical Investigation** Project Number: **G22006QUE**
Location / Site: **122 - 124 Queenscliff Road, Queenscliff NSW** Client: **Gemini Queenscliff Pty Ltd**

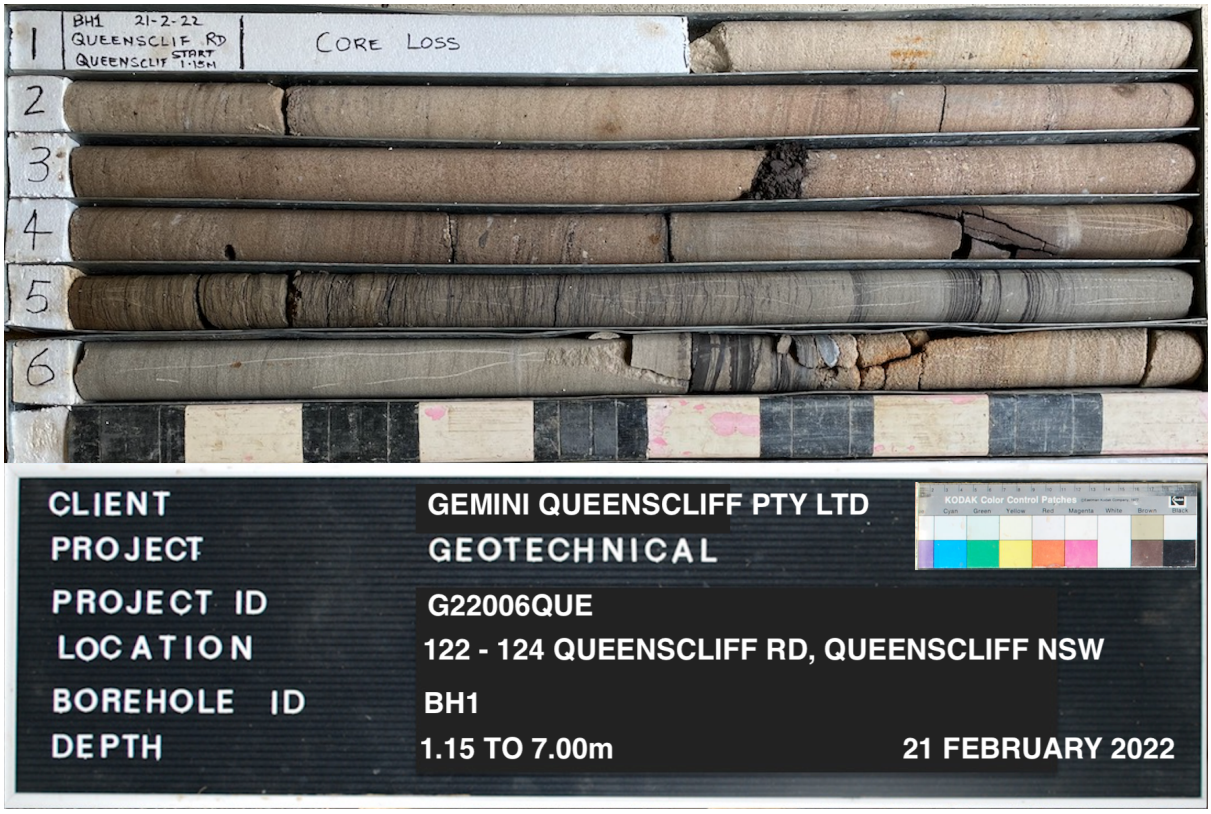
Drilling Company: **FICO Group** Date Started: **21-FEB-22** Ground Level: **RL26.15m** (approx)
Drill Method: **SFA / NMLC** Date Completed: **21-FEB-22** Easting: ----------
Equipment: **Track Mounted** Northing: ----------

Method	Depth (m)	RL (m)	Material Type	Material Description	Weathering	Estimated Strength (MPa)	Is(50) MPa	U.C.S. (Mpa)	RQD %	Core Photo	Defect Spacing (mm)	Defect Description (type, inclination, thickness, shape, roughness, coating)	Depth (m)	Casing & Core Lifts
NMLC	5.5	20.5	Bedrock	**SANDSTONE** - grey and black, fine to medium grained, carbonaceous lenses.	SW / FR		A=0.45 D=0.24		84			HB; HB; JT, 80	5.5	
	6.0	20.0		**SANDSTONE** - grey grey white, fine to medium grained sandstone.			A=0.64 D=0.6					HB	6.0	
	6.5	19.5		**interbedded SHALE and SANDSTONE** - black grey white, medium to coarse grained.	SW							JT, 88, DIS, RF; BP, 0, RF; BP, 0; JT, 85, CUR, RF	6.5	
	7.0			**SANDSTONE** - orange white, fine to coarse grained, weakly iron stained.			A=0.2 D=0.11						7.0	7
	7.5	18.5		**Hole Terminated at 7.00 m** in sandstone bedrock									7.5	
	8.0	18.0											8.0	
	8.5	17.5											8.5	
	9.0	17.0											9.0	
	9.5	16.5											9.5	
	10.0												10.0	

Additional Comments

Logged By: **Stephen McCormack** Date: **21-Feb-22**
Checked By: **Stephen McCormack** Date: **01-MAR-22**

GEE DAVIES CH LOG G22006QUE.GPJ GEE.GDT 11-3-22 12:07:11 PM


1
BH1 21-2-22
QUEENSCLIF RD
QUEENSCLIF START 1.15M
CORE LOSS
2
3
4
5
6
CLIENT
GEMINI QUEENSCLIFF PTY LTD
PROJECT
GEOTECHNICAL
KODAK Color Control Patches
PROJECT ID
G22006QUE
LOCATION
122 - 124 QUEENSCLIFF RD, QUEENSCLIFF NSW
BOREHOLE ID
BH1
DEPTH
1.15 TO 7.00m
21 FEBRUARY 2022

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH2**
Hole Depth: **9.00 m**
Sheet: **1 of 3**

Project Name: **Geotechnical Investigation**
Project Number: **G22006QUE**
Location / Site: **122 - 124 Queenscliff Road, Queenscliff NSW**
Client: **Gemini Queenscliff Pty Ltd**

Drilling Company: **FICO Group**
Drill Method: **SFA / NMLC**
Equipment: **Track Mounted**
Date Started: **21-FEB-22**
Date Completed: **21-FEB-22**
Ground Level: **RL29.5m** (approx)
Latitude: ----------
Longitude: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests: ID No.	Samples / Tests: DCP blows/100mm	Observations / Comments
							Surface: Grass				5 10 15	
SFA		1.0	29.0		SM		**TOPSOIL/FILL: Silty SAND**- dark brown dark grey, fine to medium grained, trace fine to medium gravel.	loose	m	BH2 0.1-0.3m		
							SANDSTONE- grey-brown, medium to coarse grained, extremely weathered					Bore dry upon completion and before coring
							BH2 continued as cored hole from 1m					
		2.0	28.0									
		3.0	27.0									
		4.0	26.0									
		5.0	25.0									

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

Logged By: **Stephen McCormack** Date: **21-Feb-22**
Checked By: **Stephen McCormack** Date: **01-MAR-22**

GEE DAVIES BH LOG G22006QUE.GPJ GEE.GDT 11-3-22 12:08:49 PM

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH2**
Hole Depth: **9.00 m**
Sheet: **2 of 3**

Project Name: **Geotechnical Investigation**
Project Number: **G22006QUE**
Location / Site: **122 - 124 Queenscliff Road, Queenscliff NSW**
Client: **Gemini Queenscliff Pty Ltd**

Drilling Company: **FICO Group**
Date Started: **21-FEB-22**
Ground Level: **RL29.5m** (approx)
Drill Method: **SFA / NMLC**
Date Completed: **21-FEB-22**
Easting: ----------
Equipment: **Track Mounted**
Northing: ----------

Depth (m)	RL (m)	Material Description	Weathering	Estimated Strength (MPa)	Is(50) MPa	U.C.S. (Mpa)	RQD %	Core Photo	Defect Spacing (mm)	Defect Description (type, inclination, thickness, shape, roughness, coating)	Depth (m)	Casing & Core Lifts
0.5	29.0										0.5	
1.0	28.5	*Continued from non-cored borehole from 1m*									1.0	
1.5	28.0	**CORE LOSS (Interpretted as extremely weathered Sandstone).**									1.5	
2.0	27.5										2.0	
2.5	27.0	**Sandy CLAY** - orange-brown, low plasticity, fine to coarse grained.	RS				33				2.5	
3.0	26.5	**SANDSTONE** - grey white, fine to medium grained.	SW							BP, 0 SM, Clay, 20mm JT, 85 to 90, RF BP, 0, IR, Clay infill 3mm	3.0	
3.5	26.0				A=0.16 D=0.22					HB	3.5	
4.0	25.5	**SANDSTONE** - pink white, medium to coarse grained, trace fine rounded Gravel, weakly iron stained.	DW-SW							DB HB	4.0	3.85
4.5	25.0				A=0.66 D=0.69		64				4.5	
5.0	24.5									JT, 85 to 90, RF, some clay infill	5.0	

NMLC Coring; Bedrock

Additional Comments

Logged By: **Stephen McCormack** Date: **21-Feb-22**
Checked By: **Stephen McCormack** Date: **01-MAR-22**

GEE DAVIES CH LOG G22006QUE.GPJ GEE.GDT 11-3-22 12:07:13 PM

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH2**
Hole Depth: **9.00 m**
Sheet: **3 of 3**

Project Name: **Geotechnical Investigation**
Project Number: **G22006QUE**
Location / Site: **122 - 124 Queenscliff Road, Queenscliff NSW**
Client: **Gemini Queenscliff Pty Ltd**

Drilling Company: **FICO Group**
Date Started: **21-FEB-22**
Ground Level: **RL29.5m** (approx)
Drill Method: **SFA / NMLC**
Date Completed: **21-FEB-22**
Easting: ----------
Equipment: **Track Mounted**
Northing: ----------

Method	Depth (m)	RL (m)	Material Type	Material Description	Weathering	Estimated Strength (MPa)	$Is_{(50)}$ MPa	U.C.S. (Mpa)	RQD %	Core Photo	Defect Spacing (mm)	Defect Description (type, inclination, thickness, shape, roughness, coating)	Depth (m)	Casing & Core Lifts
NMLC Coring	5.5	24.0	Bedrock	**SANDSTONE** - pink white, medium to coarse grained, trace fine rounded Gravel, weakly iron stained.	DW-SW		A=0.73 D=0.65		64			BP, 0	5.5	
	6.0	23.5											6.0	
	6.5	23.0					A=0.54 D=0.52					HB	6.5	
	7.0	22.5										DB	7.0	6.95
	7.5	22.0		**SANDSTONE** - grey white, medium to coarse grained, trace carbonaceous laminations.	SW-FR		A=0.15 D=0.48						7.5	
	8.0	21.5		**SANDSTONE** - grey white, fine to medium grained, trace carbonaceous laminations.	FR				39			JT, 85 to 90, RF	8.0	
	8.5	21.0					A=0.51 D=0.46						8.5	
	9.0	20.5											9.0	9
	9.5	20.0		**Hole Terminated at 9.00 m** in sandstone bedrock									9.5	
	10.0	19.5											10.0	

Additional Comments

Logged By: **Stephen McCormack** Date: **21-Feb-22**
Checked By: **Stephen McCormack** Date: **01-MAR-22**

GEE DAVIES CH LOG G22006QUE.GPJ GEE.GDT 11-3-22 12:07:13 PM


QUEENSCLIFF BH2 START 1·0M 21-2-22
CORE LOSS TO
2·4M
1
2
3
4
5
6
7
8
CLIENT
GEMINI QUEENSCLIFF PTY LTD
PROJECT
GEOTECHNICAL
PROJECT ID
G22006QUE
LOCATION
122 - 124 QUEENSCLIFF RD, QUEENSCLIFF NSW
BOREHOLE ID
BH2
DEPTH
1.00 TO 9.0m
21 FEBRUARY 2022

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH3**
Hole Depth: **0.40 m**
Sheet: **1 of 1**

Project Name: **Geotechnical Investigation**
Project Number: **G22006QUE**
Location / Site: **122 - 124 Queenscliff Road, Queenscliff NSW**
Client: **Gemini Queenscliff Pty Ltd**

Drilling Company: **FICO Group**
Drill Method: **Manual**
Equipment: **Hand Auger**
Date Started: **21-FEB-22**
Date Completed: **21-FEB-22**
Ground Level: **RL27m** (approx)
Latitude: ----------
Longitude: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests: ID No.	Samples / Tests: DCP blows/100mm	Observations / Comments
							Surface: Garden				5 10 15	
Hand Auger					SM		**TOPSOIL / FILL: Silty SAND**- dark grey, fine to medium grained.	loose	m	BH3 0.10-0.3m		
												Bore dry upon completion
							Hand Auger Refusal at 0.40m on sandstone bedrock					Crowbar refusal at 0.4m
		1.0	26.0									
		2.0	25.0									
		3.0	24.0									
		4.0	23.0									
		5.0	22.0									

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

Logged By: **Stephen McCormack** Date: **21-Feb-22**
Checked By: **Stephen McCormack** Date: **01-MAR-22**

GEE DAVIES BH LOG G22006QUE.GPJ GEE.GDT 11-3-22 12:08:49 PM

Borehole Log Report

Geo Environmental Engineering Pty Ltd
82 Bridge Street
Lane Cove NSW 2066
T 02 9420 3361

Hole ID. **BH4**
Hole Depth: **0.55 m**
Sheet: **1 of 1**

Project Name: **Geotechnical Investigation**
Project Number: **G22006QUE**
Location / Site: **122 - 124 Queenscliff Road, Queenscliff NSW**
Client: **Gemini Queenscliff Pty Ltd**

Drilling Company: **FICO Group**
Date Started: **21-FEB-22**
Ground Level: **RL25.7m** (approx)
Drill Method: **Manual**
Date Completed: **21-FEB-22**
Latitude: ----------
Equipment: **Hand Auger**
Longitude: ----------

Method	Water Level	Depth (m)	RL (m)	Graphic Log	USCS Symbol	Material Type	Material Description	Consistency / Density	Moisture	Samples / Tests: DCP blows/100mm	Observations / Comments
							Surface: Grass			5 10 15	
Hand Auger					GP		**FILL: Sandy GRAVEL**- brown and grey, fine to coarse grained, fine to coarse sand with cobble size sandstone inclusions.	loose	m		
					SM	Nat.	**Silty SAND**- dark grey, fine to medium grained.	loose	m		Bore dry upon completion
		0.55	25.0				**Hand Auger Refusal at 0.55m** on sandstone bedrock				Crowbar refusal at 0.4m
		1.0									
			24.0								
		2.0									
			23.0								
		3.0									
			22.0								
		4.0									
			21.0								
		5.0									

Moisture

D	Dry
Dp	Damp
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet
Sd	Saturated

Additional Comments

Logged By: **Stephen McCormack** Date: **21-Feb-22**
Checked By: **Stephen McCormack** Date: **01-MAR-22**

GEE DAVIES BH LOG G22006QUE.GPJ GEE.GDT 11-3-22 12:08:50 PM

Geo Environmental Engineering
82 Bridge Street
Lane Cove NSW 2066
E info@geoenvironmental.com.au

Log Report Legend

MATERIAL SYMBOL

FILL	CONCRETE	ASPHALT	TOPSOIL
ORGANICS	ESTUARINE MUD		

CLAY	SAND	SILT	GRAVEL
Sandy CLAY	Clayey SAND	Clayey SILT	Clayey GRAVEL
Silty CLAY	Silty SAND	Sandy SILT	Sandy GRAVEL
Gravelly CLAY	Gravelly SAND	Gravelly SILT	Silty GRAVEL
CLAY & SAND	SAND & CLAY	SILT & CLAY	GRAVEL & CLAY
CLAY & SILT	SAND & SILT	SILT & SAND	GRAVEL & SAND
CLAY & GRAVEL	SAND & GRAVEL	SILT & GRAVEL	GRAVEL & SILT
Sandy Silty CLAY	Clayey Silty SAND	Sandy Clayey SILT	Sandy Clayey GRAVEL
Silty Sandy CLAY	Silty Clayey SAND	Clayey Sandy SILT	Clayey Sandy GRAVEL
Sandy Gravelly CLAY	Clayey Gravelly SAND	Sandy Gravelly SILT	Silty Clayey GRAVEL
Silty Gravelly CLAY	Silty Gravelly SAND	Clayey Gravelly SILT	Clayey Silty GRAVEL
Gravelly Silty CLAY	Gravelly Silty SAND	Gravelly Clayey SILT	Sandy Silty GRAVEL
Gravelly Sandy CLAY	Gravelly Clayey SAND	Gravelly Sandy SILT	Silty Sandy GRAVEL

SANDSTONE	SHALE	GRANITE	BASALT	SHALE / SANDSTONE
PORCELLANITE	GNEISS	SHALE / CLAYSTONE	MUDSTONE	
CLAYSTONE	MUDSTONE / CLAYSTONE	SHALE / SILTSTONE	IRONSTONE	

WATER LEVELS

Encountered Water

Standing Water

ABBREVIATIONS

PT	Pushtube
SFA	Solid Flight Auger
PWS	Percussion Window Sampler
HA	Hand Auger
HFA	Hollow Flight Auger

WELL GRAPHICS

Cuttings	Bentonite	Screen
Gravel Pack	Grout	Cave-in

GEE LEGEND * * 29/10/09 5:04:07 PM

APPENDIX D

Test Results (8 Sheets)

POINT LOAD STRENGTH INDEX

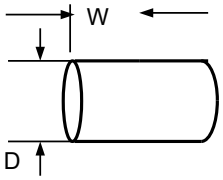
Project No.	Q22006QUE

Client:	Gemini Queenscliff Pty Ltd	Date:	15-Apr-21
Project:	Geotechnical Investigation	Tested by:	MK
Location:	122-124 Queenscliffe Road, Queenscliffe NSW	Data checked:	SM

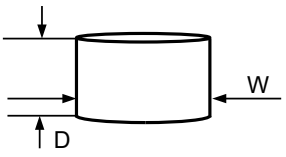
Test Machine:	GSA	Test Locality:	MHK	Core Size:	52	mm

Bore/TP	Depth (m)	Rock Type	Moisture Condition	Test Type	W (mm)	D (mm)	Load kN (P)	Failure Type	Point Load Strength Index $I_{S(50)}$ (MPa)	Strength Classification
BH1	1.74	SANDSTONE	F	D	50.0	50.0	1.19	2	0.48	M
BH1	1.74	SANDSTONE	F	A	52.0	45.0	1.66	1	0.58	M
BH1	2.58	SANDSTONE	F	D	50.0	49.0	2.18	2	0.90	M
BH1	2.58	SANDSTONE	F	A	52.0	44.0	2.72	1	0.97	M
BH1	3.37	SANDSTONE	F	D	50.0	49.0	1.60	2	0.66	M
BH1	3.37	SANDSTONE	F	A	52.0	46.0	3.02	1	1.04	H
BH1	4.57	SANDSTONE	F	D	50.0	50.0	1.52	2	0.61	M
BH1	4.57	SANDSTONE	F	A	52.0	43.0	2.56	1	0.93	M
BH1	5.47	SANDSTONE	F	D	50.0	50.0	0.61	2	0.24	L
BH1	5.47	SANDSTONE	F	A	52.0	46.0	1.32	1	0.45	M
BH1	6.34	SANDSTONE	F	D	50.0	49.0	1.46	2	0.60	M
BH1	6.34	SANDSTONE	F	A	52.0	42.0	1.75	1	0.64	M
BH1	6.90	SANDSTONE	F	D	50.0	51.0	0.29	2	0.11	L
BH1	6.90	SANDSTONE	F	A	52.0	44.0	0.57	1	0.20	L
BH2	3.37	SANDSTONE	F	D	50.0	50.0	0.54	2	0.22	L
BH2	3.37	SANDSTONE	F	A	52.0	42.0	0.43	1	0.16	L
BH2	4.17	SANDSTONE	F	D	50.0	49.0	1.66	1	0.69	M
BH2	4.17	SANDSTONE	F	A	52.0	41.0	1.75	1	0.66	M
BH2	5.82	SANDSTONE	F	D	50.0	49.0	1.57	1	0.65	M
BH2	5.82	SANDSTONE	F	A	52.0	45.0	2.10	1	0.73	M
BH2	6.61	SANDSTONE	F	D	50.0	50.0	1.29	1	0.52	M
BH2	6.61	SANDSTONE	F	A	52.0	41.0	1.44	1	0.54	M
BH2	7.31	SANDSTONE	F	D	50.0	50.0	1.21	1	0.48	M
BH2	7.31	SANDSTONE	F	A	52.0	48.0	0.46	1	0.15	L
BH2	8.54	SANDSTONE	F	D	50.0	50.0	1.16	1	0.46	M
BH2	8.54	SANDSTONE	F	A	52.0	41.0	1.36	1	0.51	M

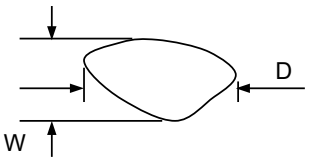
TEST TYPE :



W/D > 0.5
DIAMETRAL (D)



D/W = 0.3 - 1.0
AXIAL (A)



D/W = 0.3 - 1.0
IRREGULAR LUMP (I)

MOISTURE CONDITION :
Field (F), Saturated (S), Dry (D)

FAILURE TYPE :
1. Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.
2. Fracture along bedding.
3. Fracture influenced by pre-existing joint plane (J), microfracture (M), vein (V), chemical alteration (C).
4. Chip or partial fracture.

NOTES For specimens tested parallel to plane of weakness $D_e^2 = D^2$
For specimens tested perpendicular to plane of weakness $D_e^2 = 4WD/$□

Geo-Environmental Engineering Pty Ltd
82 Bridge St
Lane Cove
NSW 2066

Attention: **ALL INVOICES Stephen McCormack**

Report **868726-S**
Project name
Project ID QUEENSCLIFF
Received Date Mar 04, 2022

Client Sample ID			**BH1 / 0.5-0.6**	**BH2 / 0.1-0.3**	**BH3 / 0.1-0.3**
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S22-Ma10581**	**S22-Ma10582**	**S22-Ma10583**
Date Sampled			**Not Provided**[I12]	**Not Provided**[I12]	**Not Provided**[I12]
Test/Reference	LOR	Unit			
Chloride	10	mg/kg	< 10	11	< 10
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	16	42	92
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	7.3	6.9	5.4
Resistivity*	0.5	ohm.m	630	240	110
Sulphate (as SO4)	10	mg/kg	< 10	< 10	< 10
% Moisture	1	%	18	15	12

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chloride	Sydney	Mar 07, 2022	28 Days
- Method: LTM-INO-4270 Anions by Ion Chromatography			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Sydney	Mar 07, 2022	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Sydney	Mar 07, 2022	7 Days
- Method: LTM-GEN-7090 pH by ISE			
Sulphate (as SO4)	Sydney	Mar 07, 2022	28 Days
- Method: In-house method LTM-INO-4270 Sulphate by Ion Chromatograph			
% Moisture	Sydney	Mar 04, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins | Environment Testing

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261 Site # 1254

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 6253 4444
NATA # 2377 Site # 2370

Eurofins Environment Testing NZ Limited
NZBN: 9429046024954

Auckland
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Company Name: Geo-Environmental Engineering P/L
Address: 82 Bridge St
Lane Cove
NSW 2066

Project Name:
Project ID: QUEENSCLIFF

Order No.:
Report #: 868726
Phone: 02 9592 0218
Fax: 02 9519 9140

Received: Mar 4, 2022 9:05 AM
Due: Mar 11, 2022
Priority: 5 Day
Contact Name: ALL INVOICES Stephen

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254							
Sydney Laboratory - NATA # 1261 Site # 18217						X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							
Mayfield Laboratory - NATA # 1261 Site # 25079							
Perth Laboratory - NATA # 2377 Site # 2370							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH1 / 0.5-0.6	Not Provided		Soil	S22-Ma10581	X	X
2	BH2 / 0.1-0.3	Not Provided		Soil	S22-Ma10582	X	X
3	BH3 / 0.1-0.3	Not Provided		Soil	S22-Ma10583	X	X
Test Counts						3	3

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
Chloride			mg/kg	< 10			10	Pass	
Sulphate (as SO4)			mg/kg	< 10			10	Pass	
LCS - % Recovery									
Chloride			%	102			70-130	Pass	
Sulphate (as SO4)			%	99			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Chloride	S22-Ma10578	NCP	%	102			70-130	Pass	
Sulphate (as SO4)	S22-Ma10578	NCP	%	98			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25°C as rec.)	S22-Ma14766	NCP	uS/cm	67	61	9.0	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	S22-Ma14766	NCP	pH Units	10	10	<1	30%	Pass	
Resistivity*	S22-Ma14766	NCP	ohm.m	150	160	9.0	30%	Pass	
% Moisture	W22-Ma08355	NCP	%	6.7	7.9	17	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Chloride	S22-Fe22971	NCP	mg/kg	< 10	< 10	<1	30%	Pass	
Sulphate (as SO4)	S22-Fe22971	NCP	mg/kg	< 10	< 10	<1	30%	Pass	

Comments

Eurofins | Environment Testing accreditation number 1261, site 18217 is currently in progress of a controlled transition to a new custom built location at 179 Magowar Road, Girraween, NSW 2145. All results on this report denoted as being performed by Eurofins | Environment Testing Unit F3, Building F, 16 Mars road, Lane Cove West, NSW 2066, corporate site 18217, will have been performed on either Lane Cove or new Girraween site

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	N/A
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
I12	Where sampling date has not been provided, Eurofins | Environment Testing is not able to determine whether analysis has been performed within recommended holding times.

Authorised by:

Andrew Black	Analytical Services Manager
Charl Du Preez	Senior Analyst-Inorganic (NSW)

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

CHAIN OF CUSTODY RECORD

Eurofins | Environment Testing ABN 50 005 085 521

☐ **Sydney Laboratory** Unit F3 Bld.F 16 Mars Road Lane Cove West NSW 2066 02 9900 8400 EnviroSampleNSW@eurofins.com

☐ **Brisbane Laboratory** Unit 1 21 Smallwood Place Murarrie QLD 4172 07 3902 4600 EnviroSampleQLD@eurofins.com

☐ **Perth Laboratory** Unit 2 91 Leach Highway Kewdale WA 6105 08 9251 9600 EnviroSampleWA@eurofins.com

☐ **Melbourne Laboratory** 6 Monterey Road Dandenong South VIC 3175 03 8564 5000 EnviroSampleVic@eurofins.com

Company	GEO-ENVIRONMENTAL	Project №	QUEENSCLIFF	Project Manager	S.McCormack
Address	82 BRIDGE ST LANE COVE	Project Name		EDD Format ESdat, EQuIS etc	
Contact Name	S.McCormack				
Phone №	0431480980				
Special Directions					
Purchase Order					
Quote ID №					

Sampler(s)	S.McCormack				
Handed over by	"				
Email for Invoice	"				
Email for Results					

Analyses Where metals are requested, please specify "Total" or "Filtered". SUITE code must be used to attract SUITE pricing.

ACCRESSIVITY SUITE

Containers Change container type & size if necessary.

Required Turnaround Time (TAT) Default will be 5 days if not ticked.

♦Surcharge will apply

☐ Overnight (reporting by 9am)♦
☐ Same day♦ ☐ 1 day♦
☐ 2 days♦ ☐ 3 days♦
☑ 5 days (Standard)
☐ Other( )

№	Client Sample ID	Sampled Date/Time dd/mm/yy hh:mm	Matrix Solid (S) Water (W)	500mL Plastic	250mL Plastic	125mL Plastic	200mL Amber Glass	40mL VOA vial	500mL PFAS Bottle	Jar (Glass or HDPE)	Other (Asbestos AS4964, WA Guidelines)	Sample Comments / Dangerous Goods Hazard Warning
21	BH1/0.5-0.6											
22	BH2/0.1-0.3											
23	BH3/0.1-0.3											
24												
25												
26												
27												
28												
29												
30												
	Total Counts											

Method of Shipment	☐ Courier (#)	☑ Hand Delivered	☐ Postal	Name	S.McCormack	Signature		Date	4/3/22	Time	
Laboratory Use Only	Received By		SYD | BNE | MEL | PER | ADL | NTL | DRW	Signature		Date		Time		Temperature	20°C
	Received By	S.DALL	SYD | BNE | MEL | PER | ADL | NTL | DRW	Signature		Date	4/3/22	Time	9:05AM	Report №	868726

Eurofins Environment Testing Australia Pty Ltd

Submission of samples to the laboratory will be deemed as acceptance of Eurofins | Environment Testing Standard Terms and Conditions unless agreed otherwise. A copy is available on request.