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Hydrogeology Assessment – 40 The Retreat, Bradfield, NSW

Report prepared for SCG Developments Pty Ltd
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TABLE OF CONTENTS

1 INTRODUCTION	4
1.1 Background.....	4
1.2 Scope of work	5
2 EXISTING ENVIRONMENT	5
2.1 Site description.....	5
2.2 Geology and hydrogeology.....	6
2.3 Requirements for proposed development	7
3.0 FIELD INVESTIGATION AND RESULTS	8
3.1 Groundwater monitoring.....	9
3.2 Groundwater fluctuation	9
3.3 Groundwater flow direction	11
3.4 Aquifer hydraulic testing	11
3.4 Groundwater quality	12
3.5 Groundwater conceptual model	14
4.0 PREDICTED INFLOW/SEEPAGE INTO THE BASEMENT.....	15
4.1 Predicted groundwater inflow/seepage and extraction during excavation.....	15
4.2 Drawdown extent and impact on groundwater users and the neighbouring properties	16
4.3 Dewatering methodology.....	17
4.4 Groundwater disposal	17
4.5 Assumptions.....	18
5.0 Dewatering monitoring plan	18
6.0 SUMMARY AND CONCLUSIONS	19
7.0 REFERENCES	20
LIMITATIONS.....	20

TABLE OF FIGURES

Figure 1 Site location map (Source SIX.nsw.gov.au).....	6
Figure 2 Monitoring bore location map	9
Figure 3 Hydrographs (water level in mAHD) for Site monitoring bores for a period from 11 th January 2024 to 28 th February 2024 plotted with rainfall	10

Figure 4 Interpreted groundwater flow direction (28 th February 2024) -dashed line represent interpreted piezometric level (mAHD) and arrows interpreted flow direction	11
Figure 5 Predicted change in drawdown with distance from the centre of excavation (using Theis, 1935) when pumping 7 m ³ /day.....	17

LIST OF TABLES

Table 1 Summary of monitoring bore installation	8
Table 2 Summary of hydraulic conductivity results for monitoring bores	12
Table 3 Hydrogeochemical analytes	12
Table 4 Summary of physical measured parameters.....	13
Table 5 Summary of water quality results and comparison with ANZG (2018) guidelines (freshwater)	13
Table 6 Criteria for discharge of water into the stormwater system	18

LIST OF APPENDICES

Appendix A Architectural plans and survey
Appendix B Monitoring bore logs
Appendix C Analytical lab results
Appendix D Hydraulic testing analysis

1 INTRODUCTION

1.1 Background

This report presents the preliminary groundwater assessment for the proposed basement of multilevel residential development to be constructed at 40 The Retreat, Bradfield, NSW (the Site). This report was commissioned by SCG Developments Pty Ltd and presents the results of the hydrogeological investigation carried out for the proposed residential development.

This groundwater assessment was prepared to provide the understanding into groundwater conditions at the Site and to support in the future the assessment for water supply works approval in accordance with the Minimum requirements for building site groundwater investigation and reporting (DPIE, 2021).

The report outlines the groundwater conditions beneath the Site, the need for dewatering (during the construction) of a basement below ground level, potential impact on the neighbouring properties and groundwater system and any water treatment related to groundwater disposal. This investigation follows a geotechnical investigation at this Site carried out by Intrax Pty Ltd in 2024.

Based on the information and plans supplied by the client, it is understood that the proposed development comprises the construction of multi residential development with two level basement below the current ground level. The plans provided indicate that the excavation is to extend to a depth of approximately 62 and 56 mAHD which is approximately 7-9 m below the current ground level. Groundwater level is above the proposed basement; therefore, the proposed basement will require dewatering.

Updated development plans indicate that maximum depth of basement is somewhat different from the plans originally provided. Therefore, this report provides only indicative inflow and drawdown predictions, and an updated version is required for WaterNSW water works supply licence to allow dewatering.

The purpose of this investigation is to prepare a hydrogeology report that will evaluate the inflows into the basement during construction, assess and provide an indication of options for groundwater disposal, treatment and monitoring should this be required.

1.2 Scope of work

The following scope of works is based on the Minimum requirements for building site groundwater investigation and reporting (DPIE, 2021) which will in the future enable the preparation of water supply works approval (WaterNSW):

- Provide reason for dewatering and show the footprint of the area
- Understand the groundwater level and its fluctuation
- Undertake hydraulic testing to determine aquifer properties and estimate groundwater inflow into the basement and the period of discharge during basement construction
- Discuss dewatering techniques and options for discharge and treatment of groundwater and stormwater discharge point
- Assess drawdown resulting from the proposed development and impact on the neighbouring properties and groundwater system
- Describe the proposed monitoring program.

Secretary's Environmental Assessment Requirements

In accordance with section 4.39 of the *Environmental Planning & Assessment Act 1979* (EP&A Act), Secretary's Environmental Assessment Requirements (SEARs) for SSD 65729209 issued on 18 January 2024 . This report addresses only small part of the relevant issued SEARs, as set out in the table below.

SEAR	Response / Location in Report
12. Provide Groundwater Impact Assessment that assesses potential impact on groundwater resources in accordance with the Groundwater Guidelines	This report only partially covers this requirement and reports the predicted inflows into the basement. No groundwater impact assessment was completed.

2 EXISTING ENVIRONMENT

2.1 Site description

The subject Site is located at 40 The Retreat, Bradfield, NSW, as shown in **Figure 1**. Excavation which is discussed in this report is semi-rectangular in shape and is located to the northwest of the Retreat, Bradfield just east of the proposed Aerotropolis, Sydney NSW (**Figure 1**). The dimensions of the site are 210 x 99 m (approximately 20,900 m²). The site slopes gently to the south-west. The elevation across the site is approximately 69.5 mAHD in the north-easterly corner to approximately 64 mAHD in the south-westerly corner.

The Site is located about 200 m west of the small tributary to the South Creek running south-north which discharges into the Hawkesbury River at Windsor some 30 km to the north.



Figure 1 Site location map (Source SIX.nsw.gov.au)

2.2 Geology and hydrogeology

According to 1:100,000 Penrith Geological Series, Map Sheet 9030 (1991), by the New South Wales, Department of Mineral Resources, the site is located within an area underlain by a Bringelly Shale (Rwb) formed in the Triassic period. The lithology comprises shale, carbonaceous claystone with laminates of fine to medium grained lithic sandstone and rare coal and tuff. The Narellan lineament runs south – north just 200 m east of the Site and is associated with the South Creek. This area is covered by Quaternary age fine grained sand, silt and clay.

Based on the site investigation drilling (Intrax, 2021), the upper geological profile includes the extremely weathered clay and siltstone about 2 m thick, underlain by fine to medium grained sandstone and clay. Below 4.5 m depth the lithology comprises siltstone. At the southern end of the Site, the clay is present to 5.5 m depth and underlain by siltstone to around 10 m depth. Along the eastern boundary the weathered clay is underlain by sandstone to around 5 m depth. Siltstone appears to be underlying the whole sedimentary sequence from about 5 m depth across the Site.

2.3 Requirements for proposed development

This State Significant Development Application seeks consent for the detailed design and delivery (including construction and use) of a new mixed use residential development, to be developed in two (2) stages. Specifically, development consent is sought for:

Stage 1

- Overall site clearing and preparation works, including demolition of all existing development on the Site;
- The redevelopment of the northern portion of the Site, comprising:
 - Temporary Site access to the northern portion of the Site from The Retreat;
 - Temporary bin enclosure adjacent the temporary access;
 - Excavation works and construction of a shared two (2) storey basement to a maximum depth of RL 60.60, with capacity for 311 vehicle car spaces;
 - Construction of three (3) individual mixed use buildings, comprising:
 - Maximum building heights between 30.4m and 39.8m;
 - A total Gross Floor Area (GFA) of 26, 204sqm, comprising 25,744 sqm of residential GFA, 248 sqm of non-residential GFA and 212 sqm of retail GFA, distributed across the three buildings;
 - 254 residential units, distributed across the three buildings.
 - Associated landscaping, communal open space and embellishment works; and
 - Delivery and augmentation of services.

Stage 2

- The redevelopment of the southern portion of the Site, comprising:
 - Removal of the Stage 1 temporary access from The Retreat;
 - Connection and access of the Stage 1 basement to the western boundary (to become a future Collector Road);
 - Excavation works and construction of a shared three (3) storey basement to a depth of RL 56.35, with capacity for 336 vehicle car spaces;
 - Site and basement access from the western boundary (to become a future Collector Road);
 - Construction of three (3) individual mixed use buildings, comprising:
 - Maximum building heights between 23.8m and 39.9m;
 - A total Gross Floor Area (GFA) of 29,126 sqm, comprising 28,540 sqm of residential GFA, 212 sqm of retail GFA and 374 sqm of non-residential GFA, distributed across the three buildings;
 - 279 residential units, distributed across the three buildings.
 - Associated landscaping, communal open space and embellishment works; and
 - Delivery and augmentation of services.

A detailed description of the proposed development is detailed in Section 3.0 of the Environmental Impact Statement prepared by Ethos Urban.

The report was prepared in the basis that the proposed development required the basement to be excavated to between 55 m and 61 mAHD (about 7-8 m below ground level not allowing for concrete slab). Based on groundwater monitoring undertaken by Intrax Pty Ltd in three monitoring bores on Site, groundwater varies from around 61 to 63 mAHD. The updated basement maximum depth is different to the levels provided above , however this report is

considered to be a preliminary groundwater assessment. The proposed excavation will therefore intercept groundwater and will need to be dewatered.

3.0 FIELD INVESTIGATION AND RESULTS

Field investigations were carried out from January to March 2024, and they included the following;

1. Groundwater monitoring of existing monitoring bores for a period of 2 months (Intrax Pty Ltd)
2. Hydraulic testing to assess permeability; and
3. Collection of groundwater samples from all bores (undertaken by Simon Capels (ECSgroup in January 2024 and K.David in March 2024).

All monitoring bores are constructed in accordance with the standards (ADIA, 2020). The location of the bores is provided in **Figure 2**. The summary of monitoring bore construction is given in **Table 1** and logs are given in **Appendix B**.

Table 1 Summary of monitoring bore installation

<i>Bore ID</i>	<i>Total depth (m)</i>	<i>Surface elevation (mAHD)</i>	<i>Screened section (m below ground)</i>	<i>Screened lithology</i>
<i>BH1</i>	10.05	69.56	5.05-10.05	Siltstone
<i>BH3</i>	8	64.11	5-8	Siltstone
<i>BH6</i>	10	69.33	5 - 10	Siltstone/Sandstone



Figure 2 Monitoring bore location map

3.1 Groundwater monitoring

Groundwater monitoring was undertaken in monitoring bores for a period of two months during January and February 2024. This included monitoring of daily groundwater level fluctuation, hydraulic testing and groundwater quality sampling. Groundwater samples were collected from three site bores and hydraulic testing undertaken on all bores (3 tests per bore).

3.2 Groundwater fluctuation

The dataloggers have continuously monitored the water level for a period of two months. **Figure 3** shows the hydrographs for bores with measured water levels presented in mAHD to allow comparison with the proposed basement depth. The groundwater levels are plotted along with the rainfall data (BOM station SN67015).

Figure 3 shows the groundwater level in BH6 fluctuated in monitoring bores from 62 to 64.5 mAHD over the monitoring period. A rise of approximately 0.5 m (BH6) following a just over 45 mm rainfall event provides the understanding of the magnitude of the relationship with rainfall. The most significant rise of around 2 m has followed 10 mm rainfall event, which appears to be due to other reasons. That rise is either due to the discharge from the pond just upgradient of the monitoring bore (flooding) or rainfall being very localised and therefore not picked up by closest rainfall gauge. The second hypothesis is more likely as two rainfall events

that occurred on 20/21 February (total of 52 mm) have not caused any change in groundwater levels.

Groundwater level in monitoring bore BH1 shows a similar trend to that in BH3 with similar minor magnitude of groundwater rise and fall in response to rainfall and its absence. These two bores appear to be installed in the confined aquifer, while response in BH6 indicates that semi-confined conditions are likely present. The difference in response is most likely due to the presence of sandstone within screened section of BH6.

Based on the results and similar behaviour and response to rainfall in bores installed across the Site mainly in siltstone, it is considered that one hydrostratigraphic unit exists across the site which includes the siltstone and clay.

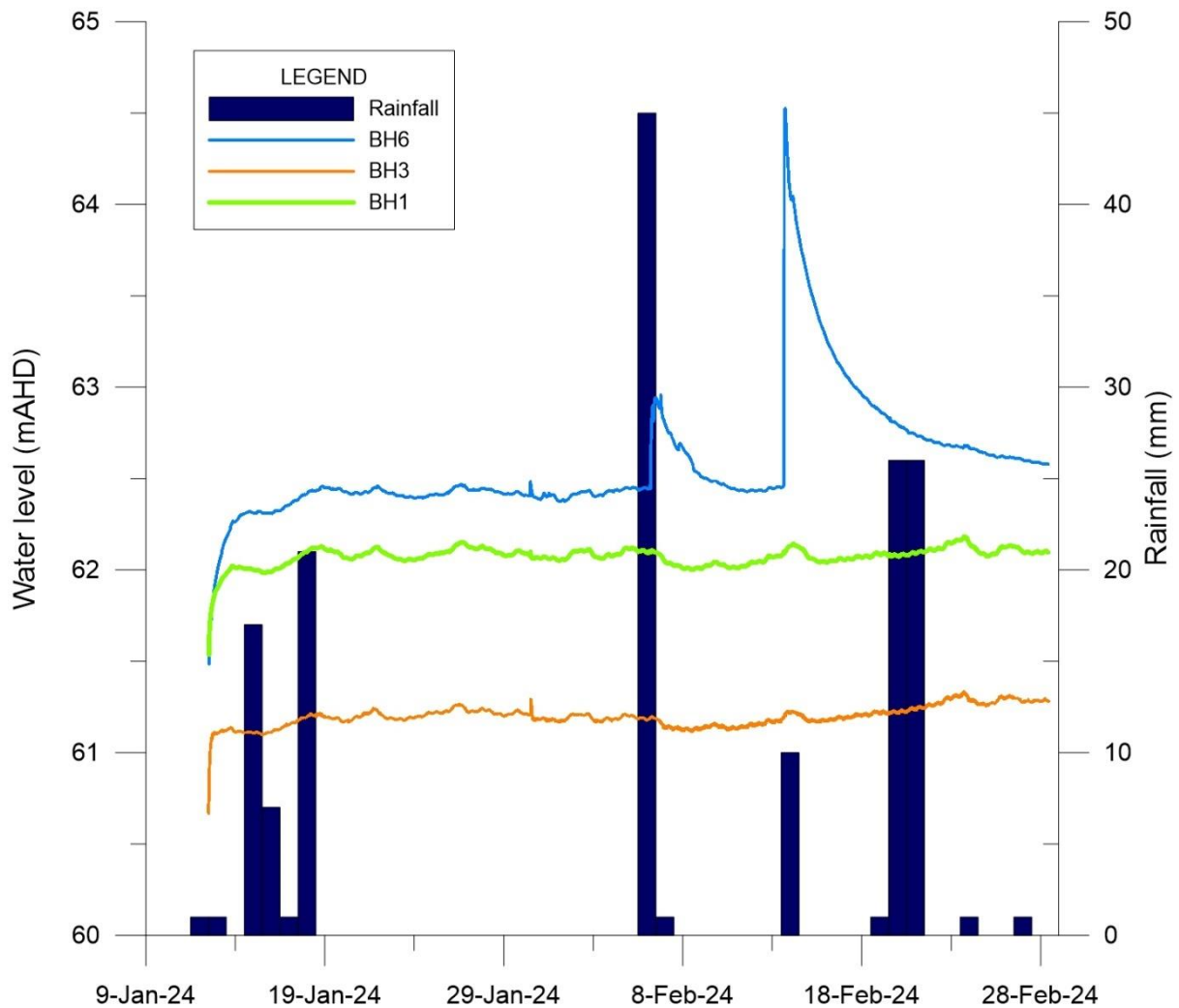


Figure 3 Hydrographs (water level in mAHD) for Site monitoring bores for a period from 11th January 2024 to 28th February 2024 plotted with rainfall

3.3 Groundwater flow direction

Based on the groundwater level readings on 28th February 2024 (and throughout the monitoring period) the interpreted groundwater flow direction is to the south-southwest. The groundwater flow mimics the topography. The gradient is gentle at approximately 1 m over 130 m distance somewhat steeper at the northern end (**Figure 4**).



Figure 4 Interpreted groundwater flow direction (28th February 2024) -dashed line represent interpreted piezometric level (mAHD) and arrows interpreted flow direction

3.4 Aquifer hydraulic testing

In-situ hydraulic conductivity data were obtained from hydraulic testing in March 2024. Rising head tests were undertaken where water was removed from the well and the recovery monitored. Three tests were undertaken on each bore to ensure bigger certainty in the results and in accordance with the Minimum requirements for building site groundwater investigation and reporting (DPIE, 2021).

The hydraulic tests were analysed using Bower and Rice (1989) method. The hydraulic conductivity results are presented in **Table 3 and Appendix D**. The results obtained from hydraulic testing are within the hydraulic conductivity range for silt to sandy silt (Domenico and Schwartz, 1990). The hydraulic conductivity across the site appears to be relatively uniform, with median around 3×10^{-2} m/d and ranging from 1.25×10^{-1} to 5.46×10^{-3} m/d.

Table 2 Summary of hydraulic conductivity results for monitoring bores

<i>Tested bore</i>	<i>Hydraulic conductivity test results (m/day)</i>
<i>BH1</i>	1.49 x 10 ⁻² to 5.39 x 10 ⁻³
<i>BH3</i>	6.75 x 10 ⁻² to 1.25 x 10 ⁻¹
<i>BH6</i>	1.28 x 10 ⁻² to 5.46 x 10 ⁻³

3.4 Groundwater quality

Three groundwater quality samples were collected in January (Environmental Consulting Services) and March 2024 (K. David) from all bores. Sampling in January 2024 was undertaken for dissolved metals and hydrocarbons, while sampling in March 2024 included the nutrients and physical parameters. Sampling in March 2024 was undertaken by using the Hydrasleeve (low disturbance sampling technique). Samples were collected in appropriate sample containers, with sample preservation where required. The samples were transported under chain-of-custody protocols in an ice-filled storage container and were analysed at NATA-certified ALS laboratory, Sydney.

Samples were analysed for the species listed in **Table 4**. All analyses were conducted within the required holding times for analytes. Chain-of-custody records and laboratory analytical reports are provided in **Appendix C** for both sampling rounds and are summarised below.

Table 3 Hydrogeochemical analytes

<i>Sample Type</i>	<i>Analytes</i>
<i>Physical parameters</i>	pH, EC, temp, turbidity, TSS
<i>Metals</i>	Al, As, Cd, Cr, Cu, Pb, Ni, Zn, Se, Fe and Hg
<i>Major ions</i>	Ca, Mg, Na, K, Cl, SO ₄ , Alkalinity, Fluoride
<i>Nutrients</i>	TP, TN, nitrate, nitrite, ammonia
<i>Hydrocarbons</i>	TRH, PAH, BTEX, pesticides

The ANZG (2018) guidelines for protection of aquatic ecosystems (fresh water) have been adopted as the main Site assessment criteria and the groundwater samples were compared against those, given that the any potential discharge to the stormwater system and interaction with the freshwater (creek) as ultimate discharge point. The 95 % level of protection of fresh ecosystems is considered the most appropriate for this ecosystem.

The measured physical parameters (**Table 5**) indicate that groundwater is saline and neutral to slightly alkaline. Salinity increases in the direction of groundwater flow.

Table 4 Summary of physical measured parameters

<i>Analytical Group</i>	<i>Analytes</i>	<i>ANZG 2018 Guidelines</i>	<i>BH1</i>	<i>BH3</i>	<i>BH6</i>
<i>Physical parameters</i>	EC (µS/cm)	125-2200	6800-10400	13000-10266	5700-6700
	pH (units)	6.5-8*	7.1-7.6	7.2-7.4	7.2-7.6
	ORP (mV)		-45.6	43	118.6
	Dissolved Oxygen (%)		21	26	30

Notes: * Lowland River pH values

The summary of analytical results and comparison with ANZG (2018) for 95 % protection of freshwater species (exceedances are marked bold) are given in **Table 6** and analytical laboratory results are presented in **Appendix C**.

Table 5 Summary of water quality results and comparison with ANZG (2018) guidelines (freshwater)

<i>Analytical Group</i>	<i>Analytes(mg/L)</i>	<i>ANZG 2018 Guidelines (mg/L)</i>	<i>BH1</i>	<i>BH3</i>	<i>BH6</i>
<i>Metals</i>	Arsenic*	0.013	0.016	0.001	0.006
	Cadmium	0.0002	0.0003	<0.0002	0.0002
	Chromium	0.001	0.004	<0.001	<0.001
	Copper	0.0014	0.015	<0.0001	0.001
	Lead	0.0034	0.017	<0.001	0.002
	Nickel	0.011	0.048	0.044	0.052
	Zinc	0.008	0.14	0.42	0.1
<i>Suspended solids</i>		50	860	381	288
<i>Hydrocarbons</i>	Ethylbenzene	0.08	<0.001	<0.001	<0.001
	Toluene	0.18	<0.001	0.002	<0.001
	m-xylene	0.075	<0.002	<0.002	<0.002
	o-xylene	0.35	<0.001	<0.001	<0.001
<i>Polycyclic aromatic hydrocarbons</i>	Benzo(a)pyrene	0.0002	<0.001	<0.001	<0.001
	Fluoranthene	0.0014	<0.001	<0.001	<0.001

<i>Analytical Group</i>	<i>Analytes(mg/L)</i>	<i>ANZG 2018 Guidelines (mg/L)</i>	<i>BH1</i>	<i>BH3</i>	<i>BH6</i>
<i>Inorganics</i>	Naphtalene	0.016	<0.001	<0.001	<0.001
	Phenanthrene	0.002	<0.001	<0.001	<0.001
	Ammonia	0.9	0.18	0.34	0.2
	Phosphorous	0.05	0.52	0.25	0.17
	Nitrogen	0.5	1.3	1.6	1.4
<i>Oil and grease</i>	Oil and grease		Not observed	Not observed	Not observed

*Arsenic (AsV) guideline used

These results indicate that:

- The measured concentrations of heavy metals were very low generally below the ANZG (2018) criteria in BH3 and BH6 (located to the east and downgradient) except for zinc. Zinc is a very mobile metal and is typically elevated within the Sydney Basin. BH1 (located upgradient at the northwest) has elevated cadmium, chromium, copper, lead and zinc above the ANZECC (2018) guidelines.
- pH is neutral to slightly alkaline and water is considered saline with salinity above 5700 µS/cm. Water is low in dissolved oxygen in agreement with the redox.
- Suspended solids for all samples were above the guidelines for discharge. Turbidity was also elevated above 250 NTU.
- Nutrients – ammonia was below the guidelines, with total phosphorous and total nitrogen above the guidelines for all samples.
- Hydrocarbons, TRH and BTEX and inorganic compounds are all below detection limit and below ANZECC (2018) guidelines.

3.5 Groundwater conceptual model

Based on the measured groundwater levels, geology logs, hydraulic testing and water quality monitoring the following conceptual hydrogeology model is proposed:

- The recharge to the groundwater system occurs:
 - Via lateral flow from the topographically higher away from the Site as can be observed in the hydrographs for BH1 and BH3
 - Direct rainfall as can be observed in hydrographs for BH6
 - Via lateral flow from the topographically higher away from the Site as can be observed in the hydrographs for BH1

- The discharge from groundwater system occurs:
 - Via lateral flow from the topographically higher away from the Site as can be observed in the hydrographs for BH1.
 - Discharge occurs via lateral flow to the southwest. The groundwater gradient across the Site is very gentle at 1 m drop over approximately 130 m distance.
- The hydrogeology conceptual model indicates that the average thickness of saturated zone above the proposed basement across the Site varies from 2 to 4 m.
- Due to relatively low hydraulic conductivity, and mainly confined conditions across the Site – in particular in the central and southern parts, the groundwater fluctuations are expected to be over >2 m as observed over the period of monitoring. It is not expected that this will change significantly over time in particular as high rainfall and fluctuation has already been captured.
- Based on the geology conditions across the Site, similar order of magnitude response to rainfall recharge and measured groundwater levels, one hydrostratigraphic unit exists beneath the Site.
- Groundwater flow direct to the southwest as inferred from the measured water levels agreed with the geochemistry and increase in salinity along the flow path.
- Confined to semi-confined conditions are supported by low dissolved oxygen levels.

4.0 PREDICTED INFLOW/SEEPAGE INTO THE BASEMENT

4.1 Predicted groundwater inflow/seepage and extraction during excavation

The plans and information provided by the client indicate the lowest level in the constructed basement will be at 55 and 61 mAHD with an area of around 20,900 m². This elevation does not include the allowance to accommodate the concrete slab.

Based on current conditions, the groundwater level will therefore be approximately 2.5 m with a maximum 6.5 m (at high water mark) above the proposed excavation level in the northeast assuming 0.5 m allowance for the concrete slab. To maintain the Site trafficability in the excavated basement, the water table will have to be lowered taking into consideration the groundwater fluctuations resulting from typical rainfall events.

Analytical groundwater assessment was undertaken to estimate the inflow into the excavation. Projected dewatering rates were calculated assuming 6 m saturation from the base of the excavation across the Site (conservative assumption), hydraulic conductivity of 2×10^{-2} m/day (based on field obtained results). Dupuit –Thiem equation (Fetter, 1994) for confined aquifer was used to calculate the groundwater inflow into the excavation as follows:

$$Q = \frac{\pi K b s}{\ln \frac{R_o}{r_w}}$$

Where R_o is equivalent radius of influence calculated using Kruseman and De Ridder (1994) approximation, s is depressurisation and b is thickness

$$R_o = \sqrt{2.25k h_o \frac{t}{S_s}}$$

Where k is hydraulic conductivity, h_o is standing water level, t is time and S_s is specific storage.

It was assumed that the excavation would take 70 days to complete. Projected short term groundwater inflow is thus calculated at 10 m³/day (0.1 L/s) and pumping at this rate should be sufficient to maintain the water level below the excavation during construction. The value provides the estimated inflow for static conditions and does not include prolonged high rainfall periods. However, high water levels have already been considered following the review of water levels. Total predicted inflow during construction is not predicted to exceed 0.7 ML.

The above estimate is related to the inflow during construction and does not address long term inflow. Based on the water levels and depth of the proposed basement it is likely that ongoing drainage and maintenance will be required if the basement is designed as drained. In addition, the Minimum requirements for building site groundwater investigation and reporting (DPIE, 2021) assert that basements should be watertight (fully tanked) for the life of the building. If a tanked basement option is adopted then completed basement should cause no obstruction to predevelopment groundwater flow.

4.2 Drawdown extent and impact on groundwater users and the neighbouring properties

Using Theis analytical solution (Theis, 1935) drawdown was calculated for known discharge. Given discharge of 10 m³/day, permeability of 0.2×10^{-2} m/day, and specific storage 10^{-5} m⁻¹ for siltstone (Heath, 1983), it is predicted that after 70 days of continuous pumping, the extent of pumping will extend to 2400 m. Drawdown at 500 m distance will be approaching 5 m (**Figure 5**). This calculation assumes that groundwater is not allowed to recover at any point in time during 70 days. The estimate assumes that any surface water will be diverted off Site and will not directly contribute to groundwater.

Most conservative option is provided here where it is assumed that basement will be dewatered in an instant i.e. material is removed at the start of the excavation. However, in reality the excavation is assumed to occur within 70 days where reduced inflow rate will occur into the basement.

The closest (one property) residential property is located 300 m distance from the centre of the basement. At that distance the maximum predicted drawdown will be approaching 7 m, which is above the natural groundwater level fluctuation. While the drawdown is significant compared to the natural fluctuation, the adverse impacts on existing groundwater users are expected to be limited due to expected slow groundwater seepage during basement excavation.

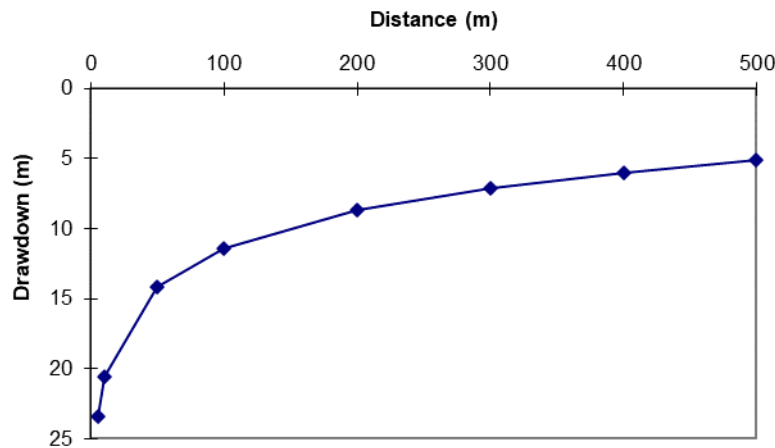


Figure 5 Predicted change in drawdown with distance from the centre of excavation (using Theis, 1935) when pumping 7 m³/day

4.3 Dewatering methodology

Given that total predicted groundwater inflow during construction could be managed (10 m³/day for a period of 70 days), it is recommended that in-pit sumps and pumps are used to collect the groundwater inflows at the lowest point within the excavation. Groundwater can be pumped from a sump to a holding tank or lined pond to be installed by licensed personnel.

The water should be stored in the sump and pumped out of the sump on a regular basis using the pumps such as the submersible dewatering pumps or firefighter pumps with capacity of over 50 m³/day. At the surface the water will need to be stored in the sediment pond/tank or discharged via silt barriers if required to settle the sediment, and then discharged via pipes to the closest stormwater discharge point. If the water is discharged to the stormwater system, it should be discharged directly to the curb pit inlet and not to gutter. The details of the proposed system have yet to be designed by the dewatering contractor. The pump capacity and operating hours or flow rate need to be recorded on a daily basis.

4.4 Groundwater disposal

The groundwater analytical results collected during this investigation indicate that groundwater is saline and has low levels of elevated metals except BH3 and no hydrocarbons, slightly elevated phosphorous and nitrogen and turbidity above the guidelines. Turbidity is exceeding the Council's requirements, ANZG (2018) guidelines and Blue Book (Managing Urban Stormwater, Soils and Construction, Volume 1, 4th Edition, 2004, Landcom).

Based on the groundwater quality and total predicted inflow of 10 m³/day during construction, it is recommended that groundwater be stored in lined sediment pond or settlement tank so that sediment can be settled before discharge. Alternatively, sediment traps or silt barriers could be used. Turbidity levels and pH need to be measured before disposal into the stormwater system. The proposal is for discharge of water into the stormwater system. The stormwater discharge

point would be into the closest curb pit inlet. Water treatment and removal of metals can be undertaken in small treatment plants using methods such as DMI-65 water filtration media, modified clay sorbent, or reactive filter. Phosphorous can be removed through chemical removal or biological advanced treatment.

Water quality criteria for disposal to the Stormwater system need to satisfy the ANZG (2018) guidelines as per **Table 7** for the protection of 95% freshwater species. In addition, the following criteria will apply as per **Table 6**.

Table 6 Criteria for discharge of water into the stormwater system

<i>Parameter</i>	<i>Criteria</i>	<i>Method</i>
<i>Oil and grease</i>	Not visible	Visual
<i>pH</i>	6.5- 8.5	Meter
<i>Total suspended solids</i>	<50 mg/L	Meter/grab sample

4.5 Assumptions

The following assumptions were made in the calculation of the inflow and drawdown:

- The properties of hydrostratigraphic unit within which the basement will be completed (siltstone/clay) do not change across the Site and are based on the testing results from three bores and 9 hydraulic tests;
- The radius of basement equivalent for the purpose of this inflow estimate is 76 m;
- Specific storage has been estimated at 10^{-5} m^{-1} based on material encountered in boreholes and recorded drill logs information;
- Any rainfall directly onto the basement footprint will be diverted and no allowance was made for extremely wet weather conditions;
- Groundwater levels across the Site do not change during dewatering period and are assumed to be highest as recorded during monitoring.
- Maximum depth of basement has been updated since this report was originally prepared, therefore this report provides only preliminary results.

5.0 DEWATERING MONITORING PLAN

Based on the preliminary groundwater assessment a dewatering monitoring plan will need to be prepared to address the impacts of basement excavation on groundwater and nearby properties.

It is considered that geotechnical assessment will need to be completed to prevent any future settlement due to the groundwater drawdown.

Groundwater monitoring and management of water during dewatering needs to be included in the dewatering management plan for the Water supply works approval.

6.0 SUMMARY AND CONCLUSIONS

This groundwater assessment has been compiled to assess the groundwater inflow rates into the basement during construction, assess the impact of groundwater drawdown and look at the options for discharge of groundwater.

The following is the summary of findings:

- The Site is underlain by clay and weathered siltstone/sandstone (up to 2.5 m) and overlies siltstone below around 5 m depth across the Site
- Measurement of groundwater level beneath Site was undertaken in Site bores installed in siltstone, with groundwater table ranging from 62 mAHD m to 64.5 mAHD. Dewatering will be required as the basement is at 61 to 55 mAHD (allowing for concrete slab);
- Groundwater inflow/seepage into the proposed basement was estimated based on nine hydraulic tests in three site bores, groundwater level fluctuation as monitored over two months and planned size and depth of the basement. The short-term groundwater inflows are estimated at 10 m³/day; for the duration of 70 days with total not expected to exceed 0.7 ML during excavation. This estimate may be slightly higher during high rainfall events although most groundwater level rise has been included in the estimate;
- It is recommended that inflow be managed by sumps with water pumped to a sediment settling pond/tank prior to discharge due to high suspended solids;
- Groundwater level fluctuations are below the predicted drawdown on the nearby buildings, however it is expected that this will occur as seepage rather than flow. Geotechnical engineer will need to assess the potential for settlement.
- Groundwater quality testing indicates that water is saline and neutral to alkaline. The heavy metals concentration is below detection limits in downgradient bores, with the exception of zinc which is slightly above the ANZG (2018) guidelines. Heavy metal concentration was exceeded in the upgradient bore for chromium, cadmium, copper, zinc and nickel. Turbidity, total phosphorous and total nitrogen were above the guidelines in all bores, and organic compounds were not detected;
- The most suitable water disposal option is considered to be discharge to stormwater however settlement of solids in sediment ponds will be required before discharge to stormwater. Water treatment and removal of heavy metals, phosphorous and nitrogen can be undertaken in small treatment plants using methods such as DMI-65 water filtration media, modified clay sorbent, or reactive filter, biological advanced treatment;

- Based on the groundwater levels and proposed depth of the basement it is preferred that a tanked basement is constructed. DECCW (former DPIE, 2021) asserts that basement should be watertight (fully tanked) to reduce energy demand, ongoing required maintenance and energy and additional administration related to licences, monitoring, and approvals. If a tanked design is adopted, the constructed basement must not cause the obstruction to predevelopment groundwater flow. The ultimate design selection will involve the input by geotechnical and structural engineer.
- Monitoring groundwater plan is required (as part of the dewatering management plan) to ensure that drawdown does not exceed the predicted, that no impact is caused by settlement and that discharge complies with Council approval.
- Given the predicted inflow of less than 3 ML/year no water access (aquifer interference) licence is required from WaterNSW.
- Water works supply licence needs to be obtained prior to dewatering from WaterNSW irrespectively whether the basement is tanked or drained.
- The maximum proposed basement level has changed and therefore this report needs to be updated to reflect the change to groundwater inflow and drawdown.

7.0 REFERENCES

ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

Clark, N.R. and Jones, D.C. (Eds). 1991 Penrith 1:100 000 Geological Sheet 9030, 1st edition. Geological Survey of New South Wales, Sydney.1991.

DPIE, 2021. Minimum requirements for building site groundwater investigations and reporting, First edition January 2021.

National Environment Protection (Assessment of site contamination) Measure. 2013. Schedule B, Guideline on Investigation levels for soil and groundwater.

LIMITATIONS

This report has been prepared for SCG Development Pty Ltd and for the specific purpose to which it refers. No responsibility is accepted to any third party and neither the whole of the report or any part or reference thereto may be published in any document, statement or circular

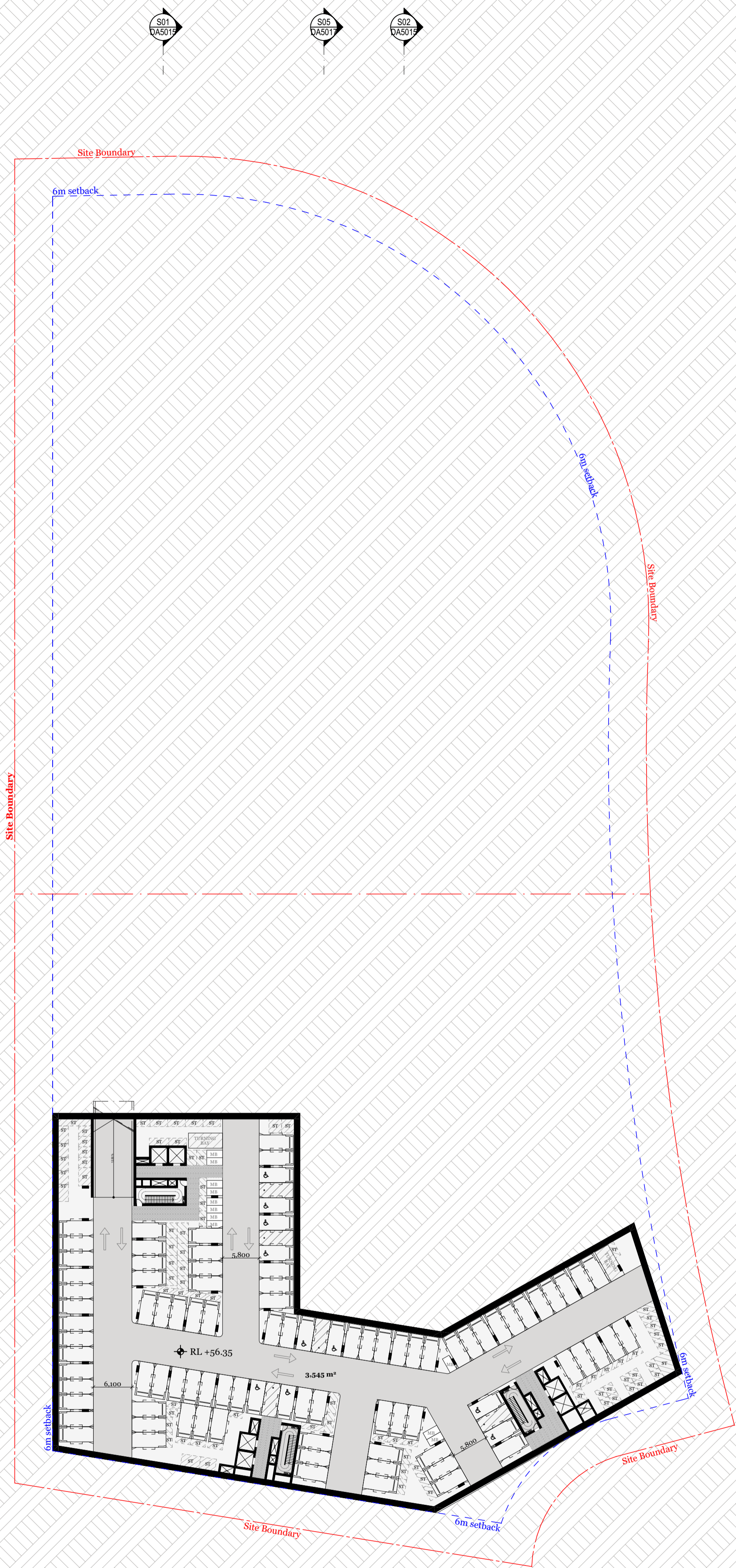
nor in any communication with third parties without our prior written approval of the form and context in which it will appear.

Dr Katarina David has used a degree of skill and care ordinarily exercised by reputable members of our profession practicing in the same or similar locality. The conclusions presented in this report are relevant to the conditions of the Site and the state of legislation currently enacted as at the date of this report. I do not make any representation or warranty that the conclusions in this report were applicable in the future as there may be changes in the condition of the Site, applicable legislation or other factors that would affect the conclusions contained in this report.

In making this assessment from a limited number of boreholes there is possibility that variations may occur between test locations. Site information is specific only at those points from which samples have been taken. The data derived from Site investigation programme are extrapolated across the Site to form an inferred geological and hydrogeological model about subsurface conditions at the proposed Site. Therefore, the actual conditions at the Site might differ from those inferred to exist, since no groundwater exploration program no matter how comprehensive can reveal all subsurface details. This program provides the professional estimate of the scope of investigation and general information of the subsurface conditions.

APPENDIX A

Excavation (footprint) plan



S01
DA501P

S02
DA501P

S03
DA501P

S04
DA501P

S05
DA501P

S06
DA501P

S07
DA501P

S08
DA501P

S09
DA501P

-3. BASEMENT 02

Scale 1:500
DRAFT
PRELIMINARY

Consultants

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Ethos Urban
Arcangelo Antoniazzi
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Traffic
TTPP
Ken Hollywood
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Heritage
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Laurent Labeirge
02 9928 6800

Quantity Surveyor
Newton Fisher
Steven Bregovic
02 9744 2626

BASIX/ESD
Jensen Hughes
Robert Romanous
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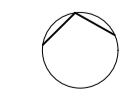
Surveyor
LTS
Joseph Monardo
1300 587 000

Connect to Country Landscape
Hardy Hardy
Bernadette Hardy
02 8571 2900

Structure
M+G Consulting
Zlatko Gashi
02 8666 7888

Waste
Foresight
Environmental
Sophie Rutherford

Rev	Date	By	Chk	Description
P1	02.02.24	SO	SO	STAGE 1 FROZEN SET
P2	15.02.24	SO	SO	STAGE 1 FROZEN SET UPDATED
P3	28.02.24	SO	SO	STAGE 2 FROZEN SET



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NSW: Nominated Architects
Kos de Keijzer 5767
David Randerson 8542



Project Name
Project Address

40 The Retreat, Bringelly
40 The Retreat
Bringelly, NSW 2556

Project Number
Drawing Name
Scale
Date

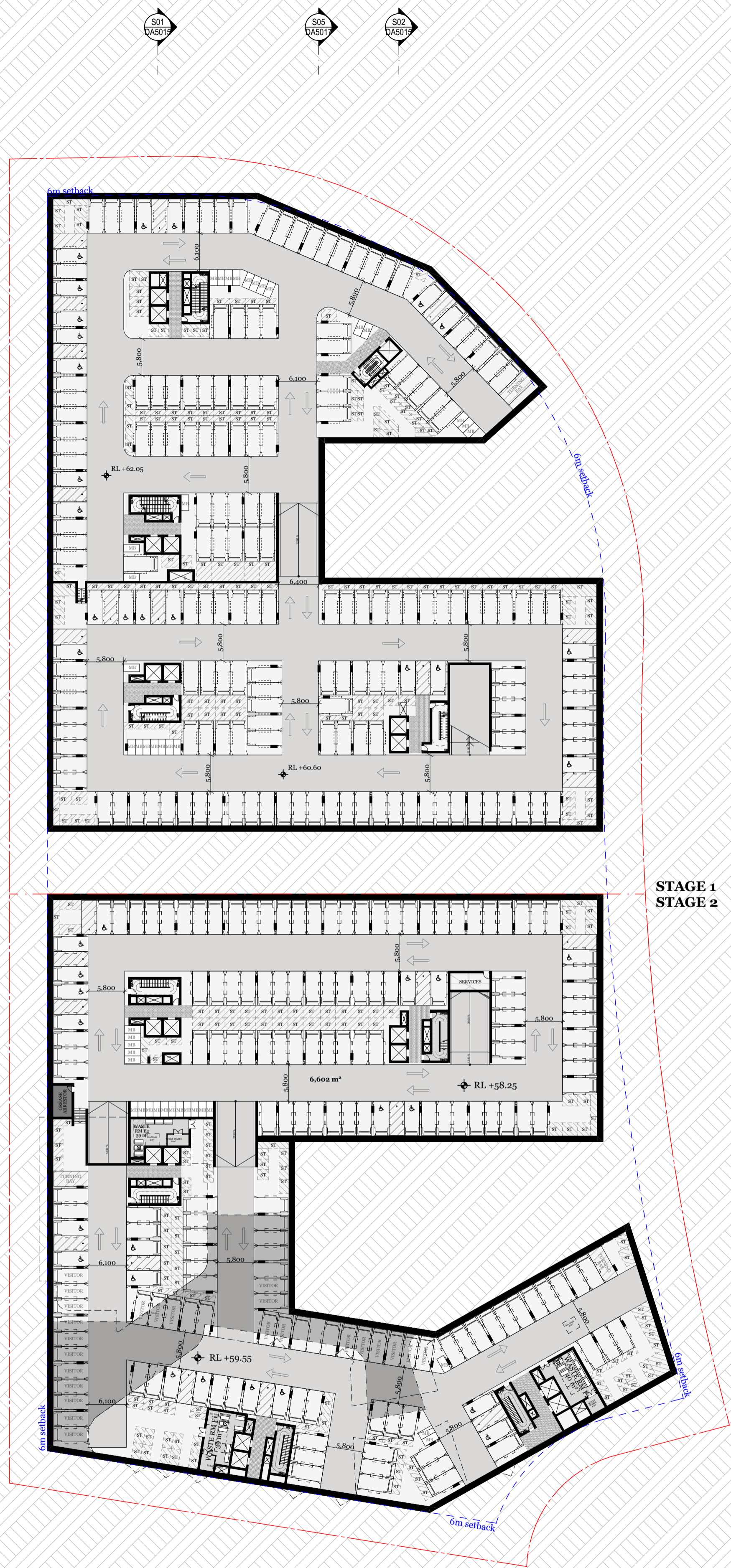
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Basement 02 Plan
1:500@A1
2/26/2024

Client

SCG

Drawing Number
Revision

DA2000
P3



STAGE 1
STAGE 2

Scale 1:500
DRAFT
PRELIMINARY

Consultants

Planner
Ethos Urban
Arcangelo Antoniazzi
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Civil
AT&L
Glen James
02 90468 8517

Traffic
TTPP
Ken Hollywood
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Urbis
Stephen Davies
02 8233 9939

Services
NDY
Laurent Laperidge
02 9928 6800

Quantity Surveyor
Newton Fisher
Steven Bregovic
02 9744 2626

BASIX/ESD
Jensen Hughes
Robert Romanous
02 8484 4086

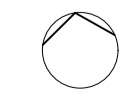
Surveyor
LTS
Joseph Monardo
1300 587 000

Connect to Country Landscape
Hardy Hardy
Bernadette Hardy

Structure
M+G Consulting
Zilako Gashi
02 8666 7888

Waste Foresight
Environmental
Sophie Rutherford

Rev	Date	By	Chk	Description
P1	02.02.24	SO	SO	STAGE 1 FROZEN SET
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Project Name
Project Address

40 The Retreat, Bringelly
40 The Retreat
Bringelly, NSW 2556

Project Number
Drawing Name
Scale
Date

13317
Basement 01 Plan
1:500@A1
2/26/2024

Client

SCG

Drawing Number
Revision

DA2001
P3

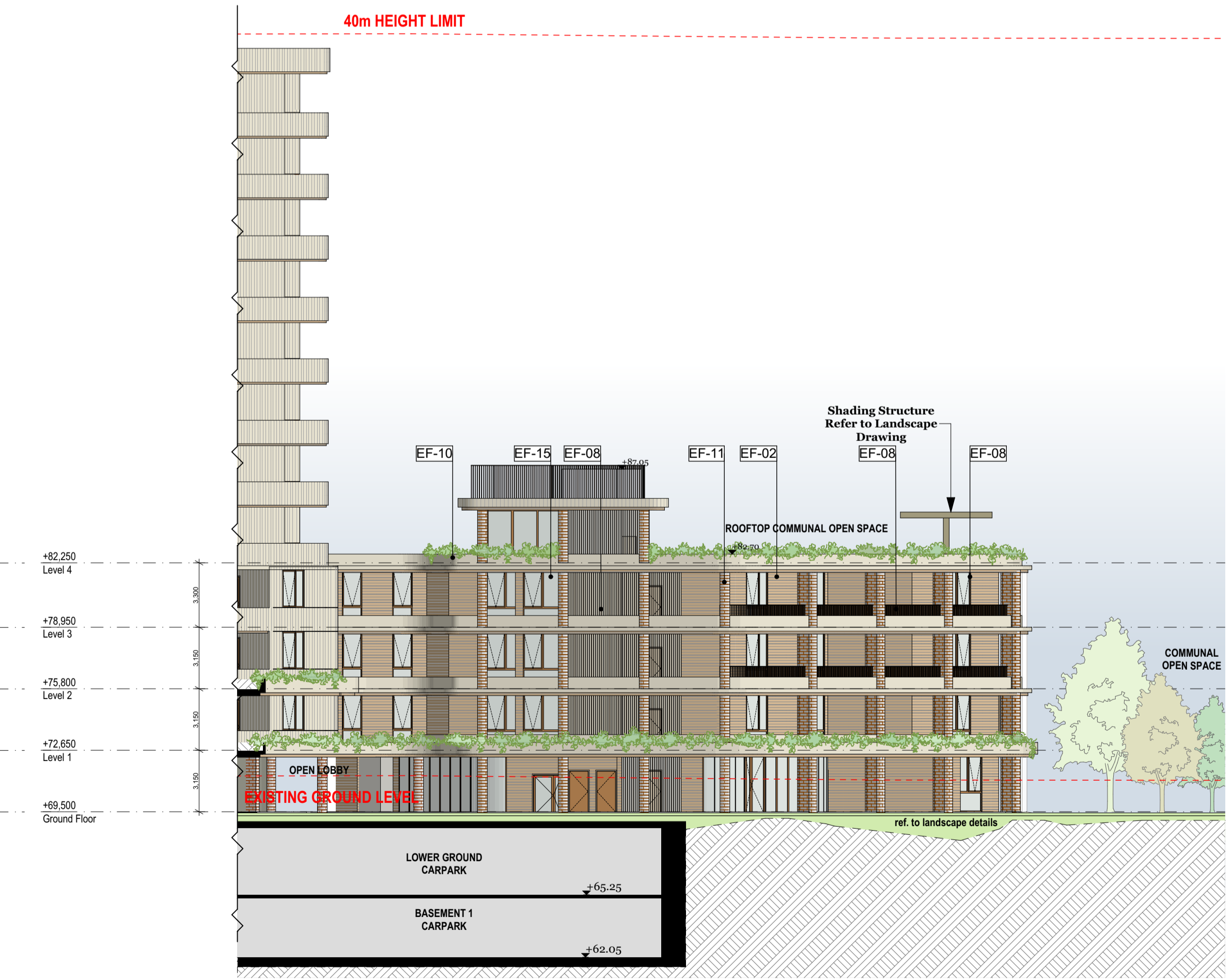


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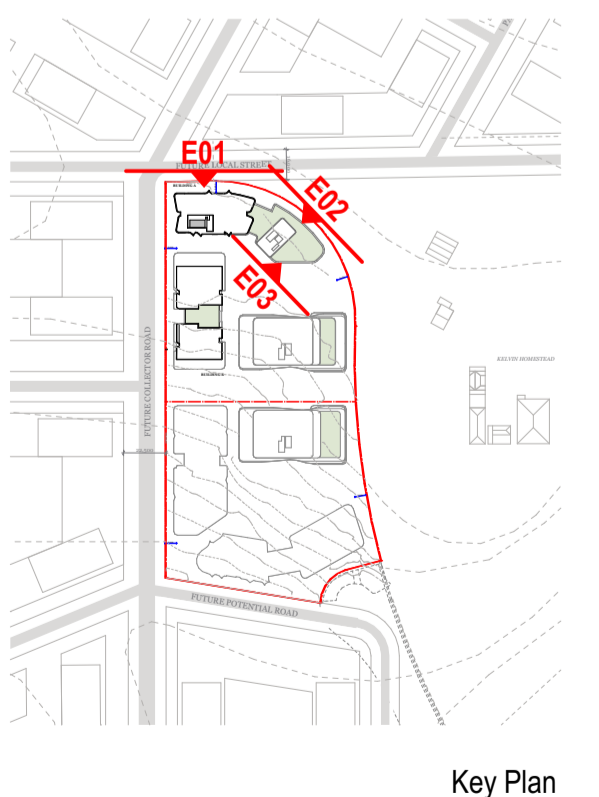
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- EF03**
Brown Finish with Vertical Profile
- EF04**
Black Powdercoat Finish
- EF05**
Light Powdercoat Finish
- EF06**
Earthy Powdercoat Finish
- EF07**
Light Bronze Powdercoat Finish
- EF08**
Bronze Powdercoat Finish
- EF09**
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Light Concrete Finish To Match EF01
- EF11**
Light Brown Brick
- EF12**
Mid Tone Brick
- EF13**
Red Tone Brick
- EF14**
Light Tone Brick
- EF15**
Glazing



E-02 BLD A - NORTH ELEVATION 2
Scale 1:200



E-03 BLD A - SOUTH EAST ELEVATION
Scale 1:200



Key Plan

DRAFT
PRELIMINARY

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Services
NDY
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Quantity Surveyor
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BASIX/ESD
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Robert Romanous
02 8484 4086

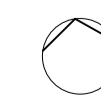
Surveyor
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Structure
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Foresight
Environmental
Sophie Rutherford

Rev	Date	By	Chk	Description
P1	02.02.24	SO	SO	STAGE 1 FROZEN SET
P2	15.02.24	SO	SO	STAGE 1 FROZEN SET UPDATED
P3	26.02.24	SO	SO	STAGE 2 FROZEN SET



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DKO

Project Name
Project Address

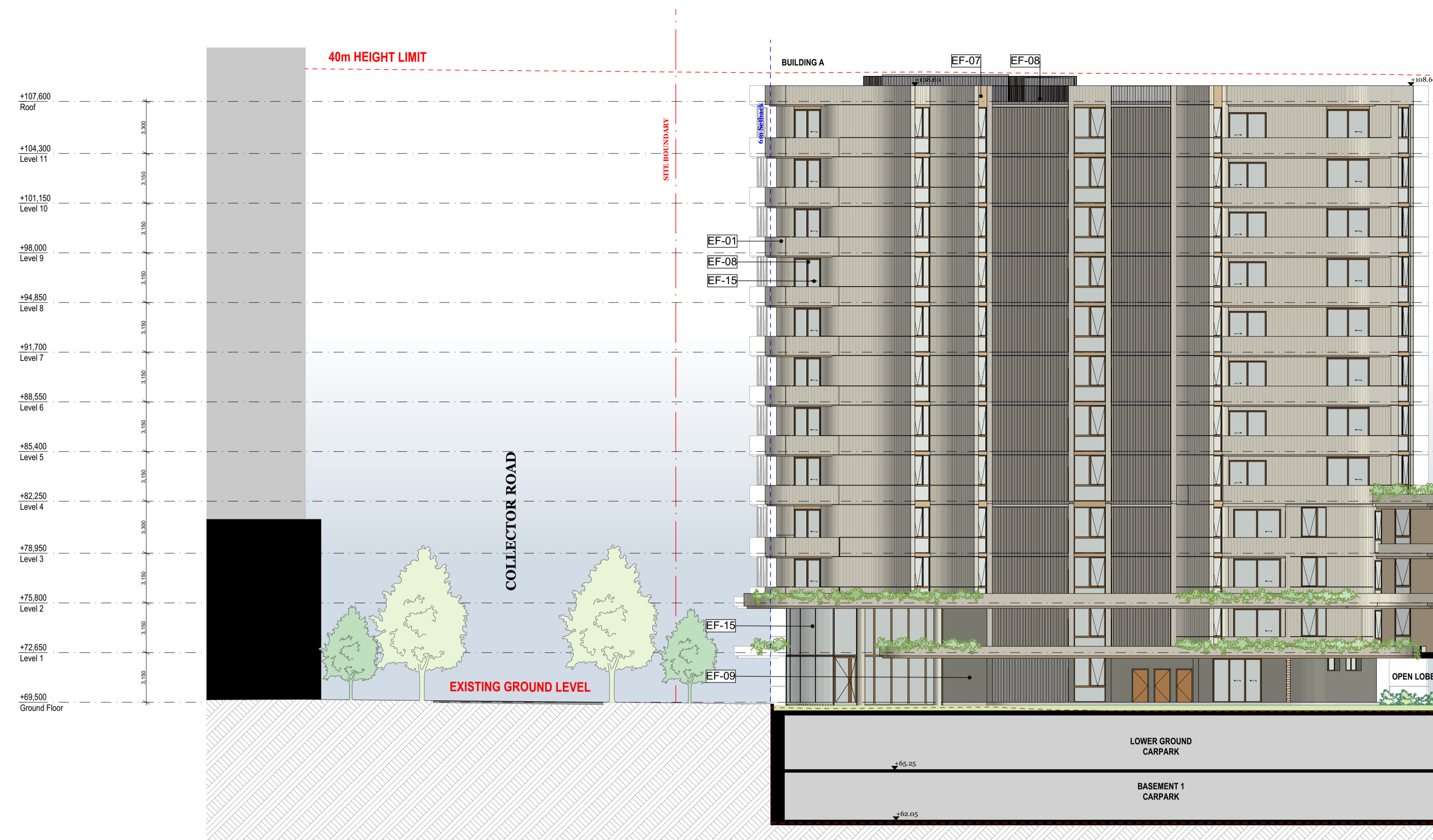
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Bringelly, NSW 2556

Project Number
Drawing Name
Scale
Date

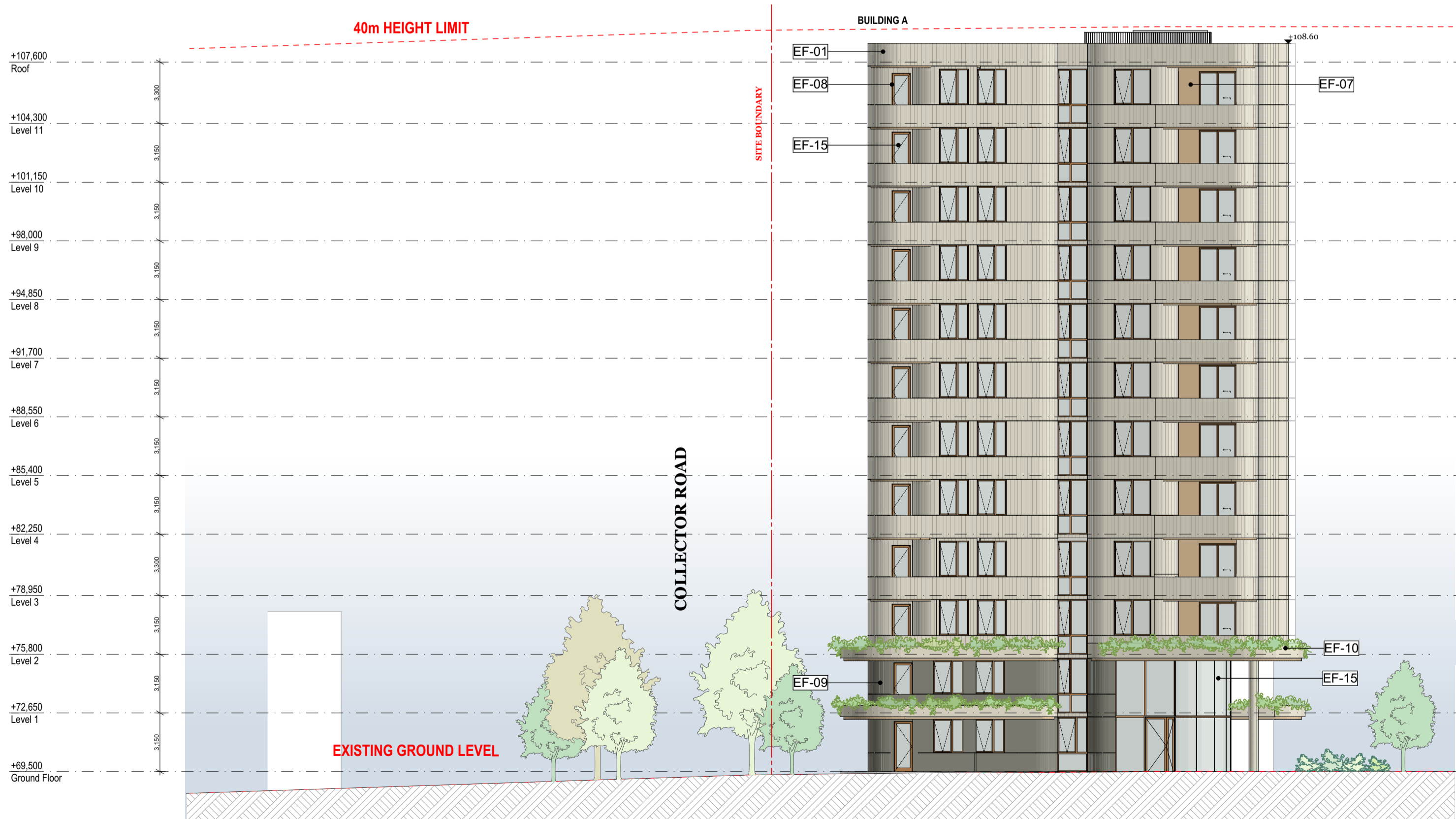
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BLD A Elevations 1 of 2
1:200@A1
2/26/2024

Client
SCG

Drawing Number
Revision
DA5000
P3

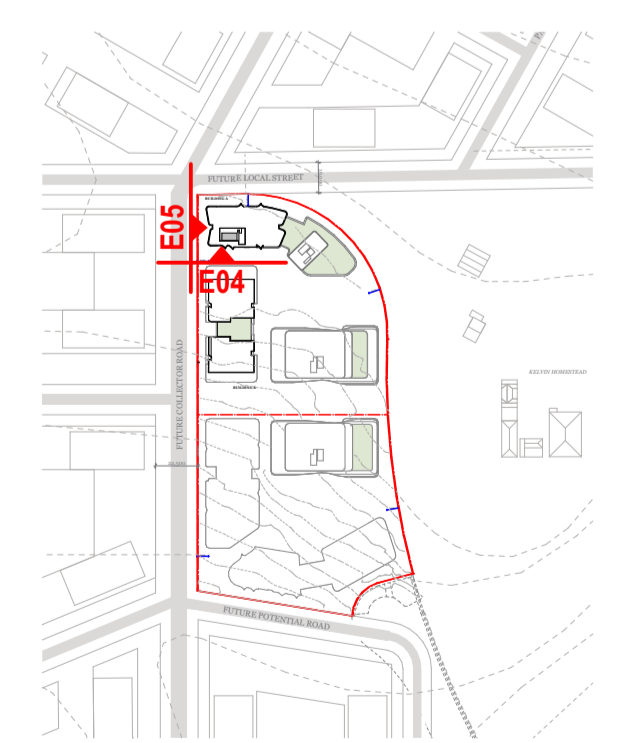


E-04 BLD A - SOUTH ELEVATION
Scale 1:200



E-05 BLD A - WEST ELEVATION
Scale 1:200

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Bronze Powdercoat Finish
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Light Concrete Finish To Match EFO1
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Red Tone Brick
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Key Plan

DRAFT PRELIMINARY

Consultants

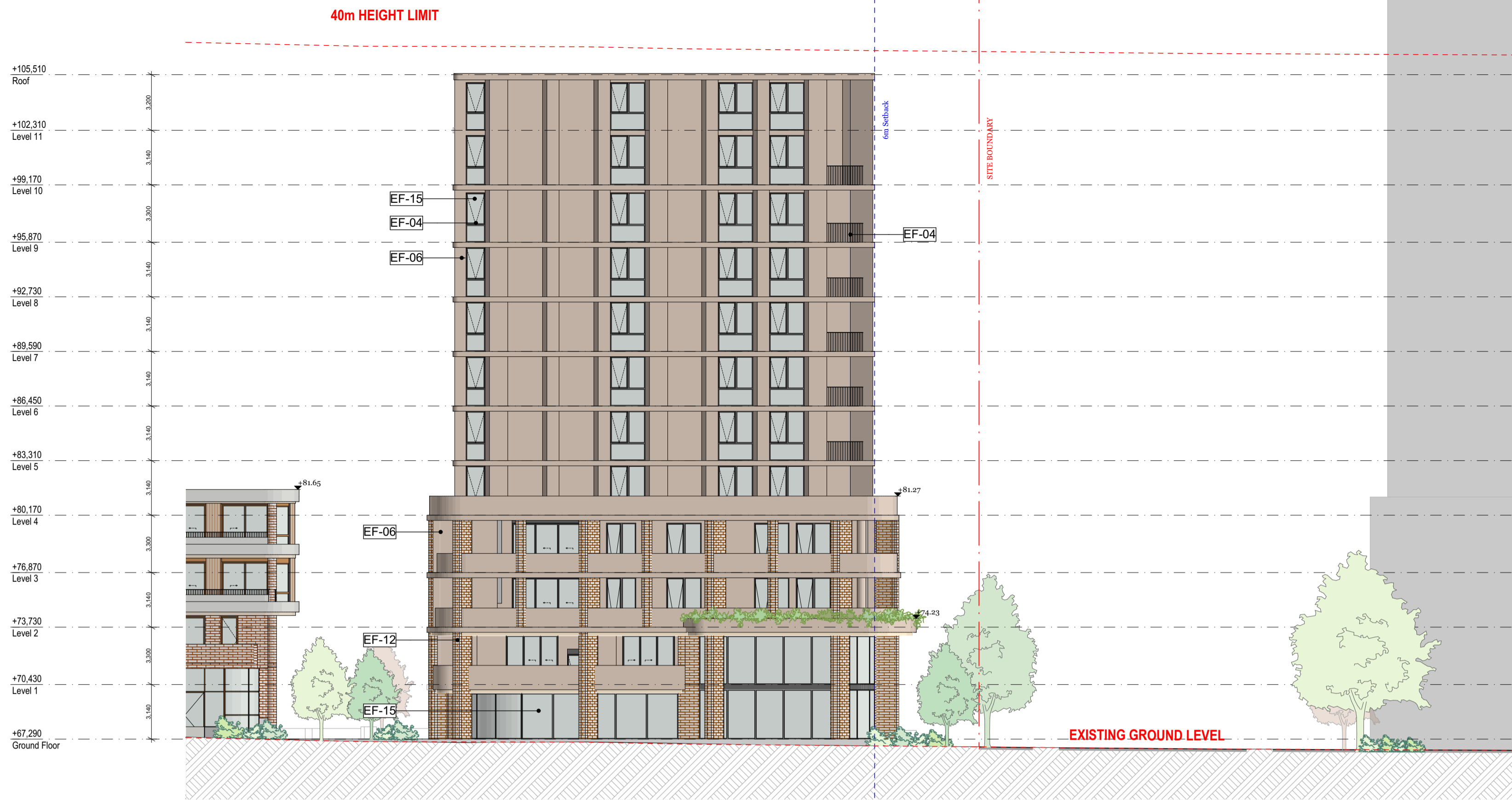
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Rev	Date	By	Chk	Description
P1	02.02.24	SO	SO	STAGE 1 FROZEN SET
P2	15.02.24	SO	SO	STAGE 1 FROZEN SET UPDATED
P3	26.02.24	SO	SO	STAGE 2 FROZEN SET

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Project Name Project Address	40 The Retreat, Bringelly Bringelly, NSW 2556	Project Number Drawing Name Scale Date	13317 BLD A Elevations 2 of 2 1:200@A1 2/26/2024
Client	SCG	Drawing Number Revision	DA5001 P3

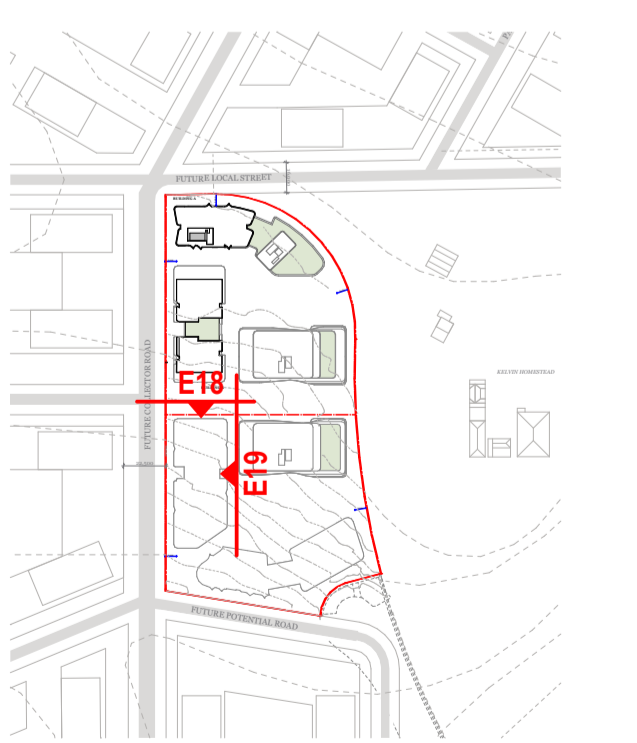


E-18 BLD E - NORTH ELEVATION
Scale 1:200



E-19 BLD E - EAST ELEVATION
Scale 1:200

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- EF02**
Light Brown Finish with Horizontal Profile
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Brown Finish with Vertical Profile
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Light Brown Brick
- EF12**
Mid Tone Brick
- EF13**
Red Tone Brick
- EF14**
Light Tone Brick
- EF15**
Glazing



Key Plan

**DRAFT
PRELIMINARY**

Consultants	Planner Ethos Urban Arcangelo Antoniazzi 0416 646 196	Civil AT&L Glen James 02 9068 8517	Traffic TTPP Ken Hollywood 02 8437 7800	Heritage Urbis Stephen Davies 02 8233 9939	Services NDY Laurent Loberige 02 9928 6800	Quantity Surveyor Newton Fisher Steven Bregovic 02 9744 2626	BASIX/ESD Jensen Hughes Robert Romanous 02 8484 4086	Surveyor LTS Joseph Monardo 1300 587 000	Connect to Country Landscape Hardy Hardy Bernadette Hardy 02 8571 2900	Structure M+G Consulting Zlatko Gashi 02 8666 7888	Waste Foresight Environmental Sophie Rutherford
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Rev	Date	By	Chk	Description
P1	02.02.24	SO	SO	STAGE 1 FROZEN SET
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P3	26.02.24	SO	SO	STAGE 2 FROZEN SET

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Project Name 40 The Retreat, Bringelly, NSW 2556	Project Number 13317	Drawing Name BLD E Elevations 1 of 2	Scale 1:200@A1
Client SCG	Drawing Number Revision	DA5008 P3	Date 2/26/2024

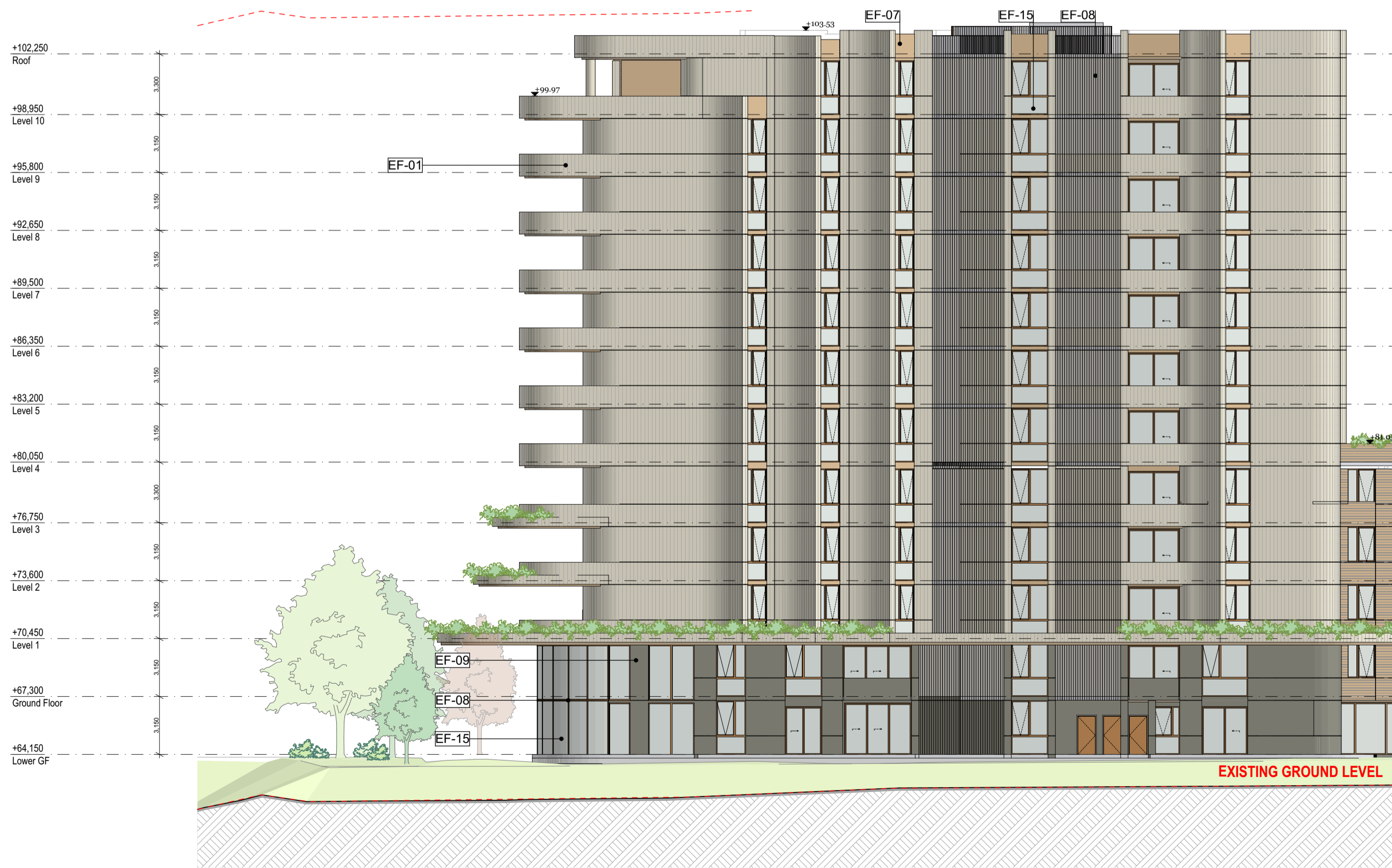
40m HEIGHT LIMIT



E-25 BLD F - EAST ELEVATION
Scale 1:200

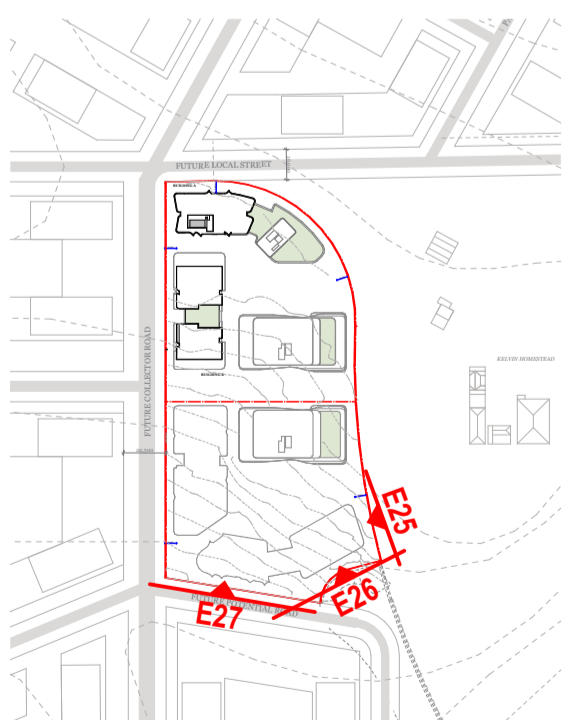


E-26 BLD F - SOUTH ELEVATION
Scale 1:200



E-27 BLD F - SOUTH ELEVATION
Scale 1:200

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- EF13**
Red Tone Brick
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Glazing



Key Plan

DRAFT PRELIMINARY

Consultants

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Stephen Davies
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Waste Foresight
Environmental
Sophie Rutherford

Rev	Date	By	Chk	Description
P1	02.02.24	SO	SO	STAGE 1 FROZEN SET
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P3	26.02.24	SO	SO	STAGE 2 FROZEN SET



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Project Name
Project Address
40 The Retreat,
Bringelly, NSW 2556

Client
SCG

Project Number
Drawing Name
Scale
Date

13317
BLD F Elevations 2 of 2
1:200@A1
2/26/2024

Drawing Number
Revision
DA5011
P3

APPENDIX B

Monitoring bore logs

Project: 40 The Retreat
 Location: 40 The Retreat, Bringelly
 Position: E: 291318.2, N: 6244492
 Project No.: 205892
 Client: Sathio Group

Surface Elevation: 69.56m
 Inclination: 90°
 Contractor: BG Drilling
 Drill Rig: Christie Engineering CE180
 Driller:

Date Started: 28/11/23
 Date Completed:
 Date Logged: 28/11/23
 Logged By: DF
 Checked By: JM

Drilling				Material				Observation			
Drilling & Casing	Water	Penetration Resistance	Samples & Tests	RL (m)	Depth(m)	Graphic Log	Group Symbol	Material Description colour, grain characteristics, plasticity, structure, minor components	Moisture Condition	Consistency / Relative Density	Origin, Structure & other observations
AD/T			0.4 - 1m B		69	0.10	SM	FILL- Silty SAND (SM) : fine to medium grained, medium dense, brown.	M	MD	0.0m - 0.9m: DCP: 5,11,10,13,12,13,16,12,15
					0.80	CH	CLAY (CH) : high plasticity, red brown and light grey.				Residual
					1	1	CH	CLAY (CH) : high plasticity, orange brown and grey, with fine to medium sized gravel, trace fine to medium grained sand. Extremely Weathered Bringelly Shale	w<PL	H	Siltstone
				68	1.45	See next page for rock logging below 1.45m					
				2							
				67							
				3							
				66							
				4							
				65							
				5							
				64							

Project: 40 The Retreat
 Location: 40 The Retreat, Bringelly
 Position: E: 291318.2, N: 6244492
 Project No.: 205892
 Client: Sathio Group

Surface Elevation: 69.56m
 Inclination: 90°
 Contractor: BG Drilling
 Drill Rig: Christie Engineering CE180
 Driller:

Date Started: 28/11/23
 Date Completed:
 Date Logged: 28/11/23
 Logged By: DF
 Checked By: JM

Drilling				Material				Defect & Observation					
Progress		TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description colour, grain characteristics, structure, minor components, formation	Weathering	Strength Is ⁵⁰ ● Axial ○ Diametral	Defect Spacing (mm)	Visual	Discontinuities & other observations
Drilling & Casing	Water												
						0.10							
					69								
						1.46							
						1.50		See previous page for soil logging above 1.45m					
		100	0		68	1.50 - 2.00		SILTSTONE: orange brown, fine grained, bedded at 0 to 5 deg. Bringelly Shale CLAY (CI-CH) : medium to high plasticity, and red brown, trace fine to medium sized gravel.	HW				
		100	0		67	2.00 - 3.04		SANDSTONE: light orange brown and grey, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	EW				
				Isoc A=0.62MPa	66	3.04 - 3.70		SANDSTONE: grey and red brown, fine to medium grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	HW to MW				3.33-3.35m, EW 3.57-3.59m, EW 3.59-4.30m, JT, UN, RF, SN, Open
		100	47		65	4.57 - 4.74		SILTSTONE: dark grey and orange brown, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	HW				4.70-4.74m, EW 4.85-4.88m, EW
				Isoc A=0.44MPa	64	4.74 - 5.78		SILTSTONE: dark grey and orange brown, fine grained.					5.15-5.17m, EW 5.30-5.31m, EW 5.42-5.44m, EW 5.55-5.56m, EW
		100	70			5.78 - 5.78		SILTSTONE: grey and light grey	MW to SW				5.70-5.76m, CS, SN
				Isoc A=0.45MPa									

Generated with CORE-GS by Geococ - BH Soil Rock Photo - 21/02/2024, 3:34:44 PM

Project: 40 The Retreat
 Location: 40 The Retreat, Bringelly
 Position: E: 291318.2, N: 6244492
 Project No.: 205892
 Client: Sathio Group

Surface Elevation: 69.56m
 Inclination: 90°
 Contractor: BG Drilling
 Drill Rig: Christie Engineering CE180
 Driller:

Date Started: 28/11/23
 Date Completed:
 Date Logged: 28/11/23
 Logged By: DF
 Checked By: JM

Drilling				Material				Defect & Observation					
Progress		TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description colour, grain characteristics, structure, minor components, formation	Weathering	Strength I _{s50} ● Axial ○ Diametral	Defect Spacing (mm)	Visual	Discontinuities & other observations
Drilling & Casing	Water												
		100	70	I _{Sp} : A=062MPa	63	7		[CONT] SILTSTONE: grey and light grey	EL -40.03 VI -40.1 L -40.3 M -1 H -3 VH -10 EH				6.15-6.43m, JT, 85°, UN, RF, CN, Open 6.50-6.70m, JT, 70°, PR, RF, CN, Open
				I _{Sp} : A=041MPa	62	8							
				I _{Sp} : A=153MPa	61	9							
		100	100	I _{Sp} : A=153MPa	60	10							
					58.46			End Of Hole: 10.16m - Target depth - Monitoring well installed					
					59	11							
					58								

Project: 40 The Retreat
 Location: 40 The Retreat, Bringelly
 Position: E: 291304.6, N: 6244344
 Project No.: 205892
 Client: Sathio Group

Surface Elevation: 64.11m
 Inclination: 90°
 Contractor: Intrax
 Drill Rig: Drillman GT-30
 Driller:

Date Started: 12/12/23
 Date Completed:
 Date Logged: 12/12/23
 Logged By: DF
 Checked By: JM

Drilling				Material				Observation			
Progress		Penetration Resistance	Samples & Tests	RL (m)	Depth(m)	Graphic Log	Group Symbol	Material Description colour, grain characteristics, plasticity, structure, minor components	Moisture Condition	Consistency / Relative Density	Origin, Structure & other observations
Drilling & Casing	Water										
AD/V				64	0.10		SM	FILL- Silty SAND (SM) : fine to medium grained, medium dense, brown.	M	MD	0.10m - 0.8m: DCP: 7,12,12,13,12,10,12,12
					0.80			CLAY (CH) : high plasticity, red brown mottled light grey, with fine to medium grained sand.	w<PL		Residual
			1 - 1.5m B		1			CLAY (CH) : high plasticity, red brown mottled light grey, with fine to medium grained sand.	w>PL	H	Residual
			SPT 1.5-1.95m 1.3.7 N=10 Rec:450/450mm		1.50			CLAY (CH) : high plasticity, light grey and red brown.			Residual
					2			CLAY (CH) : high plasticity, light grey mottled orange brown.	w<PL	St	Residual
			SPT 2.5-2.95m 7.12.14 N=26 Rec:450/450mm		2.50		CH	CLAY (CH) : high plasticity, light grey mottled orange brown.			Residual
					3			CLAY (CH) : high plasticity, grey dark grey.			Residual
				61							
				60							
		SPT 4-4.3m 13,16/150mm HB N=R Rec:300/300mm		4					w=PL	VSt	Residual
				4.50				CLAY (CH) : high plasticity, dark grey dark brown, fragments of siltstone layers. Extremely Weathered Bringelly Shale			Siltstone
				59					w<PL	H	Siltstone
				5.40				CLAY (CH) : high plasticity, grey light grey orange brown. Extremely Weathered Bringelly Shale			Siltstone
				5.50				See next page for rock logging below 5.5m			

Project: 40 The Retreat
 Location: 40 The Retreat, Bringelly
 Position: E: 291304.6, N: 6244344
 Project No.: 205892
 Client: Sathio Group

Surface Elevation: 64.11m
 Inclination: 90°
 Contractor: Intrax
 Drill Rig: Drillman GT-30
 Driller:

Date Started: 12/12/23
 Date Completed:
 Date Logged: 12/12/23
 Logged By: DF
 Checked By: JM

Drilling				Material				Defect & Observation					
Drilling & Casing	Water	TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description colour, grain characteristics, structure, minor components, formation	Weathering	Strength I _{s50} ● Axial ○ Diametral	Defect Spacing (mm)	Visual	Discontinuities & other observations
NMLC					58	6.35	Shale CORE LOSS						6.00-6.35m, ?, Core Loss
			73	26		7	SILTSTONE: light grey light brown, fine grained, bedded at 40 to 50 deg, bed thickness between 2mm to 20mm.		MW				6.45m, JT, 30°, UN, RF, CN, Open 6.48m, JT, UN, RF, CN, Open 6.54m, JT, PR, S, SN, Open 6.62m, IS, 30°, CU, CT, Closed, Healed Joint 6.65m, JT, 20°, UN, RF, CN, Open 6.77m, P, 5°, UN, S, SN, Open 6.80-7.00m, FZ, 70°
						7.30	CORE LOSS						7.04-7.07m, EW, 5°, Clay 7.11m, JT, 10°, CU, S, CN, Closed
			63	33	I _{s50} : A=062MPa	56	7.85	SILTSTONE: grey orange brown, fine grained, bedded at 40 to 50 deg, bed thickness between 2mm to 20mm, iron staining at joints.					7.30-7.85m, ?, Core Loss 7.98-8.00m, EW, sandy gravel 8.00-8.16m, FZ
				I _{s50} : A=033MPa	55	9			SW				8.20m, JT, 30°, CU, RF, CN, Closed 8.46-8.58m, JT, 70°, PR, RF, Open 8.61m, P, 5°, UN, RF, CN, Closed
		100	78	I _{s50} : A=052MPa	54	10							8.95m, JT, 10°, PR, S, CN, Open 9.43m, JT, 30°, CU, RF, SN, Open 9.43-9.52m, FZ 9.52m, JT, 20°, UN, RF, SN, Open
				I _{s50} : A=0.6MPa	53	10.20	End Of Hole: 10.20m - Target depth - Monitoring well installed						9.79-9.84m, EW, 5°



Project: 40 The Retreat
 Location: 40 The Retreat, Bringelly
 Position: E: 291372.1, N: 6244500
 Project No.: 205892
 Client: Sathio Group

Surface Elevation: 69.33m
 Inclination: 90°
 Contractor: BG Drilling
 Drill Rig: Christie Engineering CE180
 Driller:

Date Started: 27/11/23
 Date Completed:
 Date Logged: 27/11/23
 Logged By: DF
 Checked By: JM

Drilling				Material				Observation			
Progress		Penetration Resistance	Samples & Tests	RL (m)	Depth(m)	Graphic Log	Group Symbol	Material Description colour, grain characteristics, plasticity, structure, minor components	Moisture Condition	Consistency / Relative Density	Origin, Structure & other observations
Drilling & Casing	Water										
AD/T			0.1 - 0.7m B	69	0.80		Cl-CH	CLAY (Cl-CH) : medium to high plasticity, light grey and orange brown.	w<PL	VSt - H	Residual
				1	1.20		CH	Silty CLAY (CH) : high plasticity, orange brown and brown, with fine grained sand, trace fine to medium sized gravel.		St - VSt	Residual
				68	1.30			SANDSTONE: orange brown and brown, fine to medium grained, bedded at 0 to 5 deg. low strength, highly weathered. Bringelly Shale			
<p>See next page for rock logging below 1.3m</p>											
				2							
				67							
				3							
				66							
				4							
				65							
				5							
				64							

Project: 40 The Retreat
 Location: 40 The Retreat, Bringelly
 Position: E: 291372.1, N: 6244500
 Project No.: 205892
 Client: Sathio Group

Surface Elevation: 69.33m
 Inclination: 90°
 Contractor: BG Drilling
 Drill Rig: Christie Engineering CE180
 Driller:

Date Started: 27/11/23
 Date Completed:
 Date Logged: 27/11/23
 Logged By: DF
 Checked By: JM

Drilling				Material				Defect & Observation					
Progress		TCR (%)	RQD (%)	Samples & Tests	RL (m)	Depth (m)	Graphic Log	Material Description colour, grain characteristics, structure, minor components, formation	Weathering	Strength I _s ⁵⁰ ● Axial ○ Diametral	Defect Spacing (mm)	Visual	Discontinuities & other observations
Drilling & Casing	Water												
		100	56	I _{1S50} : A=0.2MPa	63		[CONT] SILTSTONE: grey light grey and orange brown, grained.	HW to MW					6.00-6.18m, JT, 80°, PR, RF, Open 6.18-6.28m, CS, 100mm
					7								6.95-7.03m, JT, 80°, PR, RF, Infilled
					62	7.37	SANDSTONE: grey and light grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.	MW to SW					7.24-7.27m, CS, 30mm 7.32-7.37m, CS, 50mm
				I _{1S50} : A=2.17MPa	7.88	8	SILTSTONE: grey and light grey, fine grained, bedded at 0 to 5 deg, bed thickness between 2mm to 20mm.						7.76-7.77m, EW, 10mm 7.86-7.88m, EW, 20mm
		100	81		61	9		SW					8.62-8.66m, EW, 40mm
					60								9.50-9.52m, EW, 20mm
					59	9.82	End Of Hole: 9.82m - Target depth - Monitoring well installed						
					58	11							

Notes:

See explanatory notes and abbreviations for terminology & basis of descriptions.

APPENDIX C

Analytical lab results and COC

Environmental Consulting Services
 10 Fort Street
 Petersham
 NSW 2049



NATA Accredited
 Accreditation Number 1261
 Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
 NATA is a signatory to the ILAC Mutual Recognition
 Arrangement for the mutual recognition of the
 equivalence of testing, medical testing, calibration,
 inspection, proficiency testing scheme providers and
 reference materials producers reports and certificates.

Attention: **All results - Simon Caples**

Report **1059323-W**
 Project name **BRINGELLEY**
 Received Date **Jan 12, 2024**

Client Sample ID			A	B	C
Sample Matrix			Water	Water	Water
Eurofins Sample No.			S24-Ja0013856	S24-Ja0013857	S24-Ja0013858
Date Sampled			Jan 12, 2024	Jan 12, 2024	Jan 12, 2024
Test/Reference	LOR	Unit			
Total Recoverable Hydrocarbons					
TRH C6-C9	0.02	mg/L	< 0.02	< 0.02	< 0.02
TRH C10-C14	0.05	mg/L	< 0.05	< 0.05	< 0.05
TRH C15-C28	0.1	mg/L	0.1	0.1	< 0.1
TRH C29-C36	0.1	mg/L	< 0.1	< 0.1	< 0.1
TRH C10-C36 (Total)	0.1	mg/L	0.1	0.1	< 0.1
TRH C6-C10	0.02	mg/L	< 0.02	< 0.02	< 0.02
TRH C6-C10 less BTEX (F1) ^{N04}	0.02	mg/L	< 0.02	< 0.02	< 0.02
TRH >C10-C16	0.05	mg/L	< 0.05	< 0.05	< 0.05
TRH >C10-C16 less Naphthalene (F2) ^{N01}	0.05	mg/L	< 0.05	< 0.05	< 0.05
TRH >C16-C34	0.1	mg/L	0.1	0.1	< 0.1
TRH >C34-C40	0.1	mg/L	< 0.1	< 0.1	< 0.1
TRH >C10-C40 (total)*	0.1	mg/L	0.1	0.1	< 0.1
BTEX					
Benzene	0.001	mg/L	< 0.001	< 0.001	0.001
Toluene	0.001	mg/L	< 0.001	< 0.001	0.002
Ethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002	< 0.002	< 0.002
o-Xylene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Xylenes - Total*	0.003	mg/L	< 0.003	< 0.003	< 0.003
4-Bromofluorobenzene (surr.)	1	%	119	125	122
Total Recoverable Hydrocarbons - 2013 NEPM Fractions					
Naphthalene ^{N02}	0.01	mg/L	< 0.01	< 0.01	< 0.01
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Benzo(b&j)fluoranthene ^{N07}	0.001	mg/L	< 0.001	< 0.001	< 0.001
Benzo(g,h,i)perylene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Chrysene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Dibenz(a,h)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Fluorene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Indeno(1.2.3-cd)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001

Client Sample ID			A	B	C
Sample Matrix			Water	Water	Water
Eurofins Sample No.			S24-Ja0013856	S24-Ja0013857	S24-Ja0013858
Date Sampled			Jan 12, 2024	Jan 12, 2024	Jan 12, 2024
Test/Reference	LOR	Unit			
Polycyclic Aromatic Hydrocarbons					
Naphthalene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Phenanthrene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001
Total PAH*	0.001	mg/L	< 0.001	< 0.001	< 0.001
2-Fluorobiphenyl (surr.)	1	%	69	76	61
p-Terphenyl-d14 (surr.)	1	%	INT	INT	INT
Organochlorine Pesticides					
Chlordanes - Total	0.002	mg/L	< 0.002	< 0.002	< 0.002
4,4'-DDD	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
4,4'-DDE	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
4,4'-DDT	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
a-HCH	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Aldrin	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
b-HCH	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
d-HCH	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Dieldrin	0.0002	mg/L	< 0.0002	< 0.001	< 0.0002
Endosulfan I	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Endosulfan II	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Endosulfan sulphate	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Endrin	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Endrin aldehyde	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Endrin ketone	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
g-HCH (Lindane)	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Heptachlor	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Heptachlor epoxide	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Hexachlorobenzene	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Methoxychlor	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Toxaphene	0.005	mg/L	< 0.005	< 0.005	< 0.005
Aldrin and Dieldrin (Total)*	0.0002	mg/L	< 0.0002	< 0.001	< 0.0002
DDT + DDE + DDD (Total)*	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Vic EPA IWRG 621 OCP (Total)*	0.002	mg/L	< 0.002	< 0.002	< 0.002
Vic EPA IWRG 621 Other OCP (Total)*	0.002	mg/L	< 0.002	< 0.002	< 0.002
Dibutylchloroendate (surr.)	1	%	145	149	135
Tetrachloro-m-xylene (surr.)	1	%	139	INT	146
Conductivity (at 25 °C)					
	10	uS/cm	5700	6800	13000
pH (at 25 °C)					
	0.1	pH Units	7.6	7.6	7.4
Heavy Metals					
Arsenic (filtered)	0.001	mg/L	0.006	0.016	< 0.001
Cadmium (filtered)	0.0002	mg/L	0.0002	0.0003	< 0.0002
Chromium (filtered)	0.001	mg/L	< 0.001	0.004	< 0.001
Copper (filtered)	0.001	mg/L	0.001	0.015	< 0.001
Lead (filtered)	0.001	mg/L	0.002	0.017	< 0.001
Mercury (filtered)	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001
Nickel (filtered)	0.001	mg/L	0.052	0.048	0.044
Zinc (filtered)	0.005	mg/L	0.10	0.14	0.042

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
Eurofins Suite B9 (filtered metals)			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions - Method: LTM-ORG-2010 TRH C6-C40	Sydney	Jan 16, 2024	7 Days
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: LTM-ORG-2010 TRH C6-C40	Sydney	Jan 15, 2024	7 Days
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: LTM-ORG-2010 TRH C6-C40	Sydney	Jan 16, 2024	7 Days
BTEX - Method: LTM-ORG-2010 BTEX and Volatile TRH	Sydney	Jan 15, 2024	14 Days
Polycyclic Aromatic Hydrocarbons - Method: LTM-ORG-2130 PAH and Phenols in Soil and Water	Sydney	Jan 16, 2024	7 Days
Organochlorine Pesticides - Method: LTM-ORG-2220 OCP & PCB in Soil and Water	Sydney	Jan 16, 2024	7 Days
Metals M8 filtered - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS	Sydney	Jan 16, 2024	28 Days
Conductivity (at 25 °C) - Method: LTM-INO-4030 Conductivity	Sydney	Jan 16, 2024	28 Days
pH (at 25 °C) - Method: LTM-GEN-7090 pH in water by ISE	Sydney	Jan 16, 2024	0 Hour



Melbourne 6 Monterey Road Dandenong South VIC 3175 +61 3 8564 5000 NATA# 1261 Site# 1254	Geelong 19/8 Lewalan Street Grovedale VIC 3216 +61 3 8564 5000 NATA# 1261 Site# 25403	Sydney 179 Magowar Road Girraween NSW 2145 +61 2 9900 8400 NATA# 1261 Site# 18217	Canberra Unit 1,2 Dacre Street Mitchell ACT 2911 +61 2 6113 8091 NATA# 1261 Site# 25466	Brisbane 1/21 Smallwood Place Murarie QLD 4172 T: +61 7 3902 4600 NATA# 1261 Site# 20794	Newcastle 1/2 Frost Drive Mayfield West NSW 2304 +61 2 4968 8448 NATA# 1261 Site# 25079 & 25289
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Perth 46-48 Banksia Road Welshpool WA 6106 +61 8 6253 4444 NATA# 2377 Site# 2370	Auckland 35 O'Rorke Road Penrose, Auckland 1061 +64 9 526 4551 IANZ# 1327	Auckland (Asb) Unit C1/4 Pacific Rise, Mount Wellington, Auckland 1061 +64 9 525 0568 IANZ# 1308	Christchurch 43 Detroit Drive Rolleston, Christchurch 7675 +64 3 343 5201 IANZ# 1290	Tauranga 1277 Cameron Road, Gate Pa, Tauranga 3112 +64 9 525 0568 IANZ# 1402
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web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Company Name: Environmental Consulting Services	Order No.:	Received: Jan 12, 2024 11:30 AM
Address: 10 Fort Street Petersham NSW 2049	Report #: 1059323	Due: Jan 19, 2024
	Phone: 02 9518 1161	Priority: 5 Day
	Fax:	Contact Name: All results - Simon Caples
Project Name: BRINGELLEY		Eurofins Analytical Services Manager : Bonnie Pu

Sample Detail						Conductivity (at 25 °C)	pH (at 25 °C)	Eurofins Suite B9 (filtered metals)
Sydney Laboratory - NATA # 1261 Site # 18217						X	X	X
External Laboratory								
No	Sample ID	Sample Date	Sampling Time	Matrix	LAB ID			
1	A	Jan 12, 2024		Water	S24-Ja0013856	X	X	X
2	B	Jan 12, 2024		Water	S24-Ja0013857	X	X	X
3	C	Jan 12, 2024		Water	S24-Ja0013858	X	X	X
Test Counts						3	3	3

Internal Quality Control Review and Glossary

General

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

Holding Times

Please refer to the '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 before sample receipt deadlines as stated on the SRA.

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

Holding times apply from the date of sampling; therefore, compliance with 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, the holding time is 14 days.

Units

mg/kg: milligrams per kilogram	mg/L: milligrams per litre	ppm: parts per million
µg/L: micrograms per litre	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
CFU: Colony forming unit	Colour: Pt-Co Units	

Terms

APHA	American Public Health Association
CEC	Cation Exchange Capacity
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 moisture has been determined on a solid sample, the result is expressed on a dry weight 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 represents 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 similar compound to the analyte target is reported as percentage recovery. See below for acceptance criteria.
TBTO	Tributyltin oxide (<i>bis</i> -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 only be used as a guide 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. SVOCs recoveries 20 – 150%, VOC recoveries 70 – 130%

PFAS field samples containing surrogate recoveries above the QC limit designated in QSM 5.4, where no positive PFAS results have been reported or reviewed, and no data was affected.

QC Data General Comments

- Where a result is reported as 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.
- 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 are not data from your samples.
- 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.
- Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery, the term "INT" appears against that analyte.
- For Matrix Spikes and LCS results, a dash "-" in the report means that the specific analyte was not added to the QC sample.
- 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							
Total Recoverable Hydrocarbons							
TRH C6-C9	mg/L	< 0.02			0.02	Pass	
TRH C10-C14	mg/L	< 0.05			0.05	Pass	
TRH C15-C28	mg/L	< 0.1			0.1	Pass	
TRH C29-C36	mg/L	< 0.1			0.1	Pass	
TRH C6-C10	mg/L	< 0.02			0.02	Pass	
TRH >C10-C16	mg/L	< 0.05			0.05	Pass	
TRH >C16-C34	mg/L	< 0.1			0.1	Pass	
TRH >C34-C40	mg/L	< 0.1			0.1	Pass	
Method Blank							
BTEX							
Benzene	mg/L	< 0.001			0.001	Pass	
Toluene	mg/L	< 0.001			0.001	Pass	
Ethylbenzene	mg/L	< 0.001			0.001	Pass	
m&p-Xylenes	mg/L	< 0.002			0.002	Pass	
o-Xylene	mg/L	< 0.001			0.001	Pass	
Xylenes - Total*	mg/L	< 0.003			0.003	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/L	< 0.01			0.01	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/L	< 0.001			0.001	Pass	
Acenaphthylene	mg/L	< 0.001			0.001	Pass	
Anthracene	mg/L	< 0.001			0.001	Pass	
Benz(a)anthracene	mg/L	< 0.001			0.001	Pass	
Benzo(a)pyrene	mg/L	< 0.001			0.001	Pass	
Benzo(b&j)fluoranthene	mg/L	< 0.001			0.001	Pass	
Benzo(g,h,i)perylene	mg/L	< 0.001			0.001	Pass	
Benzo(k)fluoranthene	mg/L	< 0.001			0.001	Pass	
Chrysene	mg/L	< 0.001			0.001	Pass	
Dibenz(a,h)anthracene	mg/L	< 0.001			0.001	Pass	
Fluoranthene	mg/L	< 0.001			0.001	Pass	
Fluorene	mg/L	< 0.001			0.001	Pass	
Indeno(1,2,3-cd)pyrene	mg/L	< 0.001			0.001	Pass	
Naphthalene	mg/L	< 0.001			0.001	Pass	
Phenanthrene	mg/L	< 0.001			0.001	Pass	
Pyrene	mg/L	< 0.001			0.001	Pass	
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/L	< 0.002			0.002	Pass	
4,4'-DDD	mg/L	< 0.0002			0.0002	Pass	
4,4'-DDE	mg/L	< 0.0002			0.0002	Pass	
4,4'-DDT	mg/L	< 0.0002			0.0002	Pass	
a-HCH	mg/L	< 0.0002			0.0002	Pass	
Aldrin	mg/L	< 0.0002			0.0002	Pass	
b-HCH	mg/L	< 0.0002			0.0002	Pass	
d-HCH	mg/L	< 0.0002			0.0002	Pass	
Dieldrin	mg/L	< 0.0002			0.0002	Pass	
Endosulfan I	mg/L	< 0.0002			0.0002	Pass	
Endosulfan II	mg/L	< 0.0002			0.0002	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endosulfan sulphate	mg/L	< 0.0002			0.0002	Pass	
Endrin	mg/L	< 0.0002			0.0002	Pass	
Endrin aldehyde	mg/L	< 0.0002			0.0002	Pass	
Endrin ketone	mg/L	< 0.0002			0.0002	Pass	
g-HCH (Lindane)	mg/L	< 0.0002			0.0002	Pass	
Heptachlor	mg/L	< 0.0002			0.0002	Pass	
Heptachlor epoxide	mg/L	< 0.0002			0.0002	Pass	
Hexachlorobenzene	mg/L	< 0.0002			0.0002	Pass	
Methoxychlor	mg/L	< 0.0002			0.0002	Pass	
Toxaphene	mg/L	< 0.005			0.005	Pass	
Method Blank							
Conductivity (at 25 °C)	uS/cm	< 10			10	Pass	
Method Blank							
Heavy Metals							
Arsenic (filtered)	mg/L	< 0.001			0.001	Pass	
Cadmium (filtered)	mg/L	< 0.0002			0.0002	Pass	
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	
Copper (filtered)	mg/L	< 0.001			0.001	Pass	
Lead (filtered)	mg/L	< 0.001			0.001	Pass	
Mercury (filtered)	mg/L	< 0.0001			0.0001	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Zinc (filtered)	mg/L	< 0.005			0.005	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons							
TRH C6-C9	%	82			70-130	Pass	
TRH C10-C14	%	70			70-130	Pass	
TRH C6-C10	%	91			70-130	Pass	
TRH >C10-C16	%	70			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	122			70-130	Pass	
Toluene	%	110			70-130	Pass	
Ethylbenzene	%	94			70-130	Pass	
m&p-Xylenes	%	98			70-130	Pass	
o-Xylene	%	94			70-130	Pass	
Xylenes - Total*	%	97			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	94			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	90			70-130	Pass	
Acenaphthylene	%	96			70-130	Pass	
Anthracene	%	107			70-130	Pass	
Benz(a)anthracene	%	93			70-130	Pass	
Benzo(a)pyrene	%	91			70-130	Pass	
Benzo(b&j)fluoranthene	%	95			70-130	Pass	
Benzo(g,h,i)perylene	%	93			70-130	Pass	
Benzo(k)fluoranthene	%	93			70-130	Pass	
Chrysene	%	97			70-130	Pass	
Dibenz(a,h)anthracene	%	95			70-130	Pass	
Fluoranthene	%	105			70-130	Pass	
Fluorene	%	97			70-130	Pass	
Indeno(1,2,3-cd)pyrene	%	93			70-130	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code	
Naphthalene	%	79			70-130	Pass		
Phenanthrene	%	100			70-130	Pass		
Pyrene	%	111			70-130	Pass		
LCS - % Recovery								
Organochlorine Pesticides								
Chlordanes - Total	%	89			70-130	Pass		
4.4'-DDD	%	88			70-130	Pass		
4.4'-DDE	%	91			70-130	Pass		
4.4'-DDT	%	85			70-130	Pass		
a-HCH	%	82			70-130	Pass		
Aldrin	%	84			70-130	Pass		
b-HCH	%	89			70-130	Pass		
d-HCH	%	89			70-130	Pass		
Dieldrin	%	94			70-130	Pass		
Endosulfan I	%	91			70-130	Pass		
Endosulfan II	%	87			70-130	Pass		
Endosulfan sulphate	%	89			70-130	Pass		
Endrin	%	89			70-130	Pass		
Endrin aldehyde	%	92			70-130	Pass		
Endrin ketone	%	87			70-130	Pass		
g-HCH (Lindane)	%	88			70-130	Pass		
Heptachlor	%	82			70-130	Pass		
Heptachlor epoxide	%	88			70-130	Pass		
Hexachlorobenzene	%	82			70-130	Pass		
Methoxychlor	%	81			70-130	Pass		
LCS - % Recovery								
Conductivity (at 25 °C)	%	104			70-130	Pass		
LCS - % Recovery								
Heavy Metals								
Arsenic (filtered)	%	88			80-120	Pass		
Cadmium (filtered)	%	89			80-120	Pass		
Chromium (filtered)	%	88			80-120	Pass		
Copper (filtered)	%	84			80-120	Pass		
Lead (filtered)	%	89			80-120	Pass		
Mercury (filtered)	%	87			80-120	Pass		
Nickel (filtered)	%	89			80-120	Pass		
Zinc (filtered)	%	87			80-120	Pass		
Test	Lab Sample ID	QA Source	Units	Result 1		Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery								
Total Recoverable Hydrocarbons				Result 1				
TRH C6-C9	N24-Ja0010500	NCP	%	83		70-130	Pass	
TRH C10-C14	N24-Ja0014482	NCP	%	88		70-130	Pass	
TRH C6-C10	N24-Ja0010500	NCP	%	90		70-130	Pass	
TRH >C10-C16	N24-Ja0014482	NCP	%	82		70-130	Pass	
Spike - % Recovery								
BTEX				Result 1				
Benzene	N24-Ja0010500	NCP	%	79		70-130	Pass	
Toluene	N24-Ja0010500	NCP	%	86		70-130	Pass	
Ethylbenzene	N24-Ja0010500	NCP	%	84		70-130	Pass	
m&p-Xylenes	N24-Ja0010500	NCP	%	88		70-130	Pass	
o-Xylene	N24-Ja0010500	NCP	%	91		70-130	Pass	
Xylenes - Total*	N24-Ja0010500	NCP	%	89		70-130	Pass	
Spike - % Recovery								
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1				

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Naphthalene	N24-Ja0010500	NCP	%	117			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic (filtered)	S24-Ja0013858	CP	%	106			75-125	Pass	
Cadmium (filtered)	S24-Ja0013858	CP	%	96			75-125	Pass	
Chromium (filtered)	S24-Ja0013858	CP	%	89			75-125	Pass	
Copper (filtered)	S24-Ja0013858	CP	%	82			75-125	Pass	
Lead (filtered)	S24-Ja0013858	CP	%	88			75-125	Pass	
Mercury (filtered)	S24-Ja0013858	CP	%	84			75-125	Pass	
Nickel (filtered)	S24-Ja0013858	CP	%	81			75-125	Pass	
Zinc (filtered)	S24-Ja0013858	CP	%	86			75-125	Pass	
Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Total Recoverable Hydrocarbons				Result 1	Result 2	RPD			
TRH C10-C14	S24-Ja0013045	NCP	mg/L	0.07	0.07	3.0	30%	Pass	
TRH C15-C28	S24-Ja0013045	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH C29-C36	S24-Ja0013045	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH >C10-C16	S24-Ja0013045	NCP	mg/L	0.07	0.07	1.8	30%	Pass	
TRH >C16-C34	S24-Ja0013045	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH >C34-C40	S24-Ja0013045	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (at 25 °C)	S24-Ja0014930	NCP	uS/cm	790	850	7.7	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic (filtered)	S24-Ja0018266	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cadmium (filtered)	S24-Ja0018266	NCP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium (filtered)	S24-Ja0018266	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper (filtered)	S24-Ja0018266	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Lead (filtered)	S24-Ja0018266	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Mercury (filtered)	S24-Ja0018266	NCP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel (filtered)	S24-Ja0018266	NCP	mg/L	0.019	0.020	1.3	30%	Pass	
Zinc (filtered)	S24-Ja0018266	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons				Result 1	Result 2	RPD			
TRH C6-C9	S24-Ja0013858	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
TRH C6-C10	S24-Ja0013858	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	S24-Ja0013858	CP	mg/L	0.001	0.001	18	30%	Pass	
Toluene	S24-Ja0013858	CP	mg/L	0.002	0.002	16	30%	Pass	
Ethylbenzene	S24-Ja0013858	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
m&p-Xylenes	S24-Ja0013858	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
o-Xylene	S24-Ja0013858	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Xylenes - Total*	S24-Ja0013858	CP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S24-Ja0013858	CP	mg/L	< 0.01	< 0.01	<1	30%	Pass	

Comments

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	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs

Authorised by:

Ursula Long	Analytical Services Manager
Fang Yee Tan	Senior Analyst-Metal
Roopesh Rangarajan	Senior Analyst-Organic
Roopesh Rangarajan	Senior Analyst-Volatile
Ryan Phillips	Senior Analyst-Inorganic



Glenn Jackson
Managing Director

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](#).

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CERTIFICATE OF ANALYSIS

Work Order : **ES2407634**
Client : **KATARINA DAVID**
Contact : **MS KATARINA DAVID**
Address : **6 Lawrence Street**
Blackheath 2785
Telephone : **----**
Project : **Brin**
Order number : **----**
C-O-C number : **----**
Sampler : **----**
Site : **----**
Quote number : **ES24KATDAV0001**
No. of samples received : **3**
No. of samples analysed : **3**

Page : 1 of 4
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 08-Mar-2024 11:20
Date Analysis Commenced : 09-Mar-2024
Issue Date : 18-Mar-2024 16:55



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO₂ and Fluoride to the Anions.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BH6	BH3	BH1	----	----
Sampling date / time				08-Mar-2024 00:00	08-Mar-2024 00:00	08-Mar-2024 00:00	----	----	
Compound	CAS Number	LOR	Unit	ES2407634-001	ES2407634-002	ES2407634-003	-----	-----	
				Result	Result	Result	----	----	
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L	288	381	860	----	----	
EA045: Turbidity									
Turbidity	----	0.1	NTU	250	279	712	----	----	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	778	574	1340	----	----	
Total Alkalinity as CaCO3	----	1	mg/L	778	574	1340	----	----	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	181	368	281	----	----	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	2040	2900	2480	----	----	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	84	154	51	----	----	
Magnesium	7439-95-4	1	mg/L	165	281	166	----	----	
Sodium	7440-23-5	1	mg/L	1530	1830	2160	----	----	
Potassium	7440-09-7	1	mg/L	18	28	21	----	----	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	0.20	0.34	0.18	----	----	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	0.08	<0.01	<0.01	----	----	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	0.36	0.61	<0.01	----	----	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L	0.44	0.61	<0.01	----	----	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.0	1.0	1.3	----	----	
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BH6	BH3	BH1	----	----
Sampling date / time				08-Mar-2024 00:00	08-Mar-2024 00:00	08-Mar-2024 00:00	----	----	
Compound	CAS Number	LOR	Unit	ES2407634-001	ES2407634-002	ES2407634-003	-----	-----	
				Result	Result	Result	----	----	
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued									
^ Total Nitrogen as N	----	0.1	mg/L	1.4	1.6	1.3	----	----	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L	0.17	0.25	0.52	----	----	
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L	76.8	101	102	----	----	
∅ Total Cations	----	0.01	meq/L	84.8	111	111	----	----	
∅ Ionic Balance	----	0.01	%	4.90	4.81	3.80	----	----	

Mandatory Fields

CHAIN OF CUSTODY

CLIENT CODE:

*PROJECT MANAGER:

SAMPLER:

*CLIENT: *L. Dend*

*PM MOBILE: *0412080362*

SAMPLER MOBILE:

OFFICE: *(Invoiced Office)*

ALS QUOTE # *ESLTA+DAN24*

PURCHASE ORDER NO.:

PROJECT NO./PROJECT:

Bin

SITE:

*INVOICE TO: *(Client default if nil)*

CC Invoice to PM

*EMAIL REPORTS TO: *(default to PM if blank)*

***ANALYSIS REQUIRED**

(NB: ALS Quote No. and/or Analysis Site Codes must be listed to attract sub-quoted price)
Where Materials are required, specify Total (unfiltered bottle required) or Dissolved (filtered bottle required).
Mark an X in the boxes below analysis to indicate the parameter listed above to be tested on that sample.

Country of Origin: *(if not Australia)*

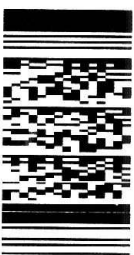
BIOSECURITY

Page of

CoC #: *(if applicable)*



Environmental Division
Sydney
Work Order Reference
ES2407634



Telephone : + 61-2-8784 8595

*** STORAGE REQUIREMENTS**

Please check box:

Standard Storage

Extended Storage

Standard Storage time from receipt of samples: *→*

Waters - 3 weeks

Soils - 2 months

*** TURNAROUND**

Please check box:

5+ days (no surcharge)

3 day (+15%)

2 day (+30%)

1 day (+50%)

(Not all tests can be expedited; contact Client Services for more information)

Specify Disposal Date: *Note: Extended storage incurs a fee and requires a signed agreement.*

Comments:

ALS Use Only	Sample ID	Depth	Date/Time	No. Bottles	MATRIX: Soil/Solid(S) Water(W) Sediments (SD), Dust (D), Product (P), Biota (B), Biosolid (BS)
	<i>B#6</i>		<i>9/15</i>	<i>2</i>	<i>Suspended solids turbidity</i>
	<i>BA3</i>		<i>6/15</i>	<i>2</i>	
	<i>B#1</i>		<i>8/15</i>	<i>2</i>	

Receipt Detail (see Use ONLY)	Chilling Method:	Ice:	Frozen / Melted	Ice Bricks:	Frozen / Thawed	None	Sample Temp at Receipt	°C	°C	°C	Security Seal Intact (circle)	Yes / No / N/A(None)	Carrier Details Con Note #	Signature	Date/Time	Received by:	Signature	Date/Time	Reinquired by:	Signature	Date/Time	

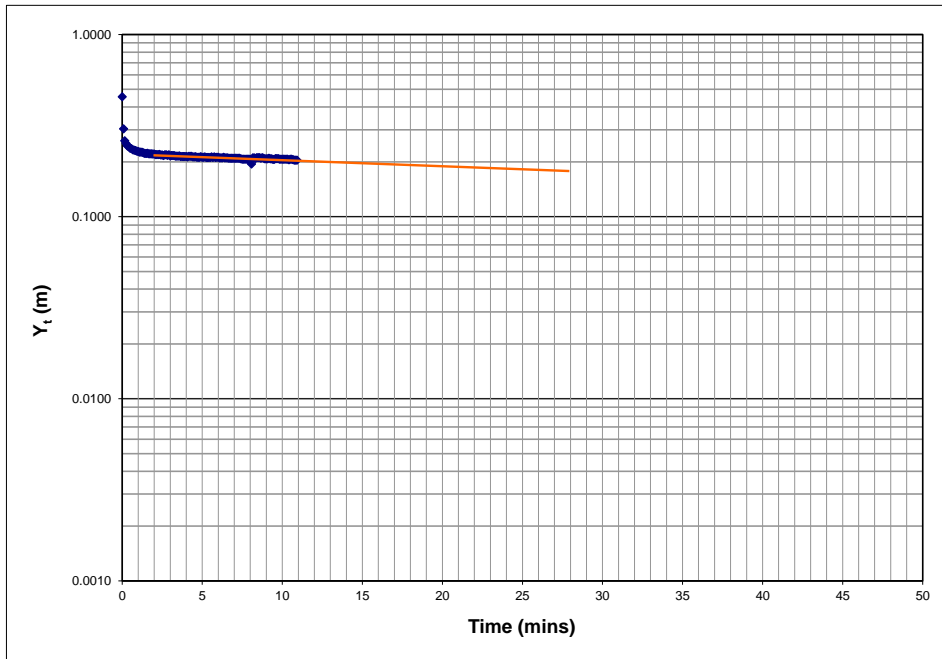
Received by:	Signature	Date/Time
<i>Tami</i>	<i>[Signature]</i>	<i>8/3/24</i>
<i>Am</i>	<i>[Signature]</i>	<i>11:20a</i>

Lab QC (Additional bottles req.)	Dup	MS	Additional Information (Comment on hazards - e.g. asbestos, known high contamination)	Packaging: (Circle)	Count	Hard Eddy	Foam Eddy	Bow/Bag/Other
	<input type="checkbox"/>	<input type="checkbox"/>						

APPENDIX D

Hydraulic testing analysis

Project Name: 40 The Retreat, Bringelly Date: 8-Mar-24
 Client: Simon Caples 9am
 Well No. / Name: BH1_1 Depth to equilibrium water level (m bgl): 7.57 m
 Type of test: Falling head Well Completion: Fully Penetrating
 Rising head



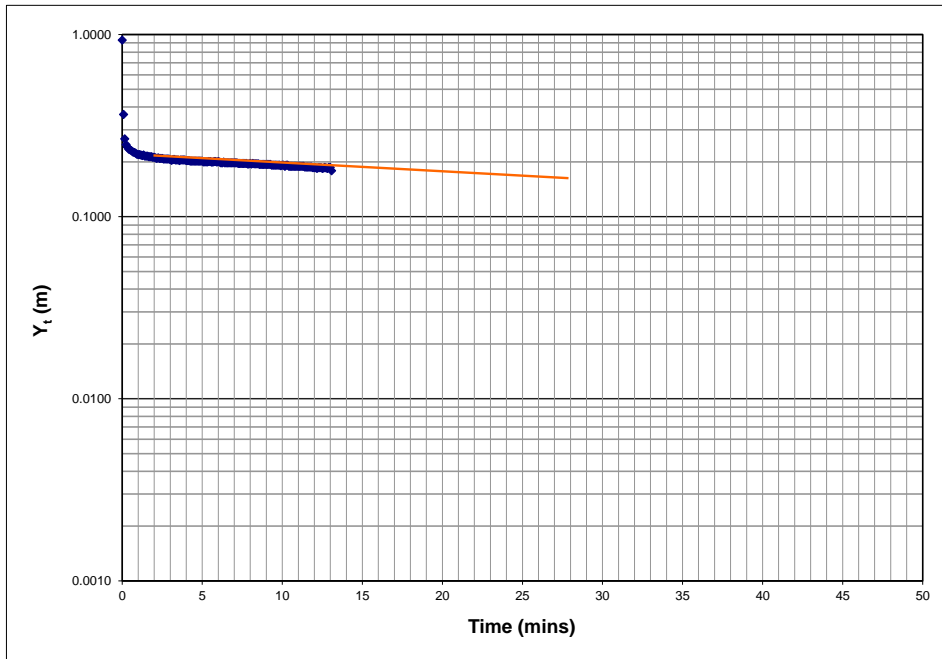
r_c = casing radius	0.025	If $L_w < H$	$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A+B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$ $= 2.65 \text{ m}$
r_w = radial distance between undisturbed aquifer and well centre	0.051		
L_e = length of intake	5	If $L_w = H$	$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$ $= L_w < H \text{ m}$
H = saturated thickness of aquifer	10		
L_w = distance b/n water table and bottom of intake	2.43		
R_e = effective well radius	0.72		
t = time	13		
Y_o = initial drawdown	0.45		
Y_t = vertical distance between the water level in well at time t and equilibrium level	0.2		
L_e/r_w =	98.03921569		
A = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	4.1		
B = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	1		
C = dimensionless co-efficient that is a function of L_e/r_w , and $L_w = H$	4		

$$K = [r_c^2 \cdot \ln(R_e/r_w)] 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)$$

= 1.03E-05 m/min
 = 1.49E-02 m/d

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
 Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.

Project Name: 40 The Retreat, Bringelly Date: 8-Mar-24
 Client: Simon Caples 9am
 Well No. / Name: BH1_2 Depth to equilibrium water level (m bgl): 7.77 m
 Type of test: Falling head Well Completion: Fully Penetrating
Rising head Partially Penetrating



r_c = casing radius	0.025	If $L_w < H$ $\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A+B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$ $= 2.65 \text{ m}$ If $L_w = H$ $\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$ $= L_w < H \text{ m}$
r_w = radial distance between undisturbed aquifer and well centre	0.051	
L_e = length of intake	5	
H = saturated thickness of aquifer	10	
L_w = distance b/n water table and bottom of intake	2.43	
R_e = effective well radius	0.72	
t = time	9	
Y_o = initial drawdown	0.93	
Y_t = vertical distance between the water level in well at time t and equilibrium level	0.2	
L_e/r_w =	98.03921569	
A = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	4.1	
B = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	1	
C = dimensionless co-efficient that is a function of L_e/r_w , and $L_w = H$	4	

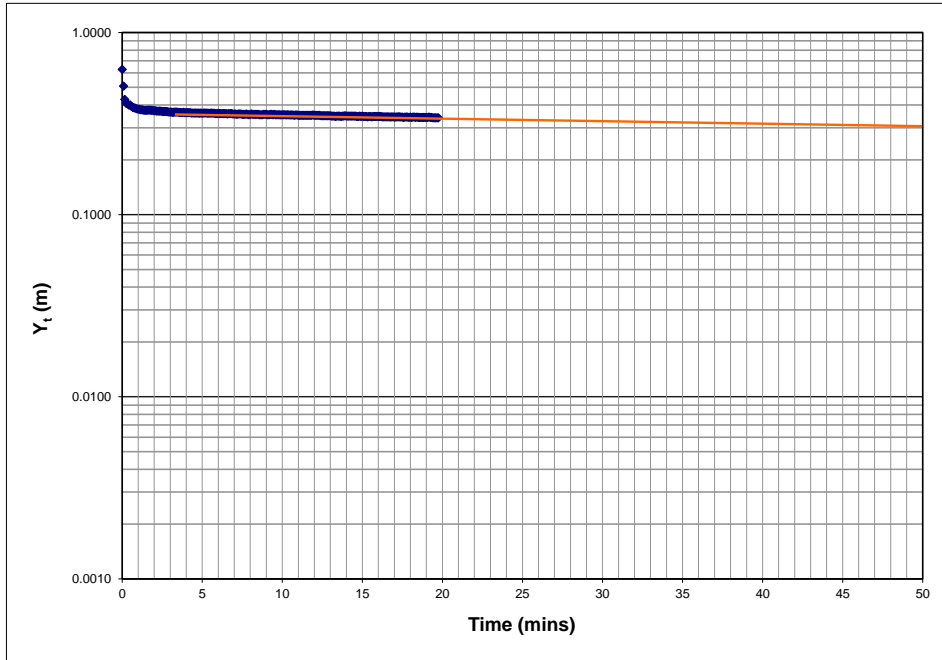
$$K = [r_c^2 \cdot \ln(R_e/r_w)] 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)$$

$$= 2.83E-05 \text{ m/min}$$

$$= 4.07E-02 \text{ m/d}$$

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
 Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.

Project Name: 40 The Retreat, Bringelly Date: 8-Mar-24
 Client: Simon Caples 9am
 Well No. / Name: BH1_3 Depth to equilibrium water level (m bgl): 7.77 m
 Type of test: Falling head Rising head Well Completion: Fully Penetrating Partially Penetrating



r_c = casing radius	0.025
r_w = radial distance between undisturbed aquifer and well centre	0.051
L_e = length of intake	5
H = saturated thickness of aquifer	10
L_w = distance b/n water table and bottom of intake	2.43
R_e = effective well radius	0.72
t = time	50
Y_o = initial drawdown	0.93
Y_t = vertical distance between the water level in well at time t and equilibrium level	0.3
L_e/r_w =	98.03921569
A = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	4.1
B = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	1
C = dimensionless co-efficient that is a function of L_e/r_w , and $L_w = H$	4

If $L_w < H$

$$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A+B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$$

= 2.65 m

If $L_w = H$

$$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$$

= $L_w < H$ m

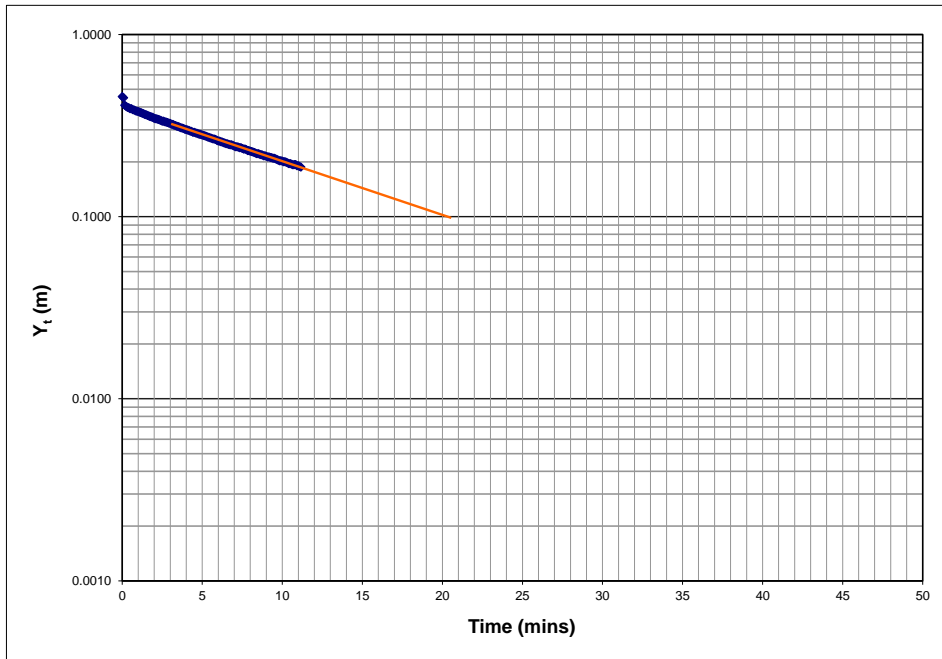
$$K = [r_c^2 \cdot \ln(R_e/r_w)] 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)$$

= 3.75E-06 m/min

= **5.39E-03** m/d

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
 Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.

Project Name: 40 The Retreat, Bringelly Date: 8-Mar-24
 Client: Simon Caples 9am
 Well No. / Name: BH3_1 Depth to equilibrium water level (m bgl): 3.01 m
 Type of test: Falling head Well Completion: Fully Penetrating
Rising head Partially Penetrating



r_c = casing radius	0.025	If $L_w < H$	$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A+B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$ $= 2.79 \text{ m}$
r_w = radial distance between undisturbed aquifer and well centre	0.051		
L_e = length of intake	3	If $L_w = H$	$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$ $= L_w < H \text{ m}$
H = saturated thickness of aquifer	10		
L_w = distance b/n water table and bottom of intake	5		
R_e = effective well radius	0.83		
t = time	22		
Y_o = initial drawdown	3.46		
Y_t = vertical distance between the water level in well at time t and equilibrium level	0.1		
L_e/r_w =	58.82352941		
A = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	3.5		
B = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	0.75		
C = dimensionless co-efficient that is a function of L_e/r_w , and $L_w = H$	2.5		

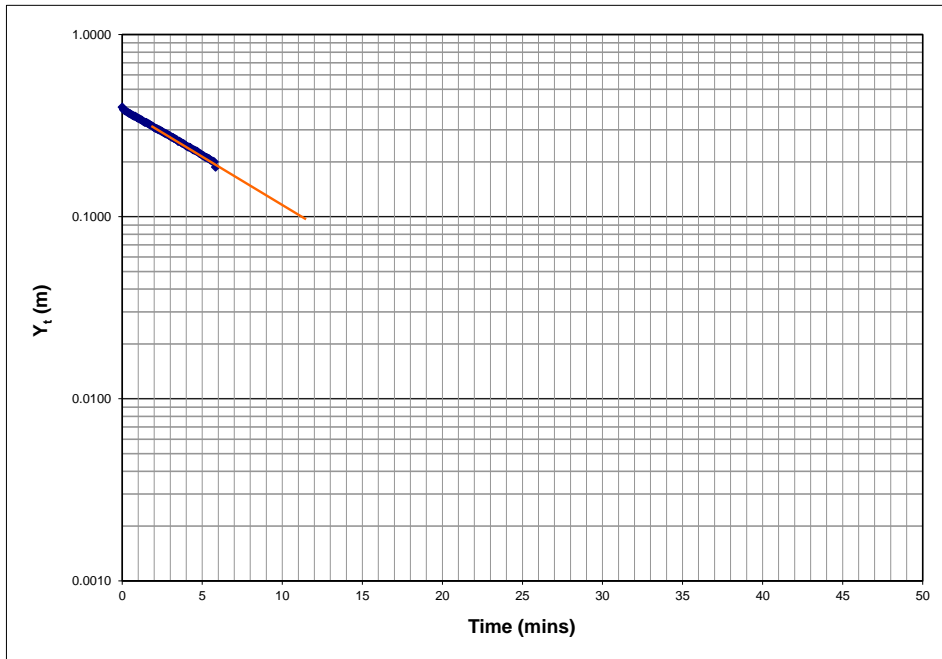
$$K = [r_c^2 \cdot \ln(R_e/r_w)] 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)$$

$$= 4.69E-05 \text{ m/min}$$

$$= \mathbf{6.75E-02} \text{ m/d}$$

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
 Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.

Project Name: 40 The Retreat, Bringelly Date: 8-Mar-24
 Client: Simon Caples 9am
 Well No. / Name: BH3_2 Depth to equilibrium water level (m bgl): 3.19 m
 Type of test: Falling head Rising head Well Completion: Fully Penetrating Partially Penetrating



r_c = casing radius	0.025
r_w = radial distance between undisturbed aquifer and well centre	0.051
L_e = length of intake	3
H = saturated thickness of aquifer	10
L_w = distance b/n water table and bottom of intake	5
R_e = effective well radius	0.83
t = time	12
Y_o = initial drawdown	3.58
Y_t = vertical distance between the water level in well at time t and equilibrium level	0.1
L_e/r_w =	58.82352941
A = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	3.5
B = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	0.75
C = dimensionless co-efficient that is a function of L_e/r_w , and $L_w = H$	2.5

If $L_w < H$

$$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A+B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$$

= 2.79 m

If $L_w = H$

$$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$$

= $L_w < H$ m

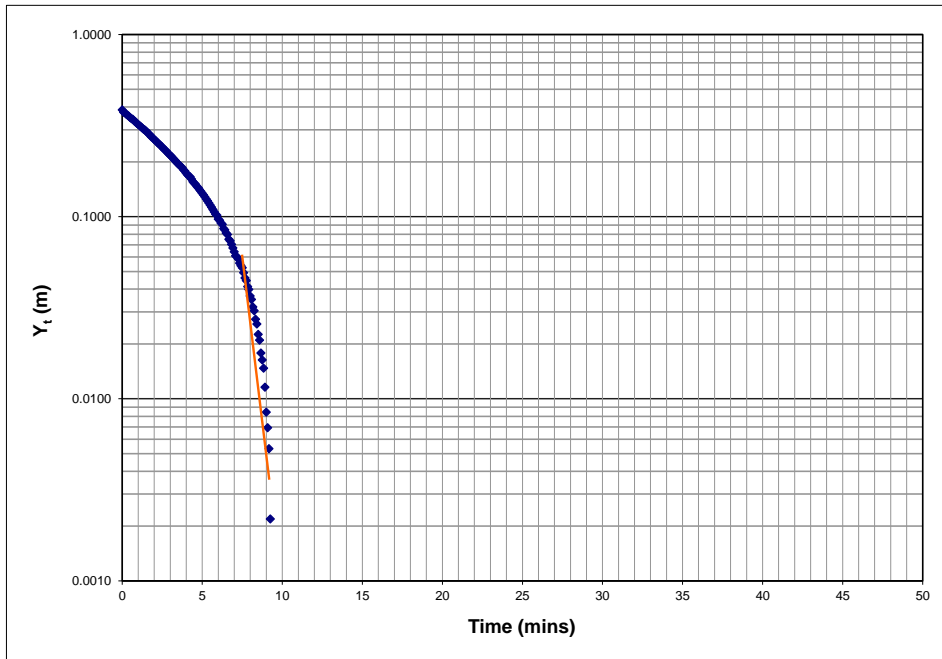
$$K = [r_c^2 \cdot \ln(R_e/r_w)] 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)$$

= 8.68E-05 m/min

= 1.25E-01 m/d

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
 Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.

Project Name: 40 The Retreat, Bringelly Date: 8-Mar-24
 Client: Simon Caples 9am
 Well No. / Name: BH3_3 Depth to equilibrium water level (m bgl): 3.37 m
 Type of test: Falling head Well Completion: Fully Penetrating
 Rising head Partially Penetrating



r_c = casing radius	0.025
r_w = radial distance between undisturbed aquifer and well centre	0.051
L_e = length of intake	3
H = saturated thickness of aquifer	10
L_w = distance b/n water table and bottom of intake	5
R_e = effective well radius	0.83
t = time	9
Y_o = initial drawdown	3.75
Y_t = vertical distance between the water level in well at time t and equilibrium level	0.004
L_e/r_w =	58.82352941
A = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	3.5
B = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	0.75
C = dimensionless co-efficient that is a function of L_e/r_w , and $L_w = H$	2.5

If $L_w < H$

$$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A+B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$$

= 2.79 m

If $L_w = H$

$$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$$

= $L_w < H$ m

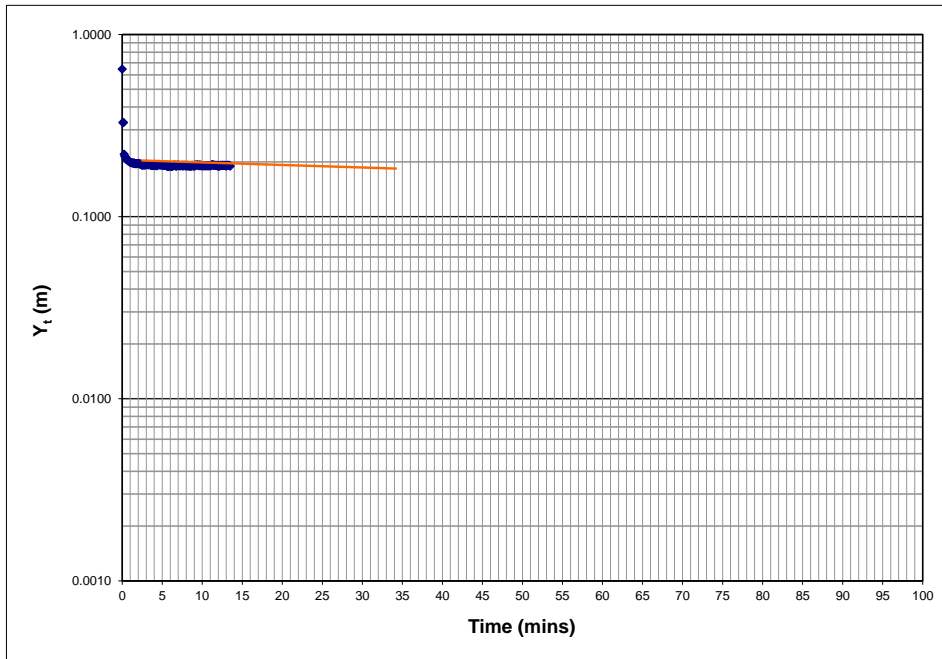
$$K = [r_c^2 \cdot \ln(R_e/r_w)] 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)$$

= 2.21E-04 m/min

= 3.19E-01 m/d

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
 Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.

Project Name: 40 The Retreat, Bringelly Date: 8-Mar-24
 Client: Simon Caples 9am
 Well No. / Name: BH6_1 Depth to equilibrium water level (m bgl): 6.9 m
 Type of test: Falling head Well Completion: Fully Penetrating
Rising head Partially Penetrating



r_c = casing radius	0.025	If $L_w < H$ $\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A+B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$ $= 2.81 \text{ m}$	
r_w = radial distance between undisturbed aquifer and well centre	0.051		
L_e = length of intake	5		
H = saturated thickness of aquifer	10		
L_w = distance b/n water table and bottom of intake	3		
R_e = effective well radius	0.85		
t = time	200		If $L_w = H$ $\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$ $= L_w < H \text{ m}$
Y_o = initial drawdown	7.54		
Y_t = vertical distance between the water level in well at time t and equilibrium level	0.1		
L_e/r_w =	98.03921569		
A = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	4.5		
B = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	0.8		
C = dimensionless co-efficient that is a function of L_e/r_w , and $L_w = H$	4		

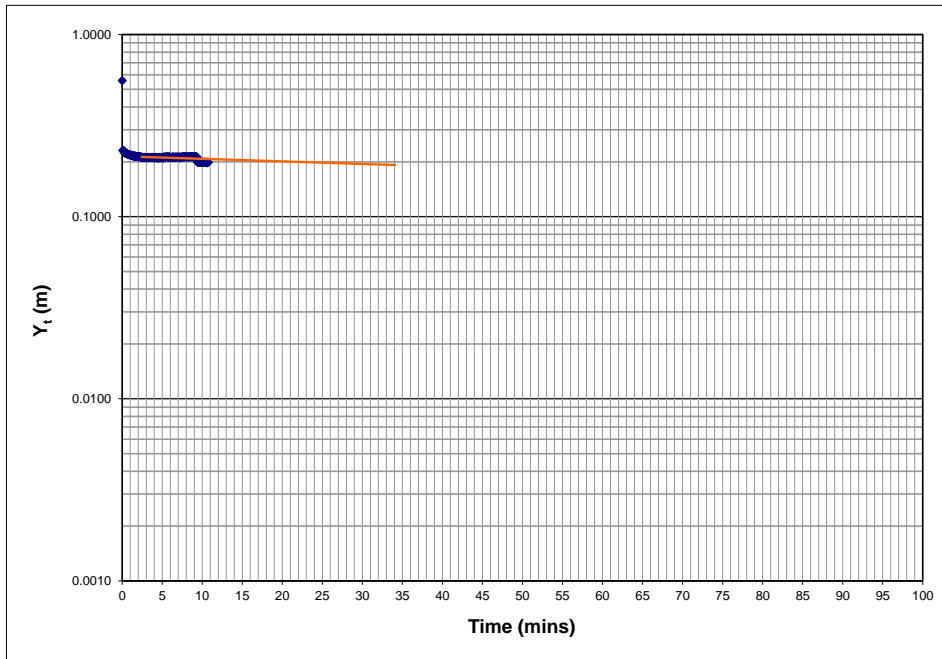
$$K = [r_c^2 \cdot \ln(R_e/r_w)] 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)$$

$$= 3.79E-06 \text{ m/min}$$

$$= 5.46E-03 \text{ m/d}$$

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
 Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.

Project Name: 40 The Retreat, Bringelly Date: 8-Mar-24
 Client: Simon Caples 9am
 Well No. / Name: BH6_2 Depth to equilibrium water level (m bgl): 7.08 m
 Type of test: Falling head Well Completion: Fully Penetrating
Rising head Partially Penetrating



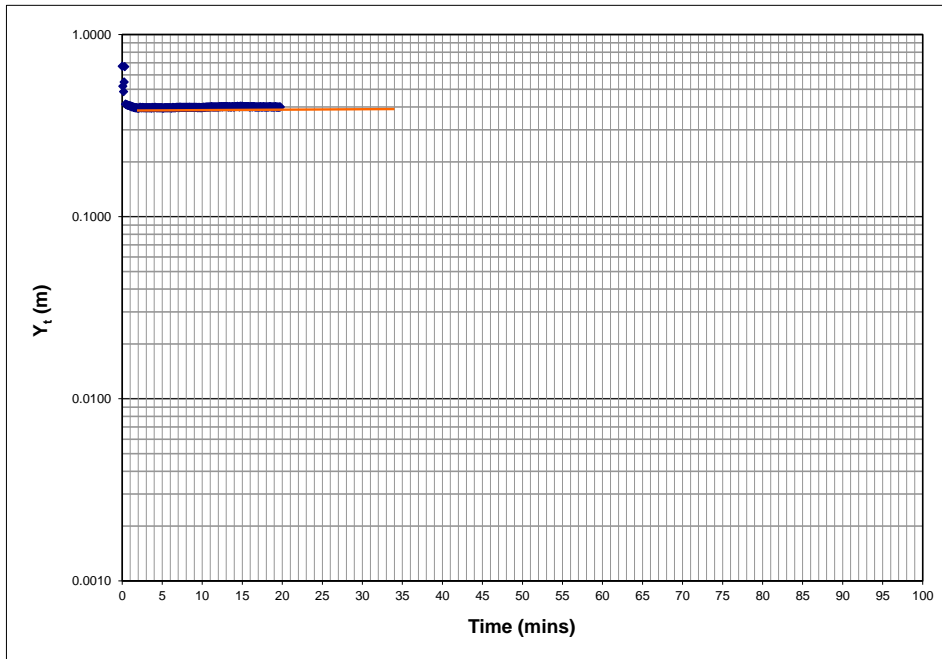
r_c = casing radius	0.025	If $L_w < H$ $\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A+B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$ $= 2.81 \text{ m}$	
r_w = radial distance between undisturbed aquifer and well centre	0.051		
L_e = length of intake	5		
H = saturated thickness of aquifer	10		
L_w = distance b/n water table and bottom of intake	3		
R_e = effective well radius	0.85		
t = time	20		If $L_w = H$ $\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$ $= L_w < H \text{ m}$
Y_o = initial drawdown	0.55		
Y_t = vertical distance between the water level in well at time t and equilibrium level	0.2		
L_e/r_w =	98.03921569		
A = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	4.5		
B = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	0.8		
C = dimensionless co-efficient that is a function of L_e/r_w , and $L_w = H$	4		

$$K = [r_c^2 \cdot \ln(R_e/r_w) \cdot 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)]$$

= 8.88E-06 m/min
 = 1.28E-02 m/d

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
 Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.

Project Name: 40 The Retreat, Bringelly Date: 8-Mar-24
 Client: Simon Caples 9am
 Well No. / Name: BH6_3 Depth to equilibrium water level (m bgl): 7.08 m
 Type of test: Falling head Well Completion: Fully Penetrating
Rising head Partially Penetrating



r_c = casing radius	0.025	If $L_w < H$
r_w = radial distance between undisturbed aquifer and well centre	0.051	
L_e = length of intake	5	$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + A+B \cdot \ln[(H-L_w)/r_w] \cdot (L_e/r_w)^{-1}\}^{-1}$ $= 2.81 \text{ m}$
H = saturated thickness of aquifer	10	
L_w = distance b/n water table and bottom of intake	3	If $L_w = H$
R_e = effective well radius	0.85	
t = time	15	$\ln(R_e/r_w) = \{1.1 \cdot [\ln(L_w/r_w)]^{-1} + C \cdot (L_e/r_w)^{-1}\}^{-1}$ $= L_w < H \text{ m}$
Y_o = initial drawdown	0.55	
Y_t = vertical distance between the water level in well at time t and equilibrium level	0.4	
L_e/r_w =	98.03921569	
A = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	4.5	
B = dimensionless co-efficient that is a function of L_e/r_w , and $L_w < H$	0.8	
C = dimensionless co-efficient that is a function of L_e/r_w , and $L_w = H$	4	

$$K = [r_c^2 \cdot \ln(R_e/r_w)] 2L^{-1} \cdot t^{-1} \cdot \ln(Y_o/Y_t)$$

$$= 3.73E-06 \text{ m/min}$$

$$= 5.37E-03 \text{ m/d}$$

Ref. Bouwer H. 1989. *The Bouwer and Rice Slug Test - an Update*. Ground Water. Vol.27, No.3. May - June 1989.
 Kruseman G.P. and N.A. de Ridder. 1991. *Analysis and Evaluation of Pumping Test Data*. 2nd Ed. Int. Inst. For Land Reclamation and Improvement. Wageningen. The Netherlands.