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Report on
Acid Sulfate Soil Management Plan

Proposed Commercial Development
Proposed Lot 106 Williamtown Drive, Williamtown

Prepared for
Newcastle Airport Pty Limited

Project 39728.32
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Report on Acid Sulfate Soil Management Plan
Proposed Commercial Development
Proposed Lot 106 Williamtown Drive, Williamtown

1. Introduction

Douglas Partners Pty Ltd (DP) has been engaged by Cox Architects on behalf of Newcastle Airport Pty Limited to prepare this acid sulfate soil management plan (ASSMP) for the proposed commercial development for the site at Proposed Lot 106 Williamtown Drive, Williamtown (the site). The site is shown on Drawing 1, Appendix A.

The ASSMP was prepared with reference to DP's proposal 39728.32.P.001.Rev0 dated 25 May 2023.

The purpose of this ASSMP is to provide management methods and procedures to minimise environmental impacts resulting from the disturbance of acid sulfate soils (ASS) during the construction of the proposed development. This ASSMP provides a summary of previous ASS test results, neutralisation and treatment methods, verification testing and monitoring requirements, emergency response procedures and groundwater / leachate water management procedures and contingency.

This ASSMP is devised on the basis of the following guidelines and reference documents endorsed by NSW EPA and with reference to other national guidelines where considered appropriate:

- Acid Sulfate Soils Management Advisory Committee (ASSMAC) Acid Sulfate Soils Management Guidelines (1998) (ASSMAC, 1998);
- Dear, S-E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McElnea, A. E., Moore, N. G. & Watling, K. M., 2014. Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines. Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government (Dear *et al* 2014);
- NSW Environment Protection Authority (EPA) Waste Classification Guidelines (2014) (EPA, 2014);
- Sullivan, L, Ward, N, Toppler, N and Lancaster, G 2018, National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, Canberra, ACT. CC BY 4.0 (Sullivan *et a*l 2018); and

This ASSMP has been prepared to address Clause 7.1(3) of the Port Stephens LEP 2013 has been prepared for the proposed works with reference to ASSMAC (1998) Acid Sulfate Soils manual and the abovementioned guidelines.

This report must be read in conjunction with all appendices including the notes provided in Appendix B.

2. Site Information

Site Address	Proposed Lot 106 Williamtown Drive, Williamtown
Legal Description	Part Lot 11 Deposited Plan 1036501 (Proposed Lot 106 and Part Lot 107)
Area	2125 m^2
Zoning	Zone B7 Business Park
	Zone RU2 – Rural Landscape
Local Council Area	Port Stephens Council
Current Use	Vacant – proposed commercial subdivision
Surrounding Uses	North – Commercial Airport, vacant commercial subdivision East – vacant commercial subdivision, open space South – vacant commercial subdivision, open space, rural-residential West – vacant commercial subdivision, open space, bushland

The approximate location of the proposed Lot 106 and Lot 107 is shown in Figure 1 below. Figure 2 shows the approximate development area within the current subdivision. Figure 3 shows the proposed development area ('the site'), including the eastern extent of the proposed development encroaching onto the western portion of the proposed Lot 107.

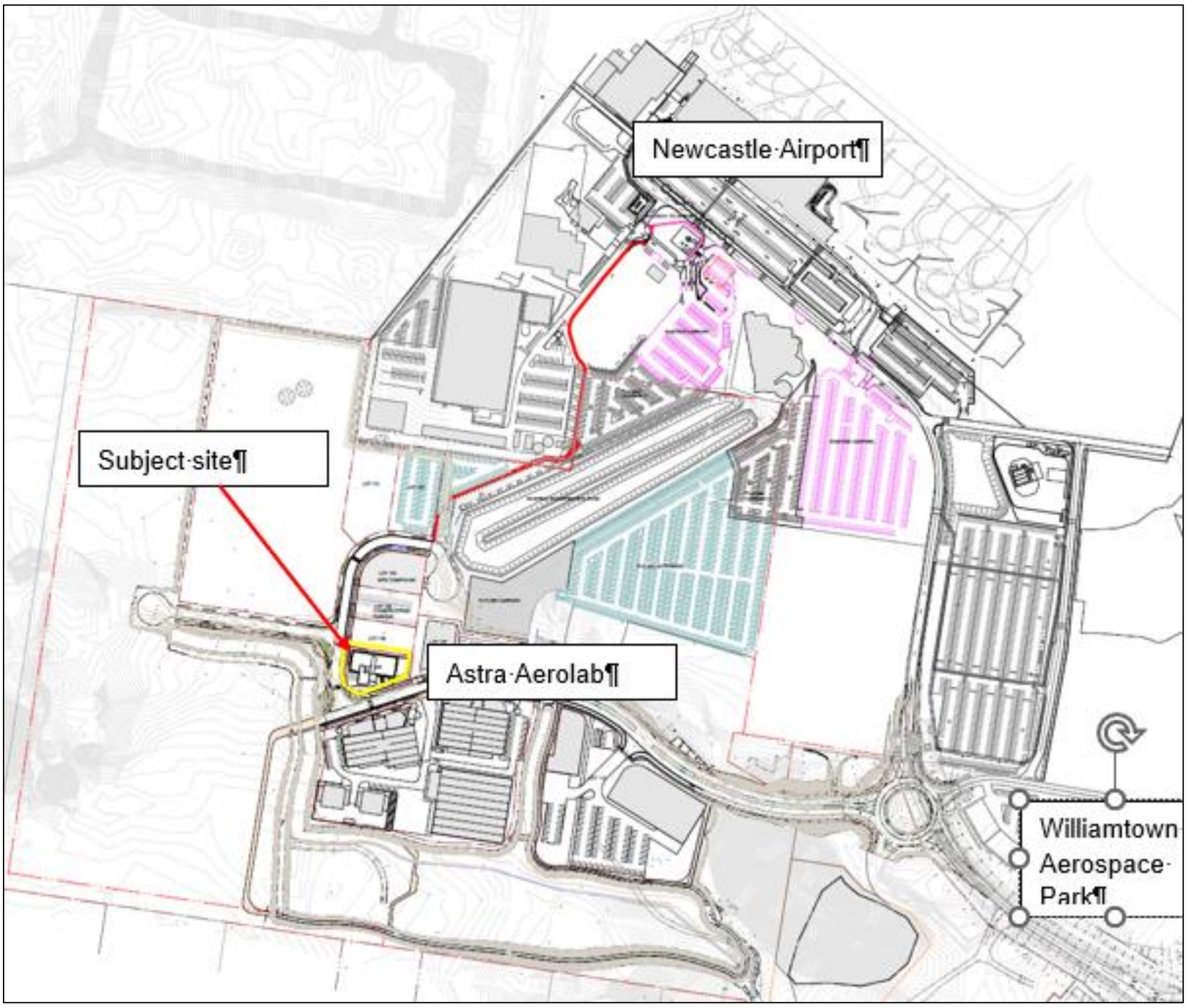

Figure 1: Location of proposed site (yellow outline)

Figure 2: Site location (red outline), within the Astra Aerolab Stage 1 area

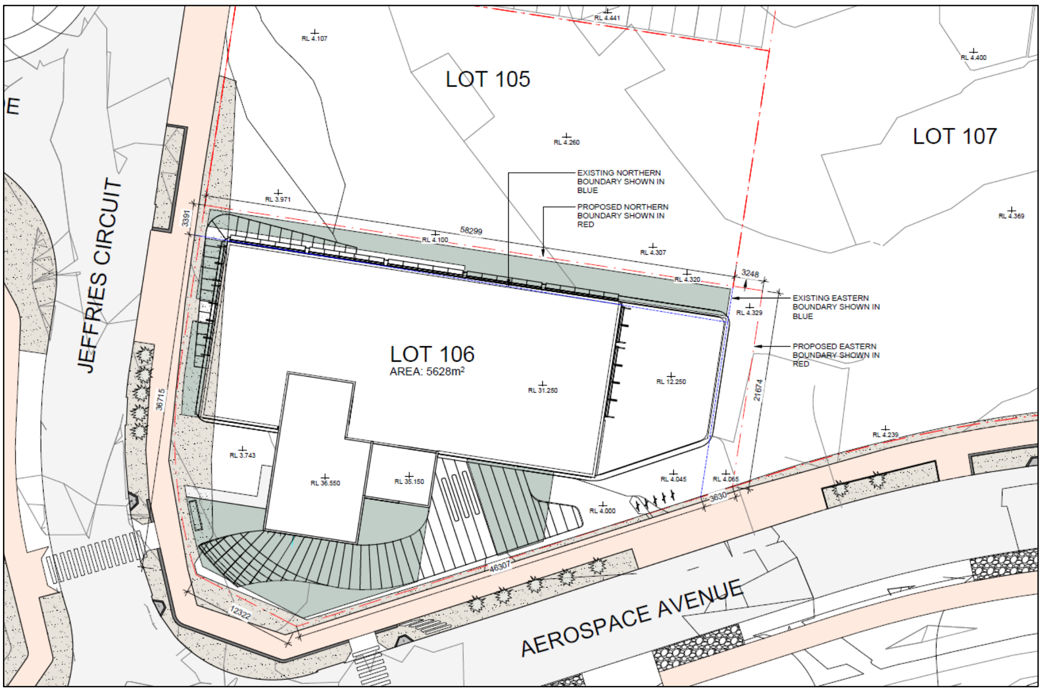

Figure 3: Proposed development area ('the site'), including extension of the proposed development into the western portion of the adjacent Lot 107

3. Environmental Setting

Regional Topography	The Astra Aerolab area is generally low-lying, there is a slight fall to the south towards Fullerton Cove.
Site Topography	The site is predominantly low-lying with typical surface elevations of about RL 5 m AHD following subdivision construction The site is generally flat, with possible minor fall to the south.
Geology	Reference to the Quaternary geological mapping produced by the Geological Survey of NSW for the Comprehensive Coastal Assessment 2004 indicates that the site is underlain by Pleistocene aged coastal barrier dune sand.
Acid Sulfate Soils	Published acid sulfate soil (ASS) mapping indicates that the site is described as having a low probability of occurrence of ASS materials at depths greater than 3 m. The ASS map for the site is shown in Figure 4 below.
Surface Water	There is a pond located approximately 100 m north-east of the site, likely to be an effluent pond associated with the adjacent RAAF wastewater treatment works. There are several unnamed constructed and natural drains and creeks to the south of the Astra Aerolab area, generally draining to the south towards the Fourteen Foot Drain, located approximately 1.7 km south of the site which subsequently flows into Fullerton Cove, which is located approximately 2.6 km south-west of the site.
Groundwater	Groundwater is relatively shallow at the site, with recent subsurface investigation (DP, 2019) encountering groundwater at depths of between 0.0 m and 1.6 m below the natural ground surface. Groundwater levels are affected by factors such as soil permeability and the prevailing weather conditions and vary with time. Three registered groundwater bores are located between approximately 500 m and 700 m east-south-east of the proposed development area and are registered as monitoring bores. Standing water level in the wells is 0.6 m below ground level. Based on previous investigations in the vicinity of the site, the regional groundwater flow regime is believed to be to the south/south-west of the site, towards Fullerton Cove.

Figure 4: Acid sulfate soil mapping (site in blue) indicating low probability ASS below 3 m depth

4. Background on Acid Sulfate Soils

ASS are naturally occurring sediments that contain iron sulfides / reduced inorganic sulfur (RIS), primarily pyrite, commonly deposited in estuarine environments. The occurrence of ASS is associated with areas or regions that have previously been or are currently estuarine environments. Due to changes in sea level or geomorphologic changes to coastal systems, these sediments are often overlain by terrestrial sediments.

When ASS are exposed to air (e.g. due to bulk excavation or dewatering), the oxygen reacts with iron sulfides / RIS in the sediment, producing sulfuric acid. This acid can be produced in large quantities and is highly mobile in water. The acid can result in severe acidification of soil and groundwater and mobilise metals (for example iron, aluminium, copper, cobalt, zinc), metalloids (for example arsenic), nutrients (for example phosphate) and rare earth elements. The sulfuric acid can drain into waterways causing severe short and long term socio-economic and environmental impacts, including damage to man-made structures and natural ecosystems (for example fish kills) both on the subject site and downstream via groundwater and surface water movements.

ASS can either be classified as 'actual acid sulfate soils' (AASS) which are soils that have already reacted with oxygen to produce acid, or 'potential acid sulfate soils' (PASS) and are often found in the same soil profile, with AASS overlying PASS. PASS are soils containing iron sulfide that have not been exposed to oxygen (e.g. soils below the water table). PASS therefore have not produced sulfuric acid but have the potential to do so if exposure to oxygen occurs

ASS field and laboratory-based criteria for determining if soils are classified as PASS / AASS and/or exceed the Action Criteria for management if disturbed are provided in Section C2.0, Appendix C.

5. Proposed Development

The subject site comprises the proposed Lot 106 and Part Lot 107, within which is the location of the proposed 'Commercial Building 1' within the Astra Aerolab Stage 1 area, Williamtown Drive, Williamtown. The proposed Lot 106 and Lot 107 is within the current lot known as Lot 11 DP 1036501.

The proposed development is outlined on the drawings (Cox Architecture, reference 221182 Revision A) in Appendix B, and generally comprises the following:

- Construction of a seven-level commercial structure, including ground floor commercial and retail, first floor vehicle parking and five levels of commercial;
- Construction of associated pavements and landscaped areas.

It is noted that there are no basement levels in the proposed development.

Details on excavation depths have not been provide at this time, however, it is anticipated that excavations for the development will include footings, general site levelling, underground services (grease arrestor, sewer pump station (as shown) and communications, sewer, water, electrical etc.), stormwater detention/infiltration/management and general landscaping including tree plantation.

6. Review of Previous Investigations

6.1 DP (2009) and DP (2013)

DP has conducted several subsurface investigations at the site, including assessment of ASS conditions within and in the vicinity of the proposed commercial development.

Test locations relevant to the current site area are shown on Drawing 1, Appendix A, and generally comprise test pits excavated in natural materials. It is noted that the subsurface investigations and testing were conducted by DP prior to the bulk earthworks for subdivision construction. Subdivision construction involved the placement of fill across the proposed Stage 1 Astra Aerolab area.

Test pit logs for the relevant locations (Pits 202, 205, 306, 307 and 308) are presented in Appendix C. A summary of the ASS testing for the relevant test locations is provided in Tables 1 and 2 below. Groundwater depths during the previous investigations were generally measured at about 2 m AHD.

Table 1: Summary of ASS screening results for test pits in the vicinity of the current site area

Sample ID (2008 to 2010)	Sample Depth [a] (m)	Sample RL (m (AHD) [e]	Sample Description	Screening Test Results			
				pH			Strength of Reaction [b]
				pH_F	pH_{FOX}	$pH_F - pH_{FOX}$	
202	0.1	2.84	Sand - grey	6.6	5.0	**1.6**	1
202	0.5	2.44	Sand - grey	6.8	4.7	**2.1**	1
205	0.2 - 0.3	2.51-2.61	Silty Sand - brown	5.9	3.6	**2.3**	2,F
205	1.0	1.81	Sand - light brown	5.9	5.0	0.9	1
306	0.2	3.3	Sand	6.2	3.5	**2.8**	1 to 2
306	0.5	3.0	Sand	6.7	4.7	**2.0**	1
306	1.0	2.5	Sand	7.6	5.1	**2.5**	1
306	1.6	1.9	Sand	6.5	5.1	**1.5**	1
307	0.2	2.3	Filling - Clayey / Silty Sand	6.6	4.6	**2.0**	1
307	0.5	2.0	Filling - Clayey Sand	6.8	4.4	**2.4**	1
307	0.8	1.7	Clayey Sand	6.2	5.6	0.6	1
307	2.0	0.5	Sand	6.3	4.5	**1.8**	1
QASSIT Action Criteria				<4[c]	<3.5[d]	≥1[d]	-

Notes to Table 1:

a Depth below ground surface

b Strength of Reaction

1 denotes no or slight reaction

2 denotes moderate reaction

3 denotes high reaction

4 denotes very vigorous reaction

H heat

F frothing

c For actual acid sulphate soils (ASS)

d Indicative value only for Potential Acid Sulphate Soils (PASS)

e levels estimated from digital terrain model and are therefore approximate only

* organics present

Shaded & **Bold** results indicate PASS conditions

Table 2: Summary of ASS acid base accounting for test pits in the vicinity of the current site area

Sample ID	Sample Depth (m)	Approx. Sample RL (AHD)	Sample Description	Probability of Encountering Acid Sulphate Soils Based on ASS Risk Map	Laboratory Results			
					pH_{KCL}	Scr %S	s-TAA %S	Net Acidity[a] %S
202	1.0	1.94	Sand – grey	Low	5.8	<0.02	<0.02	<0.02
205	0.4 - 0.5	2.36	Silty Sand – grey	Low	5.1	<0.02	<0.02	<0.02
NASSG Action Criteria				Coarse Texture (Sands to loamy sands)				0.03b/0.03c
				Medium Texture (Clayey sands to light clays)				0.06b/0.03c
				Fine Texture (Light medium to heavy clays)				0.1b/0.03c

Notes to Table 2:

a Calculated from ABA equation in ASS Laboratory Methods Guidelines

b NASSG Action Criteria for disturbance of 1-1000 tonnes of material

c NASSG Action Criteria for disturbance of more than 1000 tonnes of material

Bold and Shaded results indicate an exceedance of NASSG action criteria

ANC not tested due to 4.5<pHKCl<6.5

Please note that sample depth is prior to placement of engineered fill for subdivision construction

The limited detailed testing conducted indicates the samples tested are not ASS. Comparison of the material types, relative levels and groundwater levels within the subject site (i.e. Pit 306) and the above detailed tests in Table 2 suggest that the tested samples are similar to the materials previously encountered within the subject site. It s noted, however, that the previous assessment comprised limited subsurface investigation within the proposed Lot 106 and Part Lot 107.

It is also noted that soil disturbance for the proposed development may encounter soils at lower elevations than previously tested, which may be PASS.

Sandy soils located closer to the high-risk areas to the east of the subject site indicated potential ASS above the adopted action criteria.

6.2 DP (2019)

DP has previously prepared an Acid Sulfate Soil Management Plan (ASSMP, DP (2019)) for the Astra Aerolab Stage 1 subdivision, which includes the current subject site. This report presents a summary of ASS conditions encountered within the Astra Aerolab Stage 1 area from previous investigations, plus procedures for management and monitoring of ASS for the subdivision construction. For the current assessment, proposed Lot 106 and part Lot 107 is mapped within an area of low probability of ASS at depths greater than 3 m below natural ground levels.

The ASSMP noted that based on the existing data at the time of writing, which included variable ASS testing results across the Stage 1 area, all natural soils within Stage 1 Astra Aerolab area (i.e. prior to subdivision construction), with the exception of dune sand and surficial topsoil, should be considered potential acid sulfate soils (PASS), and treated accordingly, unless further assessment indicates otherwise.

A preliminary assessment of risk was provided in DP (2019), based on the ASS risk map for the area, reproduced in Figure 4 above. The subject site (i.e. Lot 106 and Part 107) is located within the 'low risk' zone (the orange shading in Figure 4). The requirements and methodology for treatment of ASS (ie all underlying natural soils) for this area was detailed in the ASSMP (DP, 2019) and has been provided in this ASSMP.

The assessment criteria adopted for this ASSMP for determination of the presence of PASS / AASS are provided in Appendix C.

DP (2019) noted that excavated soil should be initially limed (Grade 1 superfine Agricultural lime) at the following average rates for neutralisation as soon as practicable following excavation:

- High Risk Zone: 7 kg lime / tonne of ASS (12 kg / m^3);
- Low Risk Zone: 2 kg lime/ tonne of ASS (4 kg / m^3).

Th current subject site is located with the low-risk area based on ASS mapping. Limited detailed ASS testing within the upper soils within the Astra Aerolab Stage 1 area suggested the absence of PASS in the soils tested within the subject site, however, it is noted that existing and potential sulfur results within soils within the Stage 1 Astra Aerolab area were variable, based on the results provided in DP (2009) and DP (2013).

7. Data Gap Assessment

Previous investigation within the Astra Aerolab area has identified the potential for ASS with the Stage 1 subdivision area. Site-specific investigation is, however, recommended for the site.

Following detailed design, including estimation of footing depths, excavation conditions and depths, it is recommended that the requirements for treatment and monitoring /management of ASS are further assessed. Additional investigation is recommended following the further design, including soil investigation, sampling and additional ASS testing.

Additional data collection for ASS can be conducted as part of further geotechnical investigation for the site, which would include soil sample collection, groundwater sample collection and testing of soil and groundwater samples within and beyond the depth of proposed excavation/dewatering as per the National ASS guidance (Sullivan, et al., 2018).

The assessment criteria adopted for this ASSMP for determination of the presence of PASS / AASS and the verification criteria for treated PASS / AASS are provided in Appendix C.

8. Potential for Oxidising ASS and Risk Categorisation

8.1 ASS Oxidation Potential

Based on the proposed development (refer to Section 5), excavation depths and locations have not been finalised for the development. It is likely that the following excavations and possible exposure of PASS would be required:

- Cut/fill of underlying natural soils (i.e. located beneath imported crushed rock materials);
- Footing/pile installation for the proposed multi-storey structure. It is anticipated that the footings, regardless of type, will require excavation into the underlying natural PASS;
- Excavation for installation of sewer and stormwater infrastructure (pipes, pump stations, detention pits/cells); and
- Localised dewatering for installation of subsurface structures (e.g. lift shafts, deeper sewer and stormwater infrastructure, grease arrestor).

Based on the results of previous investigations (refer to Section 6) any excavations which disturb or uncover natural soils within the site have the potential to oxidise PASS and/or disturb AASS.

ASS may also be exposed during dewatering, where required (i.e. if excavation beneath the groundwater table and subsequent dewatering of ASS is required).

Any disturbance (eg excavation or dewatering) of ASS must be undertaken in accordance with this ASSMP.

Based on the results of previous assessment and the understanding of the subdivision construction, the following tasks will NOT require ASS treatment:

- Excavation and reuse of upper imported materials (i.e. quarry materials generally comprising grey fine to coarse grained sand and fine gravel (crushed rock)) used as part of bulk filling as part of subdivision construction;
- Stripping of organics/topsoil.

It is understood that the materials imported to the site as part of subdivision construction generally comprised imported natural soil and rock sourced from commercial quarries. For the purposes of this ASSMP, the imported materials are not considered to be ASS.

8.2 Risk Categorisation

Dear *et al* (2014) relates environmental risk from ASS to the treatment level and volume of disturbance of ASS. The tonnage of ASS to be disturbed and the quantity of lime treatment required as part of this project has not yet been determined. Based on the low risk of ASS in the proposed development area, a preliminary risk categorisation of “High Treatment” has been assigned to this development. This risk category should be assessed following further data gap assessment and this ASSMP updated as required.

Dear et al (2014) confirms that a formal ASS Management Plan is required as part of the proposed development for a high treatment risk category, and that the following practices are to be included:

High level of treatment – Category H

- Treat soils with a suitable neutralising agent to counter the Existing & Potential Acidity;
- Thoroughly mix neutralising agent with soil;
- Bunding must be provided to divert run-on and collect all site runoff during earthworks;
- Monitor the pH of water within bunds, sumps, pooled areas (particularly after rain) and appropriately treat prior to release or re-use to keep pH in the range 6.5 to 8.5 (or as per site-specific conditions);
- All leachate from treatment pads and/or discharge water from excavations should be contained and must meet acceptable standards of pH, metal content (particularly iron and aluminium), and turbidity prior to release; and
- Application of a guard layer of neutralising material to treatment pad surfaces to help intercept and neutralise leachate from ASS.

The above points have been incorporated into this ASSMP.

9. ASS Management

9.1 Management Options

ASSMAC (1998) and Dear et al (2014) provides the following potential soil management options:

1. Non-excavation or minimal earthworks (avoidance);
2. On-site treatment (neutralisation) followed by:
    - o Off-site disposal;
    - o On-site re-use;
3. Off-site treatment and disposal;
4. On-site reburial below the permanent water table without treatment (PASS only);
5. Off-site reburial below the permanent water table without treatment (PASS only); and
6. Hydraulic separation of ASS fines.

Based on the proposed development, Option 2 - on-site treatment followed by off-site disposal (and/ or on-site reuse) has been identified as the preferred management option, in accordance with the relevant guidelines and reference materials.

9.2 Proposed Management Strategy

9.2.1 General

The general process for the treatment of ASS is as follows:

- Prepare a treatment pad as described in Section 9.2.2;
- Manage ASS during stockpiling and treatment to minimise dust and leachate generation (e.g. by covering, or lightly conditioning with water). If wet weather prevails, stop works and cover the stockpiled soil with plastic sheeting to reduce the formation of leachate;
- Transport ASS requiring treatment and place on the guard layer of the treatment pad;
- Spread the ASS over the guard layer in layers of up to 0.3 m thick, leaving a buffer between the toe of the spread soil and the containment bund or drain. When spreading the first soil layer, care should be taken to maintain the integrity of the lining and guard layer;
- Apply agricultural lime (commonly known as aglime) over the 0.3 m layer at the minimum lime dosing rate (refer to Section 9.2.3 and harrow/ mix thoroughly. Use of rotary plough equipment (e.g. auger bucket) may be appropriate, where adequate mixing is difficult to achieve. Note: If ASS materials are too wet, adequate mixing of aglime may not be achieved and soils may require a period of drying prior to mixing;
- Completion of validation testing (as outlined in Section 11) to confirm that the ASS has been adequately neutralised in each layer prior to placement of the next layer to be treated. If validation testing indicates that additional neutralisation is required, add additional aglime (at an appropriate liming rate) and mix as described above;
- Continue the spreading/ liming / harrowing / verification cycle for each 0.3 m layer until excavation is finished;
- When validation testing indicates that the ASS have been adequately neutralised, the soil may be removed from the treatment pad for disposal off-site in accordance with the waste classification or the soil may be removed from the treatment pad for on-site reuse with reference to the contractors site management plan; and
- Management of leachate water and groundwater may also be required where leachate is produced and / or if groundwater is impacted by the works as outlined in Section 10 and Appendix G.

9.2.2 Preparation of Treatment Pads

The key features of the treatment area and design considerations are summarised below and shown in Figure 2 below:

- **Treatment pad area** – The treatment pad should be of an appropriate area for the volume of soil to be treated/stored, and should be prepared on relatively level or gently sloping ground to minimise the risk of potential instability issues, with a fall to the local drainage sump;
- **Pad location** – The pad should be located as far as practical from any potential ecological receptors (such as drainage lines which enter the stormwater system and nearby water bodies);
- **Lining** – the treatment pad should be lined to minimise the potential for leachate seepage into underlying soils. Options for lining include the following:
    - o Geosynthetic liner (such as HDPE sheeting);

- o Impervious physical barrier, such as a concrete slab or bitumen sealed hardstand;
- o Natural low permeability clay; and
- o A compacted clay layer.

- **Guard Layer** – A guard layer of fine agricultural lime ('aglime') should be applied over the clay subgrade or lining to neutralise downward seepage. For the proposed development, a guard layer of 1-2 kg/m^2 of aglime per metre height of stockpile should be placed at the surface of the treatment pad prior to placement of untreated ASS;
- The guard layer should be re-applied following removal of treated soils and prior to addition of untreated ASS;

  NOTE: if the stockpiled soils on the treatment pad are expected to be greater than 3 m in height, it is recommended that the guard layer be applied as a base guard layer, with interim guard layers through the height of the stockpile; and
- **Bunding** – The treatment pad should be bunded to contain and collect potential leachate runoff within the treatment pad area and to prevent surface water from entering the treatment pad. The inner bund slopes should be lined to prevent leachate seeping into the ground surface and sized to prevent overflow of untreated leachate onto the site.

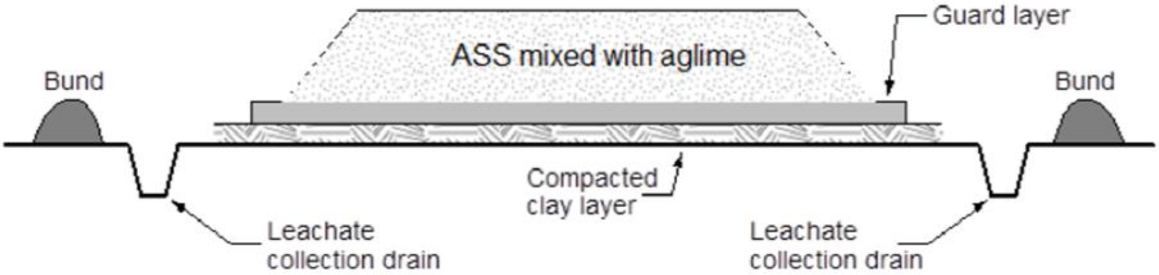

Figure 2: Schematic cross-section of an example treatment pad, including clay layer, guard layer, leachate collection drain and bunding (Fig 8-1 Dear et al (2014))

9.2.3 Liming Rate

Based on the assessment results, natural soils that are to be disturbed during excavation are to be treated using aglime prior to off-site reuse or disposal. Table 3 provides indicative liming rates for neutralisation of the ASS likely to be disturbed.

Table 3: Indicative liming rate for soil

Material	Existing and Potential Acidity (%S)	'Ag' Lime Application Rate for Treatment of Soil [b] (kg/tonne)
Natural Soils: Generally grey and grey/brown sand in LOW RISK areas	0.02<%S<0.05	2
Natural Soils: Generally grey and grey/brown sand in HIGH RISK areas	<0.05%S<0.15	7

Depending upon the source of the aglime and ultimately the representative Effective Neutralising Value (ENV) of the aglime selected, the minimum lime dosing rate may be increased or decreased. Prior to the commencement of works, the minimum lime dosing rate should be finalised following review of the ENV of the selected ag-lime.

9.2.4 Neutralising Materials

Agricultural lime, commonly known as aglime, is the preferred neutralisation material for the management of ASS, as this material is usually the cheapest and most readily available product for acid neutralisation. Furthermore, aglime is slightly alkaline (pH of 8.5 to 9), non-corrosive, of low solubility and does not present handling problems or generate high pH leachate and it only liberates alkalinity in the presence of acid.

Dolomite and calcined magnesia also have low solubility; however, they produce magnesium sulfate during neutralisation reactions which is quite soluble and may degrade water quality in waterways if large quantities are produced. Agricultural lime on the other hand hydrates to gypsum which is less soluble and therefore less likely to affect water quality and also has other beneficial impacts on soil properties particularly soil structure.

Aglime comprises calcium carbonate ($CaCO_3$), typically made from limestone that has been finely ground and sieved to a fine powder. Aglime with the following properties are the preferred neutralising agent:

- Purity of at least 98% or better (i.e. NV > 98, where NV is the neutralising value, a term used to rate the neutralising power of different forms of materials relative to pure, fine calcium carbonate which is designated NV = 100);

  NOTE: There could be economic justification for using a less pure grade of aglime, however, under these circumstances, the individual lime dosing rates described in Section 9.2.3 would need to be carefully considered, as the cost savings from using less pure material may be offset by the corresponding increase in the required dosing rates (lime volumes required), and the transport and disposal costs; and

- Fine ground (at least <0.5 mm) and dry, as texture and moisture can decrease the effective NV.

Aglime requires no special handling, however, it would be advisable to cover any aglime stockpiles with a tarpaulin both to minimise wind erosion and wetting, as the material is more difficult to spread when wet.

Due to its low solubility in water, aglime is not suitable for the neutralisation of leachate, which requires a product with a very quick reaction and high solubility. The most suitable neutralising agent for leachate and retained drainage water/groundwater is slaked lime or hydrated lime (calcium hydroxide ($Ca(OH)_2$)). This is made by treating burnt lime (calcium oxide (CaO)) with water (slaking) and comes as a fine white powder. It has a typical NV of about 135. Due to its very strong alkalinity (pH or about 12.5 to 13.5), slaked lime or hydrated lime should not be allowed to come into contact with the skin or be inhaled and care must be taken to not overshoot pH adjustment with such alkaline agents.

9.3 Alternate Strategy or Contingency Plan

Where the proposed primary management option is not possible, or practical, alternate or contingency strategies may be considered. These options are outlined in Appendix E.

10. Leachate Water and Groundwater Management

Potential leachate water and groundwater management strategies are provided in Appendix G.

11. Validation Testing of Treated Soils

Validation testing to assess whether ASS have been adequately neutralised will be undertaken by means of the following:

- Screening tests (pH_F and pH_{FOX}) at the frequencies detailed in Table 4; and
- Acid base accounting (e.g. using chromium suite) of testing at the frequencies detailed in Table 4.

Based on a “Category H” treatment level, verification testing of the ASS and leachate water (if present) is required to be conducted after the addition of lime to test whether the soil/water has been adequately neutralised, whether or not adequate mixing of the ASS has been achieved, and to reduce the risk of acidic water being returned to the environment (including watercourses). The verification testing frequency is presented in Table 4.

Table 4: Verification testing frequency

Test	Frequency
Field test: pHF and pH_{FOX} screening	• One sample / 25m³ OR four tests per batch <100 m³
Laboratory analysis: Acid Base Accounting (e.g. Chromium suite)	• One sample / soil type; AND ○ Net Acidity <0.5%S – 1/1000m³ ○ Net Acidity 0.5-2%S – 1/500m³ ○ Net Acidity >2% - 1/250m³ (From Dear et al (2014))

Notes to Table 4:

Verification testing frequencies should be adjusted (either increased or decreased) depending on performance.

Laboratory analysis on untreated soils for each treatment layer should be considered where heterogenous materials are present and initial ASS investigations indicate the presence of existing ANC (unverified).

In addition, the pH of all ponded leachate water around the confines of the treatment bunds should be measured daily and results assessed against the criteria provided in Table 5 and also against background (pre-construction) levels. The soil and water contained within the bunded treatment area should not be removed until the target values presented in Table 5 below have been achieved. Treatment of deeper soil layers should not be commenced until the existing surface layer has been validated and removed.

Table 5: Target Levels of Neutralised Soil and Water

Test	Component	Target Level
Monitoring of water (leachate, surface water and groundwater)	pH	6.5 < pH < 8.5, or one pH unit from background levels
	Turbidity	To comply with either values determined in consultation with the Authority or less than local background levels (baseline monitoring required).
	Aluminium (Al) and Iron (Fe)	Establish local water quality data prior to site disturbance and ensure that these values are not exceeded.
	Dissolved Oxygen	To comply with either values determined in consultation with the Authority or less than local background levels (baseline monitoring required).
Field screening of soil[b]	pH_F	$5.5 \leq pH_F \leq 8.5$ (but ideally between pH 6.5 and 8.5)
	pH_{FOX}	$pH_{FOX} > 5$
Acid based accounting of soil (SPOCAS suite OR Chromium Suite)	Net acidity (using appropriate fine factor)[a]	Zero or negative
	pH_{KCL}	$pH_{KCL} \geq 6.5$
	TAA	Zero

Notes To Table 5:
[a] determined using equations C1 / C2 / C3, Appendix C
[b] used as a guide only to assess when adequate neutralisation and soil mixing has been achieved.

It should be noted that laboratory tests will require at least four days turnaround, possibly longer, and hence sufficient time should be allowed in the treatment programme for such verification testing. Only appropriately skilled staff should collect and test verification samples.

12. General Site Monitoring

It is recommended that prior to commencement of works, a Construction Environmental Management Plan (CEMP) should be developed by the lead contractor. The CEMP should also include a programme for general site monitoring pertinent to the ASS. A typical monitoring programme is provided in Table 6 below and should be implemented by the responsible parties.

Table 6: General Monitoring Requirements

Task	Frequency	Standard	Reporting/Record Keeping	Responsibility
Inception Meeting	Pre-start	ASSMP	Minutes	Project Manager, Site supervisor, Environmental Consultant
Site inspection	Daily	Visual/olfactory signs of ASS	File note	Site supervisor
Site inspection	Monthly	Visual/olfactory signs of ASS	File Note	Project Manager
Monitoring of disturbed excavations that are in ASS	Daily	Visual until backfilled	File note	Site supervisor
Monitoring of ASS treatment area/s	Daily	Visual Daily pH testing until results show ASS or leachate has been neutralised (refer Section 10 for criteria and testing requirements)	File note and results of pH testing to be recorded in field sheets	Site supervisor
Dewatering excavation in ASS	Prior to planned discharge	Treated and tested to demonstrate compliance with or regulatory requirements prior to discharge	Field sheets and permit to discharge	Site supervisor/environmental consultant

13. Emergency Incident Response Plan

Construction activities which may cause potential environmental impacts with respect to ASS are summarised in Table 7 below together with recommendations for "Emergency Response Procedures".

Table 7: Emergency Response Procedures

Construction Activity	Potential Environmental Threat	Emergency Response
Excavations	Flooding of open excavation causing adjacent groundwater levels to rise, leading to potential acid leachate once the excavation is drained	• Inform site foreman and project manager/ environmental officer; • Determine pH of groundwater / floodwater in excavation; • Correct groundwater / floodwater pH by application of slaked lime (hydrated lime) to bring pH in range of 6.5 to 8.5 or to pre-construction background levels; • Drain pit to tanks/ponds for water quality assessment prior to discharge.
Treatment / Neutralisation	Soil washes or slips outside of bunded treatment area	• Inform site foreman and project manager/ environmental officer; • Estimate volume of material breaching bund; • Conduct pH analysis of adjacent watercourses (if any) and correct pH if potentially impacted; • Remove escaped soil into a bunded treatment area; • Over-excavate impacted area to 0.2m depth, apply and mix lime at rate as for guard layers (5 kg to 10 kg lime per m^2 of surface).
	Breach in containment bund	• Inform site foreman and project manager/ environmental officer; • Close breach in bund; • Conduct pH analysis of adjacent watercourses (if any); • Correct pH in any adjacent watercourse (if required).
	Extracted untreated groundwater, surface water or leachate is exiting the site in an uncontrolled manner	• Inform site foreman and project manager/ environmental officer; • Restrict/stop source of water; • Conduct pH analysis of adjacent watercourses (if any).

For all construction activity incidents which pose a potential environmental impact, an incident report must be completed in order that:

- The cause of the incident may be determined;
- Additional control measures may be implemented; and
- Work procedures may be modified to reduce the likelihood of the incident re-occurring.

14. Reporting and Record Keeping

With reference to Dear *et al* (2014), it is good practise for the contractor to maintain a record of treatment of acid sulfate soils. Such records should include the following details:

- Date;
- Location / area;
- Time of excavation;
- Neutralisation process undertaken;
- Lime rate utilised;
- Results of monitoring;
- Disposal and/or re-use location; and
- Tonnages and disposal/transfer dockets (if applicable).

A record should also be maintained confirming contingency measures and additional treatment if undertaken. A final report should be issued upon completion of the works presenting the monitoring regime and results, and confirming that appropriate management of ASS has occurred during the works.

15. Conclusions and Recommendations

DP has conducted investigation within Stage 1 of the Astra Aerolab subdivision as part of previous geotechnical and contamination assessments, including investigation within and in the vicinity of the subject site, being proposed Lot 106 and Part Lot 107 of Astra Aerolab Stage 1.

The previous work conducted at the site indicated a low risk of acid sulfate soils to the investigation depths.

Natural soils within the subject site should be considered potential acid sulfate soils (PASS), and treated accordingly, unless further assessment indicates otherwise.

Construction activities such as footing excavation, services installation and dewatering for construction of subsurface structures have been identified as activities that may expose ASS during construction.

This ASSMP provides the ASS management procedures to be enacted to minimise the impact of ASS disturbance on the environment during the proposed works.

It is recommended that further investigation be conducted prior to construction (e.g. as part of more detailed geotechnical investigation for the proposed structure) to further assess the presence and depth of ASS present at the subject site and where required update the treatment category and ASS treatment/management requirements in this ASSMP.

16. References

Ahern, C. R., McElnea, A. E., & Sullivan, L. A. (2004). *Acid Sulfate Soils Laboratory Methods Guidelines. In Queensland Acid Sulfate Soils Manual 2004.* (QASSIT) Indooroopilly, Queensland, Australia: Department of Natural Resources, Mines and Energy.

Dear, S., Ahern, C., O'Brien, L., Dobos, S., McElnea, A., Moore, N., & Watling, K. (2014). *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines.* (QASSIT). Brisbane: Department of Science: Department of Science, Information, Technology, Innovation and the Arts, Queensland Government.

DP. (2009). *Report on Geotechnical Investigation, Williamtown Aerospace Park, Williamtown.* 39728.04: Douglas Partners Pty Ltd.

DP. (2019). *Acid Sulfate Soil Management Plan, Astra Aerolab Stage 1, Williamtown Drive Williamtown.* 39728.19: Douglas Partners Pty Ltd.

Sullivan, L., Ward, N., Toppler, N., & Lancaster, G. (2018). *National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Identification and Laboratory Methods Manual.* Canberra ACT CC BY 4.0: Department of Agriculture and Water Resources.

17. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Lot 106 and Par Lot 107 Williamtown Drive, Williamtown with reference to DP's proposal dated 25 May 2023 and acceptance received from Cox Architects on behalf of Newcastle Airport Pty Limited dated 25 May 2023. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Newcastle Airport Pty Limited for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the environmental components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

Drawing 1 – Site Location and Former Test Locations
Cox Architecture DA Submission Plans Ref 221182

Site Location

0 10 20 30 40 m

Drawing adapted from Metromap Image dated 19.9.2022.

Legend

Lot 106

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Cox Architecture Pty Ltd		TITLE: **Site Plan and Previous Test Locations**	PROJECT No: 39728.27
OFFICE: Newcastle	DRAWN BY: PLH	**Proposed Commercial Building 1**	DRAWING No: 1
SCALE: 1:1,000 @ A3	DATE: 13.September.2022	**Lot 106 Williamtown Drive, Williamtown**	REVISION: 0

NEWCASTLE AIRPORT P.L. - COMMERCIAL BUILDING 1- Astro Aerolab Lot 106

DRAWING LIST

SHEET No.	SHEET NAME	Current Revision
10 Development Application		
A-DA-0101	COVER SHEET - DRAWING INDEX	A
A-DA-1001	SITE ANALYSIS PLAN	A
A-DA-1002	SITE PLAN	A
A-DA-2001	FLOOR PLAN - GROUND FLOOR	A
A-DA-2002	FLOOR PLAN - LEVEL 01	A
A-DA-2003	FLOOR PLAN - LEVEL 02	A
A-DA-2004	FLOOR PLANS - TYPICAL LEVEL	A
A-DA-2005	ROOF TERRACE	A
A-DA-2006	ROOF PLAN	A
A-DA-3001	NORTH ELEVATION	A
A-DA-3002	SOUTH ELEVATION	A
A-DA-3003	EAST ELEVATION	A
A-DA-3004	WEST ELEVATION	A
A-DA-4001	SECTION 01	A
A-DA-4002	SECTION 02	A
A-DA-7000	GFA SCHEDULE	A
A-DA-8000	SHADOW DIAGRAMS	A
A-DA-8100	3D VIEWS	A
A-DA-9100	NOTIFICATION PLAN	A
A-DA-9200	VISUAL IMPACT ASSESSMENT	A

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Client	NEWCASTLE AIRPORT PTY LIMITED
Project No.	221182
Document Control Status:	ISSUE FOR DA
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	COVER SHEET - DRAWING INDEX
Co-ordinated:	ZS
Project Architect:	ZS
Project Director:	JF
Drawing Number:	A-DA-0101
Drawn:	SP
Scale:	@ A1
Date:	09/16/22
Revision:	A

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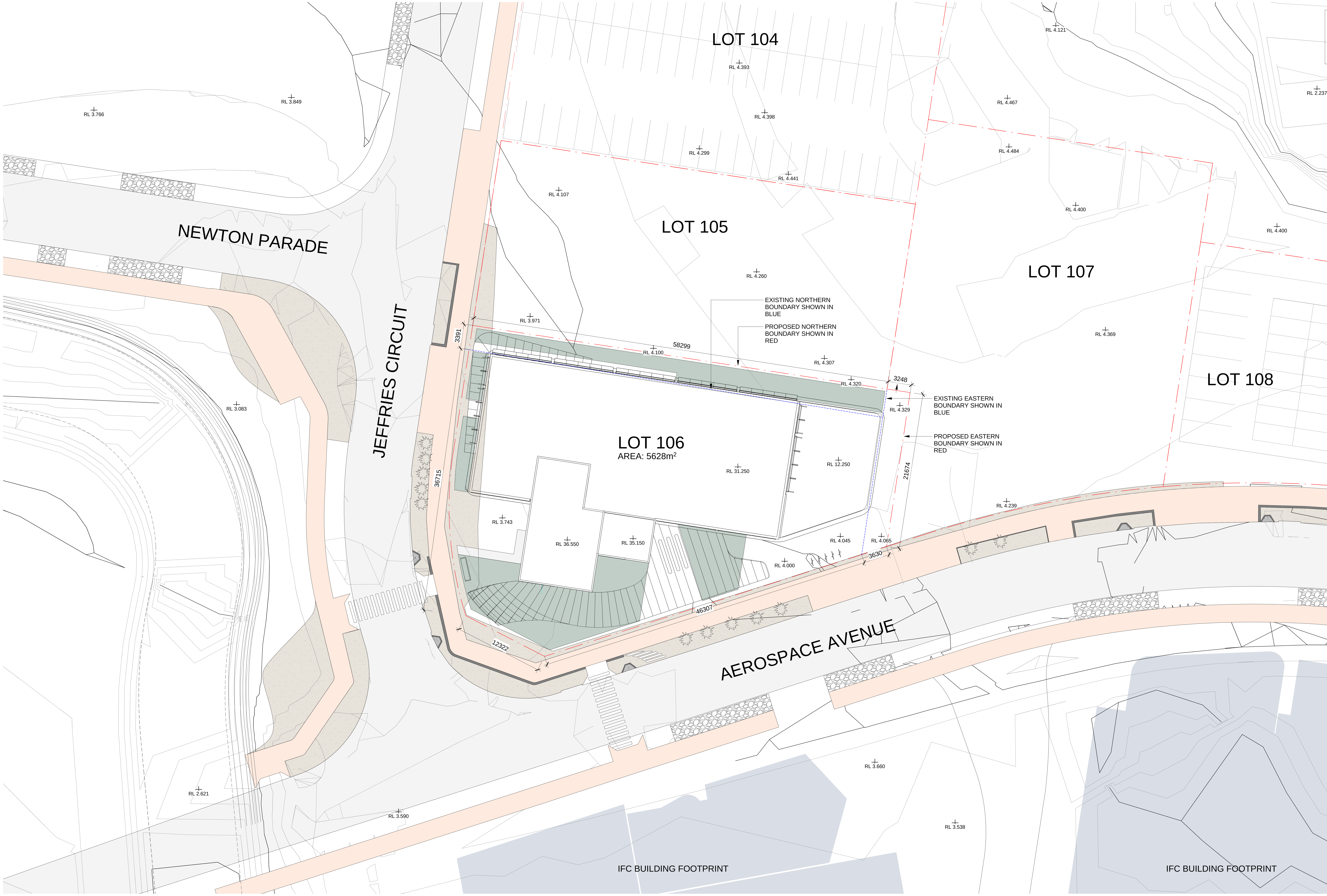
Client	NEWCASTLE AIRPORT PTY LIMITED
Project No.	221182
Document Control Status:	ISSUE FOR DA
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	SITE ANALYSIS PLAN
Co-ordinated:	Checker
Project Architect:	Designer
Project Director:	Approver
Drawing Number:	A-DA-1001
Drawn:	Author
Scale:	As indicated @ A1
Date:	07/21/22
Revision:	A

PLOT STAMP DATE: 19/09/2022 7:38:58 PM

SITE AREA: 2125M2
GFA: 5705M2



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Client	NEWCASTLE AIRPORT PTY LIMITED
Project No.	221182
Document Control Status:	ISSUE FOR DA
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	SITE PLAN
Co-ordinated:	Checker
Project Architect:	Designer
Project Director:	Approver
Drawing Number:	A-DA-1002
Drawn:	Author
Scale:	1 : 250 @ A1
Date:	08/16/22
Revision:	A

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Project No.	221182
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Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	FLOOR PLAN - GROUND FLOOR
Co-ordinated:	ZS
Project Architect:	ZS
Project Director:	JF
Drawing Number:	A-DA-2001
Drawn:	SP
Scale:	As indicated @ A1
Date:	02/09/22
Revision:	A

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Client: NEWCASTLE AIRPORT PTY LIMITED
Project No.: 221182
Document Control Status: ISSUE FOR DA
Project: NAPL-COMMERCIAL BUILDING 1
Astro Aerolab - Lot 106
Drawing Title: FLOOR PLAN - LEVEL 01
Co-ordinated: ZS
Project Architect: ZS
Project Director: JF
Drawing Number: A-DA-2002
Drawn: SP/AF
Scale: 1 : 100 @ A1
Date: 02/09/22
Revision: A

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Client	NEWCASTLE AIRPORT PTY LIMITED
Project No.	221182
Document Control Status:	ISSUE FOR DA
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	FLOOR PLAN - LEVEL 02
Co-ordinated:	ZS
Project Architect:	ZS
Project Director:	JF
Drawing Number:	A-DA-2003
Drawn:	SP/AF
Scale:	1 : 100 @ A1
Date:	09/06/22
Revision:	A

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Project No. 221182

Document Control Status: ISSUE FOR DA

Project NAPL-COMMERCIAL BUILDING 1
Astro Aerolab - Lot 106

Drawing Title FLOOR PLANS - TYPICAL LEVEL

Co-ordinated: ZS

Project Architect: ZS

Project Director: JF

Drawing Number: A-DA-2004

Drawn: SP/AF

Scale: 1 : 100 @ A1

Date: 02/09/22

Revision: A

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Client	NEWCASTLE AIRPORT PTY LIMITED
Project No.	221182
Document Control Status:	ISSUE FOR DA
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	ROOF TERRACE
Co-ordinated:	ZS
Project Architect:	ZS
Project Director:	JF
Drawing Number:	A-DA-2005
Drawn:	SP/AF
Scale:	1 : 100 @ A1
Date:	08/12/22
Revision:	A

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Client NEWCASTLE AIRPORT PTY LIMITED

Project No. 221182

Document Control Status: ISSUE FOR DA

Project NAPL-COMMERCIAL BUILDING 1
Astro Aerolab - Lot 106

Drawing Title ROOF PLAN

Co-ordinated: ZS

Project Architect: ZS

Project Director: JH

Drawing Number: A-DA-2006

Drawn: SP/AF

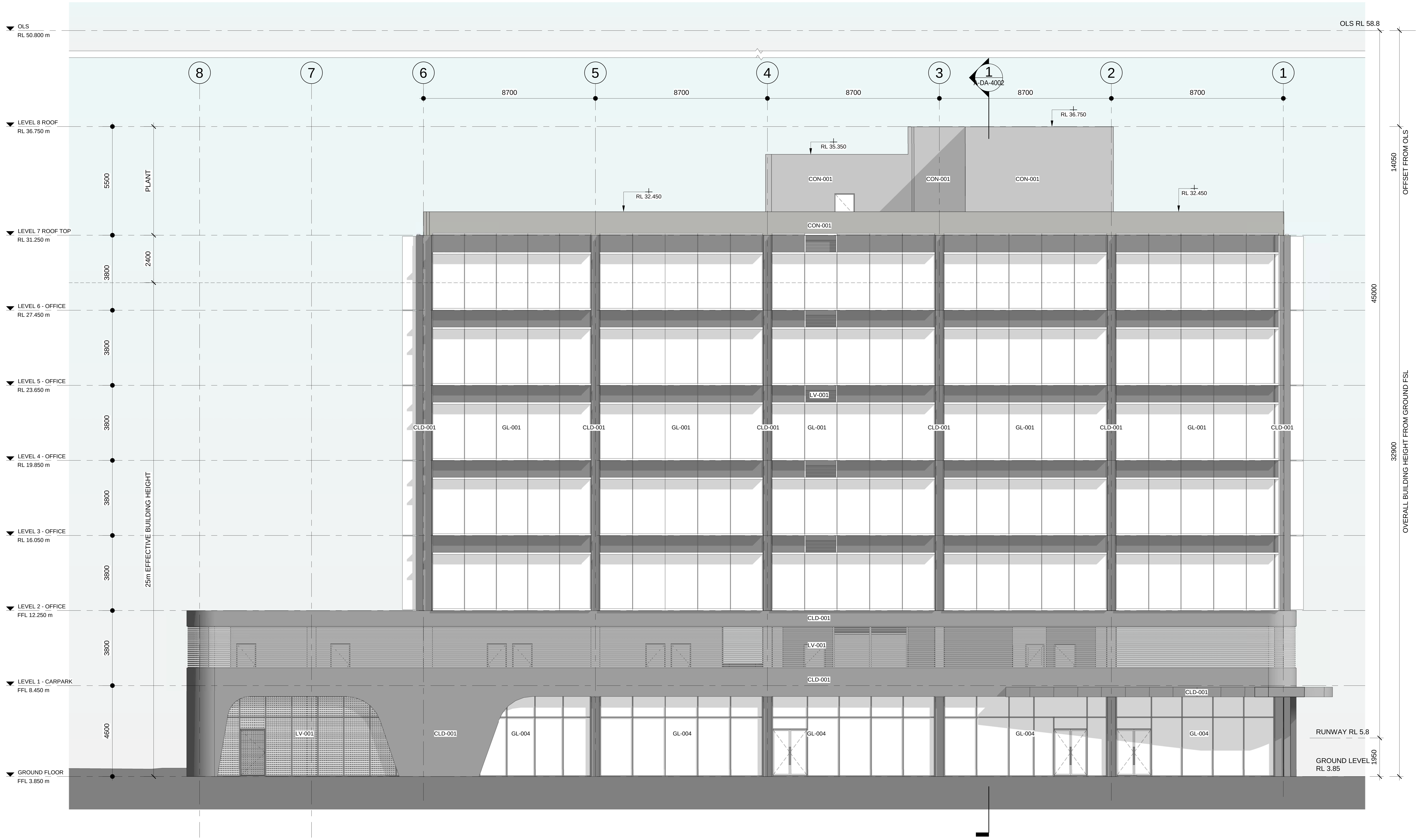
Scale: 1 : 100 @ A1

Date: 07/21/22

Revision: A

PLOT STAMP DATE: 30/09/2022 5:13:13 PM

External materials	
Material Code	Material Description
CLD-001	Aluminium cladding
CLD-002	Equitone cladding
CON-001	<varies>
GL-001	Curtain wall: Vision glass panel, Colour back glass spandrel panel. Horizontal Aluminium Louvres for sun protection
GL-002	Curtain wall: Vision glass panel, Colour back glass spandrel panel. Vertical Aluminium Louvres for sun protection
GL-003	Curtain wall: Vision glass panel, Colour back glass spandrel panel
GL-004	Shop front vision glass
LV-001	Weather proof louvre
LV-002	Metal Roller shutter, colour to match weather proof louvres



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Client	NEWCASTLE AIRPORT PTY LIMITED
Project No.	221182
Document Control Status:	ISSUE FOR DA
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	NORTH ELEVATION
Co-ordinated:	ZS
Project Architect:	ZS
Project Director:	JF
Drawing Number:	A-DA-3001
Drawn:	SP/AF
Scale:	1 : 100 @ A1
Date:	12/08/22
Revision:	A

PLOT STAMP DATE: 30/09/2022 5:35:33 PM

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CLD-002	Equitone cladding
CON-001	<varies>
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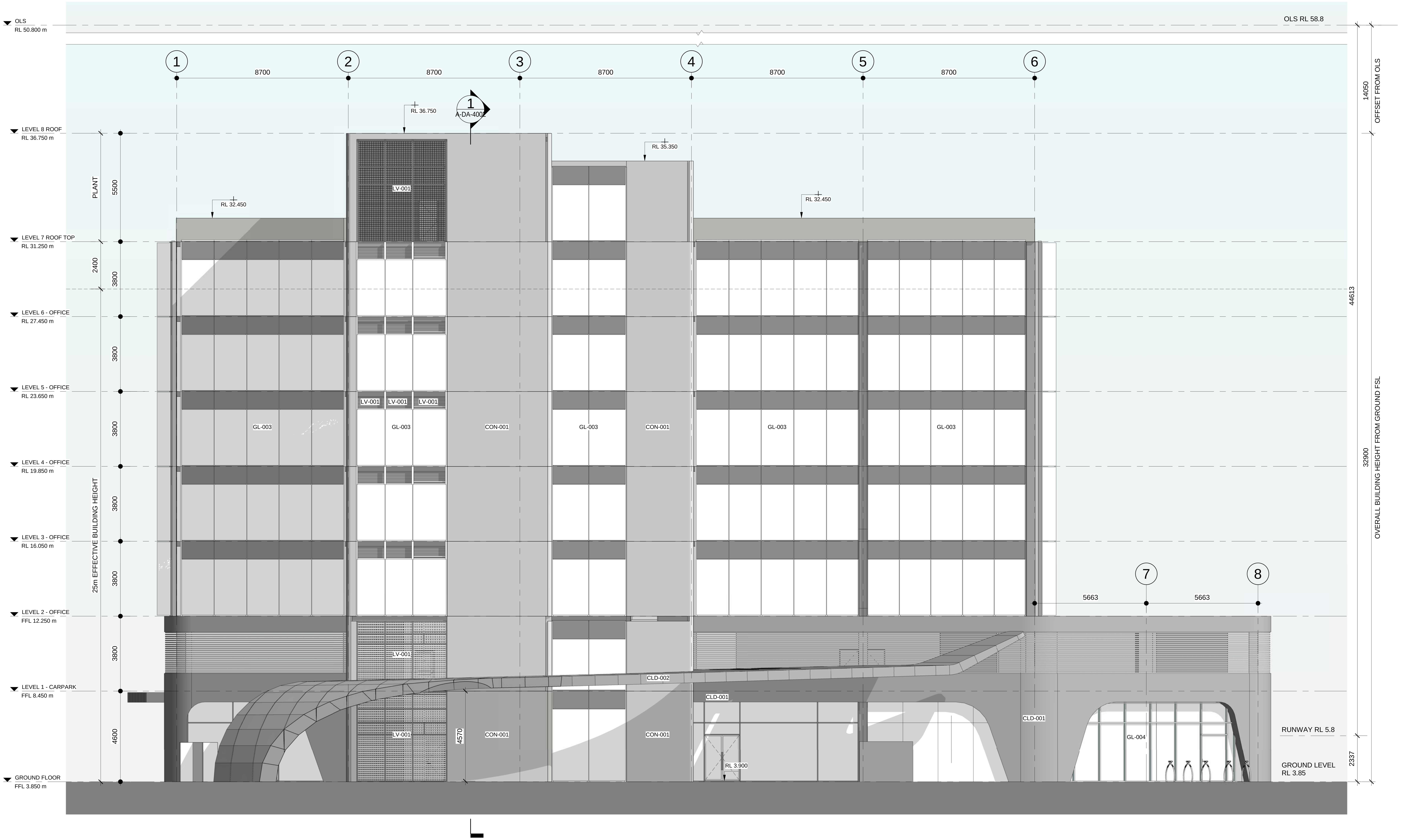
GL-002	Curtain wall: Vision glass panel, Colour back glass spandrel panel. Vertical Aluminium Louvres for sun protection
GL-003	Curtain wall: Vision glass panel, Colour back glass spandrel panel
GL-004	Shop front vision glass
LV-001	Weather proof louvre
LV-002	Metal Roller shutter, colour to match weather proof louvres



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Client	NEWCASTLE AIRPORT PTY LIMITED
Project No.	221182
Document Control Status:	ISSUE FOR DA
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	SOUTH ELEVATION
Co-ordinated:	ZS
Project Architect:	ZS
Project Director:	JF
Drawing Number:	A-DA-3002
Drawn:	SP/AF
Scale:	1 : 100 @ A1
Date:	07/21/22
Revision:	A

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Material Code	Material Description
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CLD-002	Equitone cladding
CON-001	<varies>
GL-001	Curtain wall: Vision glass panel, Colour back glass spandrel panel. Horizontal Aluminium Louvres for sun protection
GL-002	Curtain wall: Vision glass panel, Colour back glass spandrel panel. Vertical Aluminium Louvres for sun protection
GL-003	Curtain wall: Vision glass panel, Colour back glass spandrel panel
GL-004	Shop front vision glass
LV-001	Weather proof louvre
LV-002	Metal Roller shutter, colour to match weather proof louvres

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Project No.: 221182

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Project: NAPL-COMMERCIAL BUILDING 1
Astro Aerolab - Lot 106

Drawing Title: EAST ELEVATION

Co-ordinated: ZS

Drawn: SP/AF

Project Architect: ZS

Scale: 1 : 100 @ A1

Project Director: JF

Date: 07/21/22

Drawing Number: A-DA-3003

Revision: A

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External materials

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CLD-002	Equitone cladding
CON-001	<varies>
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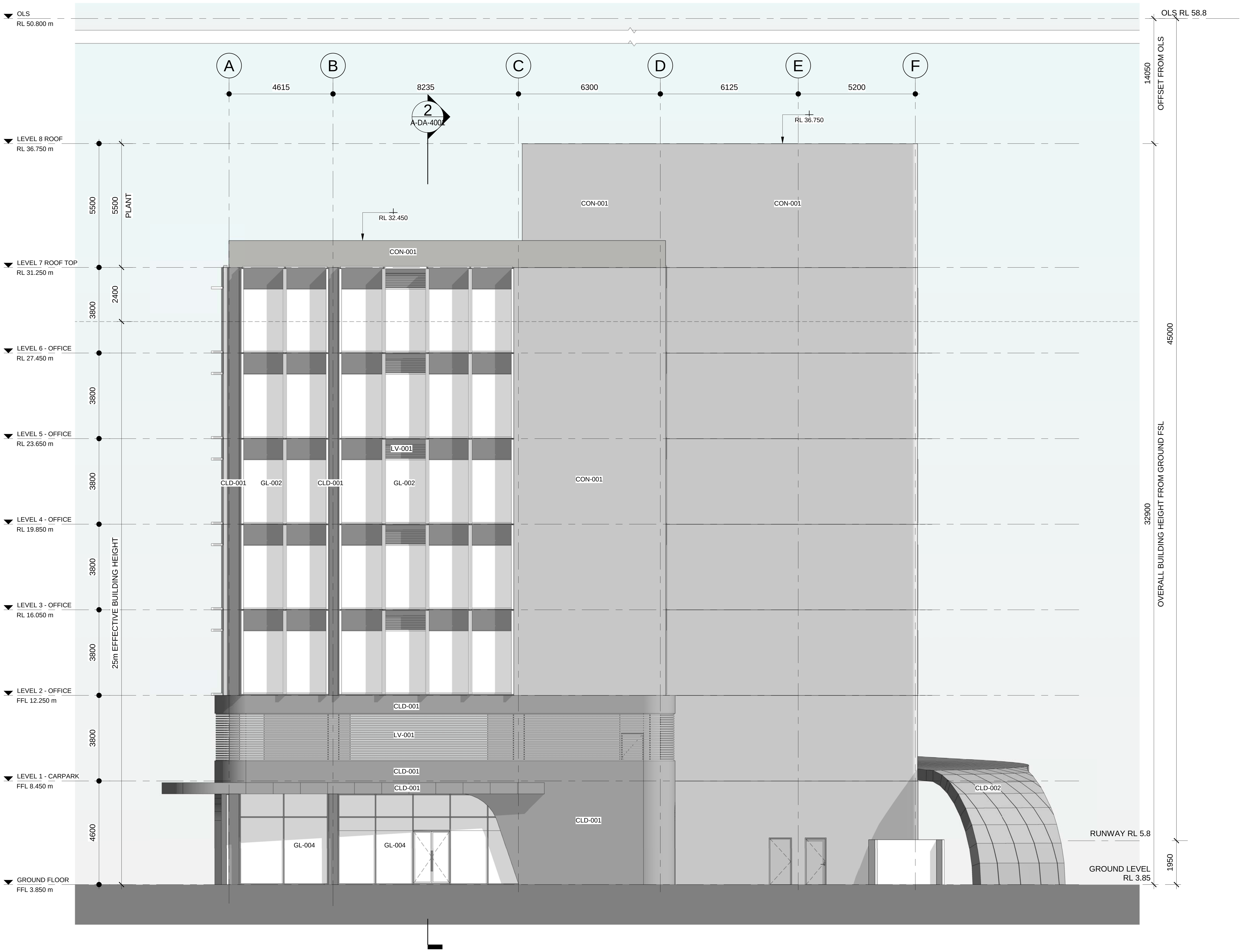
GL-002	Curtain wall: Vision glass panel, Colour back glass spandrel panel. Vertical Aluminium Louvres for sun protection
GL-003	Curtain wall: Vision glass panel, Colour back glass spandrel panel
GL-004	Shop front vision glass
LV-001	Weather proof louvre
LV-002	Metal Roller shutter, colour to match weather proof louvres



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Project No.	221182
Document Control Status:	ISSUE FOR DA
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	WEST ELEVATION
Co-ordinated:	ZS
Project Architect:	ZS
Project Director:	JF
Drawing Number:	A-DA-3004
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Date:	07/21/22
Revision:	A

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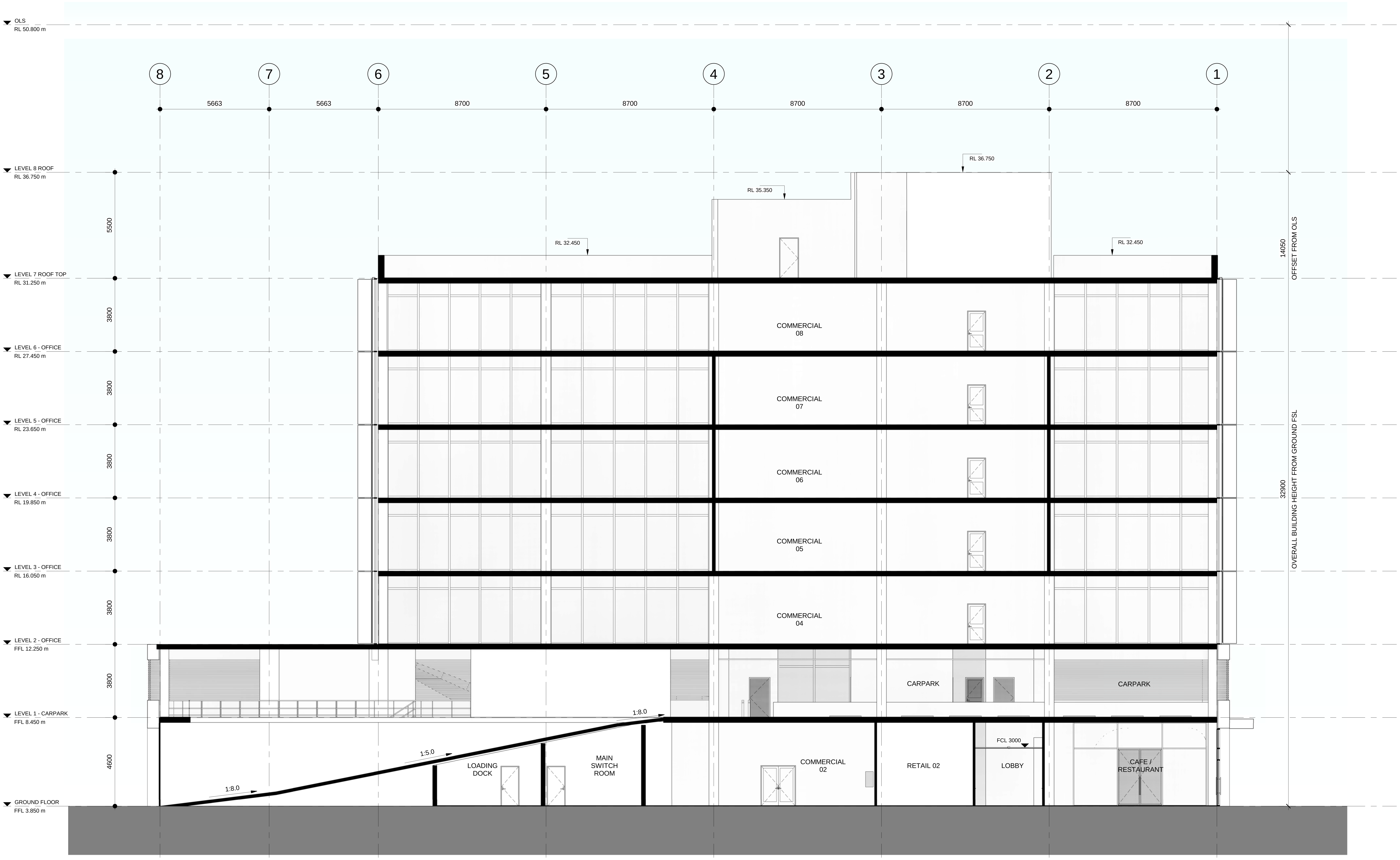

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Project No.	221182
Document Control Status:	ISSUE FOR DA
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	SECTION 01
Co-ordinated:	ZS
Project Architect:	ZS
Project Director:	JF
Drawing Number:	A-DA-4001
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Date:	07/21/22
Revision:	A

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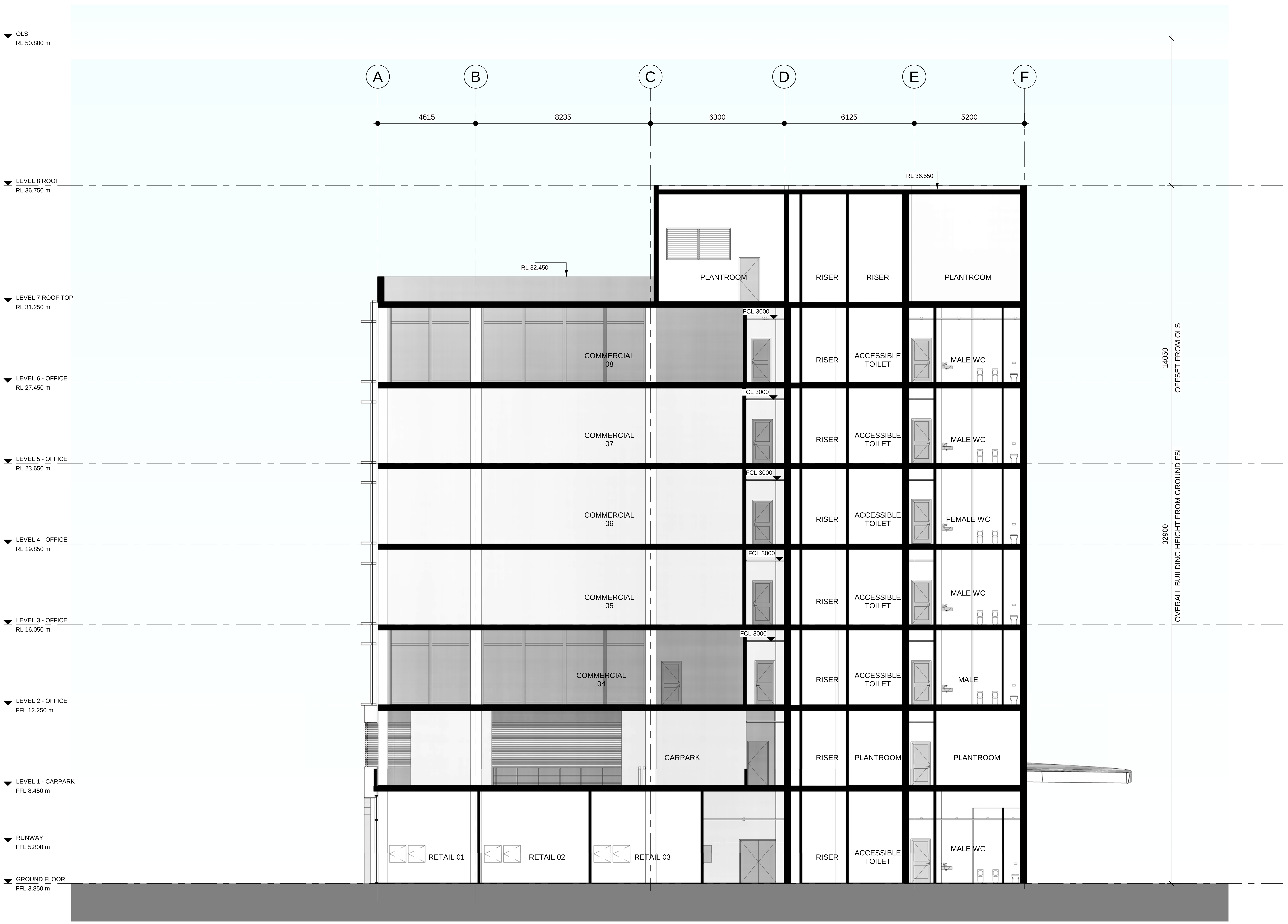

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Client	NEWCASTLE AIRPORT PTY LIMITED
Project No.	221182
Document Control Status:	ISSUE FOR DA
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	SECTION 02
Co-ordinated:	ZS
Project Architect:	ZS
Project Director:	JF
Drawing Number:	A-DA-4002
Drawn:	SP/AF
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Date:	12/08/22
Revision:	A

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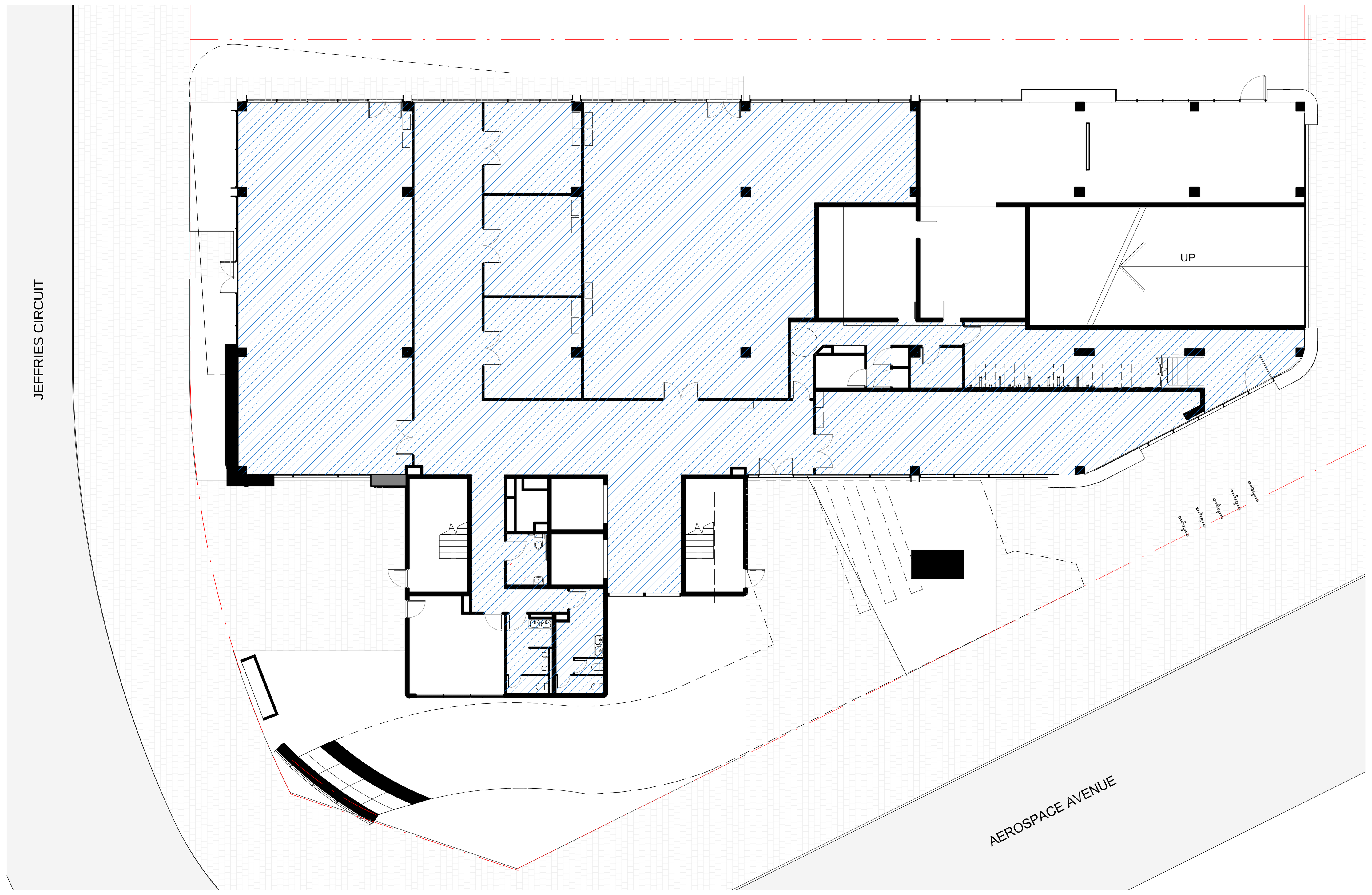
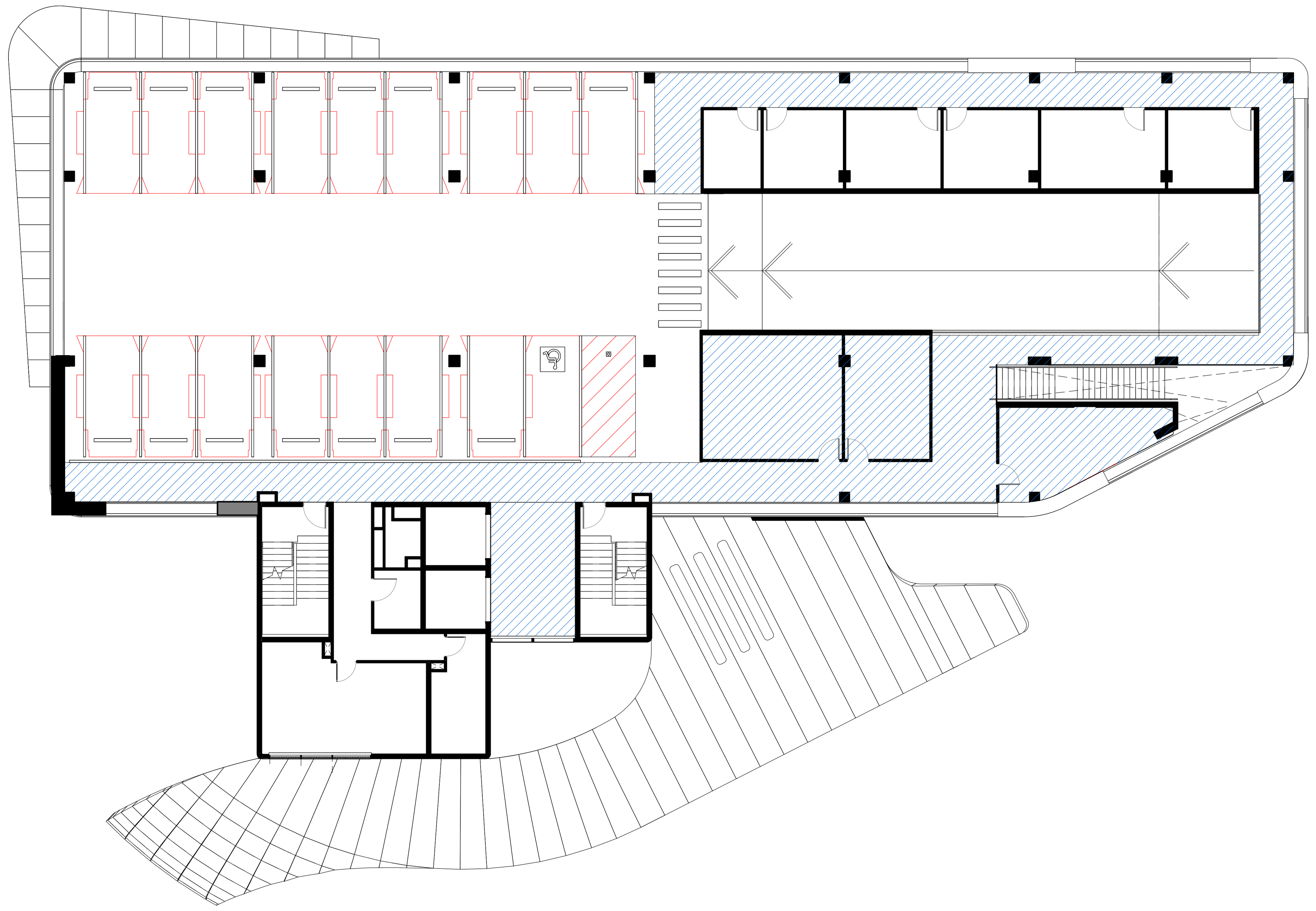
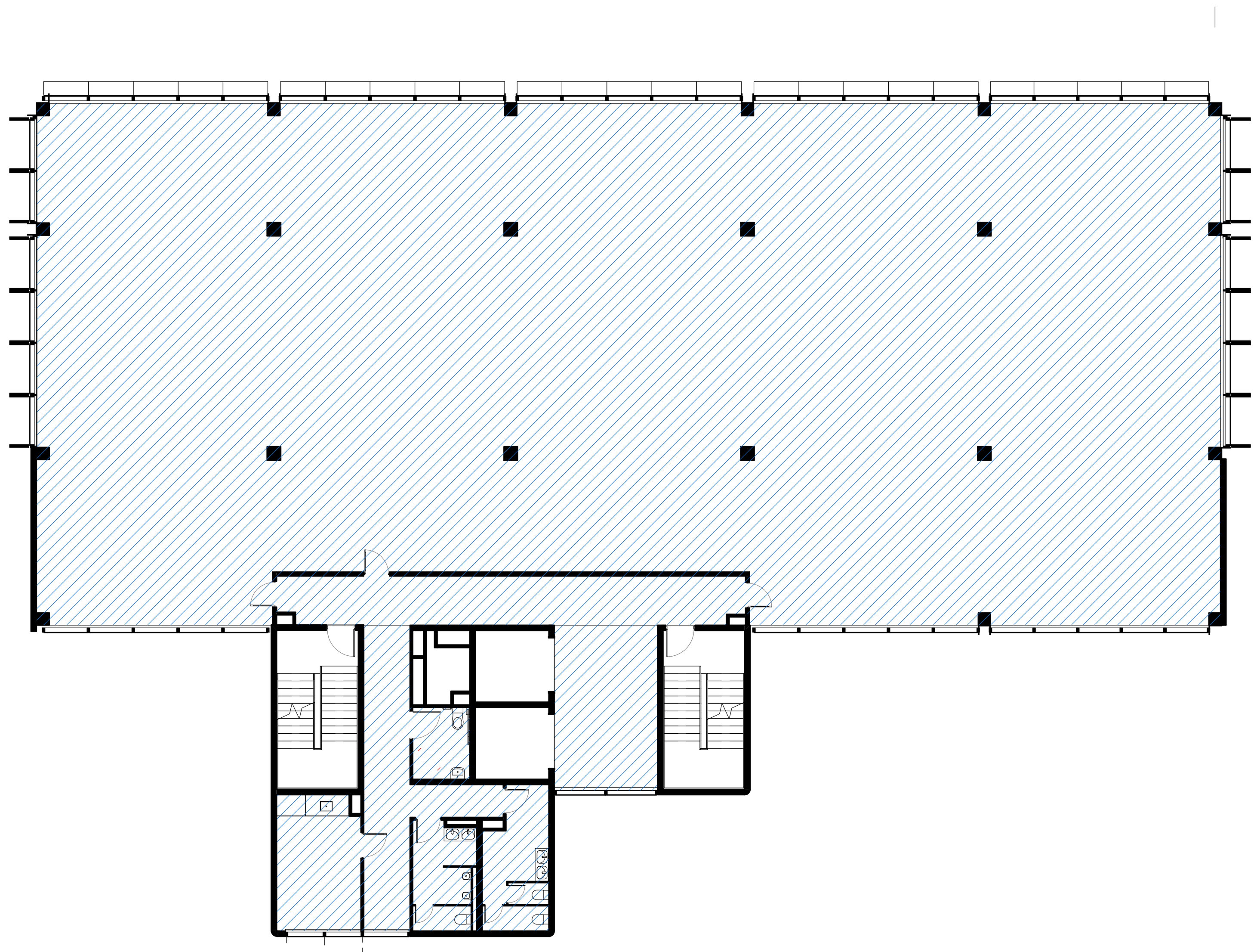


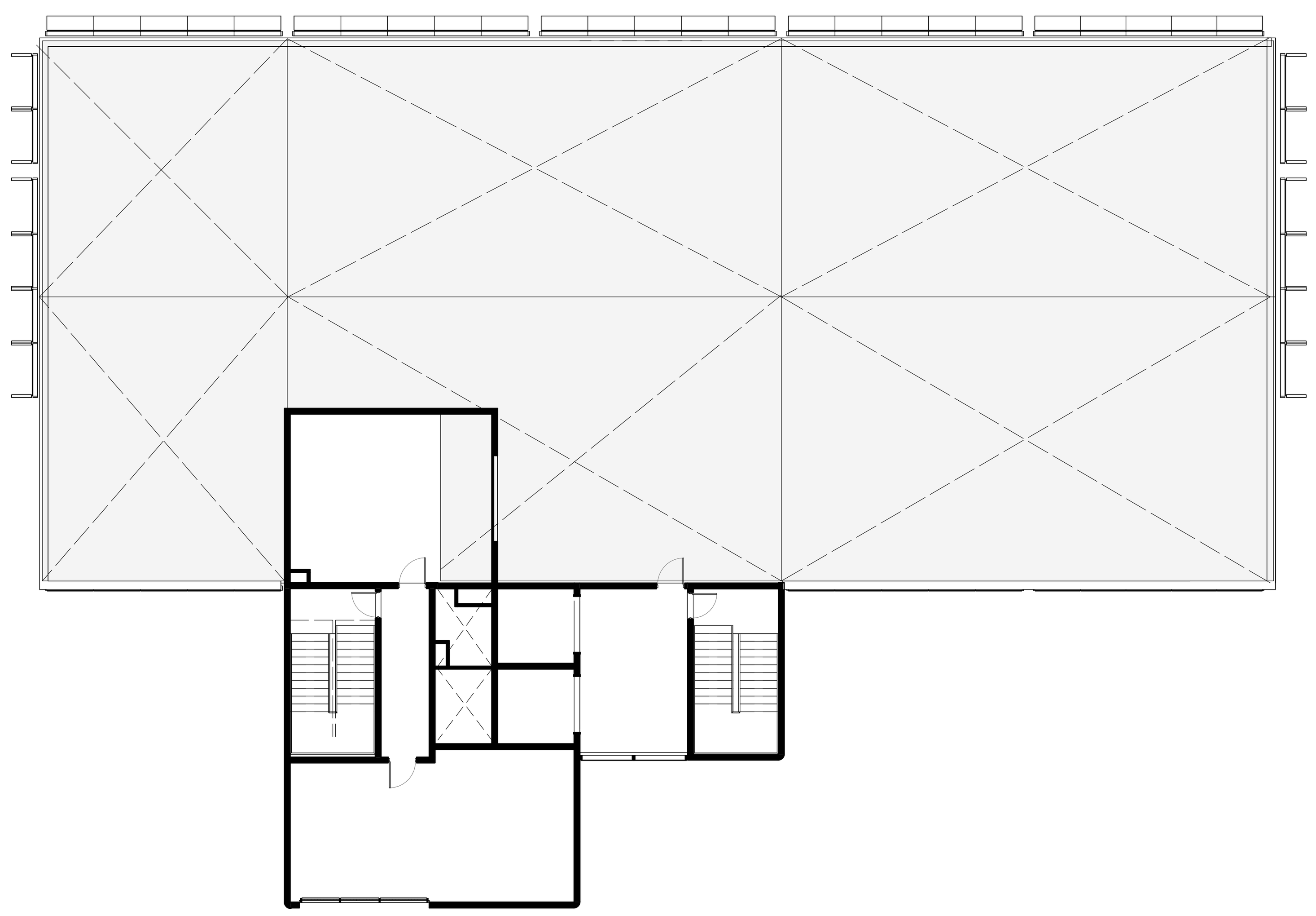
GFA - GROUND FLOOR TOTAL: 811 sqm



GFA - LEVEL 01 TOTAL: 279 sqm



GFA - TYPICAL FLOOR (LEVEL 2-6) TOTAL: 923 sqm



GFA- LEVEL 07 TOTAL: 0 sqm

GROSS FLOOR AREA

Floor	sqm
Ground Floor	811
Level 01 Carpark	279
Level 02 Commercial	923
Level 03 Commercial	923
Level 04 Commercial	923
Level 05 Commercial	923
Level 06 Commercial	923
Level 07 Roof Terrace	0
Total	**5705**

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Client: NEWCASTLE AIRPORT PTY LIMITED
Project No.: 221182
Document Control Status: ISSUE FOR DA

Project: NAPL-COMMERCIAL BUILDING 1
Astro Aerolab - Lot 106
Drawing Title: GFA SCHEDULE

Co-ordinated: SPG
Project Architect: ZS
Project Director: JF
Drawing Number: A-DA-7000

Drawn: SPG
Scale: 1 : 200 @ A1
Date: 09/16/22
Revision: A

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Client NEWCASTLE AIRPORT PTY LIMITED	**Project** NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106	**Co-ordinated:** Checker	**Drawn:** Author
Project No. 221182		**Project Architect:** Designer	**Scale:** 1 : 700 @ A1
Document Control Status: ISSUE FOR DA	**Drawing Title** SHADOW DIAGRAMS	**Project Director:** Approver	**Date:** 09/14/22
		Drawing Number: A-DA-8000	**Revision:** A

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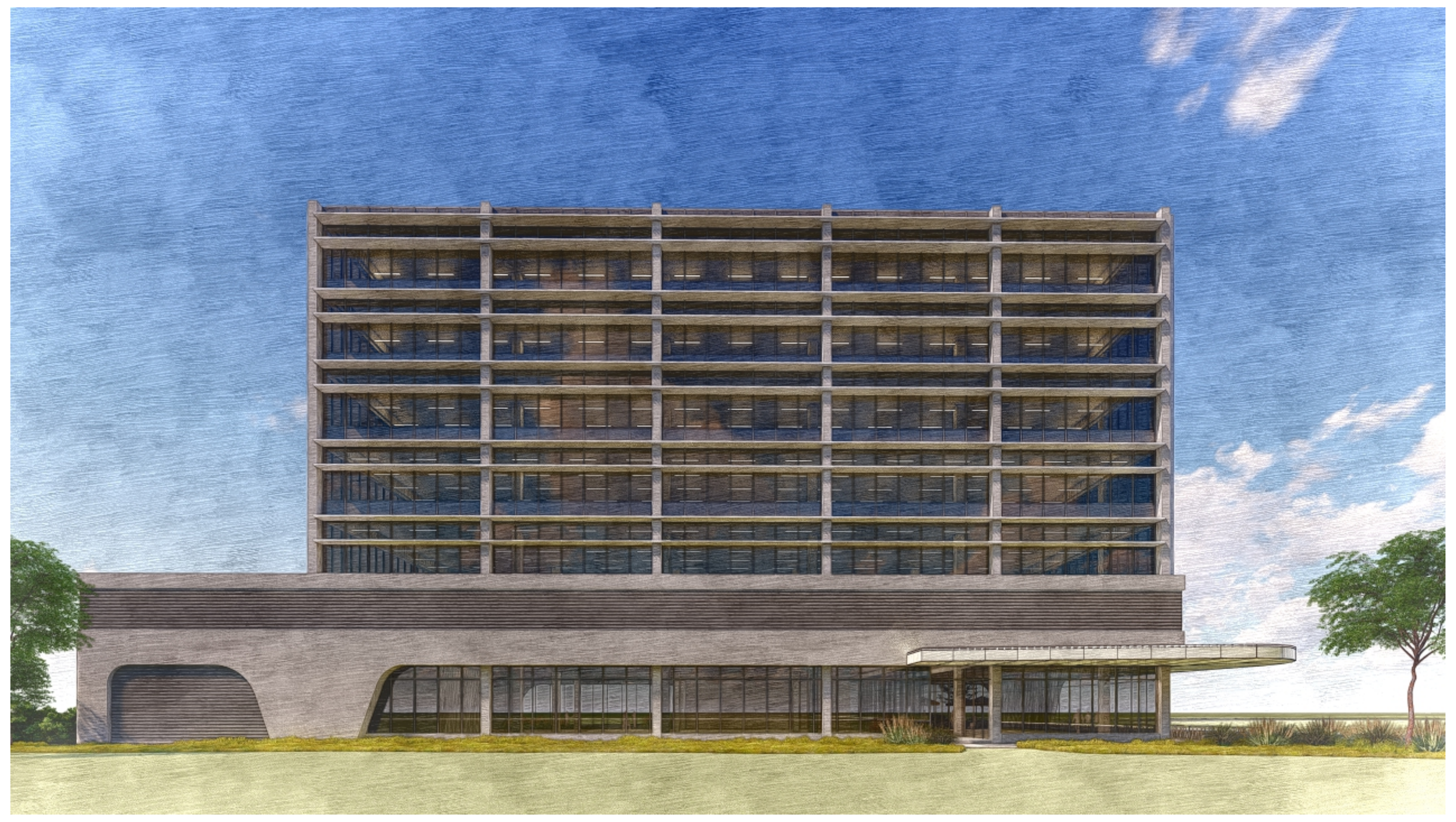
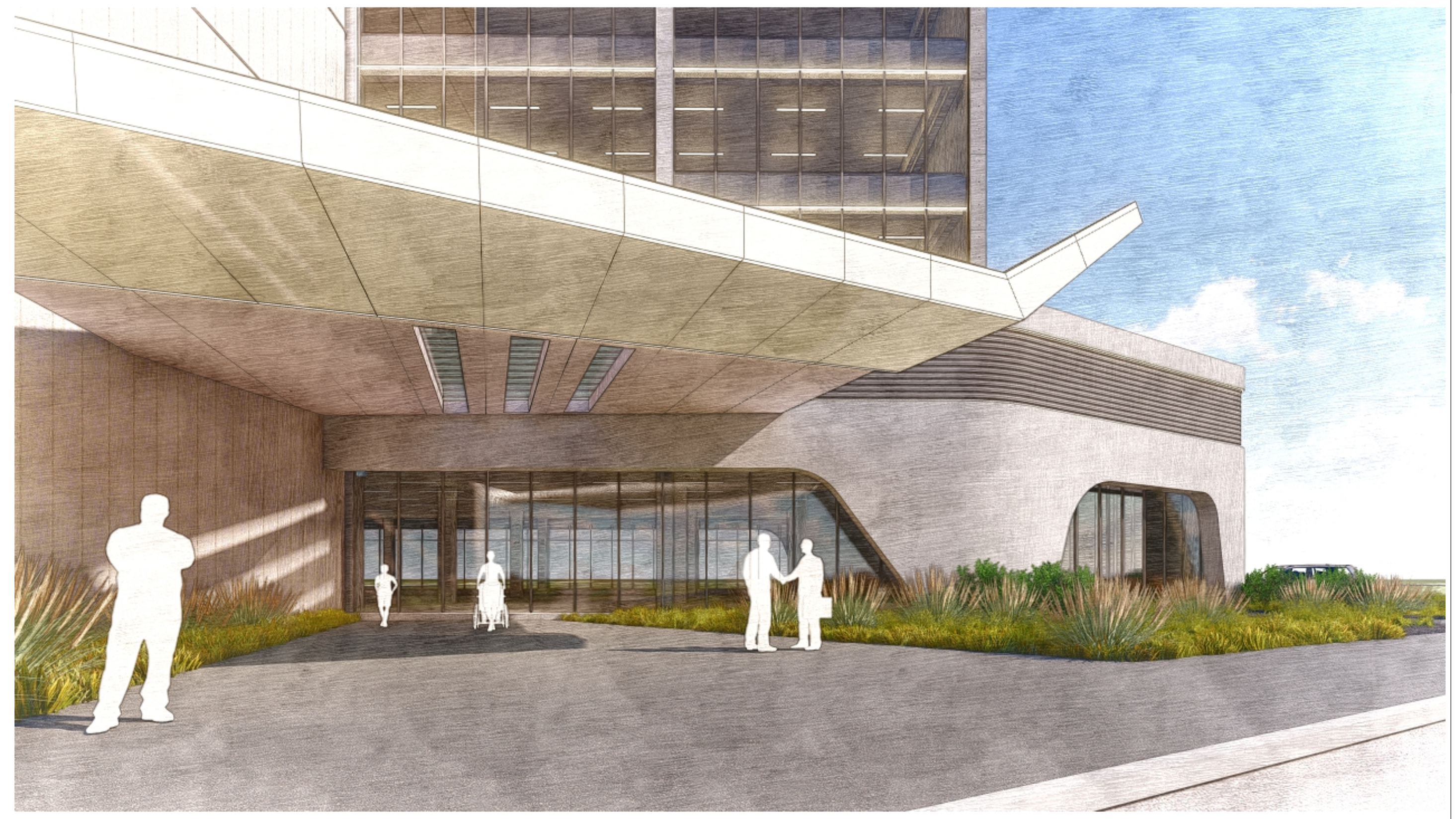
View from the South West



View from the North



View of the Entry

View from the West

View from the East

Finishes - The building is a simple and robust design with off shutter concrete construction with aluminium framing to the double glazing andf shading devices while the canopies are finished equitone cladding panels

View of the entrance from Aerospace Avenue

COX

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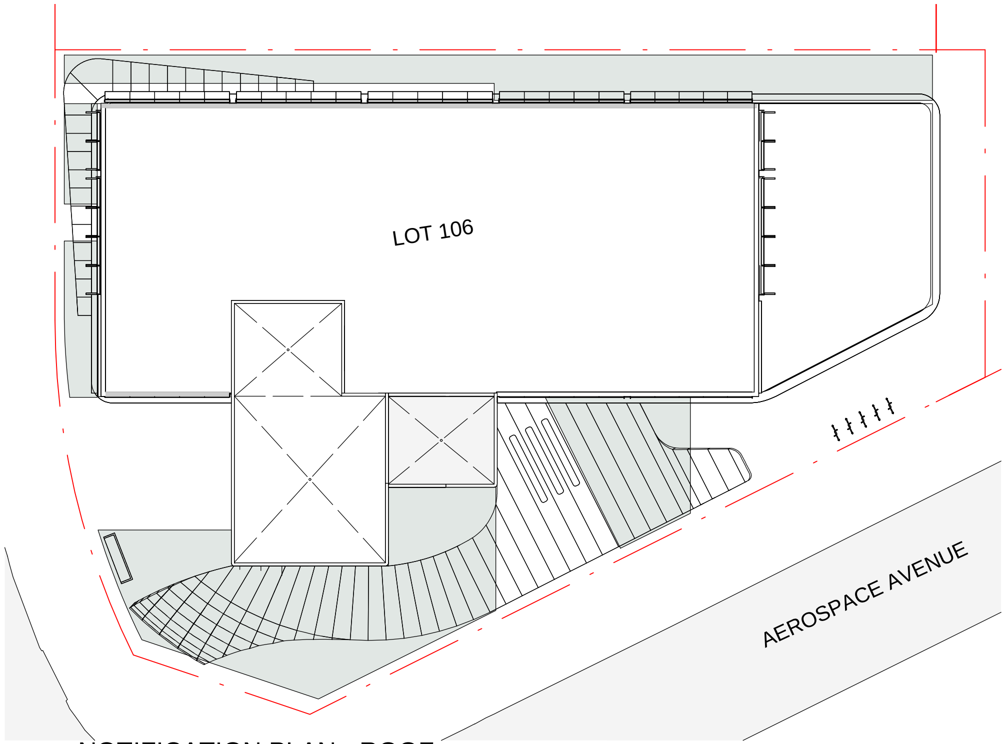
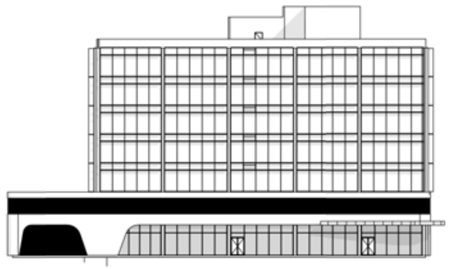
Client	NEWCASTLE AIRPORT PTY LIMITED
Project No.	221182
Document Control Status:	DA SUBMISSION
Project	NAPL-COMMERCIAL BUILDING 1 Astro Aerolab - Lot 106
Drawing Title	3D VIEWS
Co-ordinated:	SPG
Project Architect:	ZS
Project Director:	JF
Drawing Number:	A-DA-8100
Drawn:	SPG
Scale:	
Date:	09/16/22
Revision:	

PLOT STAMP DATE: 12/08/2022 11:32:49 PM

JEFFRIES CIRCUIT

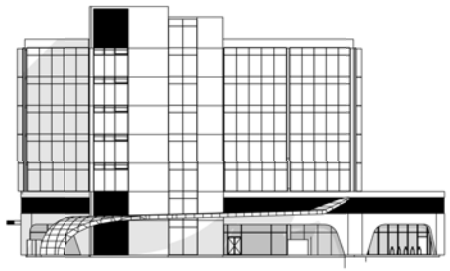


NOTIFICATION PLAN - ROOF
1 : 500



NOTIFICATION PLAN - NORTH ELEVATION
1 : 1000

NOTIFICATION PLAN - EAST ELEVATION
1 : 1000



NOTIFICATION PLAN - SOUTH ELEVATION
1 : 1000

NOTIFICATION PLAN - WEST ELEVATION
1 : 1000

COX

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Rev	Description	By	Date

Client
NEWCASTLE AIRPORT PTY LIMITED

Project No.
221182

Document Control Status:
ISSUE FOR DA

Project
NAPL-COMMERCIAL BUILDING 1
Astro Aerolab - Lot 106

Drawing Title
NOTIFICATION PLAN

Co-ordinated: ZS

Project Architect: ZS

Project Director: JF

Drawing Number: A-DA-9100

Drawn: AF/SP

Scale: As indicated @ A4

Date: 09/16/22

Revision:

PLOT STAMP DATE: 19/09/2022 7:54:43 PM

Appendix B

About this Report

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix C

ASS and Verification Criteria

Appendix C
Action Criteria and Treatment Verification
Williamtown Drive, Williamtown

C1.0 Introduction

This appendix details the acid sulfate soil action criteria, acid sulfate soil treatment verification criteria, and waste classification criteria. The action criteria are based on Sullivan *et al* (2018a).

C2.0 Action Criteria – Determination of ASS

The following section provides the indicators and action criteria to determine if the soil is ASS and if acid sulfate soil management is required.

C2.1 Field Screening

Field screening indicators do not form part of the Assessment Criteria as such but can be used to provide an indication of the ASS status and to assist in selecting samples for laboratory testing.

Field screening is indicative only and can give false positive and false negative indications of the presence of ASS. False positives can be caused by organic matter, which often "froths" during oxidation. False negatives can be caused by shells in the soil. Indicators of ASS from field screening comprise:

- Field pH (pH_F) is less than or equal to pH 4;
- pH_{FOX} is less than 3.5;
- A decrease of 1 pH unit or more from the field pH_F to the pH_{FOX};
- Bubbling, production of heat or release of sulphur odours during pH_{FOX} testing; and
- Change in colour from grey to brown tones during oxidation.

C2.2 Laboratory Analysis

The action criteria triggers are the basis for determining if management of ASS and an ASSMP is required. They are based on Net Acidity, determined by acid base accounting (ABA) procedures for ASS materials noting the acid neutralising capacity (ANC) must be verified. As clay content tends to influence a soil's natural buffering capacity, the action criteria are grouped by three broad texture categories – coarse, medium and fine. The action criteria is also grouped on the basis of quantity of materials disturbed. If the Net Acidity of any individual soil tested is equal to or greater than the action criterion management of ASS will be required and a detailed ASS management plan (ASSMP) will need to be prepared.

If the results are below the action criteria (i.e. the risk of ASS disturbance does not warrant treatment), ASS treatment and an ASSMP is not required. The following Table C1 provides the action criteria (Sullivan et al (2018a).

Table C1: Action Criteria

Type of Material		Net Acidity#			
		1-1000 t materials disturbed		>1000 t materials disturbed	
Texture Range (NCST 2009)*	Approximate Clay Content %)	% S-equiv (oven dried basis)	Mol H+/t (oven dried basis)	% S-equiv (oven dried basis)	Mol H+/t (oven dried basis)
Fine: light medium to heavy clay	>40	≥ 0.1	≥ 62	≥ 0.03	≥ 18
Medium: clayey sand to light clays	5-40	≥ 0.06	≥ 36	≥ 0.03	≥ 18
Coarse and Peats: sands to loamy sands	<5	≥ 0.03	≥ 18	≥ 0.03	≥ 18

Notes to Table C1:

* If bulk density values are not available for the conversion of cubic meters to tonnes of soil, then the default bulk densities based on the soil texture in Table C2, may be used.

Net Acidity can only include a soil material's measured Acid Neutralising Capacity where this measure has been corroborated by other data (for example slab or chip-tray incubation data as outlined in Appendix C of Sullivan et al (2018a)) that demonstrates the soil material does not experience acidification during complete oxidation under field conditions (Equation C1). Where the Acid Neutralising Capacity has not been corroborated, the Net Acidity must be determined using Equation C2.

Table C2 Default bulk densities based on soil texture.

Texture	Bulk Density (t/m^3)#
Sand	1.8
Loamy Sand	1.8
Sandy Loam	1.7
Loam	1.6
Silty Loam	1.5
Clay Loam	1.5
Clay	1.4
Peat	1.0

Notes to Table C2:

Bulk densities to be used in the absence of site-specific data

C3.0 Verification of Treatment

The following section provides the equations and methods of verifying that the neutralisation treatment has been successful / completed.

C3.1 Field Screening

Field screening results will be considered to be acceptable when the results are below the adopted criteria. When soils do meet the following criteria, confirmatory laboratory testing should be undertaken.

- Field pH (pH_F) is ≥ 5.5 (but ideally between pH 6.5 and 8.5); and
- pH_{FOX} >5.

C3.2 Laboratory Testing

C3.2.1 General

The soil will be considered successfully treated where:

- pH_{KCL} is ≥ 6.5;
- (Total actual acidity) TAA = 0; and
- Net acidity ≤ 0. Net Acidity must be determined by one of the methods outlined in Section CC3.2.2

C3.2.2 Net Acidity

Net Acidity is the quantitative measure of the acidity hazard of ASS. It is determined from an Acid Base Accounting (ABA) approach using one of the equations below. Equations C1 and C2 are used to determine the net acidity prior to treatment of ASS and therefore if acid sulfate soil treatment and / or management plan is required. Equation C3 is used to determine if the neutralisation treatment has been successful.

- Equation C1 - when the effectiveness of a soil's measured Acid Neutralising Capacity has been corroborated by other data demonstrating the soil does not experience acidification during complete oxidation under field conditions; or
- Equation C2 - when the effectiveness of a soil's measured Acid Neutralising Capacity has not been corroborated by other data; or
- Equation C3 – when the effectiveness of a management approach involving the addition of liming materials is being verified post treatment via calculation of the Verification Net Acidity.

Equation C1 Net Acidity whereby acid neutralising capacity (ANC) has been corroborated by other data.

Net Acidity = potential sulfidic acidity + actual acidity + retained acidity – Acid Neutralising Capacity

Net Acidity = Scr (or S_{POS}) + TAA at pH 6.5 + S_{NAS} - ANC_{BT} (or C_{IN})

Equation C2 Net Acidity whereby ANC has not been corroborated by other data.

Net Acidity = potential sulfidic acidity + actual acidity + retained acidity

Net Acidity = Scr (or S_{POS}) + TAA at pH 6.5 + S_{NAS}

Equation C3 Verification Net Acidity.

Verification Net Acidity = potential sulfidic acidity + actual acidity + retained acidity – (post neutralised Acid Neutralising Capacity – pre neutralised Acid Neutralising Capacity)

Verification Net Acidity = Scr (or S_{POS}) + TAA at pH 6.5 + S_{NAS} – (ANC_{BT} of treated material – ANC_{BT} of untreated material).

Note where Peroxide Oxidisable Sulfur (S_{POS}) is measured to assess potential sulfidic acidity, the results need to be verified by comparison with chromium reducible sulfur (Scr) for a minimum of 15% samples.

Where jarosite has been visually identified retained acidity (S_{NAS}) should be tested regardless of whether pH_{KCL} ≥4.5.

C4.0 Off-Site Disposal Requirements

Prior to disposal off-site the soil must be classified in accordance with the relevant guidelines.

C4.1 Waste Classification

If soil is proposed to be disposed to landfill (post treatment), it must be classified in accordance with the POEO Act, including the current guidelines, namely NSW EPA Waste Classification Guidelines (2014) (EPA, 2014) – Part 1 to Part 4 and Addendum to Part 1:

The following Table C3 presents the six step procedure outlined in NSW EPA (2014) for determining the type of waste and the waste classification.

Table C3: Six Step Classification Procedure

Step	Rationale
1. Is the waste special waste?	Presence or absence of asbestos-containing materials (ACM), clinical or related waste, or waste tyres in the material
2. Is the waste liquid waste?	Is material a soil matrix?
3. Is the waste “pre-classified”?	Are the soils pre-classified with reference to NSW EPA (2014)?
4. Does the waste possess hazardous waste characteristics?	Is the soil observed to contain or considered at risk to contain explosives, gases, flammable solids, oxidising agents, organic peroxides, toxic substances, corrosive substances, coal tar, batteries, lead paint or dangerous goods containers?
5. Determining a wastes classification using chemical assessment	Chemical concentrations of soils compared to the thresholds in Table 1 and Table 2 of NSW EPA (2014) Part 1 and Table 2 of the Addendum to Part 1.
6. Is the waste putrescible or non-putrescible?	Do the soils contain materials considered to be putrescible [a].

Notes to Table C3:

a wastes that are generally not classified as putrescible include soils, timber, garden trimmings, agricultural, forestry and crop materials, and natural fibrous organic and vegetative materials (NSW EPA, 2014).

C5.0 Disposal as PASS

Further guidance for the disposal of untreated soil as PASS is provided in Appendix E.

C6.0 References

NSW EPA. (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* NSW Environment Protection Authority.

Sullivan, L., Ward, N., Toppler, N., & Lancaster, G. (2018). *National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Identification and Laboratory Methods Manual.* Canberra ACT CC BY 4.0: Department of Agriculture and Water Resources.

Douglas Partners Pty Ltd

Appendix D

Selected Test Pit Logs (Pits 202, 205, 306 and 307)

BOREHOLE LOG

CLIENT: Hunter Land Pty Ltd
PROJECT: DAREZ Development
LOCATION: Williamtown Drive, Williamtown

SURFACE LEVEL: 2.94 AHD
EASTING: 378162
NORTHING: 1368153.3
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 39728.01
DATE: 25 Mar 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SAND - Loose, grey, fine to medium sand, some silt, dry to moist, grey, some rootlets encountered in upper 0.2m		A	0.1				
				A	0.5				
2	1	From 0.9m, wet		A	1.0			▼	1
				S	1.45		2,2,2 N = 4		
		Small fragments of decaying wood (0.5mm in size) encountered in SPT sample							
1	2	From 2m, medium dense							2
				(S)	2.5 2.8		7,12* refusal		
0	3								3
-1	4			(S)	4.0 4.3		7,12* refusal		4
	4.3	Bore discontinued at 4.3m, limit of investigation							
-2									

RIG: 4WD mounted rig **DRILLER:** Atkins Drilling (Atkins) **LOGGED:** Handley **CASING:** Uncased

TYPE OF BORING: Hollow flight auger

WATER OBSERVATIONS: Groundwater observed at 0.9m during drilling

REMARKS: *SPT limited to prevent augers from jamming from compressed sands due to vibrations. (S) No sample recovered. Temporary standpipe installed on completion

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

LOCATION: Williamtown Drive, Williamtown

SURFACE LEVEL: 2.81 AHD
EASTING: 378180.8
NORTHING: 1368335.6
DIP/AZIMUTH: 90°/--

BORE No: 205
PROJECT No: 39728.01
DATE: 26 Mar 08
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SILTY SAND - Dark brown, fine to medium grained silty sand, trace clay, wet		A	0.2 0.3				
	0.4	SILTY SAND - Grey, loose to medium dense fine to medium grained silty sand, wet		A	0.4 0.5			▼	
2									
	1.0	SAND - Light brown, loose to medium dense, fine to medium grained sand, wet		A	1.0				1
				S	1.45		3,5,5 N = 10		
1									
	2	From 2m , medium dense, light brown with some grey mottling							2
				S	2.5 2.92		5,8,8 N = 16 120mm*		
0									
	3								3
		From 3.5m - medium dense to dense, brown							
-1									
	4			S	4.0 4.3		8,14* refusal		4
	4.3	Bore discontinued at 4.3m, limit of investigation							
-2									

RIG: 4WD mounted rig **DRILLER:** Atkins Drilling (Atkins) **LOGGED:** Handley **CASING:** Uncased

TYPE OF BORING: Hollow flight auger

WATER OBSERVATIONS: Groundwater observed at 0.7m during drilling

REMARKS: *SPT limited to prevent augers from jamming from compressed sands due to vibrations. (S) No sample recovered

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

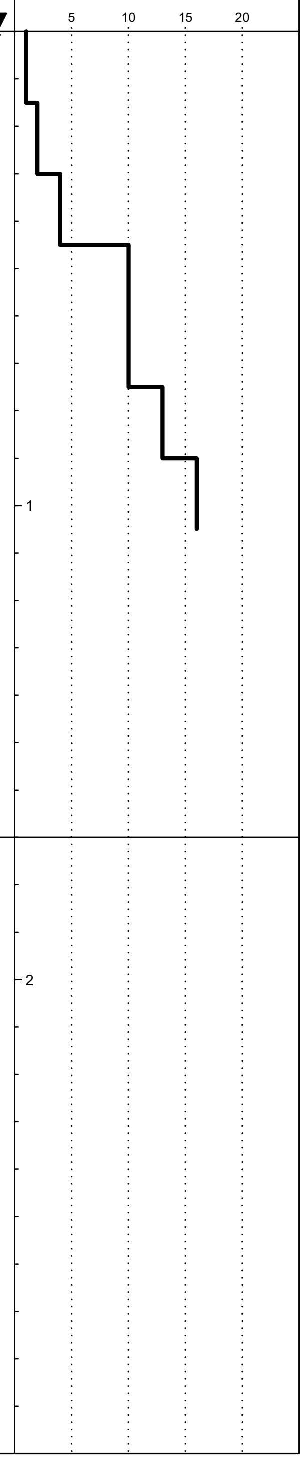
LOCATION: Williamtown Drive, Williamtown

SURFACE LEVEL: 3.5 AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 306
PROJECT No: 39728.06
DATE: 3/8/2010
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
		SAND - Loose, light grey brown fine to medium grained sand, some rootlets, damp		D	0.2			
3	0.35	SAND - Medium dense to dense, brown sand, trace to some silt, damp		D	0.5			
		From 0.6m, some dark brown weakley to moderately well-cemented zones (coffee rock)						
	1			D	1.0			
2				D	1.6			
	1.7	Pit discontinued at 1.7m, collapse						
	2							
1								

Dynamic Penetrometer Test (blows per 150mm)



RIG: 5.5 tonne excavator with 600mm bucket

LOGGED: Foote

SURVEY DATUM:

WATER OBSERVATIONS: Free groundwater observed at 1.4m

REMARKS: * Surface level estimated from digital terrain model and is approximate only

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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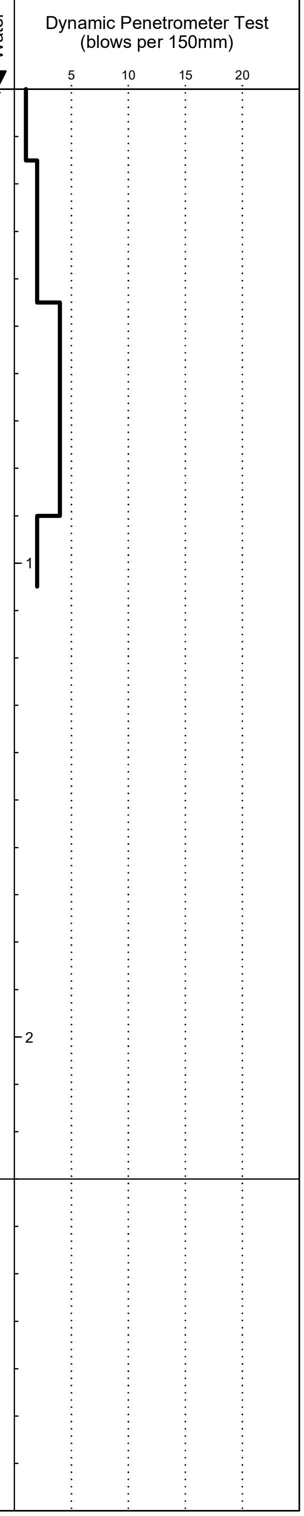
TEST PIT LOG

CLIENT: Hunter Land Developments Pty Ltd
PROJECT: Williamtown Aerospace Park
LOCATION: Williamtown Drive, Williamtown

SURFACE LEVEL: 2.5 AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: 307
PROJECT No: 39728.06
DATE: 3/8/2010
SHEET 1 OF 1

Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments
0.0–0.1	TOPSOIL - Loose, brown clayey sand topsoil, some gravel, wet				
0.1–0.6	FILLING - Typically poorly compacted brown grey filling, generally comprising clayey sand, some gravel, some cobbles, trace brick, trace coal, wet	D D	0.3 0.5		
0.6–1.1	CLAYEY SAND - Loose, grey mottled orange-brown clayey sand, trace gravel, some weathered siltstone inclusions, wet. Behaves low plastic, M>Wp (possible filling)	D	0.8		
1.1–1.8	PEAT - Soft black peat, fibrous, saturated	D	1.2		
1.8–2.3	SAND - Brown fine to medium grained sand, trace to some silt, saturated	D	2.0		
2.3	Pit discontinued at 2.3m, collapse				



RIG: 5.5 tonne excavator with 600mm bucket
LOGGED: Foote
SURVEY DATUM:

WATER OBSERVATIONS: Groundwater flows in from 1m

REMARKS: Groundwater probably close to surface. * Surface level estimated from digital terrain model and is approximate only

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Appendix E

Contingency Options to On-site Treatment

Appendix E
Contingency Options to On-site Treatment
Williamtown Drive, Williamtown

E1.0 Introduction

This Appendix provides the contingency options to the selected management option.

E2.0 Off-Site Treatment and Disposal

Where on site treatment of PASS is not possible and / or practical then off-site treatment at a facility appropriately licenced to accept and treat such soil can be considered. The below general procedure should be followed for off-site treatment:

The below works will be undertaken:

- Loading the soil into trucks. Note if the soils are wet, they will be heavier than soils as normally transported at field moisture. This should be taken into consideration when loading trucks to ensure that trucks are not overloaded;
- Transport must be conducted in a sealed truck which prevents water leaking from the truck during transport;
- Completion of site records of the above and all information required by the treatment facility, and provision of copies of these records to the treatment facility;
- Tracking of loads from the subject site to the transport facility;
- Transporting of soil to the treatment facility;
- Once the ASS has been accepted by the treatment facility they will treat and manage it in accordance with ASSMAC (1998) and their EPL conditions, subject to the verification procedures documented herein. The liming rate will be based on the liming rate presented in this report or based on results that supersede those presented herein);
- Verification of the treatment of the ASS and waste classification of the soil by an Environmental Consultant; and
- Transport of the treated, classified ASS to the final receiving site/ disposal facility.

E3.0 Off-Site Disposal as PASS

E3.1 General

EPA (2014), Part 4 states that Potential ASS may be disposed of in water below the permanent water table at an appropriately licensed facility.

It is noted that this contingency disposal method is not generally undertaken due to the practicality of burial under the water table and the absence of licensed facilities to accept such waste.

E3.2 PASS Criteria

EPA (2014), Part 4 states that Potential ASS may be disposed of in water below the permanent water table, provided:

- The soils meet the definition of VENM in all aspects other than the presence of sulfidic soils or ores;
- The pH of soils in their undisturbed state is pH 5.5 or more;
- The soil has not dried out or undergone any oxidation of its sulfidic minerals;
- Soil is received at the disposal point within 16 hours of excavation, and kept wet at all times between excavation and reburial at the disposal point;
- Appropriate records are provided to the receiving site with every truck load confirming that it meets the above criteria; and
- The receiving site meets its obligations under EPA (2014) and its Licence conditions.

For the purposes of this ASSMP, potential acid sulfate soils (PASS) are defined in accordance with the NSW Environment Protection Authority (EPA) Waste Classification Guidelines (2014) (EPA, 2014) Part 4 (Acid Sulfate Soils).

This classification is applicable for direct disposal of untreated PASS to a landfill licenced by the EPA to accept PASS.

E3.3 Disposal as PASS

The below works will be undertaken by appropriately trained staff:

- Agreement with receiving site on acceptance times for trucks, and allowable time lapse between excavation and acceptance by receiving site;
- Soils will be kept wet at all times, and should be sprayed with water if required to keep them wet;
- Recording of the excavation date, time and source chainage of the excavated soil;
- Inspection of the excavated soil for moisture content, material texture/ signs of contamination concern, such as anthropogenic odours, staining or inclusions by all personnel involved in the management / handling of the spoil;

- If signs of anthropogenic impact or fill are observed, the soil will not be pre-classified as VENM PASS, and the soil will be segregated for further assessment;
- Measuring the pH in at least one sample per 50 m^3, or a minimum of 10 per shift, using a calibrated pH meter;
- If the pH is less than or equal to 6.5, the soil will not be classified as PASS, and the soil will be segregated for further assessment and treatment;
- Loading the soil into trucks and ensuring the soil is moist enough to prevent it drying out during transport. Note: due to the soils being wet, they will be heavier than soils as normally transported at field moisture (PASS estimated to be approximately 2 t/m^3). This should be taken into consideration when loading trucks to ensure that trucks are not overloaded;

  Soil should be loaded and transported as soon as possible to minimise the risk of oxidisation, which prevents it from being classified as PASS;

  Transport must be conducted in a sealed truck which prevents water leaking from the truck during transport;
- Completion of site records of the above;
- Completion of records of all information required by the receiving site, and provision of copies of these records to the receiving site, including copies sent with the truck driver for the load being carried;
- Transporting of soil meeting the PASS requirements to the receiving site within 16 hours of excavation (or earlier if required by the receiving site);
- Once the PASS have been accepted by the receiving site they are required to manage it in accordance with their EPL conditions. It is not the role of this document to discuss management of soil once they have been accepted by the receiving site; and
- Any soil which is rejected by the receiving facility will be transported back to the site and managed in accordance with the ASSMP.

E4.0 Reburial On-Site

Where possible (and if practical to do so) the ASS can be reburied on site, below the permanent water line / water table provided the soil meets the definition of PASS and the soil is reburied within 24 hours, before the soil has a chance to oxidise.

For the purpose of this ASSMP PASS are defined by NSW Environment Protection Authority (EPA) Waste Classification Guidelines (2014) (EPA, 2014) Part 4 (Acid Sulfate Soils). PASS are defined as:

- 'Soils that contain iron sulfides or sulfidic materials that have not been exposed to air and thus are not oxidised. The pH of these soils in their undisturbed state is 5.5 or more, making them neutral or slightly alkaline.'

There are a number of risks associated with this management option, as outlined in detail in Dear et al (2014), including:

- Maintaining oxygen exclusion at all stages during the burial process;

- Ability to keep oxygen away from final placement area in the long term (anoxic, preferably anaerobic (reducing) conditions required);
- Difficulty in locating the permanent water table (ideally established through long-term monitoring prior to works commencing); and
- Difficulties in placement and compaction of soils beneath a permanent water table.

If reburial is proposed development of site-specific management procedures, monitoring requirements and verification testing will be required with reference to Dear et al (2014). Consideration should also be given to the receiving soils characteristics to ensure they are commensurate with those proposed to be buried (including soil pH, salinity etc),

It is noted that the above methodology is generally impractical to implement and monitor.

E5.0 References

Dear, S., Ahern, C., O'Brien, L., Dobos, S., McElnea, A., Moore, N., & Watling, K. (2014). *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines.* (QASSIT). Brisbane: Department of Science: Department of Science, Information, Technology, Innovation and the Arts, Queensland Government.

NSW EPA. (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* NSW Environment Protection Authority.

Stone, Y., Ahern, C. R., & Blunden, B. (1998). *Acid Sulfate Soil Manual.* Acid Sulfate Soil Management Committee (ASSMAC).

Sullivan, L., Ward, N., Toppler, N., & Lancaster, G. (2018). *National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Identification and Laboratory Methods Manual.* Canberra ACT CC BY 4.0: Department of Agriculture and Water Resources.

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Appendix F

Liming Rate Equations

Appendix F
Liming Rate Equations
Williamtown Drive, Williamtown

F1.0 Introduction

This Appendix provides the equations for the calculation of liming rates.

F2.0 Liming Rates

The required liming rate can be calculated from one of the following formulas.

Equation F1:

Neutralising Material Required (kg)per unit volume of soil (tonne) = $\left(\frac{\%\,\mathrm{S\ x\ 623.7}}{19.98}\right)\ \mathrm{x}\ \frac{100}{\mathrm{ENV(\%)}}\ x\ FOS$

Equation F2:

Neutralising Material Required (kg)per unit volume of soil (m³) = $\left(\frac{\%\,\mathrm{S\ x\ 623.7}}{19.98}\right)\ \mathrm{x}\ \frac{100}{\mathrm{ENV(\%)}}\ x\ D\ x\ FOS$

Where:

net acidity (%S) is derived using the Net Acidity (%S) using the methods in Appendix C;
623.7 = % S to mol H^+ / t;
19.98 converts mol H^+ / t to kg $CaCO_3$/tonne;
FOS (factor of safety) = a minimum value of 1.5 needs to be adopted, although values of up to 2 can be suitable;
ENV = Effective Neutralising Value (e.g. Approx. 98% for fine (0.3 mm grain size) ag lime with an NV of 98%).
D = bulk density (tonne/m^3), site specific results can be used, or the bulk densities in Table 2 of Appendix C should be used

Notes:

- The ENV is calculated based on the molecular weight, particle size and purity of the neutralising agent and should be assessed for proposed materials in accordance with ASSMAC (1998).
- Natural net acidity must not be used.

An initial liming rate based on the laboratory result calculation (excluding ANC) is considered appropriate based on it including a safety factor of 1.5 and the use of ag lime with an NV of at least 98% and a grain size of less than 0.3 mm.

Depending upon the source of the aglime and ultimately the representative ENV of the aglime selected, the minimum lime dosing rate may be increased or decreased. Prior to the commencement of works, the minimum lime dosing rate should be finalised following review of the ENV of the selected ag-lime.

The liming rate to be calculated from the analytical results should therefore be considered as a “starting point”, and pH monitoring should be conducted during treatment to assess the progress of the neutralisation, and need for additional mixing and/ or addition of ag lime. Soil will only be considered to have been successfully treated when all soil has been verified in accordance with the verification criteria in the ASSMP.

F3.0 References

Stone, Y., Ahern, C. R., & Blunden, B. (1998). *Acid Sulfate Soil Manual.* Acid Sulfate Soil Management Committee (ASSMAC).

Sullivan, L., Ward, N., Toppler, N., & Lancaster, G. (2018). *National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Identification and Laboratory Methods Manual.* Canberra ACT CC BY 4.0: Department of Agriculture and Water Resources.

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Appendix G

Water and Groundwater Management

Appendix G
Water and Groundwater Management
Williamtown Drive, Williamtown

G1.0 Introduction

G1.1 General

Water is the main mechanism by which acid and metals from oxidised ASS are mobilised and transported. Careful management of water is therefore paramount to the effective management of potential adverse impacts from ASS disturbance. Management is required to provide control of treated waters for discharge and provide some margin for heavy rain periods.

The below sections provide potential strategies for management, assessment and disposal of water leaching from ASS, surface water and water from groundwater dewatering.

G1.2 Leachate and Surface Water Collection

All water that has been in contact with ASS / assumed ASS must be collected, managed, assessed, treated and appropriately disposed of in accordance with site-specific consent conditions, environment protection licence or dewatering management plan.

G1.3 Dewatering and Extracted Groundwater

In general, risks associated with dewatering in areas underlain by ASS include:

- Acidification of in situ soils drained within the dewatering cone of depression and difficulties associated with neutralising these in situ soils (this can also impact the possible PASS classification of some soils);
- Acidification of groundwater remaining within the dewatering cone of depression after the system has re-flooded;
- Iron, aluminium and heavy metal contamination of groundwater arising from mobilisation of these compounds under low pH conditions; and
- Acidification and contamination of surface water bodies which receive groundwater.

It is considered that there is the potential to expose soils within proposed excavation areas to air which may allow some acidification to take place. However, the water and ASS from within these areas will be removed and treated, mitigating associated risks.

The dewatering should be designed to not significantly affect groundwater levels outside of the area of excavation, and therefore the potential for oxidation of ASS outside of the excavation areas is expected to be limited.

The following dewatering risk management methods are recommended for the project:

- Drawdown outside of the excavation areas should be minimised;
- Drawdown as close as practical to the invert excavation depth;
- Minimise the time and volume of exposed ASS (ie stage excavation and dewatering); and
- Monitoring, treatment and disposal of water from dewatering effluent.

G1.4 Water Storage and Treatment

Water from dewatering and the ASS leachate should either be pumped directly to an on-site treatment plant for treatment or should be stored in a tank or lined drains/ detention basin prior to assessment / treatment.

At a minimum, the combined storage should be designed to store enough water to contain leachate and extracted water from a 1 in 10-year (1 hour) storm event.

G1.5 Water Assessment for Disposal

All water which has potentially come into contact with ASS requires assessment (and if necessary treatment). Minimum recommended monitoring is provided in Table G1, below.

Table G1: Suggested Water Monitoring Frequencies and Target Levels for Disposal to Stormwater (subject to regulatory approval)

Test	Frequency	Target Level for Disposal (subject to regulatory approval)
pH	Water detention basin/ tank: Prior to commencement of construction (i.e. groundwater and surrounding upstream and downstream surface waters); During storage/ treatment as required to allow timely treatment; Less than 24 hours prior to any planned discharge; Daily during discharge period; For unplanned discharges (i.e. due to rain), within 5 days of the cessation of the rainfall event. Treatment Plant: During storage/ treatment as required to allow timely treatment; and Daily during discharge period.	pH 6.5 to 8.5
Total Suspended Solids (TSS)		≤50 mg/L or equivalent turbidity measure (in NTU) where a statistical correlation between the TSS and turbidity has been determined
Oil and Grease		None observable
Iron (total and soluble) and Aluminium	Laboratory analysis: Immediately prior to disposal; Weekly checks during discharge period; and As required based on visual observations. Visual assessment of discolouration: Daily during discharge.	No obvious sign of iron staining/ settlement ≤0.3 mg/L filterable iron ≤0.8 µg/L filterable Aluminium @ < pH 6.5 ≤55 µg/L filterable Aluminium @ > pH 6.5 Reference should be made to ANZG (2018) Trigger Levels for up-to-date target concentrations
Potential contaminants [including VOC, PAH, TRH, BTEX, OCP and metals (aluminium, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, zinc)]	Laboratory analysis: Background testing prior to commencement of construction One round of testing before first disposal of ASS impacted water; If first round of testing exceeds target levels then further testing prior to disposal is required	ANZG (2018) Trigger Levels for 95% / 99% Level of Protection for appropriate freshwater or marine ecosystems if no licence conditions are available

Notes to Table G1:

VOC	Volatile organic compounds
PAH	Polycyclic aromatic hydrocarbons
BTEX	Benzene, toluene, ethylbenzene, xylenes
TRH	Total Recoverable hydrocarbons
OCP	Organochlorine pesticides

G1.6 Treatment

G1.6.1 General

The potential impacts of ASS on water generally comprise a decrease in pH, possible elevated TSS/ turbidity, iron, aluminium and other metals.

Treatment of water from construction sites is commonly required for pH and TSS. Aeration and removal of TSS also generally decreases metal concentrations in the water. Therefore an on-site water treatment plant is considered likely to be suitable for treatment of ASS impacted water that has not been oxidised.

An alternate treatment method for pH is provided in Section G1.6.2 in case treatment of excess water above the capacity of the treatment plant is required.

If a suitable treatment method for man-made contaminants in the water (e.g. VOC, PAH, TRH, BTEX, OCP, metals etc) cannot be implemented, an alternate disposal method may be required (e.g. trucking off-site to a liquid waste disposal facility or disposal to sewer in accordance with a specific Trade Waste Agreement which would need to be obtained from the relevant water regulator.

G1.6.2 Alternate pH Treatment Method

It is noted that aglime is generally not suitable for the treatment of leachate due to its low solubility in water. A commercial pH adjustment product can be used, or else slaked lime (hydrated lime) as discussed below.

Alternative neutralisation materials include calcined magnesia (magnesium hydroxide, burnt magnesite, or magnesia) and calcium hydroxide (commonly called slaked or hydrated lime).

Calcined magnesia (magnesium hydroxide, burnt magnesite, or magnesia) produces a two-step reaction, which proceeds rapidly at acidic pH and slows down as higher pH is approached, and hence reduces the potential for over-neutralisation. It should be added to the leachate as a slurry and mixing achieved via use of an agitator.

A calcium hydroxide (commonly called slaked or hydrated lime) solution can be produced by stirring calcium oxide (commonly called quicklime) into water, in a container of sufficient volume (for example, a plastic 200 litre drum). The slurry should be allowed to settle, and the clear solution (which will be caustic, with a pH of approximately 12.5 to 13) can be pumped or sprayed into the standing water in small amounts, with some agitation and monitoring. This procedure should be continued until the pH is adjusted to acceptable levels. Adequate care should be taken not to "overshoot" the desired pH with calcium hydroxide.

Quicklime is very reactive, and relatively corrosive (due to its caustic nature). When quicklime is mixed with water, the resulting reaction generates heat. Therefore, if utilised, the material should be added in increments to a large amount of water to control the reaction. Slaked or quicklime should not be allowed to come into contact with the skin or be inhaled during use. Manufacturers instructions and the SDS for the products should be followed regarding safe use.

The amount of neutraliser required to be added to the discharged groundwater can be calculated from the equation below:

Equation G1:

$$\textit{Alkali Material Required (kg)} = \frac{M_{Alkali} \times 10^{-pH\,initial}}{2 \times 10^{3}} \times V$$

Where: *M_{Alkali} = molecular weight of alkali material (g/mole) (molecular weight of slaked lime ($Ca(OH)_2$) = 74 g/mole.)*
pH initial = initial pH of leachate
V = volume of leachate (litres)

As a guide, the approximate quantities of slaked lime required to neutralise acidic water are provided in Table G2.

Table G2: Approximate Liming Rates for Water (based on slaked lime (kg of $Ca(OH)_2$))

Water pH	Volume		
	10 m^3	50 m^3	100 m^3
2	3.7	18.5	37
3	0.37	1.85	3.7
4	0.037	0.185	0.37
5	0.0037	0.0185	0.037
6	0.00037	0.00185	0.0037

G1.7 Water Discharge/Disposal

Following treatment (if required) the water should be assessed to determine if it meets the discharge criteria. Water meeting the conditions can then be disposed of accordingly..

Options for discharge/disposal include, but are not limited to, the following:

- Disposal of water into the sewer system under a relevant licence/trade waste agreement with the relevant water authority;
- Disposal of water into the stormwater system, subject to regulatory approval;
- On-site reinjection;
- On-site infiltration; and
- Off-site disposal to a licensed waste disposal facility.

G2.0 References

ANZECC. (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australia and New Zealand Environment and Conservation Council.

ANZG. (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Canberra, ACT: Australian and New Zealand Governments and Australian state and territory governments.

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