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Glen James
AT&L Associates Pty Ltd
Level 7, 153 Walker Street
North Sydney NSW 2060

29 October 2018

Ref: 754-SYDEN205656-R06b

Dear Glen,

RE: Revised Acid Sulfate Soil Management Plan, 2 Macpherson Street, Warriewood, NSW

1. Introduction

Coffey Services Australia Pty Ltd (Coffey) was requested by AT&L Associates Pty Ltd (AT&L) to revise an Acid Sulfate Soil Management Plan (ASSMP) for the site located at 2 Macpherson Street, Warriewood, NSW (the 'Site'). The initial ASSMP (Coffey Ref: 754-SYDEN205656-R06, dated 27 April 2018) was prepared for Karimbla Constructions Services (NSW) Pty Ltd. (Karimbla) in response to Coffey's proposal ref SYDEN205656-P04 dated 20 April 2018. A revised ASSMP (this document) was requested in subsequent communications with AT&L (dated 20 September 2018) to satisfy specific requirements from the Northern Beaches Council (Council) regarding Acid Sulfate Soils Management under the Pittwater Local Environmental Plan – 2014 (PLEP 2014). Council requested that the original ASSMP be revised to better reflect proposed flood volume offset and creek rehabilitation works to be undertaken in Narrabeen Creek (proposed Creek works).

This ASSMP presents the approach and methodology of acid sulfate soil management at the site during the stormwater management works, revegetation of the riparian zone and Narrabeen Creek and the proposed works therein. This ASSMP is to be followed by the Contractor and its subcontractors and provides a basis for specifications for acid sulfate soil management, however it is important to note that this document is not a specification.

The objective of the ASSMP is to reduce the potential environmental impacts associated with the disturbance of acid sulfate soils (ASS) within the area of the proposed works. The ASSMP is prepared in general accordance with the Acid Sulfate Soils Assessment Guidelines (Ahern et al, 1998a), Acid Sulfate Soils Management Guidelines (Ahern et al, 1998b) in the Acid Sulfate Soil Manual, published by the Acid Sulfate Soils Management Advisory Committee (ASSMAC) and Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines. Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government, 2014.

The location of the site is shown on Figure 1, with the approximate location of the riparian and future road shown on Figure 2. Stormwater management design plans and the general site arrangement including the extent of proposed Creek works (drawing DAC005) are provided in Appendix A.

2. Background

Based on information provided by Karimbla and AT&L, Coffey understands that the development will include the importation of construction fill material to raise the site by approximately 0.6m to 1.0m above existing ground level. An earthworks pad to suit future use would occupy the middle of the site, leaving a riparian set back along the western, eastern and northern boundaries, with an access road built around the earthworks pad, joining Macpherson Street at two locations to the south.

Coffey also understands that excavation of potential acid sulfate soils (PASS) within the area identified for the earthworks pad is not required, as this portion of the site will be raised by on average 0.8m with imported construction fill.

As part of the Development Consent Condition for application DA2018/0339, Northern Beaches Council have requested the following:

C. Acid Sulfate Soils

While the submitted geotechnical report addresses acid sulfate soils encountered during excavation of the site, it does not address management of acid sulfate soils within the creek where they are likely to be present. An Acid Sulfate Soil Management Plan would therefore need to be submitted.

This Acid Sulfate Soil Management Plan (ASSMP) has been prepared in response to Council's request. ASS management will potentially be required during the flood volume offset and rehabilitation work proposed for Narrabeen Creek. These works are intended to improve the capacity of the Creek to carry waters during heavy rainfall events and reduce the potential for flooding on the Site. This ASSMP is general in nature as detailed designs have not yet been developed for the proposed Creek works. This general ASSMP will be updated to include management protocols relevant to the design details of the proposed Creek.

3. Site Characteristics

Coffey undertook a Detailed Site Investigation (DSI) at the site in mid-2017 (report ref. SYDEN205656-R01, dated 16 August 2017) to assess contamination at the Site. The report indicated that the Site is underlain by alluvial sediments of Quaternary age. The acid sulfate risk map (1:25,000 Acid Sulfate Soil Risk Map, Hornsby and Mona Vale Sheet (edition two, 1997)) shows a high probability of acid sulfate soil occurrence between 1 – 3m below the natural ground surface. Works more than 1m below the natural ground surface are therefore a potential environmental risk; as are works which lower the water table more than 1m below natural ground surface.

No sampling or laboratory testing for acid sulfate soils was undertaken as part of the DSI program. Observations from the test pitting undertaken at the Site indicated evidence of potential acid sulfate soils at the depth of 0.5m bgl within one test pit (TP01). Within this test pit, natural alluvial soils described as fine grained, brown to grey black clayey sands with a sulphurous odour were observed. Natural sands were also encountered across the Site at depths ranging from 0.5m to 0.8m bgs. It is noted that most of the historic fill (specifically containing crushed terracotta) has been removed from across the site and placed beneath the future road. Natural soils are exposed at the surface in places across the site and riparian zone.

Relevant site characteristic details from the DSI are summarised below within section 3.2.

3.1. Surrounding Land Uses

The Site is situated in an area characterised by various commercial and retail land uses which are summarised in Table 3.1.

Table 3.1: Surrounding Land Uses

Site Address:	2 Macpherson Street, Warriewood NSW
Current Site Ownership	Karimbla Properties No.32
Site Area	Approximately 2.2 Ha
Site Identification Details	Lot 25 of Deposited Plan (DP) 5464
Current Zoning	Zone R3: Medium Density Residential under Pittwater Council Local (now Northern Beaches Council) Environmental Plan 2014 with restrictions on development due to the site being within a flood-prone area.
Current Site Use / Property Description	The site was formerly a plant nursery (Foley's Nursery), and was used for the cultivation, storage and display of plants for sale. The site has been cleared of structures. Terracotta impacted fill has been scraped across the site and placed beneath the future road. Natural soils are exposed at places across the riparian zone.
Proposed Site Use	Residential with garden and accessible soils with a riparian zone surrounding the perimeter of the site.

3.2. Geology, Hydrogeology and Hydrology

3.2.1. Geology and Soils

The Sydney 1:100,000 Geological Series Sheet 9130 indicates the locality is underlain by alluvial sediments of Quaternary age. The alluvial soils are typically described as silty to peaty quartz sand, silt and clay, with ferruginous and humic cementation in places and common shell layers. Hawkesbury Sandstone, of Triassic age, underlies the alluvium.

The Sydney Soil Landscape Sheet 9130 indicates that the Warriewood soil landscape is present on the site. This landscape is characterised by deep, well-sorted sandy podsols and dark mottled siliceous sands.

3.2.2. Regional topography and drainage

The site is adjacent to Narrabeen Creek, which flows around the northern and eastern site boundaries. Narrabeen Creek meanders to the south, joining Mullet Creek and South Creek which discharge into the Pacific Ocean.

Surface fill which was historically comprised mainly gravel sized crushed terracotta has recently been scraped from across the site and used to build up the internal road. Recent survey plans were not available at the time of writing.

As the site is predominantly unsealed, it is expected that surface water runoff would percolate into sub-surface soils, except during intense rainfall when surplus water would drain into the stormwater system and/or adjacent Narrabeen Creek.

3.2.3. Regional Hydrogeology

A search of groundwater bore licences was undertaken on 19 June 2017 using the NSW Department of Primary Industries, Office of Water website (http://allwaterdata.water.nsw.gov.au/water.stm). The results of the search indicated that there are two registered bores (GW106697 and GW106698) within

a 500m radius of the site. These bores are located approximately 450m to the North West of the site at 14 Macpherson Street, Warriewood and are used for monitoring purposes.

Groundwater is expected to be present at shallow depths within the underlying Quaternary deposits, discharging into Narrabeen Creek located along the northern and eastern site boundaries. Groundwater flow direction is expected to vary with flow direction ranging from north to east.

3.3. Acid Sulfate Soils

3.3.1. Coastal acid sulfate soils

Coastal ASS are soils which contain significant concentrations of iron sulfide or pyrite which, when exposed to oxygen in the presence of sufficient moisture, oxidises, resulting in the generation of sulfuric acid. Unoxidised pyritic soils are referred to as potential ASS. When the soils are exposed, the oxidation of pyrite occurs and sulfuric acids are generated, and the soils are said to be actual ASS.

Pyritic soils typically form in waterlogged, saline sediments rich in iron and sulfate. Typical environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 5 mAHD. They can also form as bottom sediments in coastal rivers and creeks.

Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period, (i.e. 10,000 years ago to present day) predominantly in the 7,000 years since the last rise in sea level. It is generally considered that pyritic soils which formed prior to the Holocene period (i.e. >10,000 years ago) would already have oxidised and leached during periods of low sea level which occurred during ice ages, exposing pyritic coastal sediments to oxygen. There is still some potential for these older soils to contain stored acidity that could be released on exposure.

3.3.2. Significance of coastal acid sulfate soils

Disturbance or poorly managed development and use of coastal ASS can generate significant amounts of sulfuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid salts, resulting in high salinity.

The low pH, high salinity soils can reduce or altogether preclude vegetation growth and can produce aggressive soil conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works.

Generation of the acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of some such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters flowing off-site into aquatic ecosystems can have a detrimental effect on aquatic ecosystems.

3.3.3. Local Conditions

The 1:25,000 Acid Sulfate Soil Risk Map, Hornsby and Mona Vale Sheet (edition two, 1997) indicates that the locality is underlain by an Aeolian sand plain (Wa2). The Acid Sulfate Soil Risk Map shows a high probability of acid sulfate soil occurrence between 1m to 3m below ground level (bgl).

No previous acid sulfate soil investigations have been carried out for this site.

3.4. Acid Sulfate Soil Risk at Site – Construction Activities

The development activities within the riparian zone will include excavations for stormwater outlets/swales, rock armouring along the creek bed, excavation and reshaping of Narrabeen Creek to improve carrying capacity and reduce flood potential, installation of riprap energy dissipaters associated with stormwater management within the riparian zone and Narrabeen Creek. Excavation

depths are expected to be around 0.5m bgs, however excavations may be deeper in localised places and up to 1 – 2m in the Creek. The development plan within Appendix A shows stormwater outlet swales with a 0.5m wide base and 1 in 4 gradient batter are proposed to manage run-off from the centre of the site and the road.

Based on the above information, it is likely that acid sulfate soils, if present, will potentially be disturbed by the stormwater infrastructure development and riparian works with the proposed works within the Creek potentially posing a higher risk of acidification. Should PASS be identified during the works, the management protocols in the sections following will be generally applicable. However, given the potentially higher risk presented by the proposed Creek works, specific management protocols will be developed and added to this ASSMP following issue of detailed designs and completion of recommended ASS assessment works.

Coffey understands that no dewatering activity is expected at this stage.

3.5. Potential Environmental Impacts from Acid Sulfate Soils

Exposure and oxidation of potential acid sulfate soils may lead to the generation of acidic leachate. Acidic leachate can be detrimental to the environment and the quality of in ground structures and services. Materials and machinery used may be susceptible to acidic corrosion. Acidic leachate can also mobilise toxic concentrations of metals.

4. Management Plan and procedures for Acid Sulfate Soils

4.1. General

This management plan will address the issues associated with excavation and construction of stormwater infrastructure within the riparian zone.

The following general management procedures are considered applicable for this site based on the current understanding of the proposed development:

i. Appoint a suitably qualified and trained person to manage acid sulfate soils during the construction activities;

ii. Undertake an Acid Sulfate Soils assessment within the Narrabeen Creek in order to identify PASS materials within the proposed work zone (s) and to investigate the risk associated with their disturbance. The ASS assessment should be completed following the availability of detailed designs for the proposed works and should be undertaken in accordance with the methodologies outlined in the Acid Sulfate Soil Manual, New South Wales, Acid Sulfate Soil Management Advisory Committee (ASSMAC) 1998;

iii. Develop a conceptual ground model specifically for the works to be undertaken in Narrabeen Creek identifying the areas of highest ASS hazard and risk. Establish a preliminary liming rate for Narrabeen Creek sediments to expedite onsite treatment;

iv. Update this preliminary ASSMP with specific ASS management procedures and protocols for the Narrabeen Creek works once final design and works details have been developed;

v. Development and implementation of a water quality monitoring and sediment management program for the proposed works in Narrabeen Creek, to identify potential acidic impact during proposed works;

vi. Excavation and temporary stockpiling of excavated spoil potentially impacted by PASS materials including works within the Narrabeen Creek and stormwater infrastructure installation works, where required;

vii. Assess stockpiles for the presence of PASS materials (if not previously assessed) and recommend appropriate liming rates;

viii. Undertaking liming (if required); and

ix. Dispose of the limed stockpile to an appropriately licensed landfill, or reuse on site (subject to chemical classification).

These procedures are further discussed in the following sections.

4.2. Training and Responsibilities

The Contractor should appoint a suitably qualified and trained environmental scientist responsible for the management of acid sulfate soils during the earthwork activities.

The person should be familiar with:

- Details in this ASSMP and any future updated or amended versions;
- Council and other relevant statutory requirements;
- Recognition of acid sulfate soils;

- Acid sulfate soil testing and treatment procedures; and
- Onsite management of acid sulfate soils, including implementing management procedures.

The suitably qualified person may also train the Contractor or their nominee in the management of acid sulfate soils during the works activities.

4.3. ASS Assessment – Narrabeen Creek

An ASS Assessment should be undertaken in Narrabeen Creek to understand the extent and characteristics of the sediment to be disturbed during the proposed works. The ASS assessment should be completed following the availability of detailed designs for the proposed works and should be undertaken in accordance with the methodologies outlined in Section 4 of the Acid Sulfate Soil Manual, New South Wales, Acid Sulfate Soil Management Advisory Committee (ASSMAC) 1998.

Following the completion of the assessment a conceptual ground model should be prepared specifically for the works to be undertaken in Narrabeen Creek identifying the areas of highest ASS hazard and risk. A preliminary liming rate should also be established for Narrabeen Creek sediments to expedite onsite treatment.

4.4. Regular Visual Assessment and Screening of Soils During General Excavations

Excavated soils should be regularly checked (visually) and screened (using hydrogen peroxide) to confirm the absence of acid sulfate soils. This should be carried out by staff experienced in identifying and testing acid sulfate soils in the field. Screening should be undertaken in accordance with Appendix 1 of ASSMAC 1998.

The following procedures are generally recommended for the screening and management of stockpiled excavated materials. Depending on site constraints or the development of specific protocols for spoil management (i.e. Narrabeen Creek works), other procedures may be adopted by the Contractor as appropriate:

- Site excavations will be regularly observed for potential acid sulfate soils as per Section 4.4.1.
- Soil samples will be regularly collected, and field tested as per Sections 4.4.2.
- Based on the above field classification tests (visual and field screening tests), materials suspected as being at moderate to high risk of containing PASS will be stockpiled separately to non-PASS soils. Temporary stockpiling of such materials should be carried out as per Section 4.5.
- Materials assessed as having a low risk of acid sulfate soils will be stockpiled in accordance with normal good earthworks practice to reduce water ponding, and to control surface erosion and sediment transport outside the stockpiled areas. These soils may be regarded as general fill subject to geotechnical and other relevant requirements.

4.4.1. Visual Observation

Visual observation of excavated soils should be undertaken regularly. The visual assessment should be based on material type, colour, odour and consistency. Dark grey/brown sands and sandy clays will be classified as suspected acid sulfate soils. Jarosite staining (unlikely in sands), indicative of acid sulfate conditions, will be noted and used as further field evidence of acid sulfate soils presence. Soils containing a sulphurous odour will also be classified as suspected PASS.

Suspected PASS should be subjected to the field screening test as per Section 4.4.2, at a minimum rate of one screening test per 25m^3.

4.4.2. Field Screening Test Using Hydrogen Peroxide

A field screening test using hydrogen peroxide (H_2O_2) should be performed regularly on the excavated soils at a minimum rate of one screening test per 25m^3 for each 0.5m depth interval. The peroxide screening test should be carried out based on Appendix 1 of the ASSMAC Guidelines 1998. Soils that record a pH below 3, following oxidation with H_2O_2, will be managed as acid sulfate soils (Section 4.5). Soils that record a pH between 3 and 4, following oxidation, will be treated as highly suspicious and will be confirmed as PASS using laboratory analysis including the improved peroxide oxidation combined acidity and sulfate (SPOCAS) or Chromium Suite (CrS) methods.

Selected soils samples (at a minimum rate of 10%) should be sent for laboratory analysis to confirm the peroxide screening test results and assess the required liming rate.

4.5. Excavation and Temporary Stockpiling

The excavated soils should be temporarily stockpiled and treated (if required) on a specially prepared treatment (or liming) pad. The treatment pad should be constructed in general accordance with the design considerations contained in Section 8.4 of Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines v4.0, Department of Science, Information Technology, Innovation and the Arts, Queensland Government (DSITIA) 2014.

The liming treatment pad (s) should be established on lands between the proposed new road MC01 and the Narrabeen Creek (see General Arrangement Plan in Appendix A) with works staged such that the Creek works are undertaken first. Treatment pads should be placed in relatively proximity of the Creek and gradually moved west toward the proposed location of the new road MC01 as the Creek batters are reshaped. The treatment pad should ideally be located on a concrete paved area. If no concrete area is available, an area should be covered by timber boards on a minimum of two layers of polythene or low-density polyethylene sheet of at least 0.25mm thickness. The stockpile should be covered by polythene or low-density polyethylene sheet of at least 0.25mm thickness to prevent erosion of stockpiled materials. Heavy objects not containing any sharp edges should be placed on the sheets to prevent them from being blown by the wind. Straw bales or a silt fence should be placed on the perimeter of the stockpile area to filter runoff. Infiltration of water to the stockpile, such as run-on water from upslope, should be managed with diversion banks. The surface area of the stockpile exposed to oxidation should be minimised, and the stockpile should be covered when not in use.

Extended periods of stockpiling (more than a couple of days) will require leachate collection and monitoring. Where monitoring of the leachate indicates low pH (below 6.5), the addition of lime will be required prior to discharge to sewer/drain[1], subject to requirements/approvals from the relevant authorities.

4.6. Laboratory Testing

Laboratory testing should be carried out for representative soil samples collected from the stockpile to assess the level of acid sulfate strength and the required liming rate. Depending on the volume of the stockpile, a minimum of three representative samples, or 1 per 25m^3 should be collected. The soil samples will be tested by a NATA accredited laboratory for the presence of acid sulfate soils based on the Suspension Peroxide Oxidation Combined Acidity and Sulfate (SPOCAS) or Chromium Suite (CrS) methods.

[1] Discharge to sewer/drain would also be subject to other criteria such as the presence of contaminants and suspended solids.

Based on the results, if acid sulfate soils are assessed not to be present in the stockpile, the stockpile may be reused on site, subject to further contamination testing and engineering requirements.

4.7. Liming Methodology

If laboratory testing confirms the presence of acid sulfate soils, liming should be applied to the stockpiled materials. The type and amount of lime to be applied will be such that a neutralising value (NV) of 100 can be achieved. The NV should be identified prior to mixing. NV relates to the purity of the lime and an NV of 100 is required to ensure that the lime is effective in neutralising the potential acid. Fine powdered agricultural lime ($CaCO_3$) generally has an NV of 90% to 100% whilst other manufactured forms of lime can have an NV as low as 80%. Where NV is below 100, the factor of safety, hence the amount of lime, will have to be adjusted accordingly.

The following liming procedures (or other equivalent) should be undertaken:

- Spreading of the soil in thin (<200mm) layers on the prepared treatment pads established within the boundary of the site works (Section 4.5); and
- Addition of lime by hand or machinery followed by mixing, using light weight rotovators or similar tools. The amount of lime to be added shall be assessed from the results of the laboratory SPOCAS testing, with a factor of safety of 1.5 applied to account for incomplete mixing. This factor of safety is in addition to any correction factors for purity or particle size.

4.8. Waste Classification and Offsite Disposal

The treated soil may be disposed of to an appropriately licensed landfill following a waste classification. The waste classification and disposal should be undertaken in accordance with relevant standards and requirements, including the NSW EPA (2014) Waste Classification Guidelines, Part 1: Classifying Waste. The waste classification should also take into account the acid sulfate soil requirements. It is noted that the treated soil cannot be classified as Virgin Excavated Natural Material (VENM) as per the NSW EPA definition.

Alternatively, the treated soil could be reused on site following monitoring as per Section 4.9, subject to contamination and engineering requirements.

4.9. Monitoring Following Treatment

The following monitoring program (or other equivalent) is recommended for lime treated material where the material is to be used on site for structural or general filling, prior to its placement:

- Monitoring of soil pH weekly based on Appendix I of the Acid Sulfate Soils Assessment Guidelines (Ahem et al, 1998a); and
- Laboratory testing of representative soil samples for SPOCAS (or CrS) after four weeks.

The following acceptance criteria will be used over a four-week period to assess whether the soils have sufficient neutralising capacity to account for the quantities of acid produced:

- Soil pH ≥ 6.5; and
- Net acidity level below Acid Sulfate Soils Assessment Guidelines (Ahem et al, 1998a) relevant action level (18mol H^+/tonne for material less than 1000 tonnes).

Should the soil pH fall below 6.5 and continue to fall, then additional lime will be added to the material and monitoring will continue for a further four weeks, at which time a review of the monitoring frequency will take place.

4.10. Other Unexpected Issues

Should dewatering activity be required or other unexpected issues be encountered, an appropriately qualified environmental consultant should be engaged as soon as practicable to help address the issues.

5. Limitations

This ASSMP is prepared based on the current level of understanding of the site and the proposed development. It should be reviewed and updated progressively as work is completed and if changes to the development is made. Relevant amendments in the ASSMP should be made as necessary.

This plan does not address geotechnical or contamination issues.

No site-specific sampling or ASS testing was carried out and as such the recommendations in the ASSMP are based on the interpretation of available information by Coffey and are preliminary in nature for the proposed works to be undertaken in Narrabeen Creek. Site specific information related to the presence of PASS materials in Narrabeen Creek should be obtained once final detailed designs for the Creek works are available. This report should be read in conjunction with the attached sheet entitled “Important Information about Your Coffey Environmental Report”.

This plan has been prepared at the request of AT&L Associates for Karimbla Constructions Services Pty Ltd. with the objectives of providing an ASSMP to guide proposed works activities proposed at 2 Macpherson Street, Warriewood, NSW. No warranty, expressed or implied, is made as to the information and professional advice included in this report. Anyone using this document does so at their own risk and should satisfy themselves concerning its applicability and, where necessary, should seek expert advice in relation to the particular situation.

This ASSMP is applicable only to the works activities and locations identified within the plan.

If you have any questions regarding this report, please do not hesitate to contact the undersigned on (02) 4016 2300.

6. References

1. Ahern C R, Stone Y and Blunden B (1998a) Acid Sulfate Soils Assessment Guidelines, Acid Sulfate Soils Management Advisory Committee, Wollongbar, NSW.
2. Ahern C R, Stone Y and Blunden B (1998b) Acid Sulfate Soils Management Guidelines, Acid Sulfate Soils Management Advisory Committee, Wollongbar, NSW.
3. Coffey (2017), Detailed Site Investigation: 2 Macpherson Street, Warriewood, NSW (ref: SYDEN205656-R01-Rev1).
4. 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.
5. NSW EPA (2014) Waste Classification Guidelines, Part 1: Classifying Waste.

7. CLOSURE

We trust the above report meets your current requirements. If you have any further queries regarding the information presented herein, please do not hesitate to contact us.

For and on behalf of Coffey

Paul Wright
Senior Associate

Edward Wu
Senior Associate

Attachments:

Important information about your Coffey Environmental Report

Figures

Appendices

Important information about your **Coffey** Environmental Report

Introduction

This report has been prepared by Coffey for you, as Coffey's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice,

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Coffey may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Coffey has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

Your report has been written for a specific purpose

Your report has been developed for a specific purpose as agreed by us and applies only to the site or area investigated. Unless otherwise stated in the report, this report cannot be applied to an adjacent site or area, nor can it be used when the nature of the specific purpose changes from that which we agreed.

For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination pose in the context of the agreed purpose. Such risks may be financial (for example, clean up costs or constraints on site use) and/or physical (for example, potential health risks to users of the site or the general public).

Limitations of the Report

The work was conducted, and the report has been prepared, in response to an agreed purpose and scope, within time and budgetary constraints, and in reliance on certain data and information made available to Coffey.

The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Coffey should be kept appraised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statues and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

Interpretation of factual data

Environmental site assessments identify actual conditions only at those points where samples are taken and on the date collected. Data derived from indirect field measurements, and sometimes other reports on the site, are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions.

Variations in soil and groundwater conditions may occur between test or sample locations and actual conditions may differ from those inferred to exist. No environmental assessment program, no matter how comprehensive, can reveal all subsurface details and anomalies. Similarly, no professional, no matter how well qualified, can reveal what is hidden by earth, rock or changed through time.

The actual interface between different materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but

steps can be taken to reduce the impact of unexpected conditions.

For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of a suitably qualified and experienced environmental consultant through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other unrecognised features encountered on site. Coffey would be pleased to assist with any investigation or advice in such circumstances.

Recommendations in this report

This report assumes, in accordance with industry practice, that the site conditions recognised through discrete sampling are representative of actual conditions throughout the investigation area. Recommendations are based on the resulting interpretation.

Should further data be obtained that differs from the data on which the report recommendations are based (such as through excavation or other additional assessment), then the recommendations would need to be reviewed and may need to be revised.

Report for benefit of client

Unless otherwise agreed between us, the report has been prepared for your benefit and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

Coffey assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report.

To avoid misuse of the information presented in your report, we recommend that Coffey be consulted before the report is provided to another party who may not be familiar with the background and the purpose of the report. In particular, an environmental disclosure report for a property vendor may not be suitable for satisfying the needs of that property's purchaser. This report should not be applied for any purpose other than that stated in the report.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, a suitably qualified and experienced environmental consultant should be retained to explain the implications of the report to other professionals referring to the report and then review plans and specifications produced to see how other professionals have incorporated the report findings.

Given Coffey prepared the report and has familiarity with the site, Coffey is well placed to provide such assistance. If another party is engaged to interpret the recommendations of the report, there is a risk that the contents of the report may be misinterpreted and Coffey disowns any responsibility for such misinterpretation.

Data should not be separated from the report

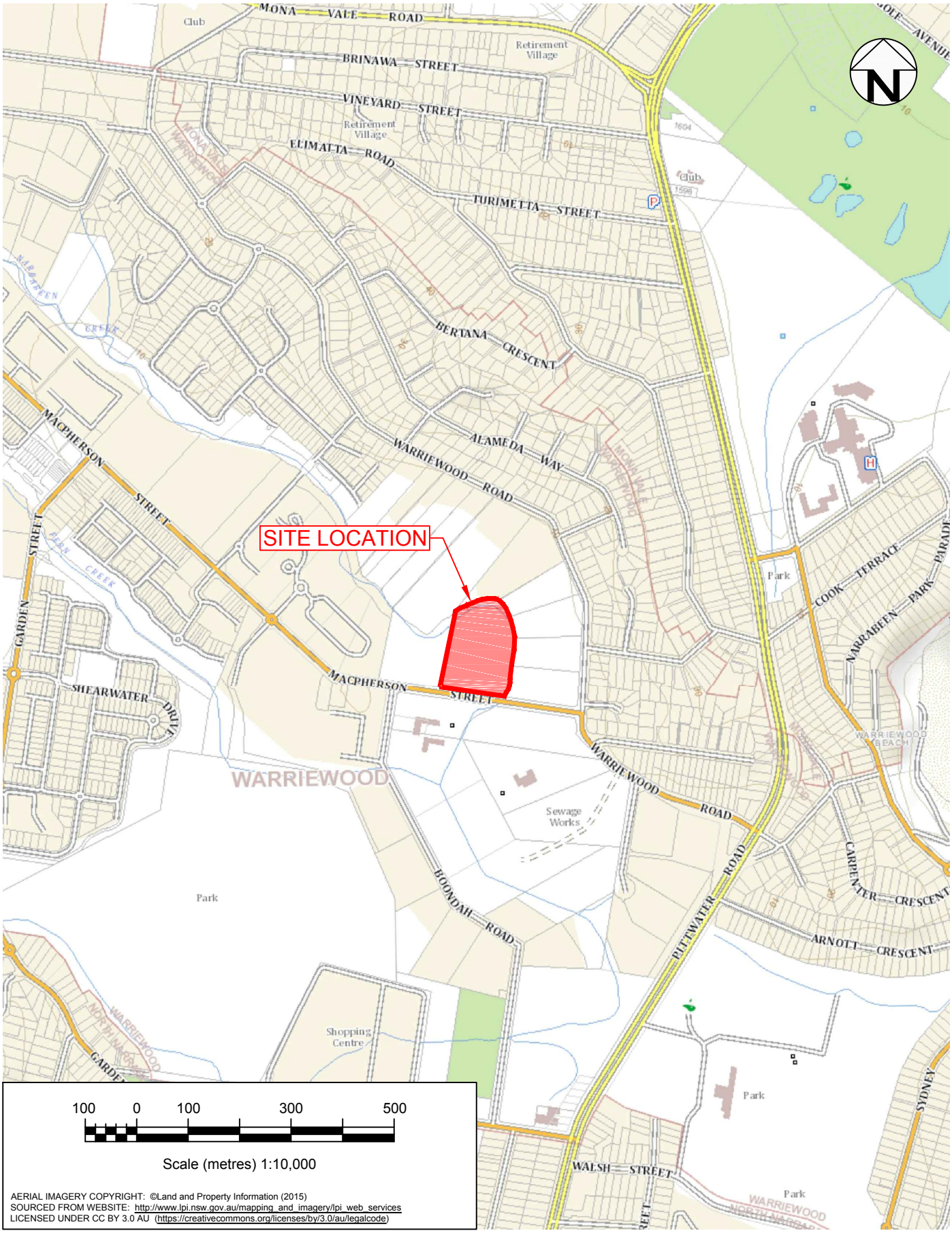
The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

This report should be reproduced in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

Responsibility

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.

Figures



drawn	JR / AW
approved	-
date	27 / 04 / 18
scale	AS SHOWN
original size	A4

coffey
A TETRA TECH COMPANY

client: KARIMBLA CONSTRUCTIONS SERVICES PTY LTD

project: ACID SULPHATE SOIL MANAGEMENT PLAN
2 MACPHERSON STREET, WARRIEWOOD NSW

title: SITE LOCATION

project no: 754-SYDEN205656-R06 | figure no: FIGURE 1 | rev: A

PLOT DATE: 27/04/2018 2:50:32 PM DWG FILE: F:\1. PROJECTS\1. SYDENENV\2017\SYDEN205656 MERITON WARRIEWOOD DS\CAD\754-SYDEN205656-R06.DWG

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

10 0 10 30 50

Scale (metres) 1:1000

drawn	JR / AW
approved	-
date	27 / 04 / 18
scale	AS SHOWN
original size	A3

coffey
A TETRA TECH COMPANY

client: KARIMBLA CONSTRUCTIONS SERVICES PTY LTD

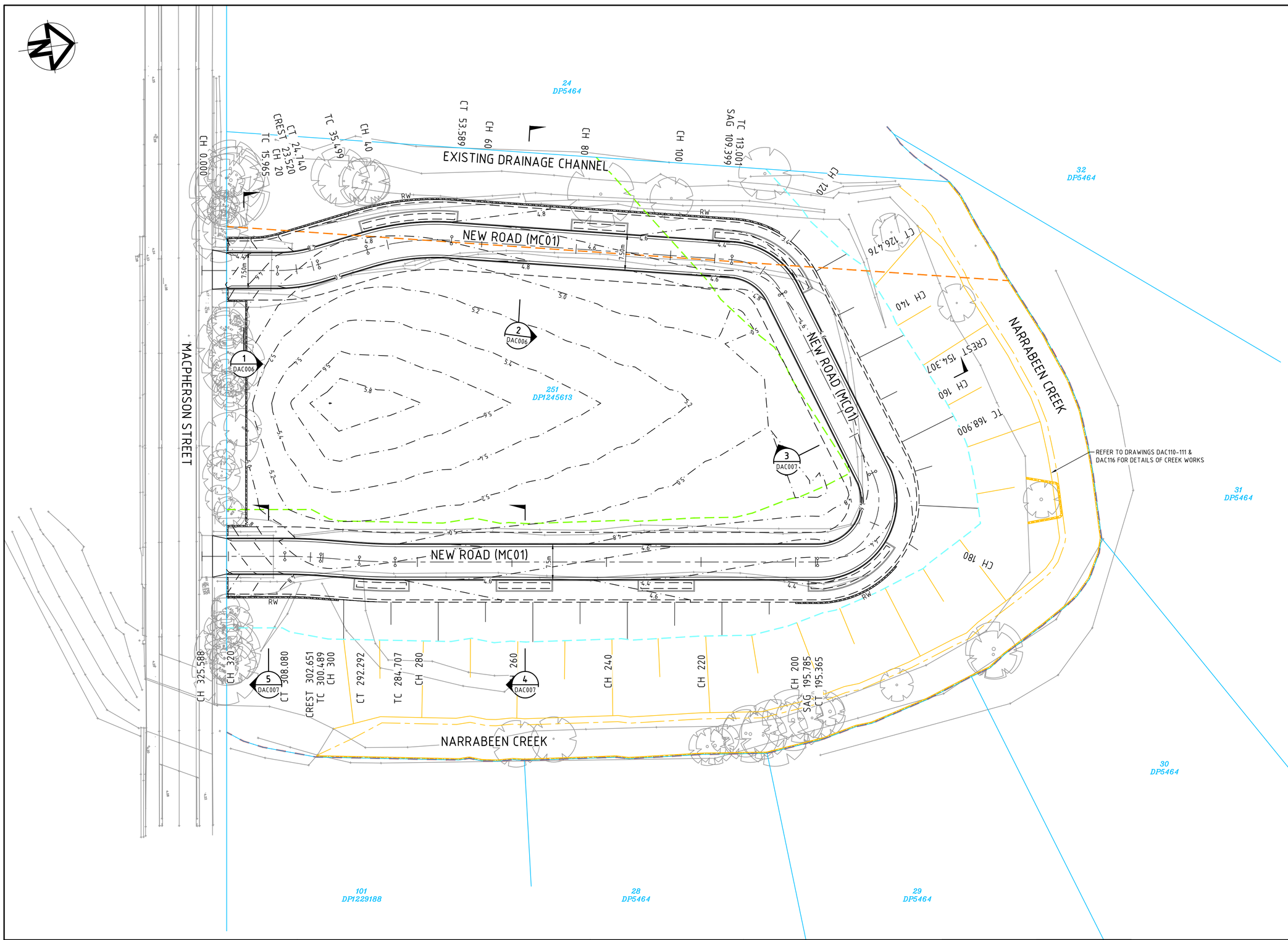
project: ACID SULPHATE SOIL MANAGEMENT PLAN
2 MACPHERSON STREET, WARRIEWOOD NSW

title: SITE LAYOUT

project no: 754-SYDEN205656-R06 | figure no: FIGURE 2 | rev: A

PLOT DATE: 27/04/2018 2:50:12 PM DWG FILE: F:\1. PROJECTS\1. SYDENENV\2017\SYDEN205656 MERITON WARRIEWOOD DS\ICAD\754-SYDEN205656-R06.DWG

Appendix A- Proposed Development Plans



GENERAL ARRANGEMENT LEGEND

EXISTING

- EXISTING BOUNDARY
- EXISTING CONTOUR (3.0)
- EXISTING 20m ASSET PROTECTION ZONE
- EXISTING TREE

PROPOSED

- PROPOSED BOUNDARY
- PROPOSED EASEMENT
- PROPOSED CREEK CENTERLINE
- PROPOSED 25m RIPARIAN CORRIDOR
- PROPOSED 25m PRIVATE BUFFER
- K&G — KERB & GUTTER
- RK — ROLL TOP KERB AND GUTTER
- BATTER
- 5.0 — CONTOUR (0.2m INTERVAL)
- RRW — ROCK RETAINING WALL
- RW — RETAINING WALL
- 375ø — STORMWATER PIPE (SHOWING SIZE)
- STORMWATER KERB INLET PIT
- STORMWATER SURFACE INLET PIT
- A\1 — STORMWATER PIT NUMBER
- STORMWATER RAINGARDEN

NOTES

1. NARRABEEN CREEK DESIGN SHOULD BE CONSIDERED INDICATIVE ONLY UNTIL DETAILED SITE SURVEY AND ADJACENT PROPERTY OWNERS DETAILED DESIGNS ARE OBTAINED IN ELECTRONIC FORMAT
2. REFER DRAWING DAC020 FOR CIVIL DETAILS.
3. REFER DRAWING DAC021-023 FOR STORMWATER DETAILS.

Issue	Description	Date
B	ISSUE FOR COMMENT	25-10-18
A	ISSUE FOR COMMENT	24-10-18

Bar Scales

0 10 20 30 40m

1 : 400 @ A1 1 : 800 @ A3

Client

KARIMBLA
CONSTRUCTION SERVICES (NSW)
PTY LIMITED
Level 11, 528 Kent Street, Sydney NSW 2000
Tel: (02) 9287 2888 Fax: (02) 9287 2777
Email: info@design.meriton.com.au
Internet: http://www.meriton.com.au

Scales	1 : 400 @ A1
Grid	MGA
Height Datum	AHD
Drawn	GJ
Designed	GJ
Checked	AT
Approved	

Project
2 MACPHERSON STREET
WARRIEWOOD
EARLY WORKS
PACKAGE

Title
GENERAL ARRANGEMENT PLAN

Civil Engineers and Project Managers
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www.atl.net.au
info@atl.net.au

Status
FOR COMMENT
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC1005	18-580	B

100mm on Original

F:\18-580 Warriewood Meriton\6.0 Drgs\Civil\Final\1000 Series - Early Works\DAC1005.dwg