APPENDIX I

Gateway Determination

NSW GOVERNMENT | Planning & Environment

Mr Ron Moore
General Manager
Camden Council
PO Box 183
CAMDEN NSW 2570

Our ref: 14/11713
Your ref: SC2110

Dear Mr Moore

Gateway Determination - Camden Local Environmental Plan 2010 Amendment No.32 – Lot 24 DP 1086823 Crase Place, Grasmere

I am writing in response to Council's request of 19 June 2014 seeking a Gateway Determination for a planning proposal to rezone land at 32 Crase Place, Grasmere, from RU1 Primary Production and part R5 Large Lot Residential to R5 Large Lot Residential.

As delegate of the Minister for Planning, I have now determined the planning proposal should proceed subject to the conditions in the attached Gateway determination.

I have also agreed the planning proposal's inconsistency with section 117 Direction 1.2 Rural zones is of minor significance. No further approval is required in relation to this Direction.

The former Minister delegated his plan making powers to councils in October 2012. It is noted that Council intends to use its delegation pursuant to Section 23 of the Environmental Planning and Assessment Act 1979 as the matter is considered to be of local significance. I have considered the nature of Council's planning proposal and have decided to issue an authorisation for Council to exercise delegation to make this plan. I have attached conditions of the determination.

The amending Local Environmental Plan (LEP) is to be finalised within 12 months of the week following the date of the Gateway determination. Council should aim to commence the exhibition of the planning proposal as soon as possible. Council's request for the Department to draft and finalise the LEP should be made directly to Parliamentary Counsel's Office six (6) weeks prior to the projected publication date. A copy of the request should be forwarded to the Department for administrative purposes.

The State Government is committed to reducing the time taken to complete LEPs by tailoring the steps in the process to the complexity of the proposal, and by providing clear and publicly available justification for each plan at an early stage. In order to meet these commitments, the Minister may take action under section 54(2)(d) of the EP&A Act if the time frames outlined in this determination are not met.

Should you have any queries in relation to this matter, please contact Mr Tai Ta on (02) 98601560.

Yours sincerely

RJ Cumming **15/8/2014**

Rachel Cumming
Director, Metropolitan Delivery (Parramatta)
Housing, Growth and Economics

Level 5, 10 Valentine Avenue, Parramatta NSW 2124 Phone: (02) 9860-1560 Fax: (02) 9895-7711

NSW GOVERNMENT | Planning & Environment

Gateway Determination

***Planning proposal (Department Ref: PP_2014_CAMDE_001_00)**: to rezone land at 32 Crase Place, Grasmere (Lot 24 DP 1086823), from RU1 Primary Production and part R5 Large Lot Residential, to R5 Large Lot Residential.*

I, the Director, Metropolitan Delivery (Parramatta), at the Department of Planning and Environment, as delegate of the Minister for Planning, have determined under section 56(2) of the EP&A Act that an amendment to the Camden Local Environmental Plan (LEP) 2010 to rezone Lot 24 DP 1086823, No. 32 Crase Place, Grasmere to R5 Large Lot residential, should proceed subject to the following conditions:

1. Prior to community consultation Council is to:

   (a) consult with the Commissioner of the NSW Rural Fire Services and give consideration to the provisions of section 117 direction 4.4 Planning for Bushfire Services;
   (b) arrange for the preparation of a Part 2 Land Capability Assessment and a visual landscape study; and
   (c) remove the word "Draft" from the cover of the planning proposal.

2. Community consultation is required under sections 56(2)(c) and 57 of the Environmental Planning and Assessment Act 1979 ("EP&A Act") as follows:

   (a) the planning proposal must be made publicly available for a minimum of **28 days**; and
   (b) the relevant planning authority must comply with the notice requirements for public exhibition of planning proposals and the specifications for material that must be made publicly available along with planning proposals as identified in section 5.5.2 of *A Guide to Preparing LEPs (Department of Planning & Infrastructure 2013)*.

3. Consultation is required with Sydney Water and Origin Energy under section 56(2)(d) of the EP&A Act. Sydney Water and Origin Energy are to be provided with a copy of the planning proposal and any relevant supporting material, and given at least 21 days to comment on the proposal.

4. A public hearing is not required to be held into the matter by any person or body under section 56(2)(e) of the EP&A Act. This does not discharge Council from any obligation it may otherwise have to conduct a public hearing (for example, in response to a submission or if reclassifying land).

5. The timeframe for completing the LEP is to be **12 months** from the week following the date of the Gateway determination.

RJCumming **15/8/2014**

Rachel Cumming
Director
Metropolitan Delivery (Parramatta)
Housing, Growth and Economics
Delegate of the Minister for Planning

NSW GOVERNMENT | Planning & Environment

WRITTEN AUTHORISATION TO EXERCISE DELEGATION

Camden Council is authorised to exercise the functions of the Minister for Planning and Environment under section 59 of the *Environmental Planning and Assessment Act 1979* that are delegated to it by instrument of delegation dated 14 October 2012, in relation to the following planning proposal:

Number	Name
PP_2014_CAMDE_001_00	Planning proposal to rezone Lot 24 DP 1086823 Crase Place, Grasmere, from RU1 Primary Production and part R5 Large Lot Residential, to R5 Large Lot Residential.

In exercising the Minister's functions under section 59, the Council must comply with the Department's "*A guideline for the preparation of local environmental plans*" and "*A guide to preparing planning proposals*".

RJCumming **15/8/2014**

Rachel Cumming
Director, Metropolitan Delivery (Parramatta)
Housing, Growth and Economics

Delegate of the Minister for Planning

Attachment 5 – Delegated plan making reporting template

Reporting template for delegated LEP amendments

Notes:

- Planning proposal number will be provided by the department following receipt of the planning proposal
- The department will fill in the details of Tables 1 and 3
- RPA is to fill in details for Table 2
- If the planning proposal is exhibited more than once, the RPA should add additional rows to **Table 2** to include this information
- The RPA must notify the relevant contact officer in the regional office in writing of the dates as they occur to ensure the department's publicly accessible LEP Tracking System is kept up to date
- A copy of this completed report must be provided to the department with the RPA's request to have the LEP notified

Table 1 – To be completed by the department

Stage	**Date/Details**
Planning Proposal Number	**PP_2014_CAMDE_001_00**
Date Sent to Department under s56	**19/6/2014**
Date considered at LEP Review Panel	**N/A**
Gateway determination date	

Table 2 – To be completed by the RPA

Stage	**Date/Details**	**Notified Reg Off**
Dates draft LEP exhibited		
Date of public hearing (if held)		
Date sent to PCO seeking Opinion		
Date Opinion received		
Date Council Resolved to Adopt LEP		
Date LEP made by GM (or other) under delegation		
Date sent to DP&I requesting notification		

Table 3 – To be completed by the department

Stage	**Date/Details**
Notification Date and details	

Additional relevant information:

APPENDIX J

Visual Character Assessment Report

VISUAL IMPACT ASSESSMENT

Proposed Rezoning
Crase Place, Grasmere
Project No 14154 – December 2014

siteplus

planning . engineering . landscape . design . management

VISUAL IMPACT ASSESSMENT

Proposed Rezoning

Lot 24 DP 1086823 Crase Place, Grasmere

PREPARED FOR

Cowbridge Holdings

PREPARED BY

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Document Tracking

Document Status		Report					
File Location		T:\Projects\14154\Visual impact assessment					
Project No.		14154			Date	November 2014	
Rev No.	Author	Author			Approved		
		Name	Signature	Date	Name	Signature	Date
A	Draft Visual Assessment	KM		Nov 2014	VM		Nov 2014
B	Final Visual Assessment	KM		Dec 2014	VMcl		Dec 2014

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EXECUTIVE SUMMARY

The visual impact assessment has been prepared by Site Plus Pty Ltd (Siteplus) on behalf of Cowbridge Holdings for a proposed rezoning and potential future subdivision at Crase Place, Grasmere. The assessment process was supported by the examination of:

- Aerial photography,
- Contour maps,
- Photomontages and
- Detailed field inspections.

Locations with opportunities for views to the site were examined in relation to the existing character and the ability of the area to absorb the proposed development.

Whilst opportunities exist to see glimpses of the site from a number of places in the local surrounds, the subject site is most visible from its immediate vicinity.

The potential future development will visually impact on the area due to the change in landscape character. However, it is considered that the low visibility of the site in addition with the type and scale of the potential future subdivision allow it to blend in with the existing surrounding character as there are similar type subdivisions and infrastructure surrounding the site. The use of screen planting and other mitigation measures (as described in this report) would further ameliorate the visual impact. The visual impact of the completed development is likely to be acceptable for the area.

1.0 INTRODUCTION

1.1 Background

Siteplus has been engaged to undertake a visual impact assessment of the proposed rezoning at lot 24 DP 1086823 Crase Place, Grasmere. This report forms part of the required documentation to proceed with the planning proposal.

1.2 Project Overview

It is proposed to rezone the subject site to R5 Large Lot Residential which will reflect the residential zoning of the land adjoining the site.

The proposed rezoning will allow the subdivision of the site and the erection of a dwelling on each of the lots. The proposed rezoning and associated future subdivision and development of the site is the subject of this visual assessment.

The indicative form of a possible future subdivision development is shown in Figure 1.1.

Figure 1.1 Indicative Subdivision Plan

Source: Siteplus

1.3 Site Context

The subject land is Lot 24 DP 1086823, Crase Place, Grasmere. The site is accessed via Crase Place which is a cul-de-sac. Werombi Road is located on the northern end of the property and the recently 'decommissioned' 'Old Oaks Road' along the eastern boundary.

The site has an area of approximately 5.6ha. It has a gentle fall from east to west with an approximate fall of 5° - 10° and is vacant of any structures. The land is grassed and there is no significant vegetation on the site.

A drainage reserve traverses the property from the cul-de-sac in Crase Place to the adjoining property to the west (Lot 25 DP 1086823). This adjoining property is vegetated along the existing drainage line and feeds two dams located on the site. This adjoining lot essentially acts as a riparian buffer zone, filtering water run-off from adjacent properties.

The West Camden WRP is located to the north east of the subject property. Figure 1.2 shows the proposed site and its context.

Figure 1.2 Regional Context Overview

Source: www.nearmap.com.au

1. Grasmere
2. Camden Airport
3. Nepean River
4. Subject Site
5. West Camden Water Recycling Plant
6. Camden Bicentennial Equestrian Park
7. Camden
8. Elderslie

2.0 VISUAL IMPACT ASSESSMENT

The visual impact assessment of the potential future subdivision has been undertaken through observation, evaluation of the existing landscape character, and analysis of the visual impact which could be caused by the proposed rezoning and its potential future development. Visual impacts relate to changes in the views experienced by people observing a landscape.

2.1 Purpose and Methodology

This report determines the visual impacts of the potential future subdivision and the anticipated change in the existing site context and character. It adopts the rationale that when the site is not visible, the visual impact is nil; when a small proportion of people view the site, the visual impact is relatively lower than when a large proportion of people view the site; and where the site is viewed for short periods of time, the visual impact is relatively lower than when the site were viewed for extended periods of time.

The visual impact assessment methodology involves the following stages:

- Desktop study of surveys, aerial photographs, locality maps and literature reviews;
- Review of the proposed rezoning and potential subdivision development within their existing context;
- Identification of key viewpoints;
- Detailed field inspection and site analysis;
- Determination of scenic quality of the site;
- Determination of visual absorption capacity of the site;
- Determination of visual impact rating of the site; and
- Recommendation of mitigation measures.

2.2 Field Investigation

Field investigations have been undertaken to enable Siteplus to develop a detailed understanding of the existing landscape character surrounding the site. Site visits to validate the results of the desktop study of potential viewpoints were conducted during November 2012. The objectives of the visits were:

- Examination of existing landform, elevations and characteristics surrounding the proposed development site.

- Identification of existing locations (viewpoints) from where the proposed development can be seen.
- Gathering of photographs from the key viewpoints to assist in the assessment process.

View locations (viewpoints) from within the locality surrounding the site were assessed. These viewpoints were identified on a map (Refer Figures 2.1). Images illustrating the views of the site are included in this report (Refer Figures 2.2 – 2.13).

Figure 2.1 View Point Locations

Source: www.maps.google.com.au

Table 2.1 Viewpoint Location Details

Viewpoint Location Details	
Viewpoint Location	**Direction of view**
1 – The Old Oaks Road	East
2 - The Old Oaks Road	North
3 - Decommissioned 'The Old Oaks Road' / Werombi Road	North East
4 – Decommissioned 'The Old Oaks Road'	South West
5 – Decommissioned 'The Old Oaks Road'	North
6 – Decommissioned 'The Old Oaks Road'	West
7 – Ferguson Lane	South West
8 – Private Road off Werombi Road	South East
9 – Smalls Road	South East
10 – The Old Oaks Road	West
11 – Subject site off Grase Place	North
12 – Harben Vale Circuit	East

2.3 Scenic Quality

Descriptions of the scenic quality have been qualified in the following categories:

- **High** – Areas with a diversity of landscape elements or areas with visually prominent features of land form which may include escarpments, ridge lines, visually significant stands of vegetation, geological formations, rivers, beaches, parks, villages, city skylines or streetscape. Views from an elevated position are also usually of high scenic value.
- **Moderate** – Land form or built features which tend to be common throughout the area and are not outstanding in visual quality.
- **Low** – Areas with features of minimal diversity or variety.

The site of the potential future subdivision is bound by Large Lot Residential to the North West and Primary Production to the South East.

Residential subdivisions are already surrounding the subject site. The scenic quality that is presented as a consequence of a potential future development can be reasonably considered as being acceptable for its context. This indicates that it has a **moderate scenic quality** rating.

2.4 Visual Absorption Capacity

Visual absorption capacity can be described as an estimation of a landscape's ability to absorb a new development without creating a significant change in visual character and quality. One of the main factors influencing visual absorption capacity is the contrast between existing landscape character and the proposed development. The visual absorption capacity can be qualified in the following categories:

- **High** – Existing landscape and built environment able to absorb development with no or minimal obstruction to significant views or desired character.
- **Moderate** – Existing landscape able to absorb some development with moderate obstruction to significant views and desired character.
- **Low –** Existing landscape unable to absorb development without a high degree of obstruction to significant views and desired landscape character.

The site of the proposed rezoning and potential future subdivision is located in an area which is evidently rural residential. The subject site is only visible from a few viewpoints within its proximate vicinity due to existing landform and vegetation. A R5 Large Lot Residential subdivision would be typical for the area and would not contrast with the existing rural residential character of the area as the surrounding subdivisions are very similar in type and scale. This indicates that the proposed rezoning and potential future subdivision development has a **high visual absorption capacity** rating.

2.5 Visual Impact Rating

The visual impact rating can be determined by comparing the scenic quality of a site with its visual absorption capacity. This cross referencing ensures that the viewer's emotional response to scenic quality is considered with respect to the capacity for change.

The ratings shown in the table below are described as:

- **High –** Developments within this rating are likely to have a significant visual impact upon the scenic quality of the surrounding landscape character.
- **Moderate –** Developments within this rating will have a visual impact upon a limited area at a local scale.
- **Low –** Developments within this rating will not have significant visual impact.

Table 2.2 Visual Impact Rating

Visual Impact Rating				
		Scenic Quality		
Visual Absorption Capacity		Low	Moderate	High
	Low	Moderate	High	High
	Moderate	Low	Moderate	High
	High	Low	Low	Moderate

From the matrix shown above the visual impact rating for the site is **low**. This means that the potential future development would add dwellings to the area but would be consistent and typical of the surrounding rural residential area. There are existing subdivisions in the locality that are very similar in scale. Therefore the proposed development will blend into the surrounding locality and not contrast in character. The subject site is barely visible from surrounding areas due existing landform and vegetation.

In conjunction with the proposed screen plantings and other mitigation measure, as described in this report, the visual impact will not be significant for the area.

2.6 Viewpoint Images

Figure 2.2 – Viewpoint 1

View from Old Oaks Road looking East showing primary production and rural residential land surrounding the site.

Figure 2.3 – Viewpoint 2

View from Old Oaks Road overlooking existing rural residential subdivision. Project site and potential future subdivision hidden behind buildings and vegetation.

Figure 2.3 - Viewpoint 3

View from intersection of decommissioned Old Oaks Road / Werombi Road looking towards West Camden Water Recycling Plant. Plant is hardly visible because of tree / shrub screen planting.

Figure 2.4 - Viewpoint 4

View along decommissioned Old Oaks Road with the potential future subdivision / subject site to the west. Existing topography doesn't allow for views into the site from this viewpoint.

Figure 2.5 - Viewpoint 5

View from highpoint along decommissioned Old Oaks Road overlooking sloping land of subject site. View towards existing rural fire station on Werombi Road.

Figure 2.6 - Viewpoint 6

View from highpoint along decommissioned Old Oaks Road overlooking sloping land of subject site. View towards existing rural residential subdivision development to the south west.

Figure 2.7 - Viewpoint 7

View from Ferguson Lane towards subject site. The potential future subdivision would be visible from this viewpoint. Ferguson Lane is a no through road; therefore not many people would see the subdivision from this viewpoint. Screen planting along Werombi Road would ameliorate the view into the site.

Figure 2.8 - Viewpoint 8

View from a private road off Werombi Road looking towards the subject site. Existing vegetation and landform screen the lower part of the project site. Only glimpses of the elevated parts of the subject site are visible.

Figure 2.9 - Viewpoint 9

View from Smalls Road towards subject site. Existing vegetation and landform don't allow any views into subject site.

Figure 2.10 - Viewpoint 10

View from Old Oaks Road towards subject site. The potential future subdivision site is not visible from this viewpoint due to existing landform.

Figure 2.11 – View overlooking subject site from an elevated position within the site (along site boundary, access from Crase Place). The site is partially visible due to existing landfrom.

Figure 2.12 - View from highpoint within existing rural residential subdivision (Harben Vale Circuit). Elevated area of the subject site is visible. Lower lying parts of the potential future subdivision would be screened by existing dwellings and vegetation.

Figure 2.13 - View from entrance to Camden Bicentennial Equestrian Park towards subject site. Subject site is not visible from this viewpoint due to existing landform.

3.0 MITIGATION

The visual impact rating has been identified as **low**, nevertheless recommendations for mitigation measures should be considered to ensure the impacts are kept to a minimum. Recommendations include the following:

- The potential future subdivision development should be screened along it's boundary with large trees that are native to the area;
- Recessive colour schemes should be used for dwellings;
- Proposed built forms should show a consistent character with existing residential developments in the area;
- Urban treatments should be reduced where possible (e.g kerbs, gates, brick driveways, manicured turfed verges and properties);
- Native plant species should be used.

4.0 CONCLUSION

The Visual Impact Assessment has:

- Reviewed available documentation (ie aerials, maps and the potential future development site);
- Analysed the potential future development site and its context;
- Assessed existing views in relation to the existing landscape character;
- Assessed the scenic quality of the potential future subdivision development from various viewpoints;
- Assessed the visual absorption capacity of the potential future subdivision development from various views;
- Assessed the visual impact rating of the potential future subdivision development from various views;
- Identified mitigation measures.

The findings of this Visual Impact Assessment report are that the potential future development has a moderate Scenic Quality rating and high Visual Absorption Capacity rating which results in an overall **low** Visual Impact Rating.

This means that the proposed development will be visible from only a number of viewing locations. The most sensitive viewing locations would be views from directly surrounding the site. However, views towards the subject site would generally be similar in appearance to the existing rural residential environment surrounding the project site. The visual impact of the proposal, located in this rural residential area, is consistent in character with its surroundings, and does not reduce the visual amenity of the area. Also, the surrounding developments will neither completely conceal nor expose the potential future subdivision development but have the ability to reduce the visual impact from outside the site boundary. It is considered in conjunction with the proposed mitigation measures the visual impact will be acceptable for the Grasmere area.

5.0 REFERENCES

Grasmere Local Environmental Study – Final Report (planning workshop Australia 2001)

Berrybank Wind Farm Landscape and Visual Impact Assessment Final Report (Urbis 2009)

Preliminary Landscape Visual Character Assessment for the Sisters Wind Farm (WAX design space 2008)

Taringa Substation – Visual Impact Assessment (Urbis 2010)

Visual Impact Assessment for a dredge material management area H for BHPBIO (SKM 2009)

Visual Impact Assessment Cross Street Double Bay (architectus 2009)

Visual Impact Assessment report - Wyong area coal joint venture (Andrews Neil Urban Design Group 2009)

Visual Impact Assessment – proposed bulk liquids storage facility Marstel Teminals, Kooragang Island (HLA Envirosciences Pty Limited 2007)

APPENDIX K

Part 2 Land Capability

Response to Gateway Conditions
Crase Place, Grasmere
Land Capability Assessment
Project No 14154 – December 2014

siteplus

planning . engineering . landscape . design . management

LAND CAPABILITY ASSESSMENT
RESPONSE TO GATEWAY CONDITIONS
AT LOT 24 DP1086823
CRASE PLACE, GRASMERE

PREPARED FOR

Cowbridge Holdings

BY

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Document Tracking

Document Status		Revision 1					
File Location		T: Projects/ 14154					
Project No.		14154			Date	December 2014	
Rev No.	Author	Author			Approved		
		Name	Signature	Date	Name	Signature	Date
1	Draft Report	AT		Nov 2014	VMcl		Nov 2014
2	Client Issue	AT		Dec 2014	VMcl		Dec 2014
3	Final Issue	AT		Dec 2014	VMcl		Dec 2014

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APPENDICIES

1.0 SUMMARY

The NSW Department of Planning and Environment (the Department) issued a Gateway Determination for Lot 24 DP 1086823 Crase Place, Grasmere. The determination was to enable the rezoning of the site to R5 Large Lot Residential.

One of the conditions of the Gateway determination was the requirement for a Part 2 Land Capability Assessment, this report is provided in response to that requirement.

The assessment has considered the previous geotechnical, contamination and salinity reports that have been prepared for this site and other properties in close proximity.

The assessment has concluded that essentially there are no inherent constraining factors associated with the consideration of the site in rezoning the site given:

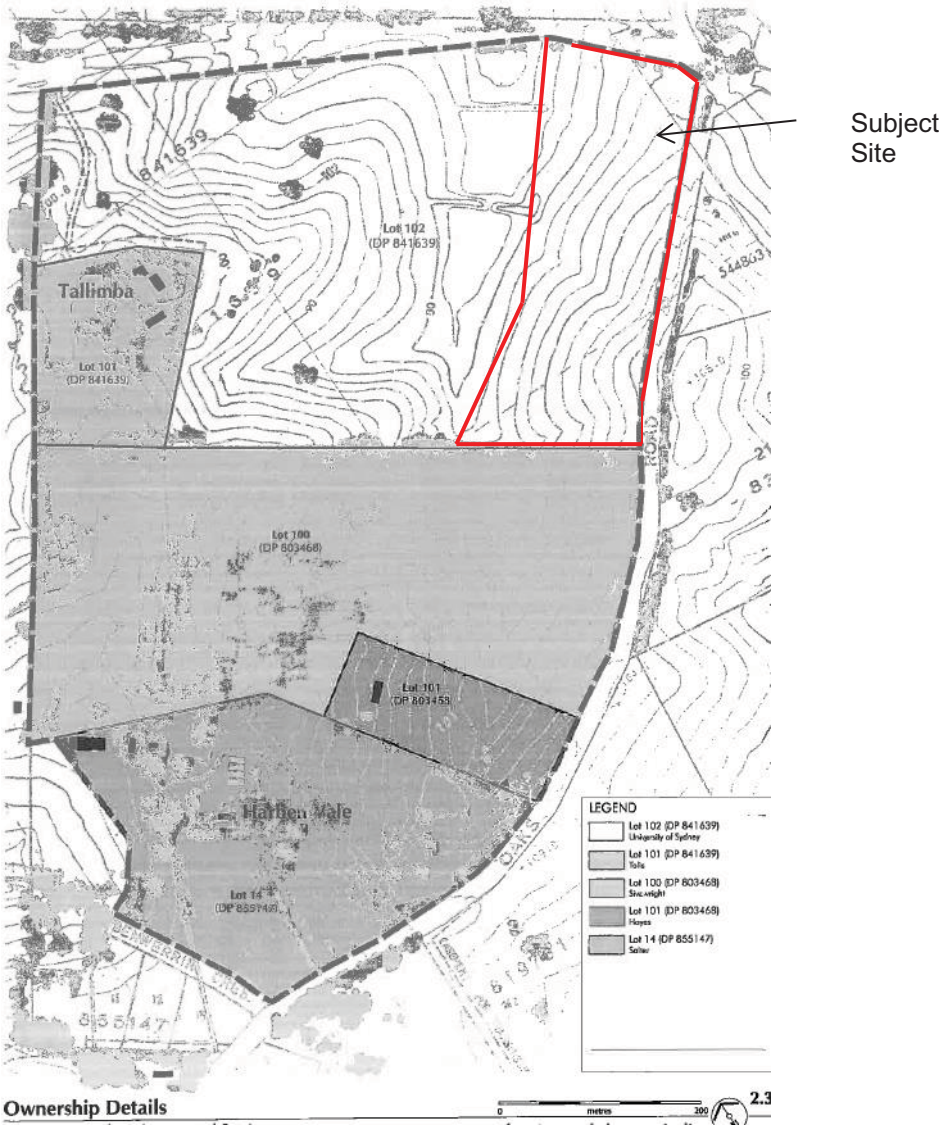
- The size of the subject site;
- Existing land ownership patterns, and
- Land Capability.

2.0 BACKGROUND

The subject site originally formed part of Lot 102 DP 1086823. Lot 102 and four (4) other lots were part of a Local Environmental Study (LES) to rezone the land from Rural 1(a) to Residential. The report was commissioned by Camden Council on behalf of the landowners and was undertaken by Planning Workshop Australia in 1999 and assessed the land capability of the site.

The area considered in the original zoning proposal is shown in Figure 2.1. The area of the subject site is indicatively shown outlined in red.

Figure 2.1 Original Planning Proposal

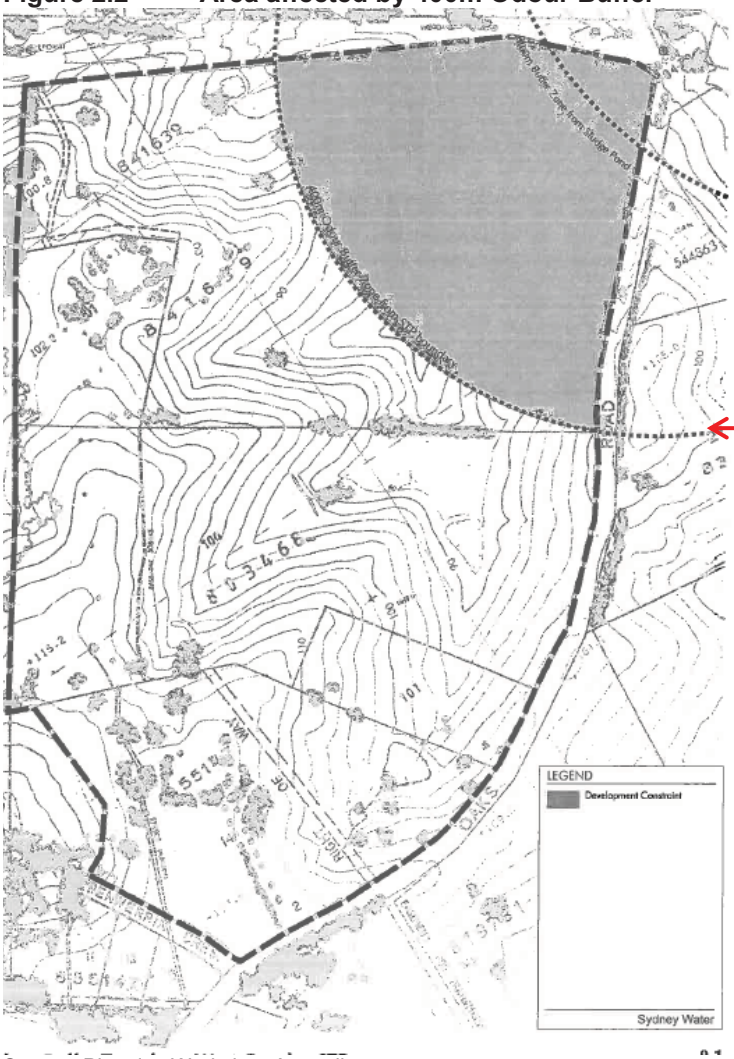


Source: Planning Workshop Australia and Siteplus

The LES ultimately led to the rezoning of the land to Residential except for that portion of the site identified as being affected by the 400m odour buffer zone from the West Camden Water Recycling

Plant. A plan showing the area affected by the 400m odour buffer is shown in Figure 2.2. Nevertheless, the LES included studies of the subject site. This included a land capability assessment undertaken by Coffey Geosciences. This is discussed in more detail in Section 3.

Figure 2.2 Area affected by 400m Odour Buffer



Source: Planning Workshop Australia

2.1 Existing Land Use

The site is vacant from any structures or land-use activities. Access to the site is from Crase Place. There is minimal vegetation on the site as shown in Figure 2.2. The site has an area of 5.652ha and has a slope of up to 10%.

Figure 2.3 is an aerial photo of the subject site.

Figure 2.3 Aerial Photograph of the Site

Source: www.nearmap.au

3.0 EXISTING REPORTS

3.1 Contamination Assessment

Coffey conducted a Phase 1 Contamination Assessment of the subject site. The assessment found that the site had been used for grazing since the 1900's and that it has remained essentially undeveloped with evidence only of minor installation of some infrastructure associated with the construction of a cul-de-sac.

Given the available site history, Coffeys considered that the likelihood of contaminating activities is low to very low and that further investigations are not considered necessary based on this information. Attachment A includes an extract from the Contamination and Salinity Assessment undertaken for the site. The appendixes referred to in this extract are located in Appendix A.

3.2 Salinity Assessment

Coffeys found the site to have a low to moderate salinity potential based on the topography of the site and the literature review. The hill crest/sandstone areas are likely to have low salinity with moderate potential for salinity in the lower areas near the western site boundary.

Salinity can be successfully and appropriately managed through a range of appropriate mitigation measures including construction techniques as the site is developed. A copy of the salinity assessment is co-located in Appendix A.

3.3 Geotechnical Assessment

Coffeys undertook a geotechnical assessment which included the subject land as shown in Figure 2.1.

The assessment described the site as having flanking slopes of 5^0 to 10^0 with colluvial and residual soils, possibly more than 2m deep developed on shale or sandstone. This land was assessed as having a 'low' risk of slope stability.

The assessed risk of slope instability as "Low Risk" derived the following geotechnical constraints for future development as:

> *Residential development should follow good engineering practices suitable for hillside construction. Risk after development normally acceptable.*

This assessment was made on the assumption that future development would be connected to the sewer and that all stormwater from any development would be collected and discharged clear of any developments on the site. An extract from the original Local Environmental Study (LES) containing the Geotechnical Assessment is included in Appendix B Section 5.2.

Details of sewer augmentation can be found in Appendix A in the main document of this report.

3.4 Agricultural Capability Assessment

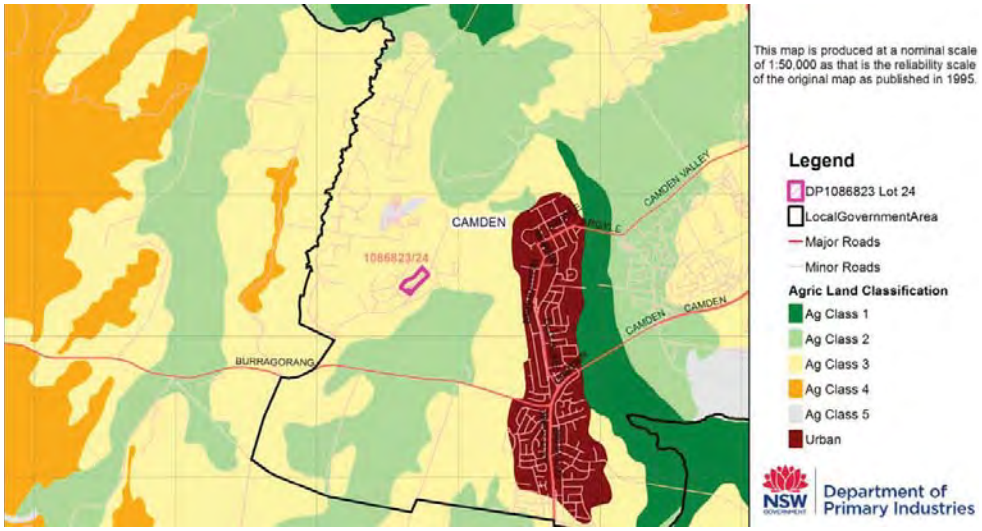
Figure 3.1 is an extract from the Agricultural Land Classification for the Sydney Basin. It has been prepared for regional planning purposes and the Department of Primary Industries has advised that it cannot be relied on for individual property planning. The map was produced in 2012.

The subject site is outlined in pink and has been identified as having a Class 3 classification. NSW Agriculture defined Class 3 land as:

> *Grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with sown pasture. The overall production level is moderate because of edaphic or environmental constraints. Erosion hazard, soil structural breakdown or other factors, including climate, may limit the capacity for cultivation and soil conservation or drainage works may be required.*

The portion of the map coloured maroon is identified as Urban land.

Figure 3.1 Agricultural Land Classification Map



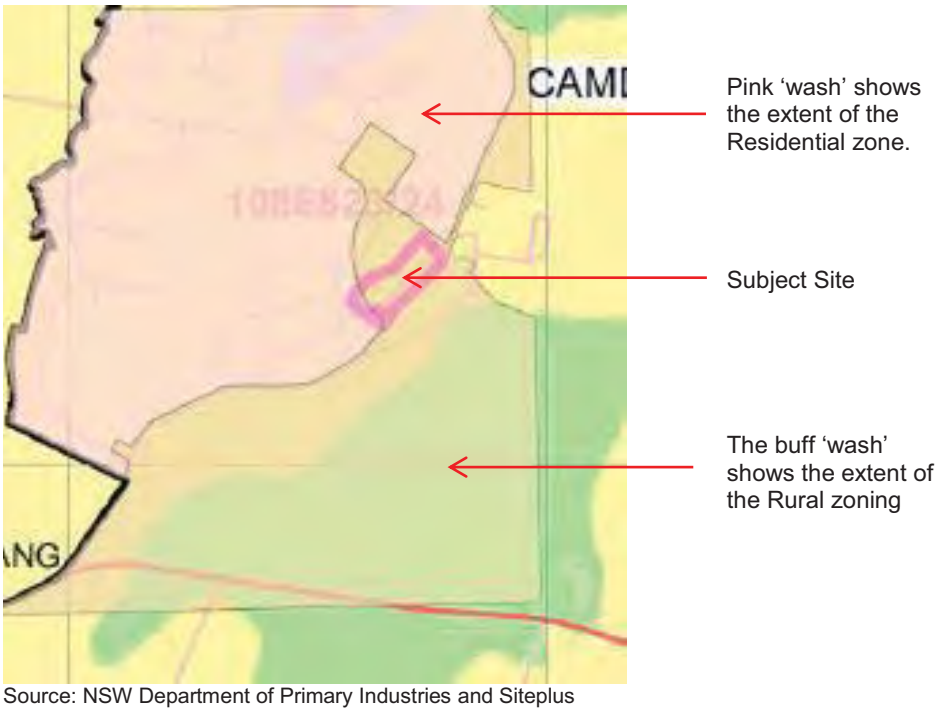
Source: NSW Department of Primary Industries

Figure 3.2 is an extract of the Agricultural Land Classification map centring on the subject site. An overlay of the existing zoning is also provided. The 'pink wash' identifies land zoned Residential, the 'buff wash' shows land zoned Rural.

It is evident from this Figure that significant portions of land surrounding the site are actually zoned residential. This is relevant as Agfact AC.25 produced by NSW Agriculture essentially states that irrespective of the method used to produce agricultural land classification maps, lands that can be clearly excluded from the assessment include land zoned urban or village. Consequently the

plan shown in Figure 3.2 is more reflective of Agricultural Land Capability given the advice contained in AgFact AG. 25.

Figure 3.2 Agricultural Land Classification Map with Zoning Map Overlay



Source: NSW Department of Primary Industries and Siteplus

3.5 Land Capability Assessment

3.5.1 Initial Assessment

A land capability assessment was undertaken by Coffey in 1999 as part of the original rezoning proposal. The assessment relied on an assessment of landform, geotechnical assessment, water storage dams, categorisation of the site into one of four geotechnical zones to inform the type of development that can be supported in the area, the mineral resources available within the area and a soil analysis. Attachment B is an extract from the LES detailing this this assessment.

The assessment concluded that the area has not been used for significant agricultural purposes for many years with limited pasture improvement. Evidence was seen of some past overgrazing, concurrent leaching and soil erosion. Native species had deteriorated and introduced species and weeds have persisted.

Coffeys concluded that:

Given the history of local development policy regarding subdivision, poor pasture management and encroachment of urban development, it would appear that such classification may not be appropriate.

This is based on the following factors:

- *The cost of returning such land to production would be exorbitant, involving the development of dams, provision of slope stability and land conservation measures and pasture remediation and restocking.*
- *Given the small size of the subject lots, the economic feasibility of an agricultural holding would be low, unless farmed with high value crops.*
- *The consolidation of properties, given past subdivision practices would be impractical and difficult.*
- *Surrounding land uses and local development policy do not facilitate retaining of the subject land in pastoral production.*

3.5.2 Land Evaluation

The Office of Environment and Heritage (OEH) prepared *The Land and Soil Capability Assessment Scheme – A general rural land evaluation system for New South Wales. (Second Approximation).* It defines land capability as *the inherent physical capacity of the land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources*.[1]

The scheme notes that a failure to manage land according to its land capability can result in degradation to the land on and off the site which can lead to a decline in natural ecosystem values, agricultural productivity and the functionality of infrastructure.

The application of the Assessment Scheme has been identified as being most relevant for broad scale assessment of lower intensity, dry land agricultural use and has less relevance for intensive agriculture or irrigation of pastures. This issue is further discussed in Section 4 of this report.

The Assessment Scheme highlights that it provides guidance only for the physical capacity of the land to support alternate agricultural uses. The Assessment does not take into consideration any other social or economic factors which might ultimately inform the final land use.

The assessment criteria under the scheme are:

- Water Erosion
- Wind Erosion
- Soil Structure Decline
- Soil Acidification
- Salinity
- Water logging
- Shallow Soils and Rock

[1] Office of Environment & Heritage. The Land and Soil Capability Assessment Scheme Pg 1

- Mass Movement

A classification is allocated for each of the criteria. The site takes on the classification of the lowest rating of the site.

The site has been considered in response to the criteria set out in this evaluation and a Class 4 classification has been allocated based on the assessment for water erosion.

The method of evaluation is shown in Table 3.1.

Table 3.1 Slope Class for Each Land & Soil Capability Class Used to Determine water Erosion Hazard

NSW Division	Slope Class (%) for each LSC Class							
	Class 1	Class 2	Class 3	Class 4[1]	Class 5[2]	Class 6	Class 7	Class 8
Eastern and Central Division	<1	1 to <3	3 to <10 or 1 to <3 with slopes >500m length	10 to <20	10 to <20	20 to <33	33 - <50	>50
Western Division[3]	<1	1 to <3 or <1 for hardsetting red soils	1-3	3-5	3-5	5-33	33-50	>50

Sand bodies are classified as Class 1 for water erosion hazard.

[1] No gully erosion sodic/ dispersible soils are present.

[2] Gully erosion and/or sodic/ dispersible subsoils are present.

[3] Western CMA provided advice on the slope classes.

The site has a slope up to 10% - which categorises the site as Class 4 land. Class 4 land is described as having:

> *Moderate to severe limitations for some land uses that need to be consciously managed to prevent soil and land degradation. The limitations can be overcome by specialised management practices with high levels of knowledge, expertise, inputs, investment and technology.*[2]

Land Management techniques for Class 4 land are located in Attachment C. In reading these management techniques, it is evident that the size of the subject site does not enable the uses anticipated by Class 4 land. This is discussed further in Section 4.

It is noted that the land classification falls on the cusp of Class 3 to 4. The lowest category rating must be applied to the site – which is Class 4. For comparison however, information regarding class 3 land is also included in Attachment C. It is evident from this advice that

[2] Office of Environment & Heritage. The Land and Soil Capability Assessment Scheme Pg 18

the capacity of the site to accommodate broad scale farming does not alter because of the limited size of the site.

Attachment D contains extracts from the NSW Soil and Land Resources for the Hawkesbury Nepean Catchment. It provides an assessment for a range of criteria which contribute to land management/ capability. It provides additional information on the site however the overall classification of the site as Class 4 remains.

4.0 MINIMUM LOT SIZE

4.1 Extensive Agriculture

Sinclair makes the distinction that in discussing minimum lot size for agricultural land that there is difference between viable and sustainable. He states that:

> *We must distinguish between the terms 'viable' and 'sustainable' in order to discuss the issue properly. Viability when applied to agricultural production really only applies to the economic return. However, sustainability brings in social and environmental issues as well as the economic ones. A 2ha market garden may make a good economic return and therefore be viable or economically sustainable, but also may cause rural land use conflict and increase the nutrient load in the surrounding streams and therefore is not socially and environmentally sustainable.* [3]

In evaluating what is a viable herd for cattle, the NSW Land and Environment Court (LEC) held that a breeding herd of 40 cows was reasonable and a typical unit for efficient and sustainable beef cattle enterprise. (NSW LEC proceedings No 10180, 1987)

The Department of Primary Industries (DPI) has estimated carrying capacity and area required for grazing in the Hunter Region. The DPI has estimated that a site which has a medium soil P (phosphate) level requires a minimum of 72ha to graze cattle for 8-9 months to achieve an economic return. This minimum area can range between 55ha to 292 ha depending on the P level. (Essentially the P level was found to be indicative of the quality of the pasture available to cattle). The subject site has an area of 5.6ha and so there is insufficient land area to sustain a viable herd of cattle.

4.2 Intensive Agriculture

The site has a total area of 5.652ha and has a slope of between 5^0 to 10^0 and whilst the site meets a theoretical lot size for intensive agriculture the slope of the land makes it difficult to undertake many intensive agricultural options such as market gardens.

Other intensive agricultural options (eg poultry farms) are likely to be problematic to adjoining property owners because of associated odour or other impacts and such an activity is unlikely to be considered acceptable in such close proximity in essentially an urban setting.

4.3 Lot Size

To achieve an economic return and to incorporate sustainable farming practices, a significantly larger site area is required.

[3] Sinclair Ian: Lot Sizes for Agriculture Pg 1

5.0 CONCLUSION

The Geotechnical Assessment, Salinity Assessment and Contamination Assessments undertaken by Coffey's have all concluded that there are no constraints which would preclude the site from being developed, subject to appropriate controls being applied during construction.

The land suitability assessment undertaken in 1999 by Coffeys concluded that:

Given the history of local development policy regarding subdivision, poor pasture management and encroachment of urban development, it would appear that such classification may not be appropriate. This is based on the following factors:

- *The cost of returning such land to production would be exorbitant, involving the development of dams, provision of slope stability and land conservation measures and pasture remediation and restocking.*
- *Given the small size of the subject lots, the economic feasibility of an agricultural holding would be low, unless farmed with high value crops.*
- *The consolidation of properties, given past subdivision practices would be impractical and difficult.*

Surrounding land uses and local development policy do not facilitate retaining of the subject land in pastoral production.

The slope of the site results in the land having a Class 4 classification which means that it has:

Moderate to severe limitations for some land uses that need to be consciously managed to prevent soil and land degradation. The limitations can be overcome by specialised management practices with high levels of knowledge, expertise, inputs, investment and technology.

The management techniques described for this class of land are designed for broad scale farming and the land is clearly insufficient in size to accommodate this level of agriculture and to be viable. Similarly, the land is not suitable for the intensive agriculture because of the slope of the land and the potential social impacts arising from such a use.

The land is capable of supporting residential development given the advice contained in the supporting studies prepared in 1999 and 2013. Given it is inappropriate to use the site for agricultural pursuits, the use of the site for residential purposes is an appropriate outcome.

6.0 REFERENCES

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APPENDIX A

Contamination Salinity Assessment

APPENDIX B

Geotechnical Assessment & Land Capability Assessment

APPENDIX C

Land Management Techniques for Class 4 and Class 3 Land

APPENDIX D

Site Assessment

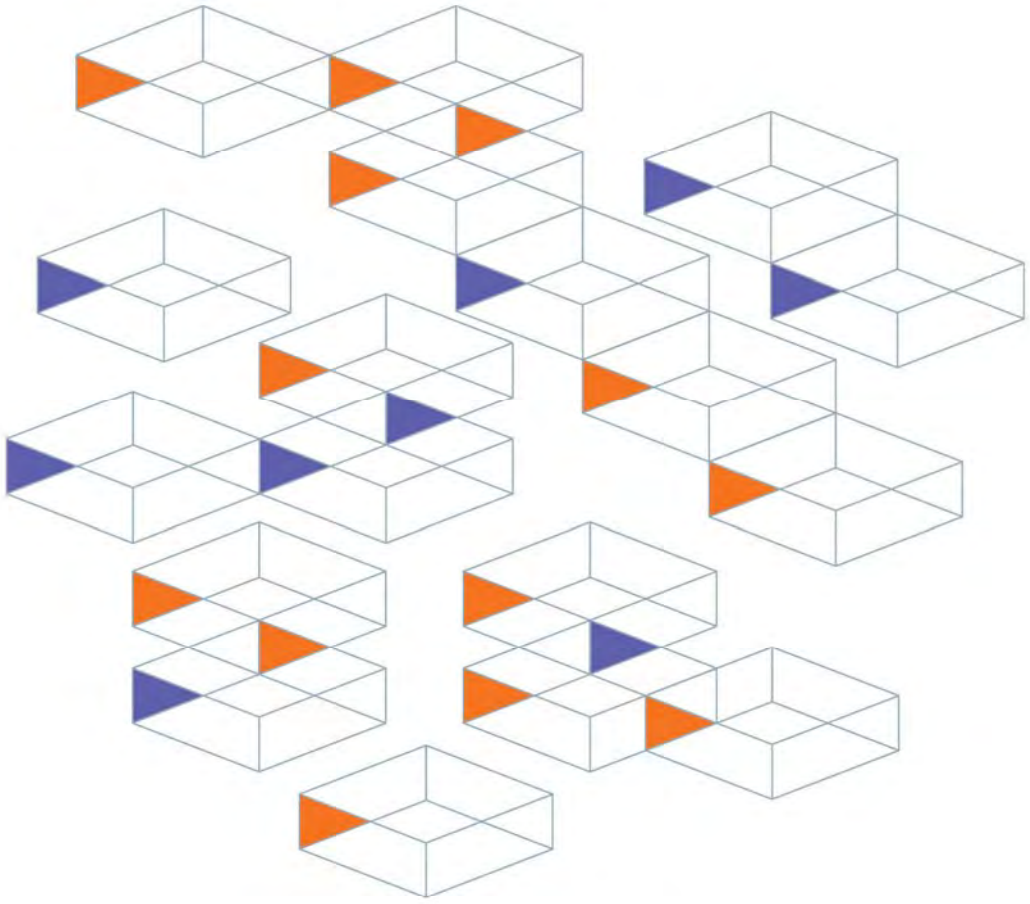
Site Plus

PHASE 1 CONTAMINATION ASSESSMENT AND SALINITY ASSESSMENT

PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

Report Date: 25 November 2013

Reference: ENAUWOLL04150AA-R01 (Rev. 1)



Boundaries
are set by those
who are afraid
to push them

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PHASE 1 CONTAMINATION ASSESSMENT AND SALINITY ASSESSMENT
PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

Report Date: 25 November 2013

Report Ref: ENAUWOLL04150AA-R01 (REV.1)

Prepared for:
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Report Status:	No. of copies	Format	Distributed to	Date	Authorised by
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LIST OF ATTACHMENTS

ABBREVIATIONS

AEC	Area of Environmental Concern
AHD	Australian Height Datum
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
COPC	Chemical of Potential Concern
DECC	Department of Environment and Climate Change (NSW)
DLWC	Department of Land and Water Conservation (NSW)
NEHF	National Environmental Health Forum
NEPM	National Environment Protection (Assessment of Site Contamination) Measure
NSW EPA	Environment Protection Authority of New South Wales
NSW SALIS	NSW Soil and Land Information System
OCP	Organochlorine Pesticide
OPP	Organophosphorus Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
TRH	Total Recoverable Hydrocarbon
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

Coffey was commissioned by Site Plus to undertake a Phase 1 Contamination Assessment and Salinity Assessment at No. 10 Crase Place, Grasmere, NSW (herein referred to as the 'Site').

We understand that a submission is being prepared to amend current zoning allowing additional dwellings to occupy the site. Camden Council has requested information concerning soil contamination and salinity, as part of this submission. The building envelope is currently constrained by an odour buffer associated with Sydney Water's water treatment plant located northeast of the site. The building envelope occupies an approximate area of 2ha.

The objectives of the assessment were to:

- Assess, at a preliminary level, the potential for contamination to be present on the site from previous site activities with respect to its proposed land use and provide recommendations on the need for further stages of assessment; and
- Assess for potential salinity issues.

The scope of work developed to meet this objective included a review of site history information, review of geotechnical reports and salinity indicators, and site walkover. The results of the desk study and site walkover were interpreted and assessed with respect to these objectives.

Contamination Issues

Site history information indicates that the site has been used for grazing land since at least the 1900's. The site had formed part of a larger parcel of land (48.4ha) and has been progressively subdivided since 2005 into smaller lots. Apart from installation of minor infrastructure (i.e. cul-de-sac and stormwater drain), the site has remained undeveloped. There were some gaps in the early site history which cannot preclude certain activities occurring or structures having been present at the site.

Based on the available site history information, the likelihood of these contaminating activities occurring at the site was assessed as low to very low. Further stages of investigation are not considered necessary based on information presently available.

It is recommended that an unexpected finds procedure be developed to manage potential contamination, should it be encountered during construction. Potential contamination may include, but not limited to, oil staining, building materials such as fibre cement, burial pits, fill, odours or discolouration.

Salinity Issues

Based on literature review and topography, the site has been assessed to have a low to moderate salinity potential. A low salinity potential is expected in hill crest/sandstone areas and transitioning to a moderate potential in the lower lying regions near the western site boundary.

Salinity issues can be exacerbated through inappropriate development practices, which can mobilise salt to the surface where it can come into contact with structures. The risk to structures and style of mitigation measures are dependent on profiling and construction details of the proposed development. Management strategies are available to mitigate the effects of potential salinity and options can be further refined following additional investigations during detailed design. Further investigations can be undertaken at a future stage, for example, as part of a development application.

EXECUTIVE SUMMARY

This executive summary must be read in conjunction with the full report and in the context of the attached “Important Information about your Coffey Environmental Report” and to the statement of limitations in Section 9 of this report.

♦ ♦ ♦

1 INTRODUCTION

Coffey was commissioned by Site Plus to undertake a Phase 1 Contamination Assessment and Salinity Assessment at No. 10 Crase Place, Grasmere, NSW (herein referred to as the 'Site') (Figure 1). The work was completed in general accordance with our proposal ENAUWOLL04150AA-P01, dated 6 September 2013. This report presents the findings of the assessment.

We understand that a submission is being prepared to amend current zoning allowing additional dwellings to occupy the site. Camden Council (Council) has requested information concerning soil contamination and salinity, as part of this submission. The building envelope is currently constrained by an odour buffer associated with Sydney Water's water treatment plant located north east of the site. The buffer zone is shown on Figure 2. The building envelope occupies an approximate area of 2ha.

The objectives of the assessment were to:

- Assess, at a preliminary level, the potential for contamination to be present on the site from previous site activities with respect to its proposed land use and provide recommendations on the need for further stages of assessment; and
- Assess for potential salinity issues.

2 SCOPE OF WORKS

The work carried out by Coffey to meet the above objectives included:

- Review of published information (e.g. topographic, geological, soil landscape, salinity potential maps) and previous geotechnical reports.
- Specific information reviewed for assessing the likelihood of potential contamination to exist at the site included review of: historical title records, aerial photographs and Camden Council planning records; and search of NSW EPA and WorkCover Dangerous Goods licence databases.
- Specific information reviewed for assessing salinity potential included the collation of broad scale information including review of climate and rainfall data, land use and vegetation history, search of the NSW Office of Water groundwater database, NSW Soil and Landscape Information Systems and defining landforms.
- A site walkover to visually assess potential sources of contamination, observe surrounding land uses, topography, drainage, nearby sensitive environments, and assess details of the site history and desk study to further assess potential areas of environmental concern (AECs) and contaminants of potential concern (COPCs) and obvious evidence of saline impacted soils.
- Preparation of this report summarising results of the desk study and site walkover and making conclusions and recommendations with respect to the objectives outlined in Section 1.

3 SUMMARY OF SITE LAND USE AND SURROUNDING ENVIRONMENT

The Site identification information is summarised in Table 1. The Site locality, Site layout and general surrounding land uses are shown in Figures 1 and 2. The Site is defined on Figure 2. The Site forms part of a larger parcel of land which extends a further 265m north.

Table 1: Summary of Site Identification Information

Street Address	10 Crase Place, Grasmere, NSW
Site Area (approximate)	2ha
Dimensions (approximate)	165m (southern boundary) by 110m (eastern boundary)
Title Identifiers	Part Lot 24 DP1086823
Local Government Area	Camden
Parish and County	Camden
Current Zoning	R5 Large Lot Residential and RUI Primary Production under the Camden Council Local Environmental Plan (LEP) 2010.
Grid Co-ordinates	285317E; 6228585N (from the southeastern corner of the Site)
Surrounding Land Uses	North: Grazing land then Werombi Road and Sydney Water Sewerage Treatment Plant East: Grazing land and a residential dwelling South: Two residential dwellings and vacant land West: Dams and connecting watercourses

3.1 Topography and Drainage

Reference to the Camden 1:25,000 topographic map published by the New South Wales Department of Information, Technology and Management indicates that the Site is at an elevation between 80m and 100m above Australian Height Datum (AHD) (Refer to Figure 1). This is consistent with survey plans included in the Local Environmental Study (Coffey, 1999).

The site is located on the western slopes of a local rise in topography and has a moderate downward slope of 5° to 10° in that direction. Surface water that is not absorbed into the ground is likely to follow the topography, flowing west, into a series of dams and connecting watercourses adjacent to the site's western boundary. Water released from these dams will flow north through a culvert beneath Werombi Road and discharging into a larger dam located approximately 580m north of the site. The topography map and aerial photographs suggest that this dam does not routinely discharge into the Napean River located 75m north of this dam.

3.2 Soil Landscape

The Wollongong to Port Hacking 1:100,000 soil landscape series sheet 9029-9129, (Soil Conservation Service of NSW, 1990) shows that the Site is situated within the Blacktown soil landscape. Blacktown is a residual soil landscape characterised by gently undulating rises on Wianamatta Group shale with broad rounded crests and ridges of gently inclined slopes. The soils on crests and upper slopes are well drained however lower slopes are subject to poor drainage and drainage depressions. Soils are moderately reactive, highly plastic and have low fertility.

3.3 Local Geology

The 1:100,000 Wollongong-Port Hacking Geological Map 9029-9129 (Geological Survey of NSW 1985) shows that the Site is underlain by the Bringelly Shale. The Bringelly Shale is described as shale, carbonaceous claystone, laminite with coal in parts which forms part of the Wianamatta Group of Rocks. The map indicated that a geological contact with an 'unnamed sandstone member' was located near the southern part of the site. This unnamed sandstone member was described as fine to medium grained quartz-lithic sandstone.

This description is generally consistent with subsurface conditions encountered during previous investigations undertaken at the site (Refer to Section 4) and observations made of road cuttings near the site (Refer to Section 4).

3.4 Local Hydrogeology and Groundwater Use

A survey of groundwater bores within a 1 kilometre radius of the site registered with NSW Office of Water indicated that there are 10 registered bores. The bores were located between 400m and 1km from the site and were either up-gradient or cross gradient of the site. Three of the ten bores were registered with work summary sheets. These three bores were installed between 1965 and 2003 and registered for stock and / or irrigation purposes. Salinity information was listed for bores GW023588 and GW105251. Groundwater from bore GW023588 was described as 'very salty' whereas the salinity was measured at GW105251 but units were not specified. Water bearing zones were encountered in the 'clay shale' at 3m and 5.5m, and depths greater than 8.5m within shale and sandstone units.

No other chemical data was listed on the work summary sheets. The work summary sheets for groundwater bores GW023588, GW072309 and GW105251 and their location are presented in Appendix A.

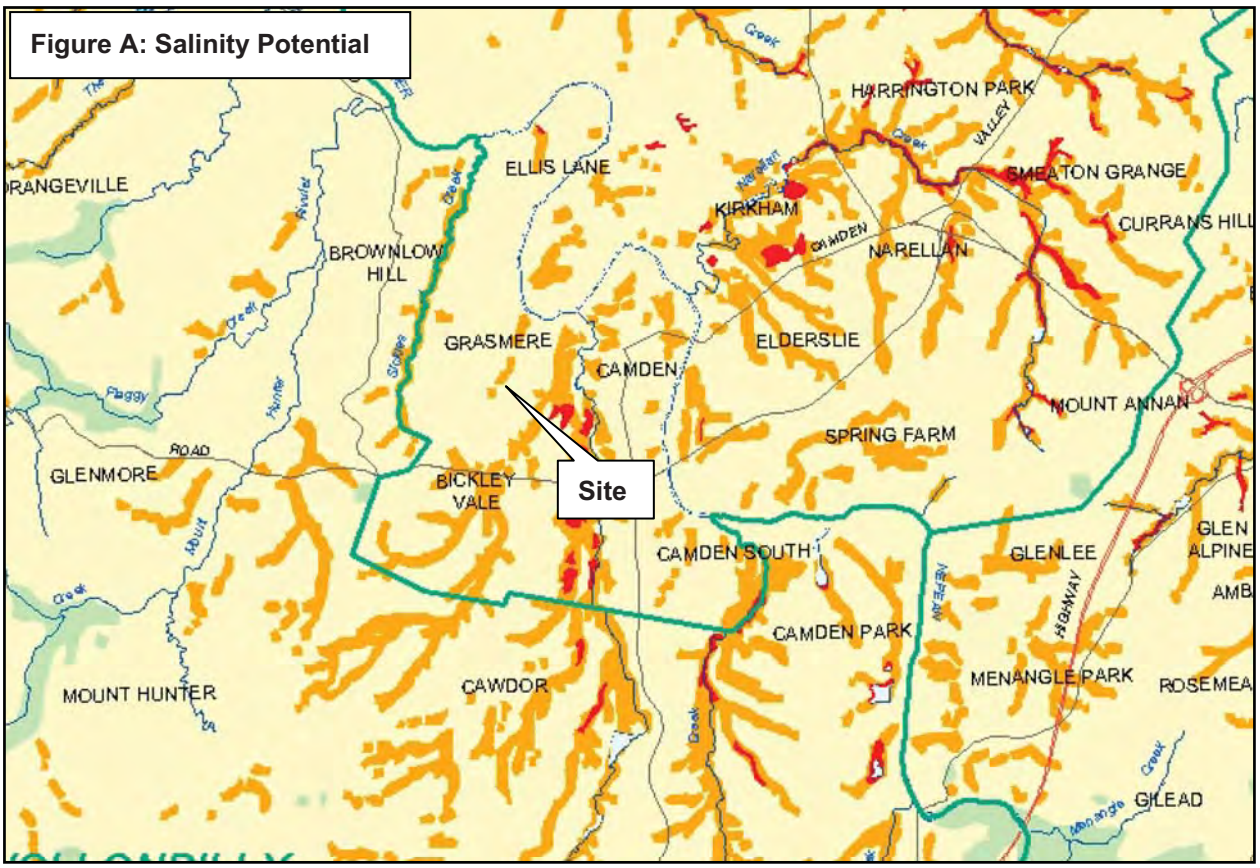
Based on site observations and results of the desk study, groundwater is expected to follow local topography, flowing in a westerly direction towards the dams and connecting watercourses. Depth to groundwater across the site is expected to be variable. In areas of higher elevation, groundwater may be encountered at depths between 3m and 5m; however in lower regions near the foot slopes, groundwater could be less than 1m from the ground surface and in periods of heavy rain groundwater seepages may be observed.

3.5 Salinity Potential

The Salinity Potential in Western Sydney 2002 (NSW DIPNR, 2003) map indicates the site located within an area of moderate salinity potential where saline areas may occur in this zone, which have not yet been identified or may occur if risk factors change adversely (Refer to Figure A). This zone is characterised by hill slopes and crests on Wianamatta Group Shales and situated within particular soil landscapes including the Blacktown Soil Landscape. Other salinity indicators such as scalding and certain vegetation types were also associated with this zone.

A high salinity potential was mapped in an area adjacent to the site's western boundary and appears to be associated with the three dams and connecting watercourses (Refer to Figure A). The map indicates these areas are predisposed to salinity based on soil, geology, groundwater and topography. This area is also located at the lower slopes of a local rise and forms part of a drainage system where water accumulation is high.

Figure A: Salinity Potential



Salinity Potential

Very Low	Moderate	High	Known Salinity

The NSW Soil and Land Information System (SALIS) database was reviewed and identified three soil technical reports prepared for properties located between 600m to 1.1km from the site. A copy of these reports and map showing where the soil survey was done is presented in Appendix A.

Profiles 58 and 59 represent hillcrest or hill slope similar to that of the site, whereas Profile 84 is located in along a plain. Electrical conductivity concentrations reported in soils from profiles 58 and 59 were notably lower than those at profile 84. This was consistent with field observations where salting was evident at Profile 84. Profiles 58 and 59 reports “no salting evident”, however Profile 59 did note “might be salty”. This observation for Profile 59 does not appear to be reflected in electrical conductivity results that suggest the potential for salt is low. Based on the descriptions provided, Profiles 58 and 59 are comparable with the landform for the site. Therefore, salinity conditions at the site could be similar to those encountered at Profiles 58 and 59.

3.6 Climate Information

Rainfall and other climate statistics for the Site were recorded by the Bureau of Meteorology at Camden Airport (Station No. 68192), which is located approximately 2.7km north of the Site (Refer to map in Appendix B).

These statistics are based on data recorded by the Camden Airport weather station since 1943 and are presented in Appendix B. Table 2 provides a summary of annual mean for temperature, rainfall and wind. No information was available on evaporation.

Table 2: Annual Mean for Climate Data

Climate Data	Rainfall (mm)	Temperature (°C)		Wind (km/h)	
		Minimum	Maximum	9am conditions	3pm conditions
Mean	768.4	10.2	23.6	7.0	15.9

Climate information can be incorporated into future salinity assessments once building designs are finalised.

4 SUMMARY OF PREVIOUS INVESTIGATIONS

Coffey was commissioned by Planning Workshop Australia in 1999 to undertake a land capability assessment incorporating items of landform, geotechnical, mineral resources, soils and agricultural capability of a 48.4ha study area, which included the current site. As part of the 1999 study, Coffey reviewed a report prepared by Regional GTS Pty Ltd presenting results of a geotechnical investigation undertaken in 1995. The references for these reports are listed below:

- Regional GTS Pty Ltd (1995) Geotechnical Assessment for proposed residential development, Lots 100, 102 and Part 1 Old Oakes Road, Camden (Report Ref: 95225/GK/1, dated 8 August 1995).
- Coffey Geosciences Pty Ltd (1999) Grasmere Local Environmental Study – Land Capability Study, southwest corner of Werombi Road and Old Oaks Road, Grasmere (Report Ref: S20166/1-AG, dated 28 July 1999).

A geotechnical report held on Council file was briefly reviewed (Geotechnique, 2005). The reference for this report is listed below:

- Geotechnique Pty Ltd (2005) Site Classification for Proposed Subdivision, cnr Werombi and Old Oakes Roads, Grasmere (Report Ref: 10255/2-AA, dated 4 July 2005).

The relevant parts of these reports are summarised in the following sections.

4.1 Geotechnical Assessment (Regional GTS, 1995)

Regional GTS (GTS) was commissioned by T.J. O'Donnell & Associates Pty Ltd to undertake a geotechnical assessment of a 43.6ha property, including the current Site. The purpose of the assessment was to assess the suitability of the land for proposed residential development. This included site stability, site classification (in accordance with AS2870.1 & .2, 1990) and other geotechnical restraints.

To achieve this objective, published geological information was reviewed, site observations of surface features such as rock outcrops and vegetation were made and collecting information on subsurface conditions from seven hand auger boreholes drilled to a maximum depth of 1.2m.

The Site and surrounding properties were mostly covered with a thick grass that had been recently slashed and trees were sparsely located throughout the area. Residential dwellings were noted west and south of the Site, but none were observed on the Site. Dams and connecting watercourses were present at the time of the assessment. The report notes that water releases from these dams flow north towards a culvert beneath Werombi Road. This culvert is located approximately 150m west of the Werombi Road and Old Oaks Road intersection.

The subsurface conditions encountered at the borehole locations were topsoil overlying residual clay soils then extremely to highly weathered shale. No fill or groundwater was observed at the borehole locations. The subsurface conditions are summarised in Table 3.

Table 3: Summary of Subsurface Conditions

Unit	Description	Unit Thickness
Topsoil	Clayey silt, low plasticity, highly organic, dry to moist, firm.	0.2m to 0.3m
Residual	Silty Clay, medium to high plasticity, red-brown becoming orange-grey with depth, moist, stiff.	0.8m to >1m
Extremely to highly Weathered Shale	Shale, grey. Extremely weathered shale (described as a soil) was dry to moist and very stiff to hard.	Unknown

The soil observed at the dams and connecting water courses was inferred to be alluvial, comprising silts but was not assessed directly. The closest borehole to the current site was located approximately 100m north of the site's northern boundary and was the only borehole to encounter highly weathered shale. Highly weathered shale was also observed in road cuttings near the Sewerage Treatment Plant, a further 170m north of this borehole. The assessment inferred the shales to be those consistent with the Bringelly Shale Member of the Wianamatta Group of rocks.

4.2 Land Capability Study (Coffey, 1999)

A land capability assessment was undertaken by Coffey in 1999 for inclusion in a Local Environmental Study being prepared by Planning Workshop Australia. The study area included five lots occupying 48.4ha. The Site formed part of Lot 102 DP841639. As previously discussed, the study included landform, geotechnical, mineral resources, soils and agricultural capability.

Land within the Grasmere area has traditionally been used for agricultural purposes such as cattle grazing, dairy farming and occasional cropping. However since the early 1970's, these activities were reduced due to land sub-division for hobby farms and rural residential use.

The study area had not been exposed to significant agricultural activities for several years however occasional grazing and pastoral improvement were still common on Lot 102 DP841639 at the time of the study. There was evidence of past overgrazing, concurrent leaching and soil erosion.

The study area was divided into four geotechnical zones based on geology, topography and risk of slope instability. The Site formed part of Zone B described as 'flanking slopes of 5° to 10°' with a low risk of slope instability. The geology for this Zone comprised colluvial and residual soils, less than 2m depth developed on either shale or sandstone. No rock outcrops were observed on Site. However, sandstone outcrops were observed in road cuttings east of the Site and another located near residential housing located approximately 400m south of the Site. Shale outcrops were noted along Werombi Road. Inferred locations of these outcrops are shown on Figure 2.

A fill mound approximately 2.5m high and 100m long was located near the south-western boundary of Lot 102 DP841639. The exact location of this fill mound was not provided. There was no further discussion concerning the occurrence of fill materials within the study area.

Four soil samples were collected across the study area targeting depths between 0.1m and 0.5m and tested for dispersion characteristics. The closest sampling location to the Site was located approximately 15m north of the northern Site boundary. This sample was collected at 0.5m representing red-brown sandy clays; clays were medium plasticity and sands fine to medium grained.

The laboratory results indicated that non-dispersive materials were present at this location. The results for other samples were variable and more dispersive.

Vegetation occurrences were discussed in broad terms for the study area. A mixture of native and introduced grasses in particular Paspalum and Phalarius, and smaller amounts of native Sedge, Kikuyu, Couch and Clovers. There was significant intrusion of weeds in the pasture, mainly of the Feather Grass and Fireweed varieties at the time of the study. Generally few trees occupied the study area. Minimal trees comprising Red Gum, and Red and Grey Box varieties generally occupied southern parts of the study area, south of the Site.

4.3 Site Classification (Geotechnique, 2005)

The majority of test pit locations were positioned in the subdivision area located west of the site. One test pit appears to have been positioned within the southern portion of the site immediately south of the cul-de-sac. The report indicates this test pit was excavated during previous geotechnical investigations. The subsurface conditions were similar to those encountered in previous investigations. No groundwater inflows were observed within the investigation depth of 2.5m. The report noted that groundwater seepages may occur in periods of rainfall.

5 SITE HISTORY

5.1 General

Information on the Site history was obtained from:

- Review of selected aerial photographs;
- A historical land title search to review previous landowners and possible past uses of the Site;
- Interviews with available people familiar with the history and operations of the Site;
- A search of NSW EPA register for listings of the Site and nearby Sites;
- A review of Camden Council records and planning certificate; and
- A search of dangerous goods licenses held for the Site by WorkCover.

The Site history information is presented in Appendix C to G and a summary is provided below.

5.2 Summary of Site History

The general chronology of the site land use history is summarised below:

- Prior to 1901 – unknown;
- 1901 to 1945 – owned by farmers/graziers;
- 1945 to 1955 – owned by a clerk and hotel keeper;
- 1955 to 1989 – owned by several government departments;
- 1989 to 2003 – owned by University of Sydney for grazing use;
- 2003 to current – owned by two company entities;
- 2005 – subdivision of Lot 1. Site formed part of Lot 102; and
- 2012 – subdivision of Lot 102. Site formed part of Lot 24.

Site history information indicates that the site has been used for grazing land since at least the 1900's. The site had formed part of a larger parcel of land (48.4ha) and has been progressively subdivided from 2005 into smaller lots. Apart from the construction of a cul-de- sac and stormwater drain (directing water from the cul-de- sac to watercourse west of the site) circa 2007, no other activities are known to have occurred on the site.

A representative from University of Sydney provided information of site activities during their tenure on the site. The University representative was involved with the site for approximately 20 years. The site was used as part of the University's agricultural / veterinarian program where a variety of sheep, cattle and horses grazed at the site. The animals were periodically transported to another property located on Mayfarm Road, where they were treated for ticks, worms and other parasites. Mayfarm Road is located approximately 3km west of the site. No chemicals (e.g. pesticides, fuels, etc) were stored onsite and no tick dips were used to manage animal parasites. Any animals that died at the site were taken to the University for dissection and further study. No crops, ploughing or filling took place during the University's tenure. The site eventually become surplus to the University's needs and was sold in 2003.

Council records indicate that a development application (DA) for student accommodation, education and associated seminars/functions was submitted for Lot 1 in 1991. Based on aerial photographs, it is likely this building was constructed south or southeast of the site. Another DA was submitted to Council for the construction of a brick stables building for Lot 24 in 2007. Based on other site history information and site observations construction of this building has not commenced. Council indicate their records do not extend past 1991 and have no record of complaints or other information pertaining to the site. A copy of these DA's is included in Appendix D.

The planning certificate for the site (under Section 149 of the Environmental Planning and Assessment Act, 1979) indicates the land is not subject to any notifications under the Contaminated Land Management Act 1997.

The WorkCover search of the Stored Chemical Information Database (SCID) for licenses to keep dangerous goods indicated that no records pertaining to dangerous goods storage existed for the site.

There are currently no notices on the NSW EPA contaminated land record.

The following gaps in the site history are noted:

- Limited information is available on the early history of the site and therefore, some site activities may not have been identified.

5.3 Historical Information for Surrounding Areas

The University representative provided anecdotal information concerning the early history of the area but was unclear if there was a direct relationship to the site. This information included:

- A boys home "on top of the hill" (presumably south or southeast of the site) operated by the Department of Youth and Community Services between 1980 and 1989; and
- Unspecified use of the area by the Department of Defence during World War 2. Based on property title information, the Commonwealth did not acquire the site until 1955 and prior to this was privately owned. This would suggest the site was not used by Department of Defence.

Although the site appears to have remained generally undeveloped, surrounding properties to the east, south and west have progressively transformed from grazing land to rural / residential land use. Northeast of the site, a sewerage treatment plant was constructed circa 1975. The dams west of the site were progressively constructed starting prior to 1954 and completed by circa 1975.

In the 1954 aerial photograph, a structure and driveway was evident in the northeastern corner of Lot 24, but had been removed by 1965. Other evidence of activities on the remaining parts of Lot 24 was not observed until 2007. In 2007, two patches of exposed soils were observed north of the site. Although some grass cover has re-established across these areas since 2007, exposed soil is still evident.

6 SITE OBSERVATIONS

An environmental scientist made observations of the Site and nearby surrounds on 21 October 2013 during a site walkover. A summary of the relevant observations made is described below, with the Site layout and relevant features shown in Figure 2. An aerial photograph showing the current Site is presented in Figure 2. Relevant Site photographs (Plates 1 to 6) are also presented in Appendix H.

The Site was irregular in shape and except for a cul-de-sac occupying the southeastern portion of the site was vacant (i.e. no buildings/structures present). The Site was accessible from Crase Place which terminated within the southeastern portion of the site. The northern and eastern site boundaries were defined by a wooden fence and the western boundary by a serious of dams, connecting watercourses and a chain wire fence. Chain wire fencing was used along parts of the southern boundary to define the property boundary between residential Lots and the site.

The Site and remaining parts of Lot 24 are situated on the western slope of a local rise (Plate 3). The ground surface has a moderate downward slope (ranging between 5% and 10%) mostly towards the west with some cross slope towards the north (Plate 3). At the base of these slopes were a series of local depression, which at the time of the site visit were dry and firm underfoot (Plates 1, 2 and 5). During periods of heavy rain, water is likely to accumulate in these areas causing saturated ground conditions. These areas generally correlated with darker green zones observed on aerial photographs.

The Site and remaining parts of Lot 24 were generally grass covered with some patches of exposed soil (Plates 2 and 5). One of these patches was located adjacent to the southern boundary and may be associated with the construction of the adjoining residential dwelling (Plates 2 and 4). Some gravel fill was observed in this area. The other two patches of exposed soil were located north of the site and corresponded to exposed ground observed in the 2007 aerial photograph (Plate 5). At the time of the site walkover some grass cover had re-established in these areas. Some brick fragments were observed suggesting these exposed areas may have been associated with a localised filling event during construction of nearby residential dwellings (Plate 6).

Evidence of a slight depression was observed between the cul-de-sac and watercourses west of the site. This depression is consistent with that observed in the 2007 aerial photograph and appears to be associated with the stormwater drainage system. This depression is also consistent with the drainage easement shown on title diagrams (Appendix E). The drainage appears to capture water accumulated within the cul-de-sac and directs it towards the watercourses located west of the site. No other structures or infrastructure was observed on the site. A building once occupied the northeastern corner of Lot 24 (offsite) circa 1954. Evidence of this former structure was not apparent during the site walkover however the long grass may have obscured any remnants.

There was no evidence of salinity indicators onsite such as yellowing vegetation or dieback, scalding or efflorescence. No groundwater seepages or springs were observed.

Apart from some localised filling in offsite areas, no other evidence of potentially contaminating activities or indications of contamination (such as oil staining, etc) was observed.

7 DISCUSSION

7.1 Contamination

Site history information and site observations indicate that site activities have generally been associated with grazing and the site has remained undeveloped. Activities and potential sources of contamination associated with this land use could have potentially included:

- Importing fill of unknown quality and origin;
- Potential weathering of hazardous building materials, demolition of site structures and use of pesticides near buildings;
- Storage of fuels and chemicals in former farming buildings and sheds;
- Use of pesticides for treating parasites on livestock;
- Filling of disused farm dams with waste materials;
- Burial of deceased livestock.

The likelihood of these activities and potential sources of contamination occurring onsite and associated Contaminants of Potential Concern (COPCs) based on site history and observation information is discussed in Table 4.

Table 4: Summary of Potentially Contaminating Activities, Potential Areas of Environmental Concern, Likelihood of Contamination and Contaminants of Potential Concern

Potentially Contaminating Activity/Source	Sub Component / Description	Potential Areas of Environmental Concern (See also Figure 2)	Likelihood of Contamination*	Potential Chemicals of Concern
Fill of Unknown Origin and Quality	Surplus soil (cut materials) transferred to site during construction of neighbouring subdivisions south and southeast of the site.	Localised areas near the northern site boundary and near the southern boundary adjacent recently constructed residential dwellings. *Soil and groundwater media potentially impacted.*	Low likelihood of contamination and appears to be localised. Geotechnical reports did not identify fill at the site. The fill material appears to have been derived from excavation of natural soils although some brick fragments were observed in filled areas near the northern boundary. Some gravel fill was observed near the southern boundary and possibly associated with the distribution of excess materials following construction of the adjoining residential dwelling. No other evidence of construction materials was observed on the ground surface near filled areas.	TRH, BTEX, PAH, OCP, OPP, PCB, heavy metals, asbestos
Potential weathering of hazardous building materials, demolition of site structures and use of pesticides near buildings	Weathering of hazardous building materials such as lead paint, fibre cement containing asbestos and galvanised iron. Potentially present from former and existing site structures. Possible use of pesticides near structures.	Typically contamination associated with this AEC is identified adjacent to former structures or in areas where demolition has taken place. *Generally near surface soil are potentially impacted.*	Very low likelihood of contamination. Site history information has not identified any structures within the site suggesting contamination associated with the use of pesticides around building and weathering of hazardous building materials is unlikely.	OCP, OPP and heavy metals, asbestos
Storage of fuels and chemicals in former farm buildings and sheds	Storage and use of fuels, oils and lubricants or other chemicals	Contamination would typically be present in near surface soils in areas where these chemicals were stored. *Soil and groundwater media potentially impacted.*	Very low likelihood of contamination. Site history information has not identified any structures onsite, storage or the use of chemicals onsite.	TRH, BTEX, PAH, OCP, OPP, arsenic
	Use of pesticides for treating parasites on livestock.	Contamination would typically occur in near designated treatment areas, such as a tick dip. Contamination would be present in both surface soil and at depth depending on the method of pesticide application. *Soil and groundwater media potentially impacted.*	Low likelihood of contamination. Site history suggests parasite management occurred offsite in recent years however limited information is available on early history for the site.	OCP, OPP, arsenic
Filling and disposal of wastes in farm dams or other areas	Filling of dams with waste materials and / or burial of dead livestock.	Contamination would typically be present within the fill materials used to fill the dam and possibly dam sediments from runoff from upslope areas. Contamination associated with livestock burial areas would be localised to burial cell. *Soil and groundwater media potentially impacted.*	Low likelihood of contamination. Three dams were constructed west of the site and are presently filled with water. Aerial photographs did not identify dams onsite or potential burial areas. The University confirmed during their tenure that dead animals were removed from site. Aerial photographs are up to 11 years apart and other site history information available prior to 1990 is limited. Filling of dams and burying dead animals were activities routinely undertaken in rural areas; and therefore it cannot be precluded that these practices did not occur at the site.	TRH, BTEX, PAH, OCP, PCB, heavy metals, asbestos, nutrients, pathogens.

* *It is important to note that this is not an assessment of financial risk associated with the AEC in the event contamination is detected, but a qualitative assessment of the probability of contamination being detected at the potential AEC, based on the site history study and field observations.*

TRH Total Recoverable Hydrocarbons
BTEX Benzene, Toluene, Ethylbenzene, Xylene
PAH Polycyclic Aromatic Hydrocarbons
PCB Polychlorinated Biphenyl
Heavy Metals arsenic, cadmium, chromium, copper, lead, nickel, mercury, zinc
OCP Organochlorine Pesticides
OPP Organophosphorus Pesticides

7.2 Salinity

The desk study has indicated that the site is located within an area of moderate salinity potential, particularly lower lying regions within the western portions of the site. Previous investigations observed sandstone near the southern and southeastern parts of the site and potentially associated with the local rise in topography. These areas are likely to pose a lower salinity potential than the lower western portions of the site.

No groundwater information was available directly relating to the site. Groundwater information from other properties in the region indicates water bearing zones encountered at depths between 3m and 5m in weathered shale. Natural springs or seepages were not observed during the site walkover however perched/shallow groundwater may daylight as springs or seepages during heavy rainfall periods. It should be noted that water bearing zones within the Bringelly Shale are typically saline.

The 2007 aerial photograph indicated potential white efflorescence in areas immediately surrounding dams, located west of the site. This white feature may also be associated with hydromulching rather than salt as vegetation growth substantially increased in later years. Potential hydromulching is consistent with site observations, as no evidence of salt impacts were noted onsite or in nearby surrounding areas.

Inappropriate development practices could mobilise the potentially saline groundwater to the surface, or lower the site surface to intercept saline soils, not just in the topographically low areas on site, but also in more elevated locations. Inappropriate practices could include:

- Excessive removal of vegetation, thereby reducing the amount of water intake by plants and increasing infiltration of rainwater into the soil, causing the water table to rise nearer the ground surface;
- Overwatering of future parks and gardens causing the water table to rise nearer the ground surface;
- Construction of retaining walls and excessive compaction can form barriers to groundwater flow, resulting in a rising groundwater table or perched water behind the wall. Saline water can also lead to damage of the retaining wall;
- Pipes extending into the groundwater zone can be corroded quicker than normal. Burst and / or leaking pipes can exacerbate the problem by rising the water table; and
- Drilling of piers, footings etc into the groundwater surface can lead to capillary rise of the groundwater table, particularly in clay soils.

8 CONCLUSIONS

8.1 Contamination

Site history information indicates that the site has been used for grazing land since at least the 1900's. The site had formed part of a larger parcel of land (48.4ha) and has been progressively subdivided since 2005 into smaller lots. Apart from installation of minor infrastructure (i.e. cul-de-sac and stormwater drain), the site has remained undeveloped. There were some gaps in the early site history which cannot preclude certain activities occurring or structures having been present at the site. Potentially contaminating activities that may occur at rural sites and may have occurred at the site include:

- Importing fill of unknown quality and origin;
- Potential weathering of hazardous building materials, demolition of site structures and use of pesticides near buildings;
- Storage of fuels and chemicals in former farming buildings and sheds;
- Use of pesticides for treating parasites on livestock;
- Filling of disused farm dams with waste materials;
- Burial of deceased livestock.

Based on the available site history information, the likelihood of these contaminating activities occurring at the site was assessed as low to very low. Further stages of investigation are not considered necessary based on information presently available.

It is recommended that an unexpected finds procedure be developed to manage potential contamination, should it be encountered during construction. Potential contamination may include, but not limited to, oil staining, building materials such as fibre cement, burial pits, fill, odours or discolouration.

8.2 Salinity

Based on literature review and topography, the site has been assessed to have a low to moderate salinity potential. A low salinity potential is expected in hill crest/sandstone areas and transitioning to a moderate potential in the lower lying regions near the western site boundary. Further investigation is required to confirm this assessment along with developing appropriate strategies for managing the level of salinity present at the site. Further investigations can be undertaken at a future stage, for example, as part of a development application.

Salinity issues can be exacerbated through inappropriate development practices, which can alter groundwater levels, or disturb soils and mobilise salt to the surface, where it can come into contact with structures. The following management strategies and options are provided for preliminary planning purposes only. Further investigation would be best undertaken once more details are known with respect to the proposed development.

Options that may be used to mitigate the effects of potential saline soils or groundwater on the site include the following:

- Minimising water infiltration;
- Landscaping using salt-tolerant native plants in areas identified with slightly saline soils;
- Sealing the base of stormwater detention ponds;
- Retaining as much deep-rooted vegetation on site as possible;
- Minimising soil disturbance such as compaction and cut and fill;
- Water proofing slab work;
- Provide good site drainage to prevent water-logging;
- The use of higher strength concrete with thicker cover and exposure class masonry;
- Minimise disturbance on groundwater flow caused by utility trenches; and
- Soils replaced in their original order if deep (<1m) excavations are undertaken.

9 LIMITATIONS

Limited information is available on the early history of the site and therefore, some site activities may not have been identified. In addition, aerial photographs are up to 11 years apart and other site history information available prior to 1990 is limited. We cannot preclude that potentially contaminating activities took place during these periods. Allowances for uncertainties and potential unexpected finds should be made during planning and development phases.

In preparing this report, Coffey has relied on information in reports made available to Coffey by the client and prepared by other consultants. Coffey has assumed that these consultants performed the scope of works in general accordance with standard industry procedures and guidance materials at the time and that the information is suitable.

We draw your attention to the attached sheet titled "Important Information about your Coffey Environmental Report" which must be read in conjunction with this report.

10 REFERENCES

1. **Coffey Geosciences Pty Ltd (1999)** *Grasmere Local Environmental Study – Land Capability Study*, southwest corner of Werombi Road and Old Oaks Road, Grasmere (Report Ref: S20166/1-AG, dated 28 July 1999);
2. **Geological Survey of NSW (1985)** *1:100,000 Wollongong to Port Hacking Geological Series Sheet No. 9029-9129*, edition 1;
3. **Geotechnique Pty Ltd (2005)** *Site Classification for Proposed Subdivision*, Cnr Werombi and Old Oakes Roads, Grasmere (Report Ref: 10255/2-AA, dated 4 July 2005);
4. **NEPC (1999)** *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, National Environment Protection Council;
5. **NEPC (2013)** *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as amended in 2013, National Environment Protection Council;
6. **NSW DEC (2006)** *Guidelines for the NSW Auditor Scheme,* 2nd Ed;
7. **NSW Department of Infrastructure, Planning and Natural Resources (2003)** *Salinity Potential in Western Sydney 2002*;
8. **NSW Department of Information, Technology and Management (2000)** *Camden 1:25,000 Topographic Map 9029-4N*, 3rd Edition;
9. **NSW OEH (2000)** *Guidelines for Reporting on Contaminated Sites*;
10. **Regional GTS Pty Ltd (1995)** *Geotechnical Assessment for proposed residential development*, Lots 100, 102 and Part 1 Old Oakes Road, Camden (Report Ref: 95225/GK/1, dated 8 August 1995).

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.

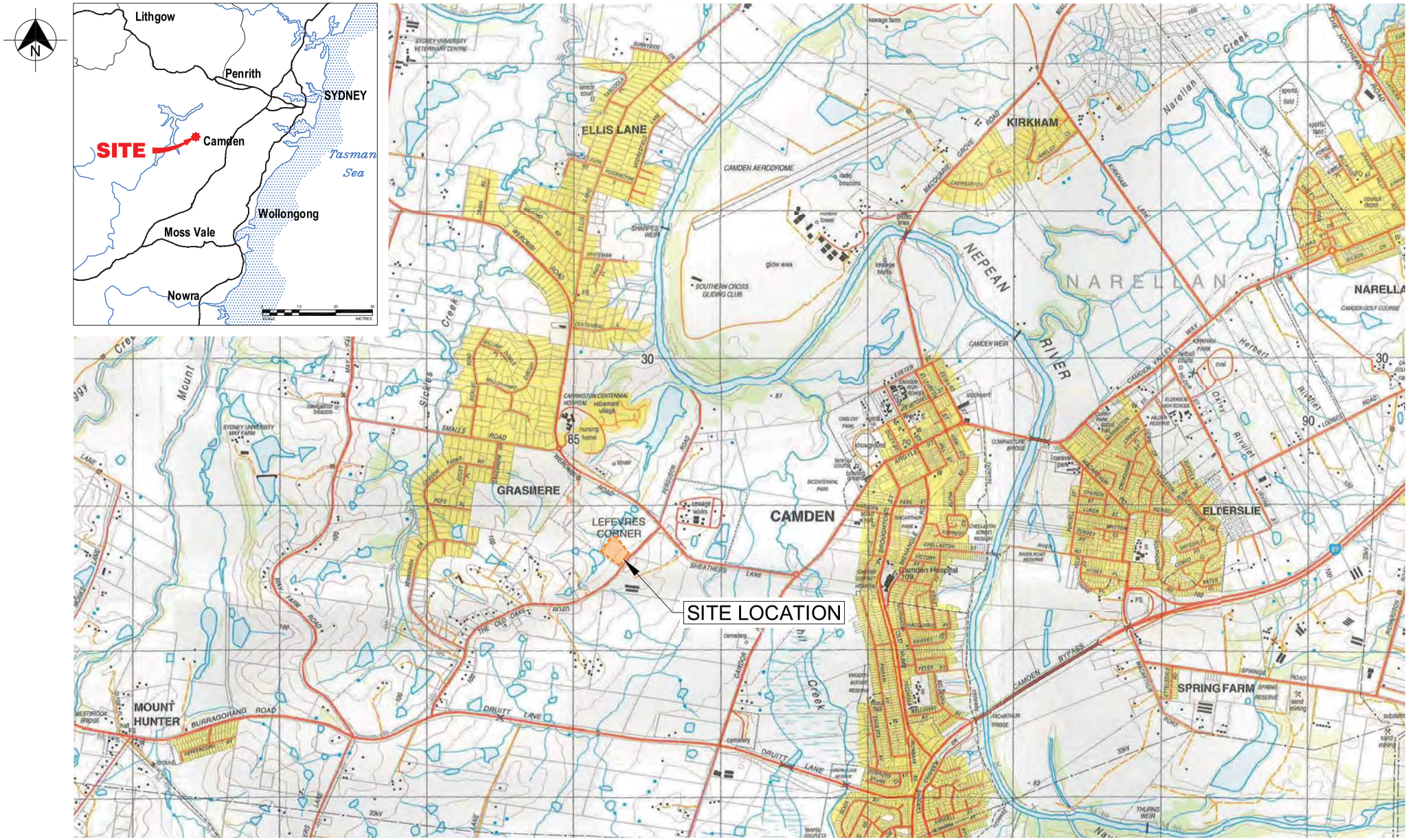
This report should be reproduced in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

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

Phase 1 Contamination Assessment and Salinity Assessment
Part Lot 24 DP1086823, 10 Crase Place,
Grasmere, NSW



SOURCE: NSW DEPARTMENT OF INFORMATION, TECHOLOGY AND MANAGEMENT (2000)
CAMDEN 1:25,000 TOPOGRAPHIC MAP 9029-4N, 3rd EDITION

revision	description	drawn	approved	date

drawn	LZ
approved	SR
date	1.10.13
scale	1:25000
original size	A3

coffey

client: SITE PLUS

project: PHASE 1 CONTAMINATION ASSESSMENT & SALINITY ASSESSMENT PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

title: SITE LOCALITY PLAN

project no: ENAUWOLL04150AA-R01

figure no: 1

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 6.0.1

revision	description	drawn	approved	date

20 0 20 40 60 80 100

Scale (metres) 1:2000

drawn	LZ
approved	SR
date	1.10.13
scale	1:2000
original size	A3

coffey

client: SITE PLUS

project: PHASE 1 CONTAMINATION ASSESSMENT & SALINITY ASSESSMENT PART LOT 24 DP1086823, 10 CRASE PLACE, GRASMERE, NSW

title: SITE LAYOUT PLAN SHOWING SITE FEATURES

project no: ENAUWOLL04150AA-R01

figure no: 2

5. LAND CAPABILITY ASSESSMENT

Coffey Geosciences Pty Ltd undertook a land capability assessment for the site. This assessment investigated issues on landform, geotechnical, mineral resources, soils and agricultural capability. The results of these investigations are detailed below.

5.1 LANDFORM

Topographically, the Study Area may be divided into three areas:

- gently sloping ridge crest areas with associated spurs to the west and south-west, where slope angles are generally less than 5^0;
- flanking slopes where the ground generally slopes at about 6^0 to 7^0, but locally up to 12^0 to 13^0; and
- broad drainage gully and tributary gully occupied by 8 major water storage dams.

Apart from the 8 major storage dams and several smaller (often dry) farm dams located throughout the site, minor slope modifications were noted associated with cuts and fills located near dwellings located on Lot 101 (DP803468) and Lot 101 (DP 841639). In addition, an elongated fenced-off mound of fill up to 2.5m high and 100m long is located near the south-western boundary of Lot 102 (DP 842639).

5.2 GEOTECHNICAL

5.2.1 Background Geology

The 'Geology of the Wollongong and Port Hacking 1:100,000 Sheets', prepared by the Geological Survey of NSW (1986), indicates the site is underlain by the Bringelly Shale (Rwb) and an 'unnamed sandstone member' (Rwbs) of the Wianamatta Group of sedimentary rocks. The 'unnamed sandstone member' is indicated as trending from the northwest corner, approximately north-south through the western half of the site. This 'unnamed sandstone member' is also indicated to be present in the vicinity of the ridge area located to the immediate east of the site.

The Bringelly Shale, which has no outcrops on the site and is described as comprising, in decreasing order of volumetric abundance, the following:

- claystone and siltstone;
- laminite;
- sandstone;
- carbonaceous claystone and siltstone; and
- coal.

The 'unnamed sandstone member' is described as consisting of a fine to medium-grained quartz-lithic sandstone. Although the thickness of this unit is unknown at the site, some very thick sandstones are reported near the top of the Bringelly Shale. These sandstones are apparently not continuous over a large area and cannot be correlated.

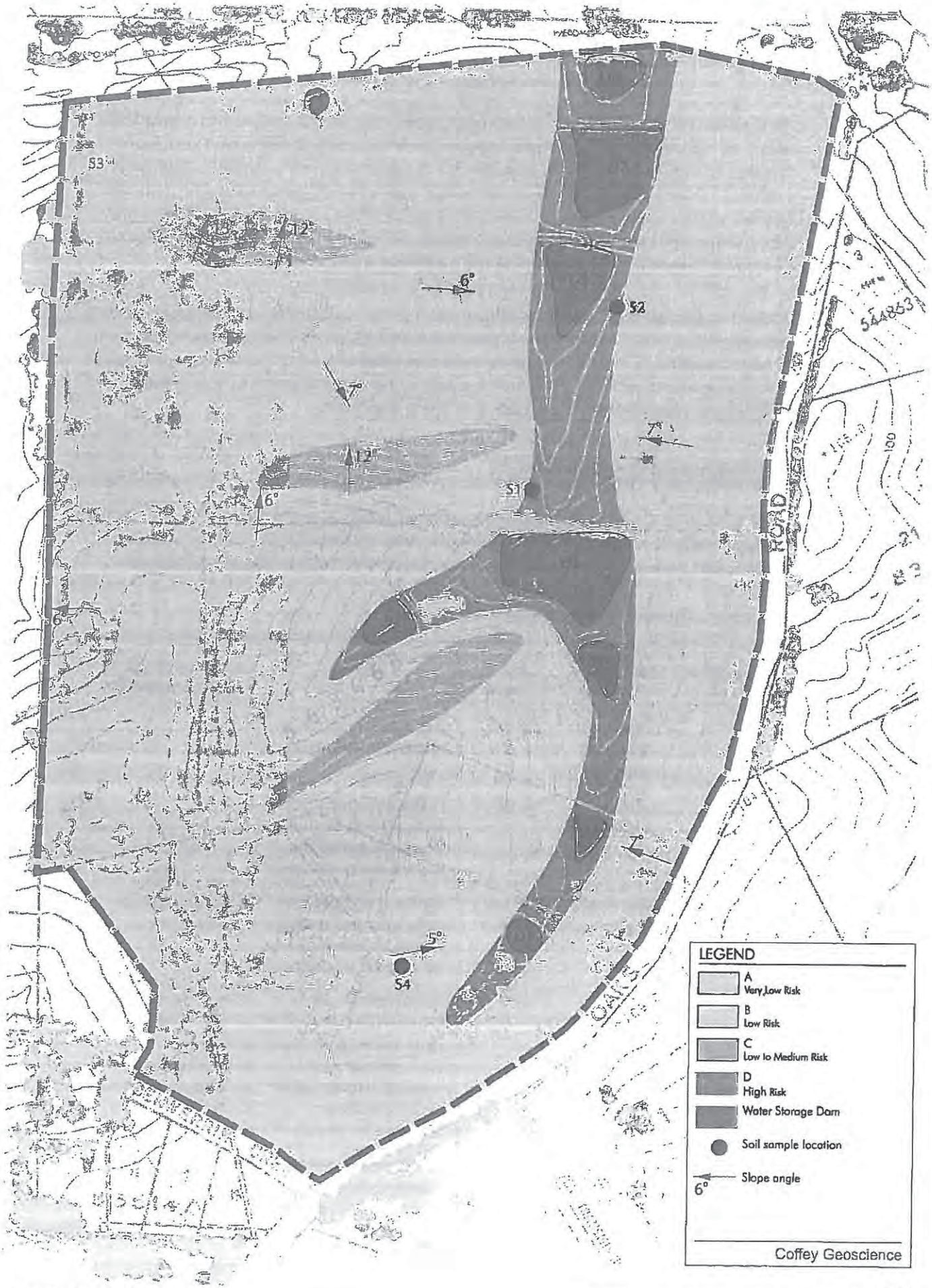
Outcrops of extremely to highly weathered, fine to medium grained, quartz-lithic sandstone were noted in a road cut near RL 100m on Old Oaks Road to east of the site. In addition, outcrops of medium grained lithic sandstone were noted in a cut located to the rear (north) of the residence located on Lot 101 (DP803468) near RL 105m.

These sandstone outcrops are considered to represent the 'unnamed sandstone member', which may have a thickness in the order of 5 metres at the site. Outcrops of extremely to highly weathered Bringelly Shale were noted in road cuts located along Werombi Road to the north of the site.

5.2.2 Water Storage Dams

The site is dominated by 8 major water storage dams located along a broad gully and a tributary side gully. These dams are designated as D1 to D8 as shown in **Figure 5.1**. A brief description of each dam is given below:

Dam No.	Lot No.	Brief Description
D1	Lot 14 DP 855147	Crest length approx. 35m, 3m high, contains water, wet area downstream.
D2	Lot 101 DP 803468	Crest length approx. 50m, 3m wide crest, 6m high, batters at about 23°, dam dry (owner claims that dam does not hold water).
D3	Lot 100 DP 803468	Crest length approx. 30m, contains water.
D4	Lot 100 DP 803468	Crest length approx. 50m, 1m wide crest, U/S batters at 20°, D/S batters at up to 30°, contains water.
D5	Lot 100 DP 803468	Crest length approx. 135m, 2m wide crest, 3m to 4m high, spillways at either end of crest, D/S batter slopes locally at 30°, see pages noted along toe of embankment with wet boggy ground in gully, located approx, 25m downstream of left (west) abutment is an erosion gully some 25m long, 4m wide and up to 1.5m deep.
D6	Lot 102 DP 841639	Crest length approx. 60m, height approx. 4m, crest width 2m, U/S batter at 30° to 38° with slip scarps to 1m high along full length, D/S batter at approx. 25° and densely grassed, dam has 5m wide central breach that exposes embankment comprised largely of gravelly clay with occasional cobbles of sandstone. Some erosion noted along a 0.5m to 1m high, 60m long scarp on eastern side of storage area.
D7	Lot 102 DP 841639	Crest length approx. 85m, width 2.5m, height approx. 3.5m, U/S and D/S batters at about 30°, crest and batters densely grassed.
D8	Lot 102 DP 841639	Crest length approx. 50m; crest width 4m, height approx. 1m, crest and batters densely grassed.



Geotechnical Zoning

Grasmere Local Environmental Study

0 metres 200

5.1

planning workshop australia

91077/Corel/figures.cdr

Although further detailed investigation and analysis would be required to assess the stability of the above dams, it would appear, based on observation alone, that none of the dams has been designed or constructed in accordance with accepted engineering practices. In particular, the downstream batters of the three largest dams (D5, D6 and D7) are steeper than what would normally be acceptable for such dams. Of the eight dams, D6 would be regarded as the least stable, which is highlighted by the presence of a central 5 metre wide failure, or breach, within the embankment.

Should a decision be made to retain any of the dams as part of future site developments, further design phase geotechnical investigations and analyses would be required, to enable the design of appropriate remediation works. Such measures may simply range from providing additional support to the embankments, or the upgrading of spillways, to complete reconstruction of the embankments.

5.2.3 Constraints on Development

On the basis of site features such as topographic position, slope angle, and underlying geology, the site has been divided into 4 geotechnical zones. These zones are listed in **Table 5.2** and are also illustrated in **Figure 5.1**, along with the risk of slope instability.

Table 5.2 – Geotechnical Zones on the Site

Geotechnical Zone	Topographic Position	Slope Angle	Geology	Assessed Risk of Slope Instability
A	Ridge Crests and major spur slopes	0^0 to 5^0	Residual soils developed on shale or sandstone.	Very Low
B	Flanking slopes	5^0 to 10^0	Colluvial and residual soils, possibly in excess of 2m depth, developed on either shale or sandstone.	Low
C	Steeper mid-slopes	10^0 to 13^0	Colluvial and residual soils, assumed less than 2m depth, developed on either shale or sandstone.	Low to Medium
D	Drainage gullies with dams	0^0 to 5^0	Colluvial soils and or minor alluvium, earth dams to 4m high, considerable areas of seepage and wet boggy ground located downstream of several dams.	High (associated with spillway cuts and dam embankments), although natural slopes in area would be regarded as Low Risk.

The risk of slope instability has been assessed using a classification system based on the Australian/New Zealand Standard on Risk Management (AS/NZS 4360-1995) with some modifications to reflect site specific considerations (see **Appendix B**).

With regard to Geotechnical Zone D, where the failure of one or more of the dams is assessed as having a Moderate Likelihood (that is, the event could occur within the medium to long term under adverse conditions) with a Major Consequence (extensive damage to most of structure, or extending beyond site boundaries), this zone is assessed as having a High Risk of slope instability. Zone C is assessed as having a Low to Medium Risk of instability (unlikely to moderate likelihood/minor consequence). Zone B is assessed as Low Risk (unlikely likelihood/minor consequence) and Zone A is assessed as Very Low Risk (rare likelihood/minor consequence).

Given the risk of slope instability, the following development constraints as identified in **Table 5.3** would apply to the four geotechnical zones at the site:

Table 5.3 – Geotechnical Constraints on Development

Geotechnical Zone	Assessed Risk of Slope Instability	Geotechnical Constraint (Implications for development)
A	Very Low Risk	Residential development should follow good engineering practice. Footings in accordance with AS 2870.
B	Low Risk	Residential development should follow good engineering practices suitable for hillside construction (see **Appendix C**). Risk after development normally acceptable.
C	Low to Medium Risk	Residential development should follow good engineering practices suitable for hillside construction. Geotechnical investigation may be needed. Risk after development generally no higher than usually accepted.
D	High	Residential development of this area should not proceed until further geotechnical assessment, involving site investigation and analysis is made of the stability of the dams.

The above assessment has been made on the assumption that any future development would be connected to the sewer and that all stormwater from any such development would be collected and discharged well clear of any developments on the site.

5.3 *MINERAL RESOURCES*

Available geological data suggests that the site is underlain at depths in excess of 600 metres by the Bulli Seam, which attains a thickness of about 4 metres in the Camden area, together with minor deeper seams. The nearest workings of the Bulli Seam are understood to be located some 2 km to the east of the site.

Information provided by the Department of Mineral Resources (DME) indicates that there is no mining, or application for mining, in the vicinity of the site. The Mine Subsidence Board (MSB) has indicated that the site is not part of a Proclaimed Mine Subsidence District, and therefore the MSB does not place restrictions on building on the site.

However, in view of the above, and the remote possibility that coal mining could occur sometime in the future, with subsidence due to mining unlikely to exceed 1.5 metres (but more probably less than 1metre), it may be prudent, but not essential, for buildings to be designed and constructed under conditions normally imposed by the MSB for such areas.

5.4 SOILS

The 'Soil Landscapes of Wollongong / Port Hacking 1:100,000 Sheet', prepared by the Soil Conservation Service of NSW (1990), indicates that the site is part of the Blacktown Soil Landscape Group. The Blacktown Group is a 'residual' landscape consisting of gently undulating rises derived from weathered Wianamatta Group sediments.

The Blacktown Group is described as possessing slopes generally less than 5° but occasionally up to 10°, with local relief to 30 metres. The soils on crests, upper slopes and well-drained areas are described as shallow to moderately deep (< 150cm) *Red Podzolic Soils* and *Brown Podzolic Soils*. On the lower slopes and in drainage depressions and localised areas of poor drainage, the soils are described as deep (150-300cm) *Yellow Podzolic Soils* and *Soloths*. Limitations of the Blacktown Group are moderately reactive, highly plastic subsoils, of low soil fertility.

In general, the Blacktown Group is regarded as having a high capability for urban development with appropriate foundation design and, with respect to rural capability where small areas of this soil landscape have not been urbanised, is capable of sustaining regular cultivation and grazing. Previous investigations at the site by Regional GTS Pty Ltd (1995) indicated the depth of soils at the site to be generally greater than 1m depth and to consist of approximately 0.2m of topsoil (clayey silt) overlying red-brown residual silty clay.

As part of this study, four soil samples were taken from depths of between 0.1m and 0.5m and tested for dispersion characteristics by the Dispersion- Determination of Emerson Class Number of a Soil Test (AS 1289.3.8.1). **Figure 5.1** shows the locations of these samples. The laboratory test results are presented in **Appendix A** and indicate that the Emerson class numbers range from 2 (dispersive) to 5 (non-dispersive), highlighting the variability in the origin, nature and composition of site soils.

In view of the above results, and the possibility of encountering areas of highly dispersive soil, any future earthworks at the site should aim to minimise the extent of areas exposed at any time, and provide appropriate soil erosion control measures during the course of the earthworks. Such erosion control measures may include silt fences, hay bales and sedimentation traps. In addition, should the site clays be used for earth dam construction, special attention must be given to compaction of the soils to reduce the risk of embankment instability through piping failures.

5.5 AGRICULTURAL CAPABILITY

5.5.1 Land Resource Assessment

The area is well covered with a mixture of native and introduced grasses, in particular Paspalum and Phalaris, and smaller amounts of native Sedge, Kikuyu, Couch and Clovers. There is significant intrusion of weeds in the pasture, mainly of the Feather Grass and Fireweed varieties.

Slope angles range from 1° on the ridgelines, to approximately 13° between the ridge and drainage channels. The valley soil is a light clay loam, with a heavy clay loam on the lower levels of the property. In general, the soils are nutritionally well balanced, and of a slightly acid pH. There is evidence of past pasture improvement and consequent leaching of nitrogen is evident, particularly along the upper slopes and ridges.

There are minimal stands of trees on the site, consistent with a grazing property. The small stands of trees at the southern end, mainly consist of Forest Red Gum and Grey Box varieties, and would not impede grazing or cropping.

There are also a number of water sources on the properties, mainly consisting of several dams that contain surrounding runoff. The indication is that with careful management, water availability would not be a constraint to grazing, but may constrain intensive cropping.

5.5.2 Land Suitability Assessment

The main agricultural uses in the area have been traditionally cattle grazing and dairy farming, with the occasional cropping. Over the past 20-30 years, these activities have diminished due to the sub-division of land for hobby farm and rural-residential use.

The subject land has not seen significant agricultural use in many years, apart from the occasional grazing and some pasture improvement (particularly Lot 102, DP841639). There is some evidence of past overgrazing, and concurrent leaching and soil erosion. Native species have deteriorated, and introduced species and weeds have persisted. The situation appears to have been exacerbated by a lack of pasture management.

The Department of Agriculture classifies the land as Class 3 – Prime Crop and Pasture Land (Kennedy, Dept. of Agriculture *Facsimile/Letter*, June 1995). This classification is based on an assessment of climate, topography, soil characteristics, and existing local environmental and socio-economic factors, with the intent to rank areas based on their potential productivity with regard to a range of agricultural activities.

Class 3 land is defined as:

> *"grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with pastures. The overall production level is moderate because of edaphic or environmental constraints. Erosion hazard, soil structural breakdown or other factors including climate, may limit the capacity for cultivation and social conservation or drainage works may be required."*

The Department of Agriculture has a policy that regards Class 3 land as having medium to high agriculture value, and seeks to locate non-agricultural development, such as residential and urban infrastructure, to sites of lower agricultural value.

Coffey Geosciences have advised that:

> *"Given the history of local development policy regarding subdivision, poor pasture management and encroachment of urban development, it would appear that such classification may not be appropriate. This is based on the following factors:*
>
> - *The cost of returning such land to production would be exorbitant, involving the development of dams, provision of slope stability and land conservation measures and pasture remediation and restocking.*
> - *Given the small size of the subject lots, the economic feasibility of an agricultural holding would be low, unless farmed with high value crops.*
> - *The consolidation of properties, given past subdivision practices would be impractical and difficult.*
> - *Surrounding land uses and local development policy, do not facilitate the retaining of the subject land in pastoral production."*

6. LANDSCAPE CHARACTER AND VISUAL QUALITY

Context Landscape Design has assessed both the landscape character and visual quality of the site, from its surrounds and within its boundaries. Results of their investigations and recommendations on strategies to retain the desirable landscape attributes of the site are detailed below.

6.1 EXISTING LANDSCAPE CHARACTER

6.1.1 Landform

The existing landscape consists of a series of undulating hills with prominent dendritic drainage patterns flowing in an easterly direction via a string of eight small dams. Ridgelines mark the northern and southern boundaries of the site, defining the catchment area that feeds into the on-site dams and a small creek and larger dam to the north of Werombi Road. The lowest point on the site is approximately RL 71.5m where this creek meets the dam on the north boundary, bordering Werombi Road. The highest point on the site is approximately 20 metres from the southern boundary of the site bordering Benwerrin Crescent.

There is an embankment at the corner of the Old Oaks Road and Werombi Road that blocks the site from the view of drivers passing by that corner. Generally, the slopes are less than 7° although the northern slopes of the spurs to the west and north are slightly steeper at between 12° and 13°. The rounded, eroded, landforms are very characteristic of Wianamatta Shale areas surrounding Sydney.

6.1.2 Land Use and Land Cover

Historically, this site was used for agricultural and pastoral purposes such as the rearing of sheep and cattle. The extent to which the site has been cleared and the numerous old fences present indicate this prior land use and its inherent visual character. The Draft Camden Scenic and Cultural Landscapes Study (Lambcon Associates, 1998) identifies this land as 'Broad Acre Grazing', although not currently in production.

The original vegetation cover, before clearing, would have been stands of Cumberland Plain vegetation associations with dominant tree species such as *Eucalyptus tereticornis,* in the valleys, *E.moluccana* on the ridgelines and *E.crebra* scattered in between. The dominant shrub species associated with these tree species would most likely have been *Bursaria spinosa*.

The north-western side of the site has no road access and is adjacent to remnant bushland that encroaches into the site in places. This bushland area separates the site from an already established rural residential subdivision.

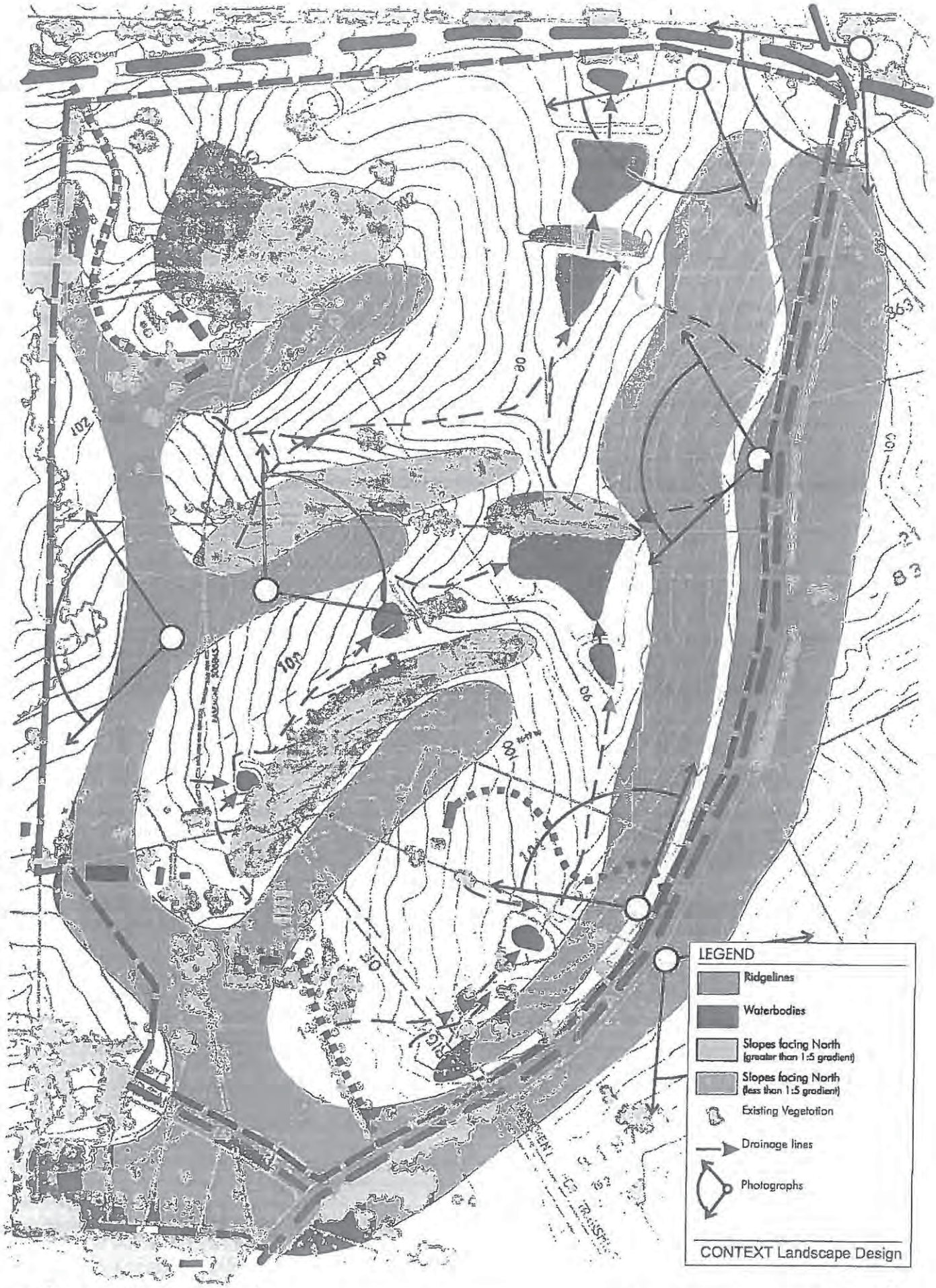
There are small pockets of trees on the site that have been planted around the lower two dams and around the established houses and driveways on the site. Remnants of the original vegetation are scarce and occur as single specimens situated very sparsely across the site. There is some evidence of minor weed infestation but on the whole the site is predominantly covered in poorly managed fodder grasses.

6.2 *EXISTING VIEWS*

This site offers one of the highest vantage points in the Camden area. Extensive views to the north around to the southeast are accessible from within the site. Significant views of Camden township to the east are accessible from the ridgelines surrounding the site *"... which should be acknowledged and protected..."* (Lambcon Associates, 1998). The following photographs accompanied by descriptions have been taken from selected points where the site is highly visible or where visual access out of the site was considered significant. Refer to **Figure 6.1** for photographic vantage point locations.

6.2.1 Internal Vantage Point Views

1. Looking north across the site from the southern end of the Old Oaks Road, the valley and water bodies characterise a picturesque backdrop of the remnant bushland on the northern side of Werombi Road with the hills on the horizon. The **European vegetation** in the left of this photo appears quite out of place in its context and tends to degrade the visual quality of this scenic valley.



Landscape Visual Analysis

Grasmere Local Environmental Study

6.1

planning workshop australia

91077/Corel/figures.cdr

2. This photo was taken looking west from Werombi Road near Lefevres Corner across the spine of the valley to the remnant bushland on the western ridgeline. This view is significant because it is currently visible to traffic passing the site along Werombi Road. Vegetation adjacent to Werombi Road should be protected and reinforced with further endemic plantings to help ameliorate any visual impacts that a rural-residential development may have on this rural scene. From Lefevres Corner looking in the opposite direction (east) extensive views to Camden town across the Matahil Creek floodplain are accessible and should be maintained with low (2-3m high) native planting under the recommendations made by the Camden Scenic and Cultural Landscapes Study (Lambcon Associates, 1998).

3. Views of the Woronora plateau to the southeast (to the right in this photo) can be seen on top of the ridgelines that surround the site. From this vantage point, the waterbodies in the valley can also be seen. These dams are a valuable visual resource that contributes to the rural character on this site. It should be noted that the slopes below the ridgeline cannot be seen from this point although the north-facing slope on the other side of the valley is very exposed.

4. Views to the West from the western ridgeline towards existing rural residential subdivisions are obscured by remnants of bushland. This bushland should be linked to the water bodies in the valley with native endemic vegetation plantings which will serve to enhance visual and environmental qualities on the site.

6.2.2 External Vantage Point Views

5. The road-cutting embankment punctuated with the silhouetted line of *Olea afticana* (African Olive) bordering the site obscures the view west from the corner of Werombi Road and the Old Oaks Road. These trees (shrub height to small tree height) provide a strong visual identity to Lefevres Corner, reflective of the treed ridgeline in the background bordering the site along its western boundary. These trees do not obscure views from within the site (looking east to Camden), however the species itself is introduced and is capable of readily self-seeding and subsequently spreading. Ideally, these trees should be removed and replaced with new planting of a similar scale, such as fast-growing local *Acacia* species, to maintain the visual identity of the corner. Additional planting on the opposite side of Werombi Road (from where this photo is taken) should be avoided in order to maintain views to the east from Werombi Road.

6. This view east across the Cumberland Plain from the southern end of the Old Oaks Road is not actually obtainable from within the site due to the ridgeline that the Old Oaks Road follows. This ridge also obscures the view to the site from Camden (visible in the left middle ground here), Cawdor Road and Druitts Lane.

7. This view west from north-eastern end of the Old Oaks Road encompasses most of the site, although from the vantage point of a vehicle on the road, the tall grasses at the edge of the road block this view considerably. The visual strength of treed ridgelines can be fully appreciated from this vantage point. The trees along the ridge largely occur on a neighbouring property.

6.3 CONSTRAINTS ON DEVELOPMENT

The visual quality of the site is considered high. Under the Draft Camden Scenic and Cultural Landscapes Study, this land is classified as 'Broad Acre Grazing' which is considered to have State significance because it is representative of the colonial period of post contact history of NSW. The impact of the proposed rural-residential landscape character classification will reduce the landscape character of the site to an area of local significance.

Sensitive planning procedure can ameliorate and often avoid some of the negative visual impacts of rural-residential developments. Some of these negative aspects are listed below:

- Buildings that are out of scale and character with the rural setting.
- Urban treatments such as kerbs, gates and brick paved driveways.
- Manicured turfed verges and properties.
- Ornamental and exotic plant species.
- Building setbacks out of character with the rural setting.
- Interruption of sensitive sightlines.
- Subdivision layouts of an essential urban character.
- Clearing of natural remnant vegetation.

As a consequence, the recommendations made in **Section 10.2** are strategies from which rural-residential development regulations for this site can be derived and implemented under the direction of the Camden Council.

6.4 VISUAL IMPACT PROTECTION

In reference to the recommendations made in the Draft Camden Scenic and Cultural Landscapes Study for 'things to encourage' and 'things to discourage' under 'Landscape Type 4', the following landscape design principles and strategies will help protect the site from negative visual impacts:

- Plant ridgelines with indigenous vegetation associations to strengthen visual quality around the site boundaries and to link with existing remnant bushland tracts.
- Mark high points on the site with vegetation that has distinctive silhouettes (ie. *Araucaria spinosa*) to create visual focus points around the site.
- Use existing landforms to accommodate new recreation areas around drainage lines and dams.
- Focus on dams for recreation and wildlife habitat creation.

Appendix A:
Geotechnical Laboratory Test Results

Coffey Geosciences Pty Ltd A.C.N. 056 335 516

Geotechnical Resources Environmental Technical Project Management

142 Wicks Road, North Ryde, NSW, 2113
Ph: (61 2) 9888 7444, Fax: (61 2) 9878 8155

Coffey

test results

client : *PLANNING WORKSHOP AUSTRALIA*
principal :
project : *LES, GRASMERE*
location :

job no : *S20166/1*
laboratory : *SYDNEY*
date : *02/06/99*
test report :

test procedure : *AS 1289.2.1.1*
test date : *27/5/99*

Sample Identification	MOISTURE CONTENT %
S1 0.5m	*11.6*
S2 0.5m	*14.6*
S3 0.1m	*11.3*
S4 0.3m	*18.0*

remarks :

Form Number L1.QR1 Version 4.0

16/6/99

Authorised Signature
NATA No 431

Coffey Geosciences Pty Ltd A.C.N. 056 335 516

Geotechnical Resources Environmental Technical Project Management

142 Wicks Road, North Ryde, NSW, 2113
Ph: (61 2) 9888 7444, Fax: (61 2) 9878 8155

Coffey

soil classification

client : *PLANNING WORKSHOP AUSTRALIA*
principal :
project : *LES,GRASMERE*
location :

job no : *S20166/1*
laboratory : *SYDNEY*
date : *02/06/99*
test report :

test procedure: *AS 1726 Appendix A, Section A2 eAS 1289.2.1.1*

test date: *1/6/99*

sample details: location	sample details: depth (m) from	sample details: depth (m) to	sample details: sample type	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components, Atterberg Limits (if determined)	moisture condition & content (%)	consistency, density index	confined compressive strength(kPa)	dry density (tonne/m^3)	confining pressure(kPa)	structure and additional observations
S1	*0.5*		*D*	*CH*	*CLAY-high plasticity,red brown,trace of sand.*	*11.6*					
S2	*0.6*		*D*	*CI*	*SANDY CLAY-medium plasticity,red brown,fine to medium sand.*	*14.6*					
S3	*0.1*		*D*	*CH*	*CLAY-high plasticity,red brown,some fine sand.*	*11.3*					
S4	*0.3*		*D*	*CI*	*SANDY CLAY-medium plasticity,fine to medium sand,trace of root fibre.*	*18.0*					

Form Number L1.1R1 Version 4.0

notes: (for terms see "Explanation Sheet 1")

sample type
U - undisturbed sample
D - disturbed sample
N - standard penetration test

classification symbols and soil description based on unified classification system

moisture condition
D - dry
M - moist
W - wet
> - greater than
< - less than
W_p - plastic limit
W_L - liquid limit

consistency
VS - very soft
S - soft
F - firm
St - stiff
VSt - very stiff
H - hard
Fb - friable

density index
VL - very loose
L - loose
MD - medium dense
D - dense
VD - very dense

confined compressive strength
* from test; otherwise from hand penetrometer

L RUSSELL 16 199

Authorised Signature James Russell

NATA No 431

Coffey Geosciences Pty Ltd A.C.N. 056 335 516

Geotechnical Resources Environmental Technical Project Management
142 Wicks Road, North Ryde, NSW, 2113
Ph: (61 2) 9888 7444, Fax: (61 2) 9878 8155

determination of emerson class number

client : *PLANNING WORKSHOPS AUSTRALIA*
principal :
project : *LES, GRASMERE*
location :

job no : *S20166/1*
laboratory : *SYDNEY*
date : *02/06/99*
test report :

test procedure : *AS1289.3.8.1*
sample identification: *S1 0.6m*

test data

air dried crumbs

time start of test: *27/5/99 9:50*

time dispersion commences:

time dispersion completed:

remoulded material

time start of test: *31/5/99 9:35*

time dispersion commences: *31/5/99 9:53*

time dispersion completed: *Not Observed*

material description

(CH) CLAY-high plasticity,red brown,trace of sand.

type of water used: *Distilled*

water temperature: *19° C*

immersion of air dried crumbs

- does not slake ☐
- slakes ☒
  - swell ☐ (7)
  - does not swell ☐ (8)
  - complete dispersion ☐ (1)
  - partial dispersion ☐ (2)
  - no dispersion ☒

immersion of remoulded material

- disperses ☒ (3)
- does not disperse ☐
  - calcite or gypsum
    - present ☐ (4)
    - absent ☐
      - vigorous shaking
        - disperses ☐ (5)
        - flocculates ☐ (6)

Emerson class number: 3

Form Number L4.BR.1 Version 4.0

J. RUSSELL 2 / 6 / 99
Authorised Signature
NATA No 431

Coffey Geosciences Pty Ltd A.C.N. 056 335 516

Geotechnical Resources Environmental Technical Project Management
142 Wicks Road, North Ryde, NSW, 2113
Ph: (61 2) 9888 7444, Fax: (61 2) 9878 8155

determination of emerson class number

client : *PLANNING WORKSHOPS AUSTRALIA*
principal :
project : *LES, GRASMERE*
location :

job no : *S20166/1*
laboratory : *SYDNEY*
date : *02/06/99*
test report :

test procedure : *AS1289.3.8.1*
sample identification: *S2 0.6m*

test data

air dried crumbs

time start of test: *27/5/99 9:55*

time dispersion commences:

time dispersion completed:

remoulded material

time start of test: *31/5/99 9:40*

time dispersion commences:

time dispersion completed:

material description

(CI) SANDY CLAY-medium plasticity,red brown,fine to medium sand.

type of water used: *Distilled*

water temperature: *20° C*

immersion of air dried crumbs

- does not slake ☐
- slakes ☒
  - swell ☐ ⑦
  - does not swell ☐ ⑧
  - complete dispersion ☐ ①
  - partial dispersion ☐ ②
  - no dispersion ☒

immersion of remoulded material

- disperses ☐ ③
- does not disperse ☒
  - calcite or gypsum
    - present ☐ ④
    - absent ☒
      - vigorous shaking
        - disperses ☒ ⑤
        - flocculates ☐ ⑥

Emerson class number: **5**

Form Number L4.6R1 Version 4.0

Authorised Signature
NATA No 431

16 6 99
James Russell

Coffey Geosciences Pty Ltd A.C.N. 056 335 516

Geotechnical Resources Environmental Technical Project Management
142 Wicks Road, North Ryde, NSW, 2113
Ph: (61 2) 9888 7444, Fax: (61 2) 9878 8155

determination of emerson class number

client : *PLANNING WORKSHOPS AUSTRALIA*
principal :
project : *LES, GRASMERE*
location :

job no : *S20166/1*
laboratory : *SYDNEY*
date : *02/06/99*
test report :

test procedure : *AS1289.3.8.1*
sample identification: *S3 0.1m*

test data

air dried crumbs

time start of test: *27/6/99 10:00*

time dispersion commences: *Not Observed*

time dispersion completed: *Not Observed*

remoulded material

time start of test:

time dispersion commences:

time dispersion completed:

material description

(CH) CLAY-high plasticity,red brown,some fine sand.

type of water used: *Distilled*

water temperature: *19° C*

immersion of air dried crumbs

- does not slake ☐
- slakes ☒
  - swell ☐ ⑦
  - does not swell ☐ ⑧
  - complete dispersion ☐ ①
  - partial dispersion ☒ ②
  - no dispersion ☐

immersion of remoulded material

- disperses ☐ ③
- does not disperse ☐
  - calcite or gypsum
    - present ☐ ④
    - absent ☐
      - vigorous shaking
        - disperses ☐ ⑤
        - flocculates ☐ ⑥

Emerson class number: **2**

Form Number L4.8R1 Version 4.0

J. RUSSELL 2/6/99
Authorised Signature
NATA No 431

Coffey Geosciences Pty Ltd A.C.N. 056 335 616

Geotechnical Resources Environmental Technical Project Management
142 Wicks Road, North Ryde, NSW, 2113
Ph: (61 2) 9888 7444, Fax: (61 2) 9878 8155

determination of emerson class number

client : *PLANNING WORKSHOPS AUSTRALIA*
principal :
project : *LES, GRASMERE*
location :

job no : *S20166/1*
laboratory : *SYDNEY*
date : *02/06/99*
test report :

test procedure : *AS1289.3.8.1*
sample identification: *S4 0.3m*

test data

air dried crumbs

time start of test: *27/5/99 10:05*

time dispersion commences: -

time dispersion completed: -

remoulded material

time start of test: *31/5/99 9:30*

time dispersion commences: -

time dispersion completed: -

material description

(CI) SANDY CLAY-medium plasticity,brown,fine to medium sand,trace of root fibres.

type of water used: *Distilled*

water temperature: *20° C*

immersion of air dried crumbs

- does not slake ☐
- slakes ☒
  - swell ☐ (7)
  - does not swell ☐ (8)
  - complete dispersion ☐ (1)
  - partial dispersion ☐ (2)
  - no dispersion ☒

immersion of remoulded material

- disperses ☐ (3)
- does not disperse ☒
  - calcite or gypsum
    - present ☐ (4)
    - absent ☒
      - vigorous shaking
        - disperses ☒ (5)
        - flocculates ☐ (6)

Emerson class number 5

Form Number LAB1 Version 4.0

J. RUSSELL 2/6/99
Authorised Signature
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James Russell

Appendix B:
Geotechnical Risk Assessment Procedure

Geotechnical Risk Assessment Procedure

The risk of slope instability has been assessed using a classification system based on the Australian/New Zealand Standard on Risk Management (AS/NZS 4360-1995) with some modifications to reflect site specific considerations. The basic process involves the qualitative assessment of risk considering both the likelihood and consequences of a particular event occurring, arriving at a risk classification using a matrix relationship.

Definitions of the key terms are as follows:

Hazard A condition or situation with the potential to cause an undesirable consequence.

Likelihood A qualitative description of probability or frequency.

Consequence The outcome of an event expressed qualitatively, being a loss, injury, disadvantage or gain.

The general risk assessment procedure is defined as follows:

1. Identify Hazards.
2. Assess the Likelihood of a Hazard Occurring (**Table A1** shows the terms used in this assessment).
3. Assess the Consequences (see **Table A2**) in terms of:
   - Elements at risk (people, houses, roads, services), and
   - Vulnerability (how they will be affected); eg. death, injury, destruction or damage.
4. Assessment of risk of the site in terms of likelihood and consequences. The outcome of the procedures is a risk classification in terms of likelihood and consequences as summarised on the risk matrix shown in **Table A3.**

Table A1 – Qualitative Measures of Likelihood of Occurrence

Qualitative Measure	Example Description
Almost certain	The event is expected to occur in the short term
Likely	The event will probably occur in the short term under adverse conditions
Moderate	The event could occur within the medium to long term under adverse conditions
Unlikely	The event could occur within the extended long term under very adverse conditions
Rare	The event may occur only in very exceptional adverse conditions

Table A2 – Consequence to Property and Life in the Event of Hazard Occurrence

Qualitative Assessment of Consequences	Examples of Circumstances	
Insignificant	Little damage, low financial loss	and no likelihood of injuries
Minor	Limited damage to part of structure, or part of site requiring some stabilisation works;	and/or first aid treatment required
	Medium financial loss	
Moderate	Moderate damage to some of structure, or significant part of site requiring large stabilisation works;	and/or serious injury
	High financial loss	
Major	Extensive damage to most of structure, or extending beyond site boundaries requiring significant stabilisation works;	and/or serious injury/single fatality
	Major financial loss	
Catastrophic	Structure completely destroyed or large scale instability requiring major engineering works for stabilisation;	and/or multiple fatality
	Huge financial loss	

Table A3 – Qualitative Risk Matrix used for the Assessment of Risk

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium Risk	High Risk	High Risk	Very High Risk	Very High Risk
Likely	Medium Risk	Medium Risk	High Risk	High Risk	Very High Risk
Moderate	Low Risk	Medium Risk	Medium Risk	High Risk	High Risk
Unlikely	Very Low Risk	Low Risk	Medium Risk	Medium Risk	High Risk
Rare	Very Low Risk	Very Low Risk	Low Risk	Medium Risk	Medium Risk

Appendix C:
Geotechnical Guidelines for Hillside Construction

TABLE 2 SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	POOR ENGINEERING PRACTICE
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical consultant at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the Risk of Instability and Implications for Development in mind.	Plan development without regard for the Risk of Instability.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements.
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use and compact clean fill materials. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may become unstable. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOUNDATIONS	Support on or within rock where practicable. Use rows of piers or strip foundations oriented up and down slope. Design for lateral creep pressures. Backfill foundation excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at toes of cut and fill slopes. Discharge to street drainage or natural water courses. Provide generous falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some low risk areas. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant.	
SITE VISITS	Site Visits by consultant may be appropriate during construction.	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident seek advice. If seepage observed, determine cause or seek advice on consequences.	

This table is an extract from GEOTECHNICAL RISKS ASSOCIATED WITH HILLSIDE DEVELOPMENT as presented in Australian Geomechanics News, Number 10, 1985 which discusses the matter more fully.

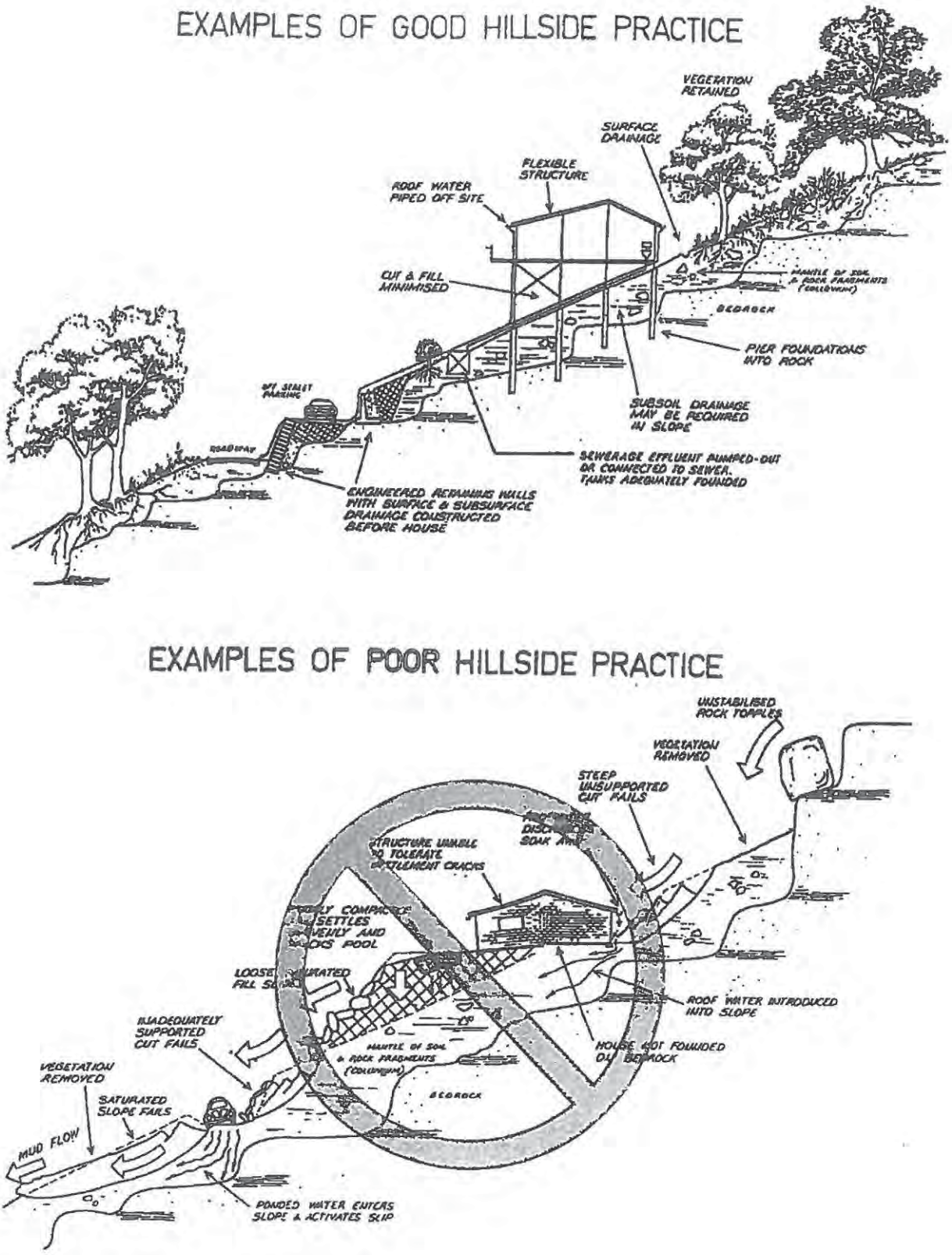


FIGURE 1 Illustrations of Good and Poor Hillside Practice

This figure is an extract from GEOTECHNICAL RISKS ASSOCIATED WITH HILLSIDE DEVELOPMENT as presented in Australian Geomechanics News, Number 10, December, 1985, which discusses the matter more fully.

Appendix D:
National Parks & Wildlife Service Flora List

3.3.3 LSC Class 3

Description

Class 3 land has limitations that must be managed to prevent soil and land degradation. However, the limitations can be overcome by a range of widely available and readily implemented land management practices. Included are sloping lands (3–10%) with slopes longer than 500 m that will require earthworks to control runoff and erosion if used for regular cultivation. Also included are lands that can be subject to wind erosion when cultivated and left bare. It is important to minimise soil disturbance, maintain stubble cover and maintain good organic matter levels. This class includes other soils with acidification and soil structure limitations that are sufficient to require the application of specific management practices.

Class 3 land includes sloping land that is capable of sustaining cultivation on a rotational basis. This land can be readily used for a range of crops including cereals, oilseeds and pulses. Productivity will vary with soil fertility. There are greater restrictions on land use than for Classes 1 and 2 due to increased limitations. Severe problems may arise if land management practices do not address the limitations of Class 3 land. For example, severe soil erosion can be caused by regular cultivation without effective erosion control measures, poor water quality can be caused by water erosion and dust storms may result from wind erosion.

Off-site impacts of land management can be significant if limitations are not managed adequately (for example, water erosion, water quality and sedimentation, wind erosion and air quality, or salinity).

Class 3 land is especially widespread on the NSW slopes and in the coastal areas. It includes a large proportion of the major agricultural producing areas of the State.

Land management considerations

This land can be subject to sheet, rill and gully erosion as well as wind erosion and soil structure decline. However, these limitations can be controlled by land management practices that are readily available and easily implemented.

Included are conservation tillage and farming practices such as retaining stubble, reducing tillage, sowing with minimum ground disturbance and the use of pasture rotations in the cropping system. Windbreaks and ground cover should be retained in areas prone to wind erosion. In western areas some timber should be retained in strips or clumps to reduce wind velocity. Salinity can be a moderate hazard. Land managers need to ensure that management practices do not cause deep drainage and movement of salt stores in the soil. Practices to manage salinity are ensuring that plant growth is adequate to maintain evapotranspiration rates, and minimising the length of fallows in cropping cycles. Acidity can be a moderate hazard and needs to be managed or the soils will suffer long-term degradation, particularly if acidity extends deep into the soil. Under long-term acidifying land uses, soil acidity levels should be monitored and lime added, or acid-tolerant perennials used where required. The management of soil structure in weakly sodic surface soils may require the use of soil ameliorants such as gypsum, attention to soil conditions before tillage and stock management to prevent surface soil compaction.

Description

Class 4 land has moderate to severe limitations for some land uses that need to be consciously managed to prevent soil and land degradation. The limitations can be overcome by specialised management practices with high levels of knowledge, expertise, inputs, investment and technology. This class includes sloping lands (10–20% slope).

Land management considerations

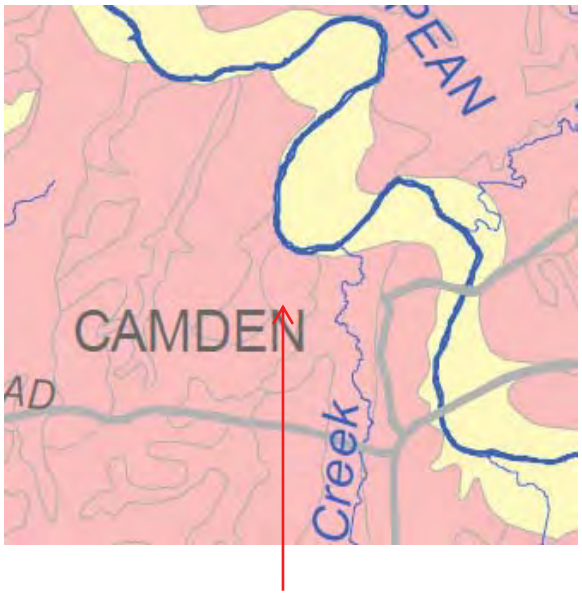
This land is generally used for grazing, and is suitable for pasture improvement. Acidification can be a problem under introduced annual legume pastures.

Class 4 land can be cultivated occasionally for sowing of pastures and crops. However, it has cropping limitations because of erosion hazard, weak structure, salinity, acidification, shallowness of soils, climate, wetness, stoniness or a combination of these factors. It is only suitable for intermittent cultivation with specialised practices. Required erosion control practices include advanced conservation tillage, pasture cropping, well-planned rotations and maintenance of ground cover.

Class 4 land has a high potential as grazing land. Soil structure decline, stoniness and soil depth can be moderate to severely limiting. Practices to manage these include well-planned rotations, additions of lime and maintenance of ground cover using perennials and natives. Erosion problems encountered in these lands include sheet, rill and gully erosion as well as wind erosion and soil structure decline under cropping. Land with weakly sodic surface soils is included in this classification. These limitations can be managed by well planned and carefully implemented conservation farming practices. Essential cropping practices include retaining stubble, reducing tillage and sowing with minimum disturbance. Minor drainage depressions with low flows are included in this class. Windbreaks and ground cover should be retained in areas prone to wind erosion. In western areas, some timber should be retained in strips or clumps to reduce wind velocity.

Salinity can be a moderate to severe hazard. Land management practices need to prevent deep drainage that causes salinity. Practices to manage salinity include ensuring plant growth is adequate to maintain evapotranspiration rates and maintaining the perenniality of pastures. Acidification can be a moderate to severe hazard and needs to be managed so soils do not suffer long-term degradation. It is particularly a problem if deeper parts of the soil profile become acidified. Land management practices need to prevent possible soil acidification and pH should be monitored regularly. Lime should be added or acid-tolerant perennials should be grown when required.

Appendix D



Subject Site

Sub-soil sodicity is widespread

SUBSOIL SODICITY

WIDESPREAD . . . . . .

LOCALISED . . . . . .

NOT OBSERVED . . . . . .

DISTURBED TERRAIN . .

CONTEXT INFORMATION

RIVER/CREEK . . . . . .

HIGHWAY . . . . . .

MAIN ROAD . . . . . .

WATER BODY . . . . . .

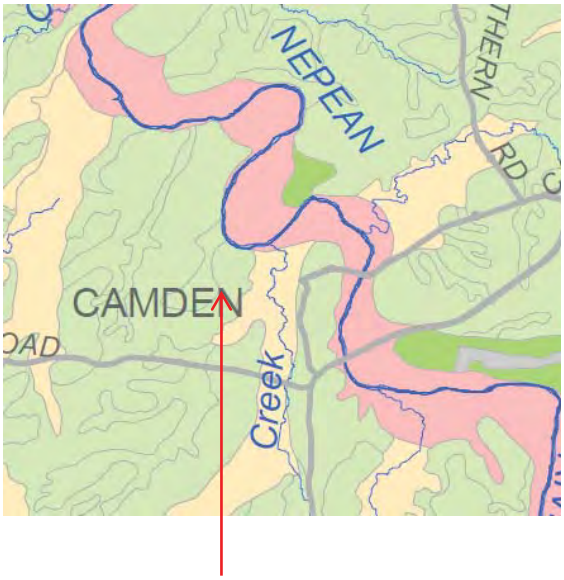
NOTES

The assessment of subsoil sodicity for the catchment area is objectively based on field observation and laboratory analysis as identified by soil landscape mapping of the catchment. It provides a broad-scale, regional, catchment view of soil landscapes that contain areas of sodic subsoils. Sodic soils have an Exchangeable Sodium Percentage (ESP) greater than 6%. They have low stability when wet, and they set hard when dry, reducing permeability and available water capacity and, when exposed at the surface, forming surface crusts that restrict plant establishment and growth. Diagnostically, they typically exhibit high bulk density and strength, a strong coarse blocky or columnar structure, and are both highly erodible and dispersible. However, their degree of dispersion in the field depends on a number of other factors such as salinity, pH, clay content, mineralogy and organic matter. Not all sodic soils are dispersible, nor are all dispersible soils sodic. The map is intended for catchment planning purposes and should only be used as a guide at a property scale. Refer to the Soil and Land Resources of the Hawkesbury Nepean Catchment interactive DVD (DECC 2008) for more information. The classes used are:

WIDESPREAD
Sodic subsoils occur throughout the soil landscape.

LOCALISED
Localised areas within the soil landscape have been assessed as having sodic subsoils; generally sodic subsoils occur in low-lying parts of the landscape.

NOT OBSERVED
Subsoils in this soil landscape are generally non-sodic, and no significant areas of sodic subsoils have been identified within the soil landscape during the course of the soil landscape mapping survey.



Subject Site

Urban Capability is Class B

LEGEND

DOMINANT URBAN CAPABILITY

- CLASS A
- CLASS B
- CLASS C
- CLASS D
- CLASS E
- DISTURBED TERRAIN

CONTEXT INFORMATION

- RIVER/CREEK
- HIGHWAY
- MAIN ROAD
- WATER BODY

NOTES

The assessment of Urban Capability for the catchment area is objectively based on physical criteria as identified by soil landscape mapping of the catchment. It defines five classes of capability (Hannam and Hicks 1980) which are based on the assessment of the soil landscape to withstand urban development. It provides a broad-scale, regional, catchment view as to the dominant urban capability class present for each soil landscape. Other, less common, urban capability classes may occur within any map unit and which are described in more detail on the Soil and Land Resources of the Hawkesbury Nepean Catchment interactive DVD (DECC 2008). This map is not intended to be used for detailed urban capability assessment which would require more intensive field investigation and accurate assessment of constraints at a suitable planning scale. The five classes are:

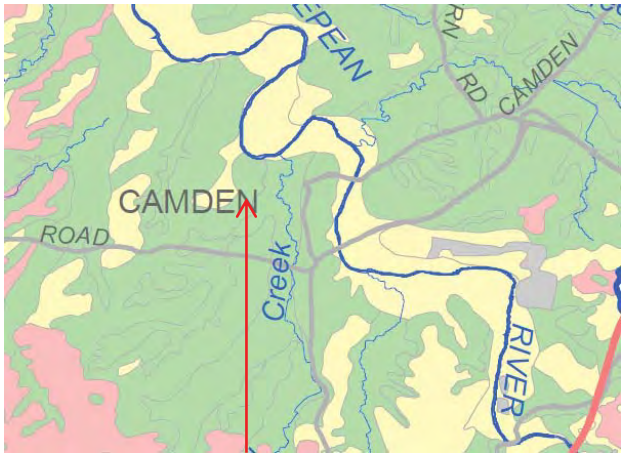
CLASS A. Areas with little or no physical limitations to urban development.

CLASS B. Areas with minor to moderate physical limitations to development. These limitations may influence design and impose certain management requirements on developments to ensure a stable land surface is maintained both during and after development.

CLASS C. Areas with moderate physical limitations to urban development. These limitations can be overcome by careful design and by adoption of site management techniques to ensure the maintenance of a stable land surface.

CLASS D. Areas with severe physical limitations to urban development which will be difficult to overcome, requiring detailed site investigation and engineering design.

CLASS E. Areas where no form of urban development is recommended because of very severe limitations to such development that would be very difficult and costly to overcome.



Subject Site

Steep Slope – Not observed

LEGEND

STEEP SLOPES

WIDESPREAD .....

LOCALISED .....

NOT OBSERVED .....

DISTURBED TERRAIN ..

CONTEXT INFORMATION

RIVER/CREEK .....

HIGHWAY .....

MAIN ROAD .....

WATER BODY .....

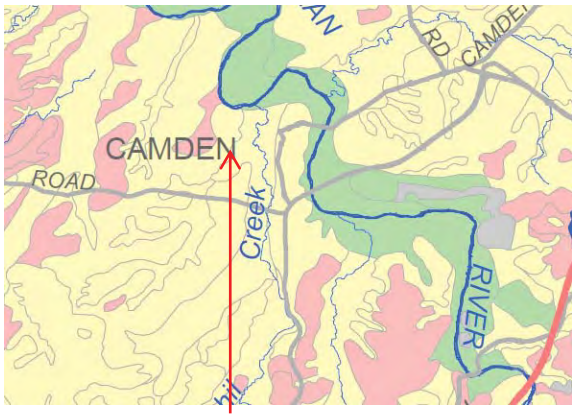
NOTES

The assessment of steep slopes for the catchment area is objectively based on aerial photographic interpretation and field observation as identified by soil landscape mapping of the catchment. It provides a broad-scale, regional, catchment view of soil landscapes that contain areas of steep slopes. The map is intended for catchment planning purposes and should only be used as a guide at a property scale. Refer to the Soil and Land Resources of the Hawkesbury Nepean Catchment interactive DVD (DECC 2008) for more information. The classes used are:

WIDESPREAD
Steep slopes occur throughout the soil landscape. As a result, soil erosion is more severe, rock outcrop is more common, soils are generally shallower and mass movement is more likely. These problems make steep slopes a limiting factor for both urban and rural land uses.

LOCALISED
Localised areas within the soil landscape have been assessed as having steep slopes, resulting in localised increased soil erosion hazard, mass movement hazard, shallow soils and stoniness. Viability of many land uses may be restricted in such areas.

NOT OBSERVED
This soil landscape is flat, gently or moderately sloped and no significant areas of steep slopes have been identified within the soil landscape during the course of the soil landscape mapping survey.



Subject Site

Sheet Erosion Hazard – Localised

LEGEND

SHEET EROSION HAZARD

- WIDESPREAD .....
- LOCALISED .....
- NOT OBSERVED .....
- DISTURBED TERRAIN ..

CONTEXT INFORMATION

- RIVER/CREEK .....
- HIGHWAY .....
- MAIN ROAD .....
- WATER BODY .....

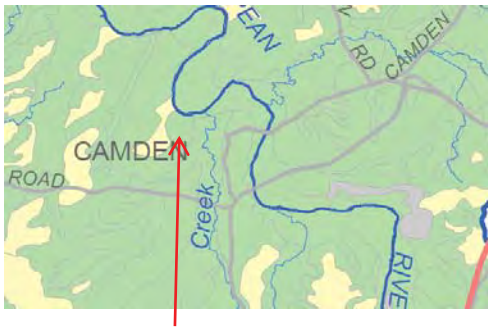
NOTES

The assessment of sheet erosion hazard for the catchment area is objectively based on field observation and laboratory analysis as identified by soil landscape mapping of the catchment.
It provides a broad-scale, regional, catchment view of soil landscapes that contain field evidence of sheet erosion and/or containing soil materials that are vulnerable to sheet erosion if exposed to erosive agents. The map is intended for catchment planning purposes and should only be used as a guide at a property scale. Refer to the Soil and Land Resources of the Hawkesbury Nepean Catchment Interactive DVD (DECC 2008) for more information. The classes used are:

WIDESPREAD
A high sheet erosion hazard is expected to occur throughout the soil landscape. Soil materials are highly erodible and therefore susceptible to erosion, and significant sheet erosion is expected to occur during and after disturbance unless soil conservation measures are implemented.

LOCALISED
Localised areas within the soil landscape have been assessed as having a high sheet erosion hazard. This may be due to the presence of highly erodible soil materials in certain parts of the landscape. Significant sheet erosion is expected to occur in these areas during and after disturbance unless soil conservation measures are implemented.

NOT OBSERVED
Soil materials are generally stable and little sheet erosion has been identified within the soil landscape during the course of the soil landscape mapping survey.



Subject Site

Shallow Soils – Not observed

NOTES

The assessment of shallow soils for the catchment area is objectively based on field observation and laboratory analysis as identified by soil landscape mapping of the catchment.
It provides a broad-scale, regional, catchment view of soil landscapes that contain areas of shallow soils. With depths of <50 cm, these soils increase the difficulty of installing underground services and restrict plant growth. The map is intended for catchment planning purposes and should only be used as a guide at a property scale. Refer to the Soil and Land Resources of the Hawkesbury Nepean Catchment interactive DVD (DECC 2008) for more information. The classes used are:

WIDESPREAD
Shallow soils occur throughout the soil landscape.

LOCALISED
Localised areas within the soil landscape have been assessed as having shallow soils.

NOT OBSERVED
Soils in this soil landscape are generally moderately deep to deep and no significant areas of shallow soils have been identified within the soil landscape during the course of the soil landscape mapping survey.

LEGEND

SHALLOW SOILS

WIDESPREAD .....

LOCALISED .....

NOT OBSERVED .....

DISTURBED TERRAIN ..

CONTEXT INFORMATION

RIVER/CREEK .....

HIGHWAY .....

MAIN ROAD .....

WATER BODY .....

Subject Site

Seasonal Water logging hazard - localised

LEGEND

SEASONAL WATERLOGGING HAZARD

WIDESPREAD .....

LOCALISED .....

NOT OBSERVED .....

DISTURBED TERRAIN ..

CONTEXT INFORMATION

RIVER/CREEK .....

HIGHWAY .....

MAIN ROAD .....

WATER BODY .....

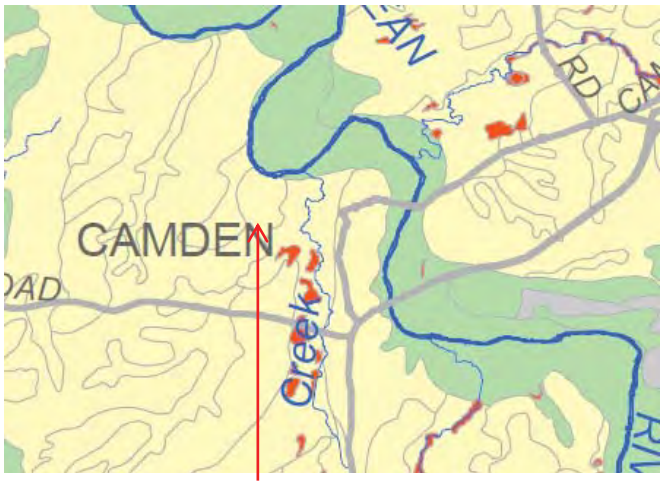
NOTES

The assessment of seasonal waterlogging for the catchment area is objectively based on field observation and laboratory analysis as identified by soil landscape mapping of the catchment.
It provides a broad-scale, regional, catchment view of soil landscapes that contain areas of seasonal waterlogging.
Periodically these soils become waterlogged, which may result in poor cohesion, high organic matter, strong salinity, high acidity, low fertility and low wet-bearing strength. These soils are unsuitable for septic effluent disposal. The map is intended for catchment planning purposes and should only be used as a guide at a property scale. Refer to the Soil and Land Resources of the Hawkesbury Nepean Catchment Interactive DVD (DECC 2008) for more information. The classes used are:

WIDESPREAD
Seasonal waterlogging occurs throughout the soil landscape.

LOCALISED
Localised areas within the soil landscape have been assessed as having a high seasonal waterlogging hazard.

NOT OBSERVED
Soils in this soil landscape are generally not affected by seasonal waterlogging and no significant areas of seasonal waterlogging have been identified within the soil landscape during the course of the soil landscape mapping survey.



Subject Site

Salinity Hazard - Localised

LEGEND

SALINITY HAZARD

WIDESPREAD .....

LOCALISED .....

NOT OBSERVED .....

DISTURBED TERRAIN ..

SALT OUTBREAKS

KNOWN SALINITY .....

CONTEXT INFORMATION

RIVER/CREEK .....

HIGHWAY .....

MAIN ROAD .....

WATER BODY .....

NOTES

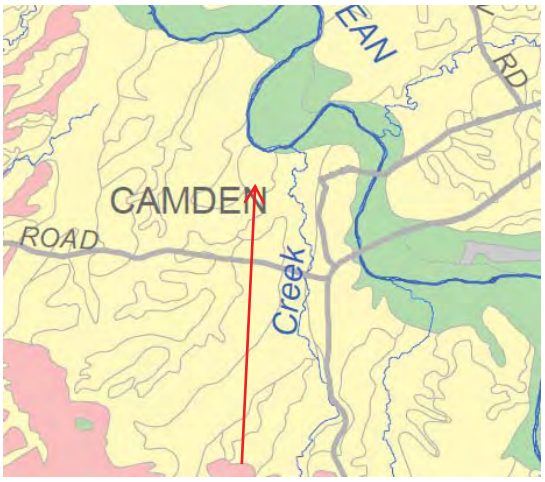
The assessment of salinity hazard for the catchment area is objectively based on field observation and laboratory analysis as identified by soil landscape mapping of the catchment. It provides a broad-scale, regional, catchment view of soil landscapes that have been assessed as containing field evidence of salinity or saline soil materials. The map is intended for catchment planning purposes only and should only be used as a guide at a property scale. The classes used are:

WIDESPREAD
Salinity is occurring or has the potential to occur over a large proportion of this landscape.

LOCALISED
Salinity is occurring or has the potential to occur over a small part of this landscape. Generally salinity is confined to breaks in lower slopes and also along drainage lines within the soil landscape. Occasionally salinity may occur due to other geological or hydrological factors.

NOT OBSERVED
Salinity has not been identified as occurring in the soil landscape during the course of the soil landscape mapping survey and it is not expected to occur.

KNOWN SALINITY
Areas where there is a known occurrence of saline soil, or where aerial photographic interpretation and field observations have confirmed the existence of more than one of the following indicators: scalding; salt efflorescence; dieback of vegetation; salt-tolerant plant species or; waterlogging. A high relative wetness index occurs in these areas.



Subject Site

Productive Agricultural Potential – Capable of Occasional Cultivation

LEGEND

PRODUCTIVE AGRICULTURAL POTENTIAL

- CAPABLE OF REGULAR CULTIVATION
- CAPABLE OF OCCASIONAL CULTIVATION
- NOT CAPABLE OF CULTIVATION
- DISTURBED TERRAIN

CONTEXT INFORMATION

- RIVER/CREEK
- HIGHWAY
- MAIN ROAD
- WATER BODY

NOTES

The assessment of Productive Agricultural Potential for the catchment area is a generalised assessment of the soil landscape's capability for production agriculture. It is a reclassification of the 8-class Rural Land Capability scheme into 3 classes. As such, this map provides a broad-scale, regional, catchment view of the soil landscape's inherent characteristics to support differing intensities of production.

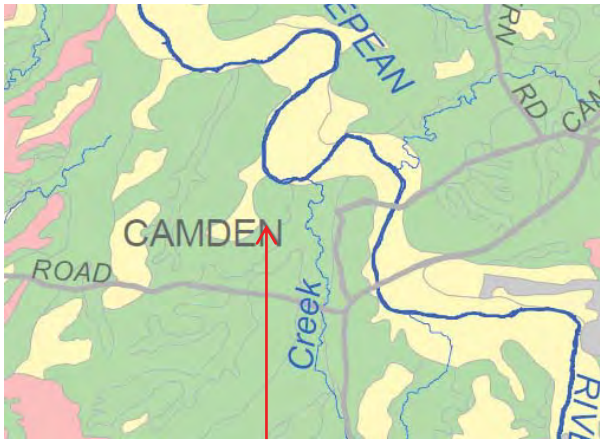
The assessment includes a wide range of issues such as landform, slope, rock outcrop, soil depth, soil stoniness, soil structure, soil drainage, soil sodicity, acidity or alkalinity and soil chemical fertility. This means that two areas with the same Productive Agricultural Potential class may have been given that class for completely different reasons. Factors external to the soil landscape, such as climate, land tenure and current land use, are not considered.

The map is intended for catchment planning purposes and should not be used for any type of assessment of the productive capacity or worth of an individual property or paddock. Refer to the Soil and Land Resources of the Hawkesbury Nepean Catchment Interactive DVD (DECC 2008) for more information. The classes used are:

CAPABLE OF REGULAR CULTIVATION
Land is generally capable of intensive agriculture with no significant physical soil constraints. Limitations caused by site factors such as soil erosion, run-on or soil fertility can be managed economically.

CAPABLE OF OCCASIONAL CULTIVATION
Land is generally capable of intensive agriculture on a rotational basis. Increased land management input is required to overcome inherent landscape limitations such as slope and run-on, and soil constraints, such as low fertility and high to severe soil erosion hazard.

NOT CAPABLE OF CULTIVATION
Land is generally not suitable for intensive agriculture. Significant inherent landscape and soil constraints occur which present significant limitations to use.



Subject Site

Mass Movement Hazard – Not Observed

LEGEND

MASS MOVEMENT HAZARD

WIDESPREAD .....

LOCALISED .....

NOT OBSERVED .....

DISTURBED TERRAIN ..

CONTEXT INFORMATION

RIVER/CREEK .....

HIGHWAY .....

MAIN ROAD .....

WATER BODY .....

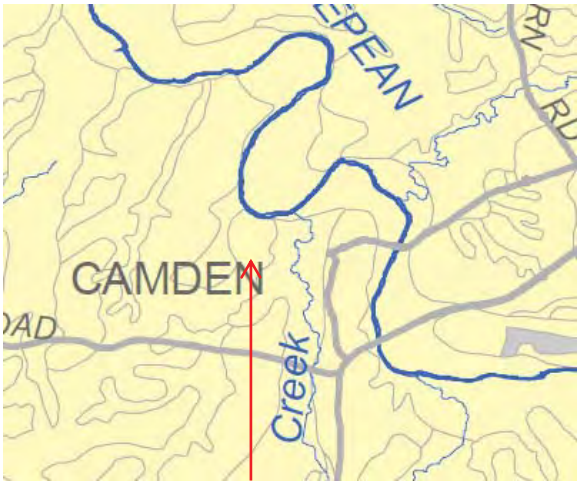
NOTES

The assessment of mass movement hazard for the catchment area is objectively based on field observation and laboratory analysis as identified by soil landscape mapping of the catchment.
It provides a broad-scale, regional, catchment view of soil landscapes that contain field evidence of mass movement and/or containing the combination of landform, lithology, soils, rainfall intensity and duration, drainage and vegetation that would promote the occurrence of mass movements. Refer to the Soil and Land Resources of the Hawkesbury Nepean Catchment Interactive DVD (DECC 2008) for more information. The classes used are:

WIDESPREAD
A high mass movement hazard is expected to occur throughout the soil landscape. The combination of landform, lithology and soil creates an increased risk of mass movements occurring in the appropriate climatic circumstances, particularly if the landscape is disturbed. It is recommended that a detailed assessment be undertaken to determine on-site mass movement hazard before any development is undertaken.

LOCALISED
Localised areas within the soil landscape have been assessed as having a high mass movement hazard. This may be due to the presence of vulnerable soil materials or lithologies in certain parts of the landscape. It is recommended that a detailed assessment be undertaken to determine on-site mass movement hazard before development is undertaken.

NOT OBSERVED
The landscape and its soils are generally stable and little risk of mass movement has been identified within the soil landscape during the course of the soil landscape mapping survey.



Subject Site

Low Fertility - Localised

LEGEND

LOW FERTILITY

WIDESPREAD

LOCALISED

NOT OBSERVED

DISTURBED TERRAIN

CONTEXT INFORMATION

RIVER/CREEK

HIGHWAY

MAIN ROAD

WATER BODY

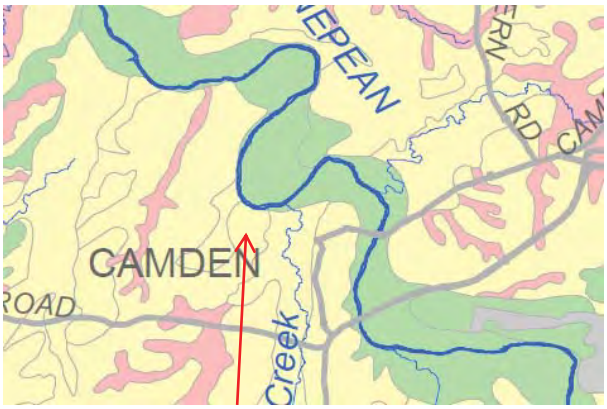
NOTES

The assessment of low fertility for the catchment area is objectively based on field observation and laboratory analysis as identified by soil landscape mapping of the catchment.
It provides a broad-scale, regional, catchment view of soil landscapes that contain areas of soils with low fertility. Soils with low chemical fertility usually require the application of chemical fertilisers, seasoned manure or compost to achieve permanent plant cover. However, some soils do not respond well to normal applications of fertiliser. For example, soils with high aluminium or iron oxide contents readily 'lock up' phosphate, making it unavailable to plants. Some soils also have low fertility due to restrictive physical properties such as shallowness, stoniness, hardsettingness and impermeability or rapidly permeability.
The map is intended for catchment planning purposes and should only be used as a guide at a property scale. Refer to the Soil and Land Resources of the Hawkesbury Nepean Catchment interactive DVD (DECC 2008) for more information. The classes used are:

WIDESPREAD
Soils of low fertility occur throughout the soil landscape.

LOCALISED
Localised areas within the soil landscape have been assessed as having soils of low fertility.

NOT OBSERVED
Soils in this soil landscape are generally moderately fertile to fertile and no significant areas of soils with low fertility have been identified within the soil landscape during the course of the soil landscape mapping survey.



Subject Site

Gully Erosion - Localised

LEGEND

GULLY EROSION HAZARD

- WIDESPREAD
- LOCALISED
- NOT OBSERVED
- DISTURBED TERRAIN

CONTEXT INFORMATION

- RIVER/CREEK
- HIGHWAY
- MAIN ROAD
- WATER BODY

NOTES

The assessment of gully erosion hazard for the catchment area is objectively based on field observation and laboratory analysis as identified by soil landscape mapping of the catchment.
It provides a broad-scale, regional, catchment view of soil landscapes that contain field evidence of gully erosion and/or containing highly erodible soil materials that may be sodic and/or dispersible. Refer to the Soil and Land Resources of the Hawkesbury Nepean Catchment Interactive DVD (DECC 2008) for more information. The classes used are:

WIDESPREAD
A high gully erosion hazard is expected to occur throughout the soil landscape. Soils are generally unstable due to the widespread presence of highly erodible soil materials that may be sodic and/or dispersible.

LOCALISED
Localised areas within the soil landscape have been assessed as having a high gully erosion hazard. This may be due to the presence of erodible soil materials in certain parts of the landscape that may be sodic and/or dispersible.

NOT OBSERVED
The landscape and its soils are generally stable and little risk of gully erosion has been identified within the soil landscape during the course of the soil landscape mapping survey.

APPENDIX L

Air QualityAssessment

Air Quality Assessment

10 Crase Place, Grasmere, NSW

Site Plus Pty Ltd

On behalf of Cowbridge Holdings Pty Ltd

siteplus

15th June 2015

Project No. 3014.216

KMH ENVIRONMENTAL

Air Quality Assessment

10 Crase Place, Grasmere, NSW

Prepared for:
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Document Control Log

Revision No.	Amendment	Date	Prepared By	Checked By	Approved By
0	Draft	27/03/2015	SN	AP	AP
1	Final	30/03/2015	SN	AP	AP
2	Re-issue	15/06/2015	SN	AP	KGH

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Glossary and Abbreviations

AWS	Automatic Weather Station
AQI	Air Quality Index
BoM	Bureau of Meteorology
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CH_4	Methane
CH_3SH	Methyl Mercaptan
DEC	NSW Department of Environment and Conservation
EPA	Environment Protection Authority
FAT	Feed Averaging Tank
GLC	Ground level concentration
ha	Hectare
H_2S	Hydrogen Sulphide
m^3/s	Cubic metres per second
LEP	Local Environmental Plan
LGA	Local Government Area
NEPH	Nepholemeter
NO_2	Nitrogen dioxide
O_3	Ozone
OEH	NSW Office of Environment and Heritage
OU	Odour Unit
OUV/s	Odour Unit Volume per second with units ($OU.m^3/s$)
POEO Act	NSW Protection of the Environment Operations Act 1997
REF	Review of Environmental Factors

Executive Summary

Site Plus Pty Ltd (Site Plus), on behalf of proponent Cowbridge Holdings Pty Ltd, proposes to seek the rezoning of Part Lot 24 DP 1086823, 10 Crase Place, Grasmere, NSW ("the site") from RU1 – Primary Production to R5 – Large Lot Residential. KMH Environmental Pty Ltd (KMH) has been commissioned to prepare an odour impact assessment in relation to these parcels of land. The site is located approximately 300 metres away from Sydney Water Corporation's (Sydney Water) West Camden Water Recycling Plant (WRP).

The purpose of this odour impact assessment is to determine whether, based on the information available, if odorous air emissions from the plant are likely to exceed the current standards for residential properties under normal operating conditions. As a consequence of recent upgrades to the WRP including an additional digester to meet future process demand, there is the potential for residents at properties near the WRP to experience odour nuisance from the WRP.

Sewerage treatment plants have the potential to produce and release a number of odorous compounds, but usually the most common and problematic of these is hydrogen sulphide (H2S) gas. Sydney Water identified Methane (CH4) to be the main gaseous compound with some methyl mercaptan (CH3SH) and H2S responsible for odour emissions from the WRP.

In 2011 Sydney Water prepared an REF for the installation of a new third anaerobic digester. The odour outputs from the plant were modelled using an Ausplume model. That modelling did not include potential odours from the new digester. Sydney Water undertook to re-model the odour emissions after full commissioning of the new digester and stable operation of the plant. At the time of this report, that re-modelling exercise has not been completed by Sydney Water.

KMH has subsequently completed Level 2 Dispersion Modelling for the potential odour emissions from the new digester. The air quality assessment was conducted in accordance with guidelines from New South Wales (NSW) Office of Environment and Heritage (OEH) and NSW DEC air quality assessment and modelling guidelines ("Assessment and management of odour from stationary sources in New South Wales"). The application of these guidelines is required by Camden Council under their Development Control Plans for this area.

KMH's modelling has focussed on odour emissions from the new digester stack using digester design criteria from Sydney Water's odour control unit standard specification with a discharge less than 500 odour units (OU). The outputs of that modelling exercise has been combined with Sydney Water's 2011 modelling to allow an assessment of the odour emissions from the entire plant (including the new digester) to be made.

The atmospheric dispersion modelling of emissions expected from the operational phase of the upgraded WRP taking into account background pollutant data from the local monitoring station at Camden Airport Automatic Weather Station (AWS) approximately 2.7 km north-east from the site indicates that emissions from the WRP are not expected to exceed the relevant air quality guideline criteria.

The results of the Level 2 dispersion modelling exercise indicate that odour emissions from the digester stack, modelled under site-specific meteorological and terrain scenario, at the maximum output design criteria of the odour control unit installed at the WRP, would have ground level concentrations (GLC) at the site below the 2 OU level. The resulting modelled concentrations for odour, lead to the conclusion that normal operations at the WRP should not present air quality issues for the site.

The modelling results also indicate that residential development outside the 300 m buffer zone is not likely to experience any more odour issues from the WRP, than existing properties on Case Place.

It should be noted that this modelling has assumed that the emissions from the stack do not exceed the maximum output design criteria from the odour control unit (500 OU). The modelling undertaken did not consider potential impacts from uncontrolled fugitive emissions or process upsets.

1. Introduction

1.1. Background

A subdivision and rezoning is proposed at Part Lot 24 DP 1086823, 10 Crase Place, Grasmere, NSW ("the site") having an area of approximately 5.6ha as shown outlined in the middle of Figure 1. The site is located at the end of Crase Place, Grasmere in the Camden Local Government Area (LGA). The property is bound by Werombi Road to the north, The Old Oaks Road to the east, existing residential development to the south and an unnamed watercourse to the west. The West Camden Water Recycling Plant (WRP) is located to the north-east of the site.

Figure 1 – Location of proposed residential premises [Source: Google Earth, March 2015]

The proposed rezoning and minimum lot size amendments would result in four (4) additional large residential allotments. The purpose of the Planning Proposal is to rezone part of the eastern side of the site to R5 – Large Lot Residential. The majority of the site is currently zoned RU1 – Primary Production and partially zoned R5 – Large Lot Residential on the south-western side as shown in Figure 2 below.

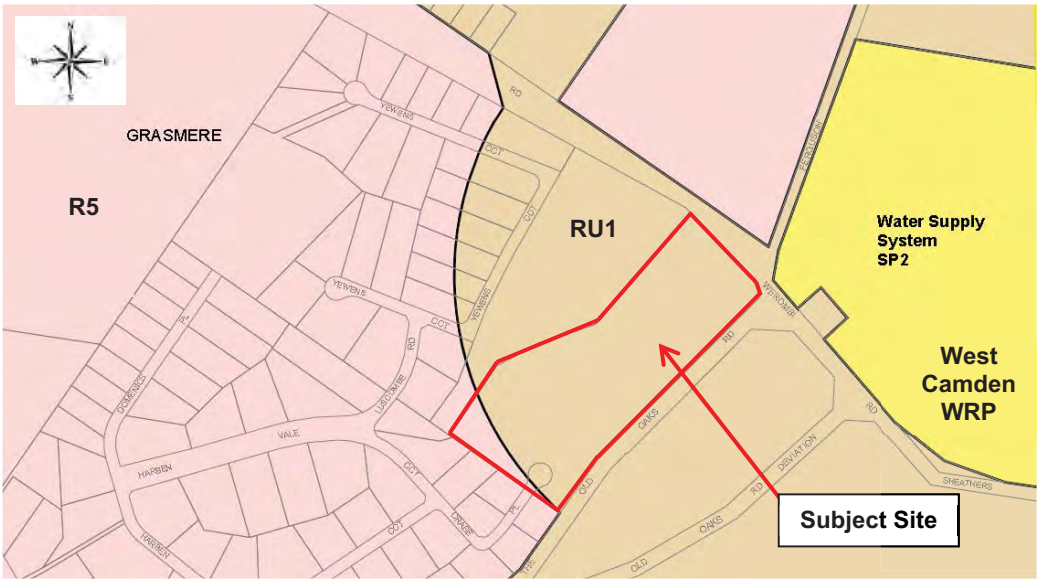

Figure 2 – Current Land Zoning Map [Source: Camden LEP 2010]

Development of the site is currently limited by an odour buffer boundary from West Camden WRP which is owned and operated by Sydney Water Corporation (Sydney Water). Figure 3 shows the odour buffer boundary derived from an iterative process conducted by Sydney Water, represented by a white dotted line. Initially plans had been prepared by Site Plus Pty Ltd (Site Plus) for Sydney Water following the upgrade of the WRP which showed the 'odour boundary' could be adjusted. Sydney Water advised they had no issue with the development of the site if development occurred beyond 300m of the boundary of the WRP. Sydney Water's response essentially amended the odour buffer from 400m to 300m. This enables the indicative development envisaged in Figure 3 from which all investigations have occurred.

Figure 3 – Location of proposed subdivision plan [Source: Sydney Water 2011b]

In order to meet the requirements of the Camden Council for the proposed development, there is a requirement for an air quality report to assess the potential odour emissions emanating from the additional digesters and gas burner at the West Camden WRP. The report is required to assess the level of pollutants on the surrounding area and compare against Air Quality Guidelines issued by the NSW Environment Protection Authority (EPA).

The decision report 'West Camden Water Recycling Plant (WRP): Biosolids Treatment Upgrade and Amplification' Project Review of Environmental Factors (REF), prepared by Sydney Water dated July 2011 highlights a shortcoming in an earlier odour modelling report where the NSW EPA had identified that the odour created from the new digester should have been included in the modelling. Further, the OEH suggested that additional management or monitoring of this impact should have been included in the mitigation strategy. Due to the exclusion of the digester odour from the earlier modelling, Camden Council is concerned that the 2 OU contour line (offensive odour line) as reported in the REF may be larger than what was reported.

KMH Environmental Pty Ltd (KMH) was engaged by Site Plus, on behalf of proponent Cowbridge Holdings Pty Ltd, to undertake an air quality assessment to include the impact of the proposed upgrades at West Camden WRP. This report assesses the air quality impact of the entire WRP, including the new digester, to the surrounding areas and compares the results with air quality guidelines for the purpose of demonstrating that the site will not impact on the proposed nearby residential properties.

The modification to the West Camden WRP comprised a new gas phase anaerobic digester which is similar to the existing two digesters. Sydney Water (2011a, p.42) noted the associated new facilities to include:

- a heat exchanger that would heat sludge prior to it being fed to the acid phase digesters.
- one gas phase anaerobic digester and two acid phase mesophilic digesters. The gas phase digester would be a 13 m diameter concrete tank with a floating roof, the same height as the existing digesters. New mixing and heating equipment (heat exchanger, macerators, sludge circulation pumps and hot water pumps) would be provided for this tank.
- The two acid phase digesters would be smaller concrete tanks and would have their own sludge circulation pumps, macerators, hot water pumps and heaters.
- a standby 500 kW water heater to provide 100% capacity backup for the existing heater.
- a sludge transfer pumping station. This pumping station would transfer sludge between the digesters and the feed averaging tank (FAT). The pumping station would be built adjacent to the acid phase digesters and would consist of two steel silos with conical bottoms with a total height of about 4.5 m in a bunded area of approximately 10.1 m x 4.6 m.
- a waste gas burner and stack. The new waste gas stack would be the same height as the existing gas stack, approximately 4 to 5 m. The new waste gas burner would burn the digester gas from the acid phase digesters and work as a duty standby for the existing waste gas burner.
- a two storey digester control building. The lower floor would house the sludge pumps and the upper floor would house the new heater, hot water pumps, heat exchangers and control room. The new control room would be approximately 11 m x 15 m and would be of concrete and brick construction. The control building would be located between the existing digesters and new gas phase digester. The top level of this building would be lower than the digester roof level.
- associated pipework, electrical and control works.

1.2. Methodology of assessment

KMH's assessment has used the results of the modelling undertaken by Sydney Water in 2011 (odour modelling of the site operations, that did not include the new digester) and extended that modelling to include the potential odour impacts of the new digester. The results of the assessment, is presented as a consolidated odour contour in Figure 8 in Section 7.

Air quality at the site and surrounding area was assessed using the following methodology:

- The identification of likely local sources of emissions (type and concentration);
- Proposed odour management practices associated with operation and maintenance;
- Examination of nearby buildings, local topography and meteorology and how they may affect the dispersion from the emission stack;
- Examination of the background air quality in the vicinity through use of data from the NSW Air Quality Monitoring Network;
- Dispersion Modelling of identified sources of emissions to determine a "source contribution concentration"; and
- Assessment of the resulting concentration against air quality parameters, leading to:
- Conclusions and findings.

2. Location

The location of the proposed residential development is Lot 24 DP 1086823 at 10 Crase Place, Grasmere, NSW as shown by the red outline in Figure 4. The objective of the Planning Proposal is to rezone the south-western lots to R5 – Large Lot Residential.

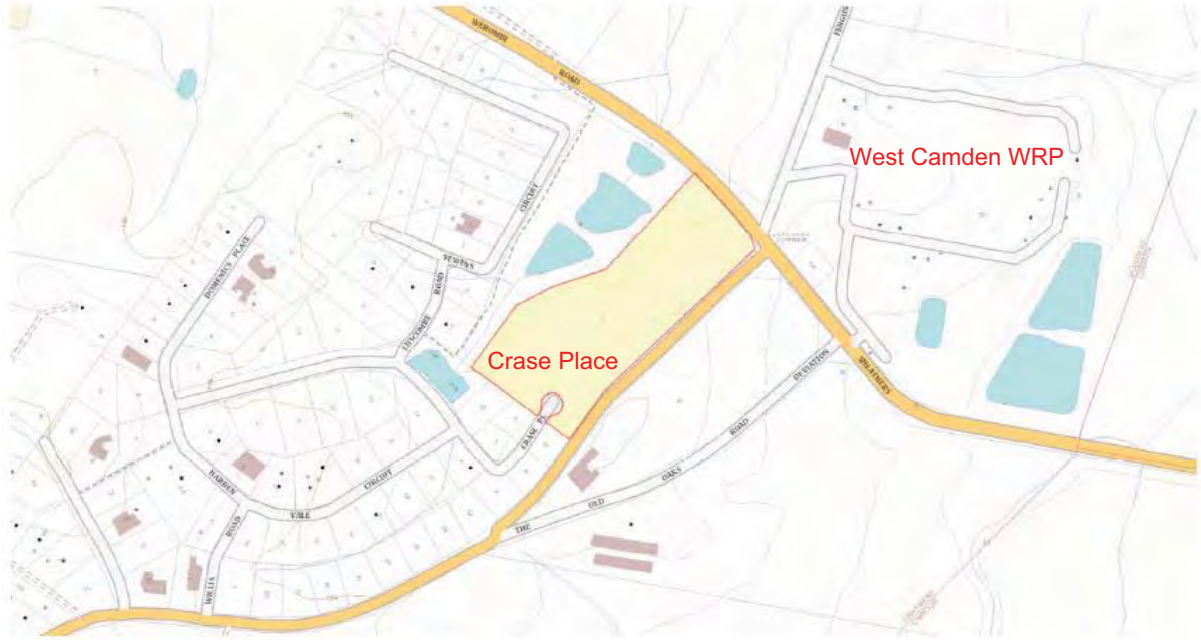

Figure 4 – Location of Proposed Residential Development [Source: Camden Council 2014]

2.1. Terrain

The site is vacant of any structures, faces the north-west and has a gentle fall from east to west with an approximate fall of 12% that gently slopes towards the drainage line and three large water supply dams on the north-western boundary. The surrounding land is characterised by large rural lots on undulating hills. The residential allotments will be located on the land closest to Crase Place on the south-western side of the subject lot (see Figure 3).

3. Odour Assessment

3.1. Emission Points

The odour generated from West Camden WRP has the potential to cause significant nuisance to nearby residences if not treated onsite before discharge. The new waste gas burner will treat emissions from the acid phase digesters and also work as a duty standby for the existing waste gas burner. Therefore, only one final emission duty and standby discharge stack as a point source has been used in the modelling to confirm emissions from WRP (Sydney Water, 2011a p.42). Other emission discharge stack parameters including a conservative stack exit temperature modelled as the mean ambient temperature are shown in Table 1.

3.1.1. Stack Height, Velocity and Location

The new digester stack design is critical to achieving good dispersion and dilution of odours. The height, velocity and location of the digester burner discharge stack are all important factors in reducing the odour impact. Inadequate height of the discharge stack is one of the main reasons for odour nuisance from stack emissions. The height, location and separation distance of the discharge stack reduces the impact of building wake effects on the plume. A velocity discharge of 10-15 m/s will provide moderate dispersion and force the discharging plume out of any building wake.

Appropriate odour mitigation management will reduce the severity of odour emanating from the site. Sydney Water has outlined standard design criteria in *Odour Control Unit Standard Specification BMIS Doc Number ACP0004* (Sydney Water, 2011c, p.8 & p.11). The vent stack is designed to maximise the air velocity out of the top of the stack to obtain maximum dilution with the surrounding air. Discharge velocity at the exit is at least 15 m/s for all equipment and odour control units (OCUs) ensure odour concentration as measured at the exit of the vent stack is below 500 OU.

The new digester and gas burner stack will be the same as the two existing units located nearby (See Figure 5). The stack height will be between 4 and 5 metres (Sydney Water, 2011a, p 70). A conservative height of 4 m has been used for the modelling of emissions as shown in Table 1 and Table 3. The discharge vent stack height shall generally comply with the Sewerage Code of Australia for vent stacks (14m above ground level) unless otherwise agreed by Sydney Water to be acceptable.

The West Camden WRP upgrade is estimated to treat at total of 8,480 tonnes of biosolids (78% moisture content) per annum by the year 2021-2022 based on an average increase of 5% per year (Sydney Water, 2011a, p.64).

Based on the information available, a conservative assumption has been made that the same volume of air is displaced from the stack. The design flowrate will be a minimum of six times the airspace/headspace volume displaced per hour (Sydney Water, 2011c, p.8). Therefore, the displacement flowrate is 0.0022 m^3/s based on a density of 1.39 m^3/tonne for sewage sludge.

Table 1 – West Camden WRP Stack Discharge Parameters

Stack Modelling Parameters	Discharge Stack
Velocity at exit (m/s)	15
Flow rate at exit (L/s)	2.2
Height (m)	4
Area at exit (m^2)	0.0001
Internal diameter at exit (m)	0.014
Temperature at exit (^oC)	17

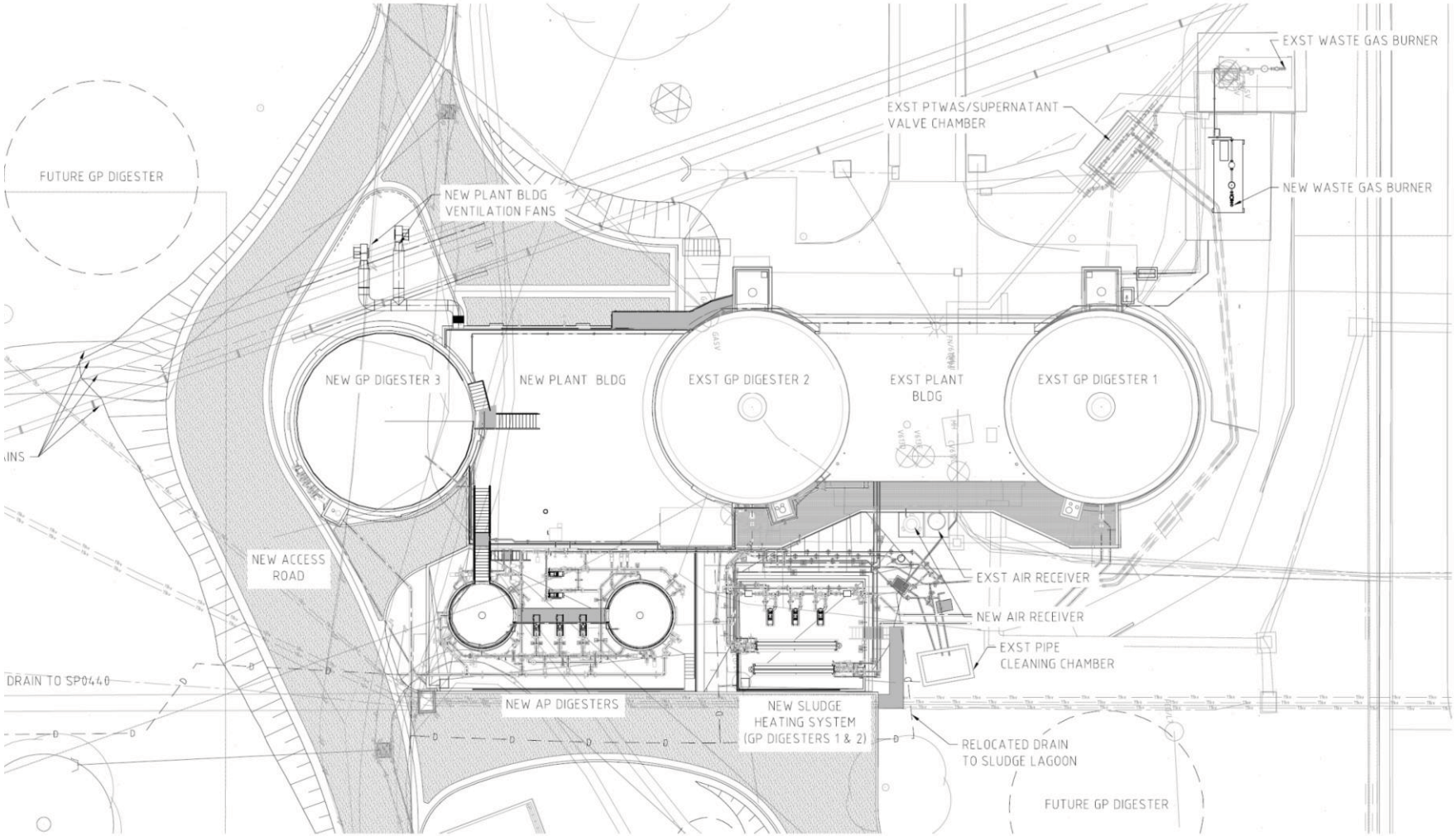

Figure 5 – Location of final ventilation exhaust discharge stack [Source: GHD – West Camden Biosolids Upgrade and Amplification – AWA Seminar 2013]

4. Regulatory Aspects of Odour and Its Assessment

4.1. The Odour Threshold

The odour loading is expected to be 500 Odour Units (OU) at the stack exit based on design criteria of OCUs (Sydney Water, 2011c, p.8). Methane (CH_4), hydrogen sulphide (H_2S) and methyl mercaptan (CH_3SH) are considered to be the principal compounds responsible for odour emissions from the West Camden WRP (Sydney Water, 2011a, p.53).

Odour nuisance is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. The point at which an odour is detected is called the 'odour threshold' and is defined as 1 OU.

In practice, the character of a particular odour can be judged by the receiver's reaction to it. DEC (2006a, p.20 & 2006b, p.4) advised the level at which an odour is perceived to be of nuisance can range from 2 OU to 10 OU depending on a combination of a number of factors including: odour quality; odour intensity; odour frequency, timing and duration; population sensitivity; background level; public expectation; source characteristics; and health effects.

4.2. NSW Best Practice Guidelines and Regulatory Frameworks

The regulatory aspects of odour management and assessment are described in the following documents:

- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, Department of Environment and Conservation (DEC), August 2005, ISBN 1 74137 488 X
- *Technical Framework - Assessment and Management of Odour from Stationary Sources in New South Wales*, Department of Environment and Conservation (DEC), November 2006a, ISBN 174 137 459 6.
- *Technical Notes - Assessment and Management of Odour from Stationary Sources in New South Wales*, Department of Environment and Conservation (DEC), November 2006b, ISBN 174 137 461 8.

The current odour performance criteria provided in the '*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales'* by DEC (2005), are based on a sliding scale relating to the population density of an area, as the response to an odour impact can vary significantly over a given population. The criteria assume that within a densely populated area there will be a greater potential for individuals within the community to be 'annoyed' by a given odour event.

Odour impact assessment criteria are summarised below in Table 2.

Table 2 – Impact assessment criteria for complex mixtures of Odorous Air Pollutants (nose-response time average, 99th percentile [source: Department of Environment and Conservation (NSW), 2005]

Population of Affected Community	Impact Assessment Criteria (OU)
Urban (≥2000 people)	2
~500 people	3
~125 people	4
~30 people	5
~10 people	6
Single rural residence (≤2 people)	7

According to the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC, 2005), in order to avoid substantial complaints about odour annoyance among an exposed population, odour concentrations in air should not be allowed to exceed 7 OU for an hour averaging period for a single rural residence and 2 OU for an urban development.

In setting these odour performance goals, DEC considered it to be reasonable that the prescribed odour levels are infringed for no more than one percent of the time. That is, compliance is required for 99 percent of the year (99th percentile).

There are three levels of dispersion modelling assessment that can be performed to determine whether odour is likely to be an issue. Level 1 assessment is the most basic and uses generic modelling data to determine if criteria have been met, while other levels of assessment are more data-intensive, such as Level 2 uses site specific data that includes both meteorological and terrain data and Level 3 incorporates actual measurements taken over a specific timescale. A Level 3 assessment may either be selected by the proponent from the outset or carried out in circumstances, where a DA has failed a Level 2 assessment.

4.3. Putting regulation and guidance into practice

It would seem likely, with respect to the information provided in the documents listed above, that for the proposed site to receive approval for a Development Application, it will need to be shown to planners, through a Level 2 Dispersion Modelling Exercise, that nearby sensitive receptors including residential dwellings are not likely to experience odour above the 2 OU odour threshold for 99% of the time, from the West Camden WRP. The modelling exercise undertaken assumes Sydney Water follow their design criteria and implement good operational and maintenance practice to minimise odour emissions in the surrounding area.

5. Background Air Quality

5.1. The NSW EPA Air Quality Monitoring Network

The New South Wales Environment Protection Authority (NSW EPA) operates a number of air quality monitoring stations around the greater metropolitan Sydney area. There is no monitoring station in Grasmere itself. The nearest monitoring station is located in Camden, approximately 2.7 km north-east from the site. The location of Camden monitoring station is shown in the map below (see Figure 6).

Figure 6 – Air quality monitoring station network [Office of Heritage and Environment website, 2015a]

The following pollutants are measured at Camden monitoring station:

- Ozone (O_3) – hourly and rolling 4 hour
- Nitrogen dioxides (NO_2)
- Carbon monoxide (CO) – rolling 8 hour
- Particulate matter 10 microns and under (PM_{10})
- Particulate matter 2.5 microns and under ($PM_{2.5}$)
- Visibility of fine particulate matter, size fraction not defined - nepholemeter (NEPH)

Background pollutant data from the local monitoring station at Camden is representative of air pollution at Grasmere. The review indicated that these pollutants are not expected to exceed their relevant air quality guideline criteria in combination of the emissions produced from the operation of West Camden WRP.

The Bureau of Meteorology (BoM) operate a weather monitoring station at Camden Airport AWS (Station No. 68192), which is located approximately 2.7 km north-east of the site (see Figure 7). The average climate and rainfall statistics since 1943 are presented in Table 3. No information was available on evaporation.

Table 3 – Camden Annual Mean for Climate Data (OEH 2015b)

Climate Data	Rainfall (mm)	Temperature (°C)		Wind (km/h)	
		Minimum	Maximum	9am conditions	3pm conditions
Mean	764.3	10.2	23.7	7.0	15.9

Figure 7 – Camden Airport Weather Station AWS Relative to the Site [Source: Google Earth, March 2015]

5.2. Local Sources of Emissions and Pollutants

The EPA POEO Public Register includes West Camden Sewage Treatment System (WRP) on Lot 1 DP 703240 (including the Sewage Treatment Plant at the corner of Sheathers and Ferguson Lanes) listed in the Grasmere area. There is no additional potential point source emission capable of slightly raising odour GLC around the Grasmere area. Table 4 summarises the only site in the Grasmere area.

Table 4 – NSW EPA POEO Public Register (NSW EPA website last visited 23/03/2015)

No.	POEO License Number	Status	Issued Date	Name	Location	Distance from Site	Activity Description
1	1675	Issued	25-May-00	Sydney Water Corporation	CORNER OF SHEATHERS AND FERGUSON LANES, GRASMERE, NSW 2570	300m	Sewage treatment processing by small plants >5,000-10,000ML discharge

6. Modelling Parameters

6.1. Modelling Parameters

For this assessment, dispersion modelling was conducted using Ausplume v6.0 to determine the ground level concentration (GLC) of odour from the new West Camden WRP digester and gas burner stack.

The stack discharge includes process gases from the new digester burner. It was assumed that the equipment is maintained in a proper and efficient condition according to Australian Standards and government regulations. The significant modelling input parameters are summarised in Table 5.

Table 5 – Modelling parameters

Parameter	Configuration / Assigned Value
Terrain effects	Horizontal Plumes
Terrain file	Grasmere – based on 90m resolution gap filled SRTM data (100 m resolution covers 4 km by 4 km)
Meteorological data	Camden Airport Data - MET file
Background concentration	Ignored
Source Type	Stack Source (See Table 6 for parameters)
Possible hours of emission	24
Averaging Time	1 hour
Land use	Rolling rural / residential (surface roughness 0.4 m)
Percentile Rank	100th percentile

6.2. Meteorological Data

Camden Airport AWS metfile data was used in the dispersion model exercise. This meteorological data is designed to return results expected at Grasmere in accordance with Level 2 assessment requirements.

6.3. Background Data

For the purposes of dispersion modelling it has been assumed that the background concentration of modelled parameters is negligible as outlined in Section 5.

6.4. Emission Sources and Rates

Operation of the West Camden WRP has the potential to impact upon air quality in the surrounding area. Unstable digester operation will cause potential foaming and odour problems. Potential odours emitted by the treatment plant digesters and discharged via a duty standby gas burner stack are typically composed of methane (CH4) and carbon dioxide (CO2) with traces of sulphur (S) based gases such as hydrogen sulphide (H2S) and methyl mercaptan (CH3SH) (Sydney Water, 2011a, p.53).

Sydney Water (2011a, p.80 and 20011b, p.14 & p.35) has committed to implement the following extra odour mitigation measures:

- Ensure biosolids products continues to meet the Grade 'B' or better stabilisation requirements described in the OEH guidelines for the use and disposal of biosolids products (NSW EPA, 1997);
- Maintain ability to re-use all biosolids;
- Odour monitoring post commissioning phase to include specific digester odour monitoring;
- Odour modelling and reporting of the West Camden site to be undertaken incorporating this new odour monitoring data; and
- Odour monitoring will be undertaken on the WRP sludge system post commissioning to provide a total image of the impact of the process change.

An odour concentration of 1.12 OUV/s has been used for modelling purposes based on information recorded by Sydney Water in the *Odour Control Unit: Standard Specification* (January 2011c) and *Review of Environmental Factors: West Camden WRP – Biosolids Treatment Upgrade and Amplification* (Sydney Water 2011a) to characterise odour strength. There is no specific data available on odour emission rates from West Camden WRP. For the purpose of this Odour Assessment of emissions at the boundary, the odour emission rate of 500 OU at the stack for West Camden WRP is used as the odour concentration for WRP along with the parameters listed in Table 6.

Table 6 – Stack source modelling values

Stack Source	Easting Coordinate (m)	Northing Coordinate (m)	Exit Diameter (m)	Exit Height (m)	Discharge Ventilation (m/s)	Discharge Ventilation (m^3/s)	Odour Emission Rate (OUV/s)
OCU Exhaust Vent	285905	6228922	0.014	4	15	0.0022	1.12

7. Modelling Assessment Findings

The potential offsite odour effects from the operations of the West Camden WRP digesters are predicted to be below the air quality guideline criteria. This is due to a number of factors:

- Implementation of Sydney Water's OCUs in accordance with Sydney Water's standard specifications;
- Sydney Water management of operation and maintenance of site equipment in a proper and efficient condition; and
- Configuration of emission points in a location conducive to dispersion (away from residents and the site).

The highest odour emission level from the new digesters, modelled under the site meteorological scenario, at the maximum output design criteria from the stack is 4 x 10^{-5} OU (odour unit) approximately 900m from the site. The results of the Level 2 dispersion modelling exercise are shown in Appendix A.

The Ausplume modelling reported in 2011 for the REF did not include this odour impact from the new digester. The odour contribution from the new digester combined with the Ausplume modelling impact reported in the REF is unlikely to result in ground level concentrations that would exceed the minimum DEC (2005) impact assessment criteria level of 2 OU for urban development at the site.

The reproduced 2OU contour line (offensive odour line) from Sydney Water is shown below in Figure 8 as the red polyline. This includes the minor impact from the new digester. The addition of the new digester is unlikely to change the 2OU contour line. There is not likely to be any major impact from new digester as they will be a minor contribution to the odour impact from West Camden WRP.

Figure 8 shows the West Camden WRP 2OU contour line from the Ausplume modelling reported in 2011 for the REF that represents the inclusion of the new digester. The dispersion modelling results indicate that the site is not likely to experience odour issues from the West Camden WRP (see Figure 9).

The majority of the wind on site is observed to be from the south and south-west. To consider the impact on the surrounding residential properties, wind rose data from the Bureau of Meteorology site at Camden Airport AWS (BoM, 2014) Air Monitoring Station were considered (located approximately 2.7 km north-east of the site). This is shown in Figure 10. Annual average wind rose plots from 9am winds indicate that the prevailing wind directions are predominantly from the south-western quadrants and to a lesser extent all other directions.

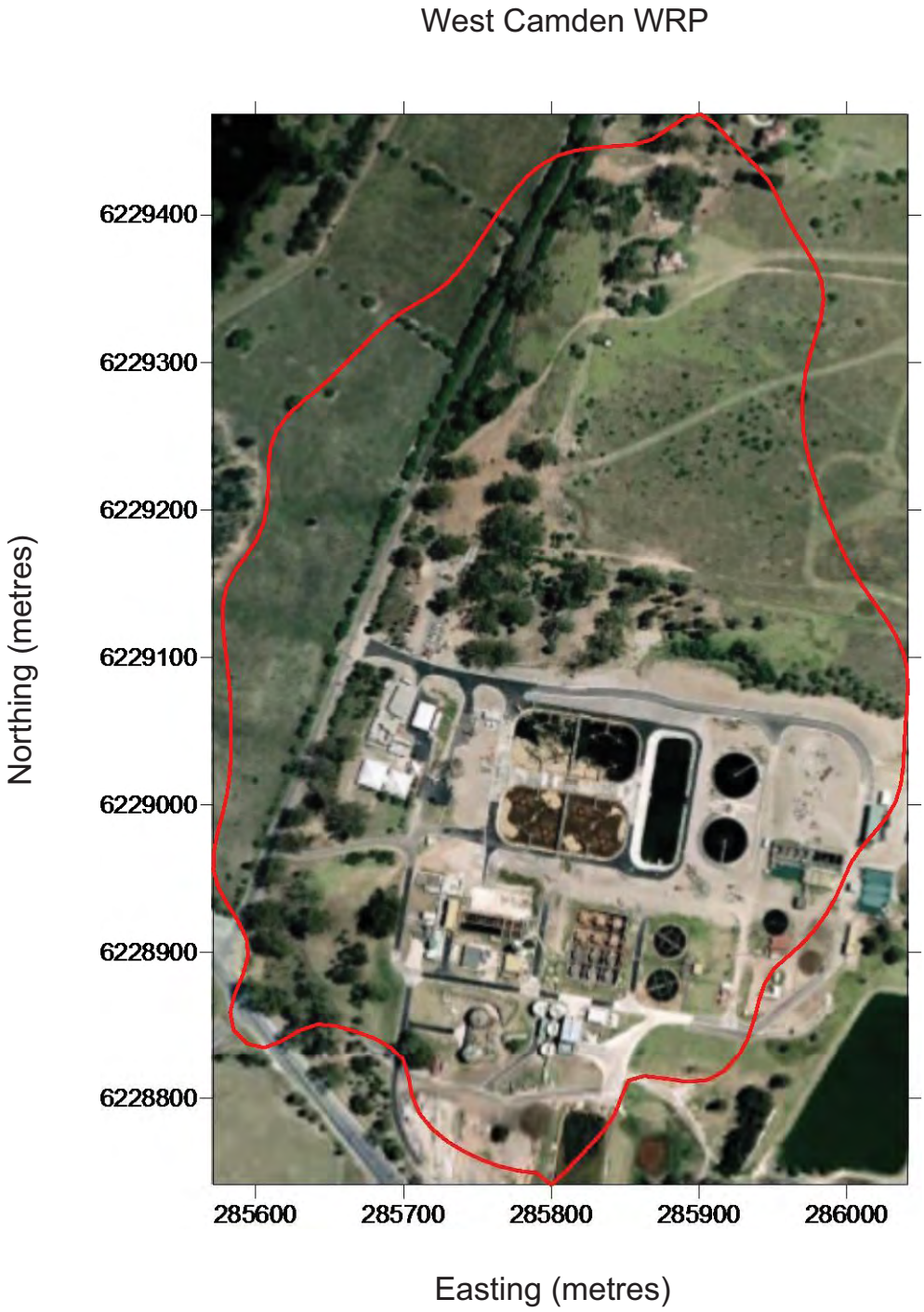

Figure 8 – Sydney Water's West Camden WRP 2 odour unit contour line modelled using Ausplume 6.0 - including contribution by the new digester

Figure 9 – Sydney Water's West Camden WRP odour impact on the site as modelled using Ausplume 6.0 – in relation to the proposed development site

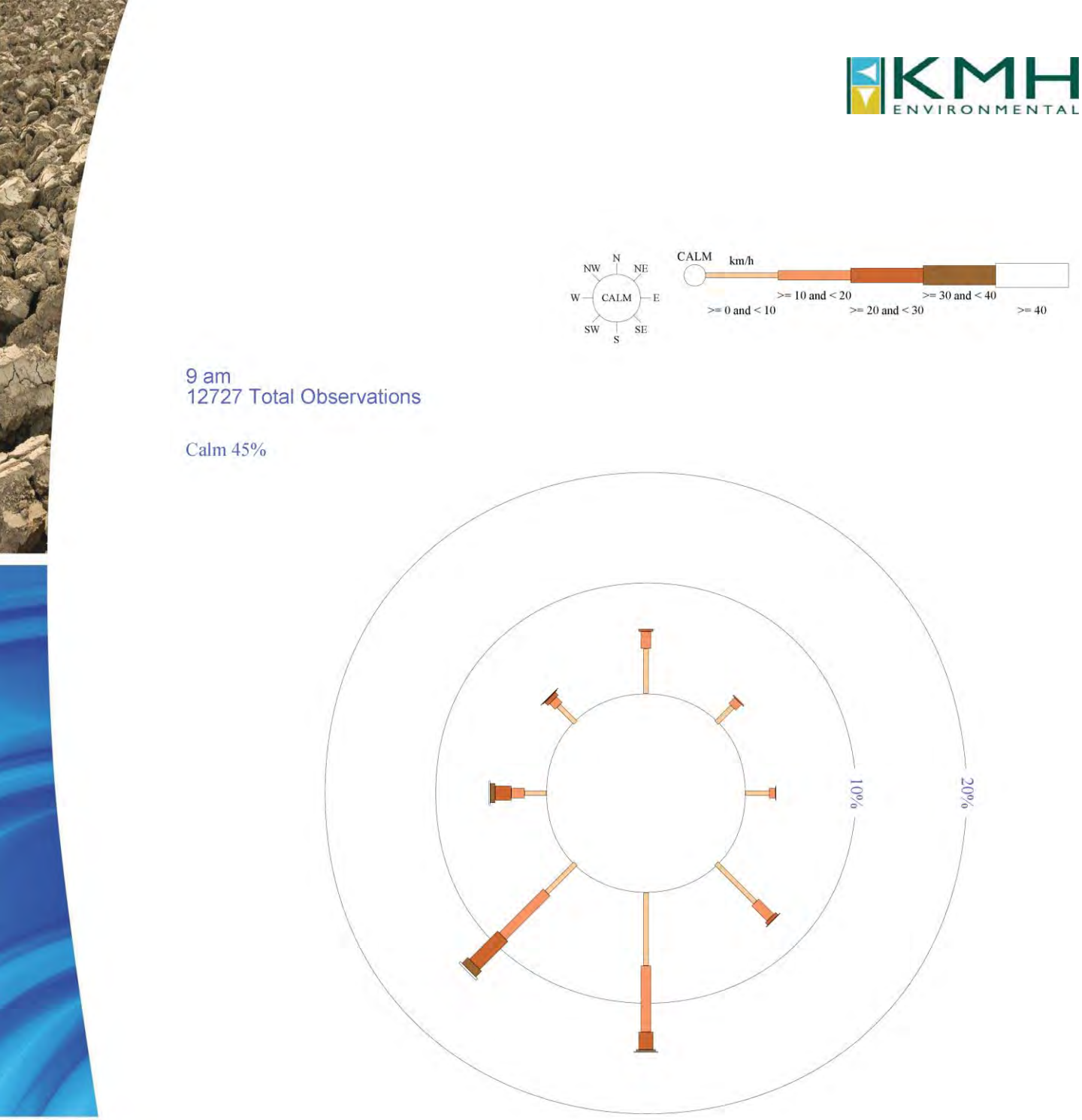

Figure 10 – Rose of Wind direction versus Wind speed in km/h at 9 am (01 Jan 1943 to 30 Sep 2010) Camden Airport AWS [source: Bureau of Meteorology, 2014]

8. Conclusions

The dispersion modelling results related to the Sydney Water West Camden WRP show the maximum air quality impact is significantly less than 2 odour units (OU) outside the 300 separation boundary. This is well below the 2 OU ground level concentrations (GLC) criterion at the proposed residential lots at 10 Crase Place, Grasmere.

Further consideration of the seasonal wind roses, identify the majority of wind will be from the south-west and towards the north-east that may disperse any odour away from the site and proposed residential properties.

The dispersion modelling concentration results for odour lead to the conclusion that operations of the new digester and associated equipment at the West Camden WRP should not present air quality issues including odour nuisance for nearby residents at 10 Crase Place, Grasmere.

In conclusion, an acceptable odour impact beyond 300 m from the West Camden WRP site boundary is likely at the proposed residential development on Crase Place with implementation of Sydney Water's OCUs and management strategies to limit odour discharge to 500 OU.

References

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Appendix A

AUSPLUME OUTPUT

10 Crase Place Grasmere NSW

Concentration or deposition	Concentration
Emission rate units	OUV/second
Concentration units	Odour_Units
Units conversion factor	1.00E+00
Constant background concentration	0.00E+00
Terrain effects	Horizontal plumes
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.300 m
Averaging time for sigma-theta values	60 min.

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Sigma-theta
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.400m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
1 hour

---

10 Crase Place Grasmere NSW

SOURCE CHARACTERISTICS

STACK SOURCE: FINAL

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
285905	6228922	0m	4m	0.01m	17C	15.0m/s

No building wake effects.
(Constant) emission rate = 1.12E+00 OUV/second
No gravitational settling or scavenging.

1

10 Crase Place Grasmere NSW

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
283268.m 283368.m 283468.m 283568.m 283668.m 283768.m 283868.m
283968.m 284068.m 284168.m 284268.m 284368.m 284468.m 284568.m
284668.m 284768.m 284868.m 284968.m 285068.m 285168.m 285268.m
285368.m 285468.m 285568.m 285668.m 285768.m 285868.m 285968.m
286068.m 286168.m 286268.m 286368.m 286468.m 286568.m 286668.m
286768.m 286868.m 286968.m 287068.m 287168.m 287268.m

and these y-values (or northings):
6226589.m 6226689.m 6226789.m 6226889.m 6226989.m 6227089.m 6227189.m
6227289.m 6227389.m 6227489.m 6227589.m 6227689.m 6227789.m 6227889.m
6227989.m 6228089.m 6228189.m 6228289.m 6228389.m 6228489.m 6228589.m
6228689.m 6228789.m 6228889.m 6228989.m 6229089.m 6229189.m 6229289.m
6229389.m 6229489.m 6229589.m 6229689.m 6229789.m 6229889.m 6229989.m
6230089.m 6230189.m 6230289.m 6230389.m 6230489.m 6230589.m

METEOROLOGICAL DATA : BoM Camden AWS Data BoM Camden Clouds SydneyAP Uair
Z

Peak values for the 100 worst cases (in Odour_Units)
Averaging time = 1 hour

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)	
1	4.72E-05	14,03/06/12	(286268, 6229189,	0.0)
2	4.71E-05	11,26/07/12	(286168, 6229189,	0.0)
3	4.70E-05	13,03/06/12	(286268, 6229189,	0.0)
4	4.69E-05	10,16/06/12	(286268, 6228989,	0.0)
5	4.69E-05	10,26/07/12	(286268, 6229189,	0.0)
6	4.67E-05	09,22/05/12	(286168, 6228789,	0.0)
7	4.67E-05	09,12/07/12	(286268, 6229189,	0.0)
8	4.67E-05	09,04/02/12	(286268, 6228789,	0.0)
9	4.65E-05	08,04/10/12	(286168, 6228789,	0.0)
10	4.65E-05	08,04/02/12	(286268, 6228789,	0.0)
11	4.63E-05	08,03/03/12	(286268, 6228689,	0.0)
12	4.63E-05	11,10/07/12	(286168, 6228789,	0.0)
13	4.63E-05	08,28/11/12	(286168, 6228889,	0.0)
14	4.63E-05	08,24/09/12	(286168, 6228889,	0.0)
15	4.62E-05	07,14/10/12	(286168, 6228989,	0.0)
16	4.62E-05	07,28/11/12	(286168, 6228889,	0.0)
17	4.62E-05	09,03/08/12	(286168, 6228989,	0.0)
18	4.62E-05	09,05/09/12	(286168, 6228889,	0.0)
19	4.62E-05	09,30/12/12	(286268, 6228689,	0.0)
20	4.62E-05	08,14/02/12	(286168, 6228989,	0.0)
21	4.61E-05	12,10/07/12	(286168, 6228789,	0.0)
22	4.61E-05	09,10/07/12	(286168, 6228789,	0.0)
23	4.61E-05	08,05/09/12	(286168, 6228889,	0.0)
24	4.61E-05	11,02/06/12	(286168, 6228889,	0.0)
25	4.61E-05	09,02/06/12	(286168, 6228889,	0.0)
26	4.60E-05	08,04/11/12	(286168, 6228989,	0.0)
27	4.60E-05	09,02/09/12	(286168, 6228989,	0.0)
28	4.60E-05	10,21/04/12	(286168, 6228789,	0.0)
29	4.59E-05	08,05/04/12	(286168, 6228889,	0.0)
30	4.59E-05	08,23/01/12	(286168, 6228789,	0.0)
31	4.59E-05	11,11/07/12	(286168, 6228989,	0.0)
32	4.59E-05	09,23/06/12	(286168, 6228889,	0.0)
33	4.58E-05	09,30/04/12	(286168, 6228789,	0.0)
34	4.58E-05	10,10/07/12	(286168, 6228789,	0.0)
35	4.58E-05	07,04/11/12	(286168, 6228989,	0.0)
36	4.58E-05	10,04/02/12	(286268, 6228789,	0.0)
37	4.57E-05	09,05/04/12	(286168, 6228889,	0.0)
38	4.57E-05	09,11/03/12	(286168, 6228889,	0.0)
39	4.56E-05	08,30/12/12	(286168, 6228789,	0.0)
40	4.55E-05	09,14/03/12	(286168, 6229089,	0.0)
41	4.54E-05	08,26/09/12	(286168, 6228889,	0.0)
42	4.54E-05	08,07/01/12	(286168, 6229089,	0.0)
43	4.54E-05	10,23/06/12	(286168, 6228889,	0.0)
44	4.54E-05	08,20/09/12	(286168, 6229089,	0.0)
45	4.53E-05	07,23/01/12	(286168, 6228789,	0.0)
46	4.53E-05	09,07/04/12	(286168, 6228789,	0.0)
47	4.53E-05	10,01/08/12	(286168, 6228789,	0.0)
48	4.53E-05	12,13/07/12	(286168, 6228989,	0.0)
49	4.52E-05	09,03/03/12	(286268, 6228689,	0.0)
50	4.51E-05	08,14/03/12	(286168, 6229089,	0.0)
51	4.50E-05	10,02/06/12	(286268, 6228889,	0.0)
52	4.50E-05	13,10/05/12	(286168, 6228989,	0.0)
53	4.49E-05	12,15/06/12	(285868, 6228489,	0.0)
54	4.49E-05	09,15/06/12	(285868, 6228489,	0.0)
55	4.49E-05	07,07/01/12	(286168, 6229089,	0.0)
56	4.48E-05	10,30/04/12	(286168, 6228789,	0.0)
57	4.48E-05	09,29/08/12	(286168, 6228989,	0.0)
58	4.48E-05	09,04/08/12	(286168, 6228989,	0.0)
59	4.48E-05	09,14/08/12	(286168, 6228889,	0.0)
60	4.47E-05	11,16/06/12	(286268, 6228989,	0.0)
61	4.47E-05	08,11/03/12	(286168, 6228889,	0.0)
62	4.47E-05	13,15/06/12	(285868, 6228489,	0.0)
63	4.46E-05	13,13/07/12	(286168, 6228989,	0.0)
64	4.46E-05	09,11/10/12	(286268, 6228789,	0.0)
65	4.46E-05	07,10/11/12	(286168, 6229089,	0.0)
66	4.46E-05	09,26/07/12	(286168, 6229089,	0.0)
67	4.46E-05	10,23/05/12	(286168, 6229089,	0.0)
68	4.43E-05	08,22/10/12	(286168, 6229089,	0.0)
69	4.43E-05	09,23/05/12	(286168, 6229089,	0.0)
70	4.43E-05	14,03/02/12	(285968, 6228489,	0.0)
71	4.43E-05	11,30/06/12	(286168, 6228889,	0.0)
72	4.42E-05	07,16/10/12	(286168, 6228989,	0.0)
73	4.40E-05	11,15/06/12	(285868, 6228489,	0.0)
74	4.40E-05	10,15/06/12	(285868, 6228489,	0.0)
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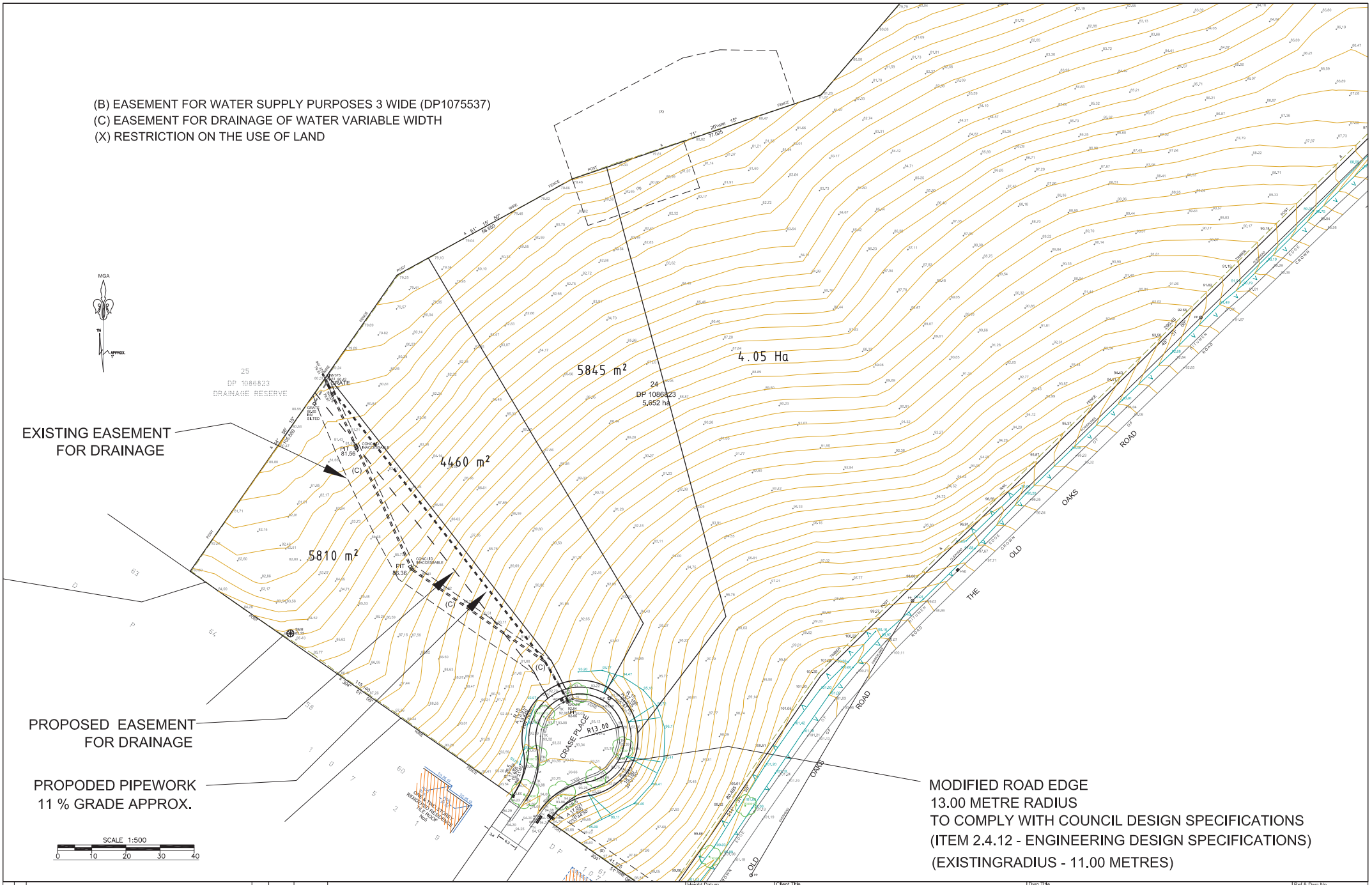
76	4.36E-05	09,21/03/12	(286168, 6228689,	0.0)
77	4.32E-05	08,13/03/12	(286168, 6229089,	0.0)
78	4.31E-05	13,08/05/12	(286068, 6228689,	0.0)
79	4.31E-05	14,10/07/12	(286068, 6228689,	0.0)
80	4.31E-05	17,26/02/12	(286068, 6228689,	0.0)
81	4.30E-05	13,10/07/12	(286068, 6228689,	0.0)
82	4.29E-05	11,11/05/12	(286068, 6228689,	0.0)
83	4.28E-05	12,21/06/12	(286168, 6228789,	0.0)
84	4.28E-05	07,02/02/12	(286168, 6229289,	0.0)
85	4.28E-05	11,04/08/12	(286068, 6228689,	0.0)
86	4.28E-05	09,09/05/12	(286068, 6228689,	0.0)
87	4.26E-05	10,04/08/12	(286068, 6228689,	0.0)
88	4.22E-05	13,08/06/12	(286168, 6229089,	0.0)
89	4.21E-05	09,20/09/12	(286068, 6228689,	0.0)
90	4.20E-05	07,26/10/12	(286068, 6229189,	0.0)
91	4.19E-05	14,21/06/12	(286068, 6229189,	0.0)
92	4.19E-05	13,21/06/12	(286068, 6229189,	0.0)
93	4.18E-05	07,14/12/12	(286068, 6229189,	0.0)
94	4.18E-05	11,24/05/12	(286068, 6229189,	0.0)
95	4.17E-05	08,01/01/12	(286068, 6228689,	0.0)
96	4.17E-05	07,01/01/12	(286068, 6228689,	0.0)
97	4.17E-05	12,19/04/12	(286068, 6228589,	0.0)
98	4.16E-05	07,25/01/12	(286168, 6229089,	0.0)
99	4.16E-05	09,13/03/12	(286168, 6229089,	0.0)
100	4.15E-05	16,26/02/12	(286168, 6228489,	0.0)

APPENDIX M

Drainage Analysis

(B) EASEMENT FOR WATER SUPPLY PURPOSES 3 WIDE (DP1075537)
(C) EASEMENT FOR DRAINAGE OF WATER VARIABLE WIDTH
(X) RESTRICTION ON THE USE OF LAND



MODIFIED ROAD EDGE
13.00 METRE RADIUS
TO COMPLY WITH COUNCIL DESIGN SPECIFICATIONS
(ITEM 2.4.12 - ENGINEERING DESIGN SPECIFICATIONS)
(EXISTINGRADIUS - 11.00 METRES)

REVISIONS No	DESCRIPTION	DRN	APP	DATE
A	ORIGINAL ISSUE	AK		05 10 12
B	CUL-DE-SAC HEAD REVISED	AK		08 12 12
C	EASEMENT AND BOUNDARY RELOCATED	AK		08 12 112
D				
E				

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Height Datum	A.H.D.
Drawn	AK
Designed	A KUMAR BE MIE
Checked	K ROOTSEY BE MIE CPENG
Approved	
Client Title	CLIENT: COWBRIDGE HOLDINGS PTY LTD
Dwg Status	CONCEPT
Local Authority	CAMDEN
Dwg Title	REZONING PROPOSAL LOT 24 IN DP1086823 CRASE PLACE GRASMERE PART PLAN
Ref & Dwg No	12 134 D
Sheet No	Sheet 1 of 1
Scale	1:500 @ A1
Date	05 10 12
Rev	A
	A1

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SAI Global

Our Reference: 14/154
LETT 14/154 ENG

8th December 2014

RE: REZONING PROPOSAL YEWENS ESTATE LOT 24 IN DP 1086823 CRASE PLACE GRASMERE

This letter is to provide engineering assessment and appraisal for the easement and modification of existing pipework in the easement. The advice is provided to assist in a rezoning proposal which will enable further subdivision of the site to create a total of four lots, three with a a minimum area of 4000m2 and the fourth with a minimum area of 4ha.

The 6m & variable width easement has an awkwardly placed alignment for drainage of stormwater water is to provide stormwater discharge from an existing cul-de-sac (Crase place) to the receiving large drainage reserve and dam. The easement and drainage line is shown in Attached part Plan of the site.

The existing 450mm diameter drainage line is 110 metres approximate with 3-1200x900 pits along the pipeline and a rock lined headwall at the end. Photos of the pits are attached.

To unbend the awkwardly placed alignment for drainage proposal is to extinguish the existing easement and provide new easement in-line with the proposed Boundary line as shown in the attached Plan (Ref 12 134 D).

The proposed straightened pipeline will have maximum of 11.0 percent grade and it is hydraulically possible to achieve acceptable pipe velocity with some additional cost.
To carry out this modification works our estimated lump sum cost is between $35,000.00 to $50, 000.00.

The estimated catchment area into the existing pipework is approximately 1.0 Ha.

The pipeline modification would be subject detailed investigation at DA stage due to other site constraints such as other pipework linking to the existing pipeline.

The existing Cul-de-sac head has radius of 11.0 metre but the Camden Council Engineering Design Specifications require minimum of 13.0 metres- (Item 2.4.12)). Thus may require to modify the head to comply with the Engineering Design Specifications subject to Council comments.

Assuming 500 sqm impervious area per lot, the net increase in stormwater flow from the total site is only 2 to 3 percent (2000 sqm :56,500 sqm total) which is negligible but if required it can be addressed at DA stage.

Ajay Kumar
Ajay Kumar BE MIE
SITE PLUS PTY LTD

GRATED PIT AT THE END

SEALED PIT 2 OFF

FLOW PATH ALONG

KIP AT THE UPSTREAM

HEAD WALL AT DOWNSTREAM

APPENDIX N

Draft DCP Controls

Camden DCP 2011

Part C – Residential Subdivision

C3.2.1 Crase Place, Grasmere

This subsection applies to the land marked in red on Figure C4.1 below:

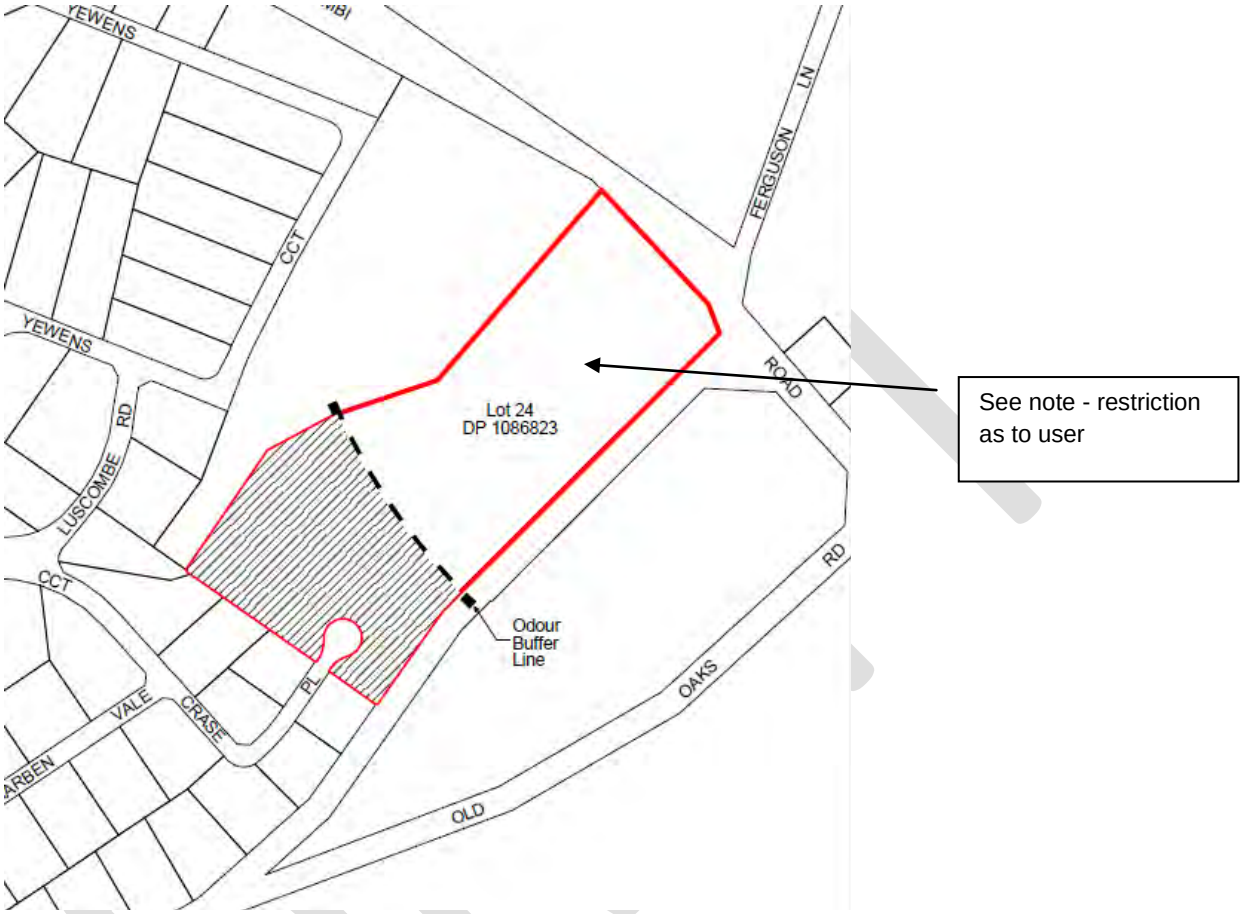

Figure C4.1 – Crase Place, Grasmere

Note: *A restriction as to user is to be placed on the lot containing the unhatched area as shown on Figure C4.1 to indicate that no dwellings are to be constructed due to odour impact from the West Camden Water Recycling Plant.*

Part D – Controls Applying to Specific Land Uses/Activities

D2.3.11 Crase Place, Grasmere

> ***Note:*** *The controls listed below are specific to Crase Place, Grasmere. They must be read in conjunction with the controls in section C3.2.1, D2.1 and D2.2 of this DCP. In the event of any inconsistency, the controls included in this subsection will take precedence.*

Objective

a) To ensure residential and associated development is designed and located to blend in with the rural residential backdrop, when viewed from the important view corridors including the vehicle entrance to Carrington hospital on the corner of Werombi and Smalls Road.

Controls

a) Native screen landscaping, incorporating trees and shrubs, must be planted along development lots to screen development.

b) Building materials and colours (of dwellings, outbuildings and hard landscaping) are to be restricted to recessive, mid-dark earth tones to blend in with the rural setting. White, cream, red, terracotta, or contrasting and reflective colours are not acceptable. Uncoloured or light concrete driveways are not acceptable.

Appendix O

NSW RURAL FIRE SERVICE

The General Manager
Camden Council
PO Box 183
CAMDEN NSW 2570

Your reference: -
Our reference:LEP/0021

28 January 2015

ATTENTION: Tanya Uppal

Dear Sir Mądam

Planning Instrument for Camden LEP Amendment 32 - Crase Place Grasmere

I refer to your letter dated 17 December 2014 seeking advice for the above Planning instrument in accordance with the Environmental Planning and Assessment Act 1979.

It is noted that the bushfire report has been based on a previous version of the Camden Bushfire Prone Land Map, but has nonetheless considered as a hazard vegetation to the north-west of this site.

Appropriate Asset Protection Zones as recommended in the report will be required to be provided at the time of subdivision.

For any queries regarding this correspondence please contact Peter Eccleston on 1300 NSW RFS.

Your sincerely

Catherine Ryland
Team Leader Development Assessment and Planning

Postal address

NSW Rural Fire Service
Records Management
Locked Bag 17
GRANVILLE NSW 2141

Street address

NSW Rural Fire Service
Glendenning Customer Service Centre
42 Lamb Street
GLENDENNING NSW 2761

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