Ethanol Technologies Limited

Hunter Pilot Biorefinery Project

Statement of Environmental Effects

October 2018

Table of contents

1. Introduction 1
   - 1.1 Overview 1
   - 1.2 Background 1
   - 1.3 Purpose of this report 2
   - 1.4 Scope and limitations 3
2. Site description 5
   - 2.1 Site location 5
   - 2.2 Real property description 5
   - 2.3 Land ownership 5
   - 2.4 Land use zones 5
   - 2.5 Description of the site and surrounds 7
3. Proposed development 12
   - 3.1 Overview of the proposal 12
   - 3.2 Design standards 14
   - 3.3 Construction of the proposal 14
   - 3.4 Operation of the proposal 16
   - 3.5 Capital investment value 20
4. Assessment of environmental effects 21
   - 4.1 The provisions of any environmental planning instrument 21
   - 4.2 The provisions of any proposed instrument 25
   - 4.3 The provisions of any development control plan 25
   - 4.4 The provisions of any planning agreement 25
   - 4.5 The provisions of the regulations 25
   - 4.6 The provisions of any coastal zone management plan 25
   - 4.7 The likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality 25
   - 4.8 The suitability of the site for the development 46
   - 4.9 Any submissions made in accordance with this Act or the regulations 46
   - 4.10 The public interest 46
5. Other legislative or policy considerations 47
   - 5.1 Commonwealth legislation 47
   - 5.2 NSW legislation 49
   - 5.3 Relevant plans and policy 51
6. Conclusion 53
7. References 54

Table index

Table 3-1 Typical construction plant and equipment 16
Table 3-2 Capital investment value estimate 20
Table 4-1 Objectives of LEP zone 23
Table 4-2 Primary chemical storage onsite 28
Table 4-3 Quantity of hazardous chemical bunded areas 29
Table 4-4 Summary of AHIMS Features 38
Table 5-1 EPBC Act protected matters search summary 47
Table 5-2 NSW legislation review 49
Table F-1 Requirements of the DCP 63

Figure index

Figure 1-1 Site location 4
Figure 2-1 Land use zones 6
Figure 2-2 Annual air pollutant exceedances for Muswellbrook 2012 – 2017 9
Figure 2-3 Air quality for Muswellbrook July 2018 10
Figure 2-4 Site analysis 11
Figure 3-1 Overview of the proposal 13
Figure 3-2 Proposed process flow 18
Figure 4-1 Sites recorded in AHIMS 39
Figure 4-2 Conceptual onsite waste water treatment system 42

Appendices

Appendix A – Geotechnical assessment

Appendix B – Designs

Appendix C – Trade waste system concept design

Appendix D – Cost estimate

Appendix E – Preliminary hazard analysis

Appendix F – Requirements of the DCP

Appendix G – Database search results

Appendix H – Stormwater management plan

Appendix I – Traffic flow path plan

Appendix J – Water services and rainwater retention designs

1. Introduction

1.1 Overview

GHD Pty Ltd (GHD) has been engaged by Ethanol Technologies Ltd (Ethtec) to prepare a statement of environmental effects (SEE) for the proposed development of the Hunter Pilot Biorefinery at Carramere Road, Muswellbrook, NSW (the proposal).

This SEE has been prepared to accompany a development application (DA) for approval of the proposal. The proposal is located within Muswellbrook local government area (LGA) and therefore the DA will be submitted to Muswellbrook Shire Council (Council).

This SEE provides a description of the subject site, the proposal, a review of relevant statutory planning controls, an assessment of potential environmental impacts and recommended mitigation measures.

1.2 Background

Ethtec, Apace Research Limited (Apace), the University of Newcastle, Council and the Australian Renewable Energy Agency (ARENA) have been working on developing the biorefinery pilot facility in the Hunter. The NSW Government has recently granted $4.6 million to the project.

The proposal would be designed, developed and constructed to provide a multi-purpose, pilot scale, research, development and education facility with a focus on advancing and promoting the commercialisation of biomass based technologies and developing new regional industries.

The facility would be operated on a not-for-profit, cost recovery basis. There are no commercial output streams or products from the facility other than knowledge generation. The biorefinery would convert approximately two tonnes of lignocellulosic materials (grain crop stubbles, cotton stubble, cotton gin trash, timber residues, sugar cane bagasse, etc.) to ethanol and lignin per day. The nominal design capacity of the plant is a throughput of 80 kilograms of feedstock per hour.

The proposal would provide an open-access pilot scale biorefinery and research hub. Although there have been significant benchtop scale research into biomass derived products (e.g. biofuels and renewable chemicals), very little of this work has transitioned to pilot plant scale due to the high costs associated with constructing and maintaining pilot plants. While demonstrating technology at pilot plant scale is an essential step in the commercialisation pipeline, the high infrastructure costs associated with pilot plants represents such a significant barrier that the gap between benchtop and pilot plant scales is often referred to as ‘the valley of death’. The proposal would facilitate the transition from benchtop to pilot plant scale by providing a modular pilot scale facility open to research organisations, industry and government.

The concept of an open-access pilot biorefinery has been successfully demonstrated internationally over a number of years. In the United States, the National Renewable Energy Laboratory in Colorado has been operating the Alternative Fuels User Facility in collaboration with the United States Department of Energy since 1995. This facility offers a range of technology partnership agreements including analytical or technical service agreements, work-for-others contracts and cooperative research and development agreements, with nearly 700 active agreements currently in place. In 2015 alone, 236 new technology partnership agreements were contracted with a value of US $33 million. The Bioprocess Pilot Facility in the Netherlands and the Biorenewables Development Centre in England perform similar roles and have been instrumental in developing technology along the innovation chain.

These facilities demonstrate the model by which the proposal will operate and lay the foundation to transform the Upper Hunter Region into Australia's national hub for biorenewables research, development and commercialisation. Indeed, to the best of our knowledge, no comparable facility exists outside of the United States or Europe, making the proposal a significant asset for Australia and the Asia-Pacific Region.

The proposal would be owned and maintained by Apace, which is an approved not for profit research institute. The facility will be managed in accordance with standard practice for a publicly accessible research and development centre. This will include the establishment of an advisory board comprising domain experts, stakeholders, government and community representation. Their role will be to ensure the delivery of a strategic plan to have this facility become a routinely used piece of infrastructure to support innovation in biotechnology and agribusiness.

Business development and partnership engagement will be administered by Apace, Ethtec and Professor Richard Bush, who is the Global Innovation Chair for the International Centre for Balanced Land Use at the University of Newcastle. Professor Bush will use his significant industry, government and university connections to ensure the facility maintains a high profile within the biomass resource and energy sectors. The facility will be publicly available to attract other bio-industrial research and development projects of significance to NSW regions. The facility will operate as a not-for-profit with all research income generated re-invested to maintain and expand the facility.

In summary, the key benefits of the proposal are that it:

- Increases the capacity of the Upper Hunter to deliver jobs and economic growth.
- Assists the Upper Hunter to capitalise on the existing skills base and assets associated with the mining and power generation industries to broaden and diversify the economy into biorenewables development and deployment.
- The open-access structure of the facility clearly demonstrates a benefit beyond one organisation.
- Aligns with several local, state and federal government priorities and plans.

1.3 Purpose of this report

This SEE assesses the proposal in accordance with the matters for consideration under Section 4.15 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). It also considers other relevant state and federal legislation and plan and strategies (refer Section 5).

The SEE is structured as follows:

- Section 1 – provides an introduction.
- Section 2 – locates and describes the site and provides information on the existing environment of the site and surrounds.
- Section 3 – describes the proposed development.
- Section 4 – assesses the proposal against the requirements of relevant legislation, as well as the potential impacts of the proposal on the environment.
- Section 5 – reviews other relevant legislation, plans and strategies.
- Section 6 - provides a conclusion to the SEE.

For the purposes of this assessment, the following definitions are employed:

- The ‘proposal site’ refers to the area that would be directly impacted by the proposal. The location of the site is shown in Figure 1-1.
- The ‘study area’ encompasses the site and the area that may be indirectly impacted by the proposed development.
- The ‘locality’ encompasses the suburb of Muswelbrook, which is the area surrounding the site.
- The ‘search area’ is the area within a 10 kilometres radius of the site.

1.4 Scope and limitations

This report: has been prepared by GHD for Ethanol Technologies Limited and may only be used and relied on by Ethanol Technologies Limited for the purpose agreed between GHD and the Ethanol Technologies Limited as set out in Section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than Ethanol Technologies Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

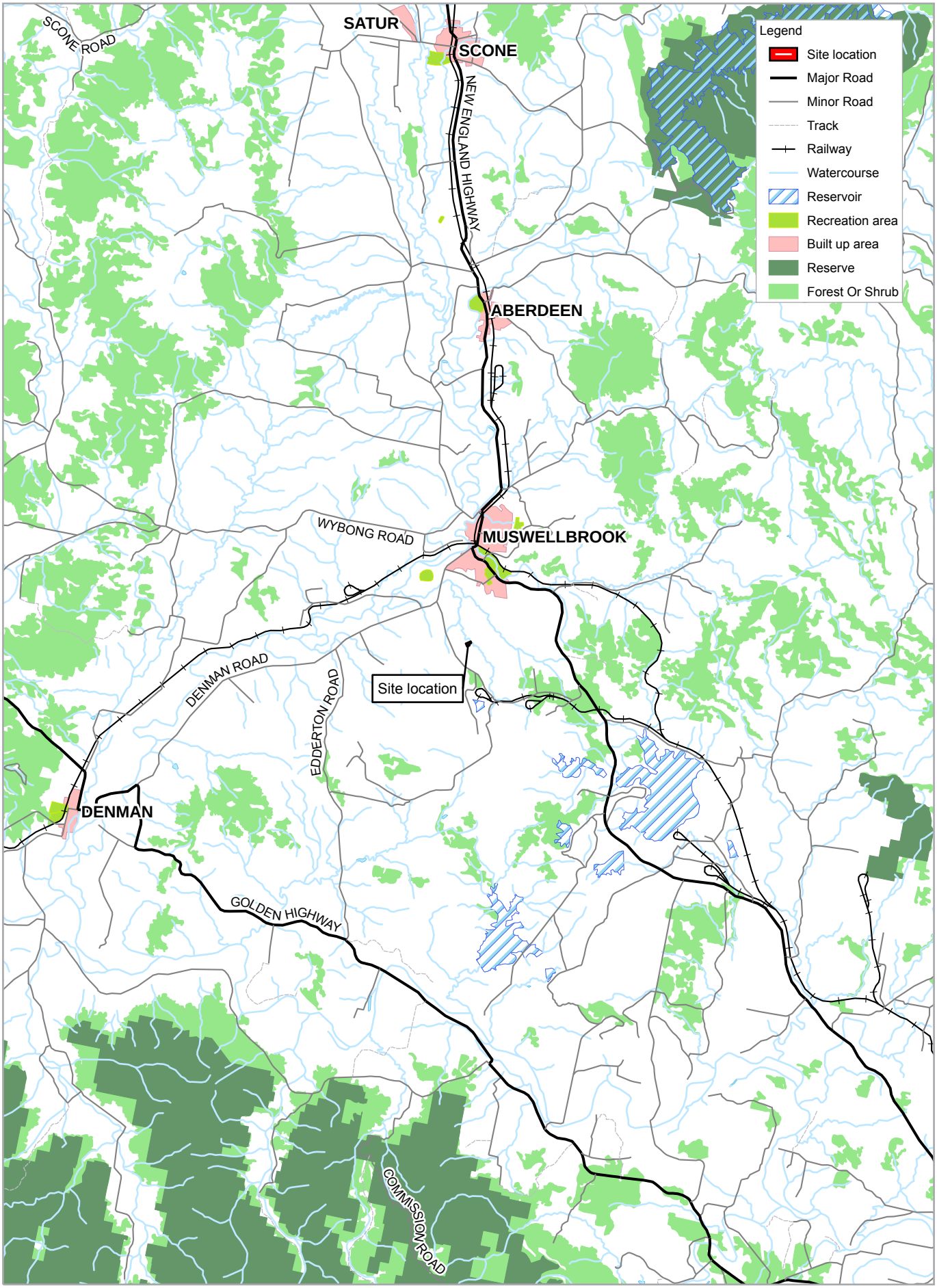
The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Ethanol Technologies Limited and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.



Paper Size ISO A4

0 1.5 3 4.5 6 7.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Ethanol Technologies Limited
Hunter Pilot Biorefinery Project
Statement of Environmental Effects

Project No. **22-19644**
Revision No. **0**
Date **29/10/2018**

Site location

FIGURE 1-1

G:\22\19644\GIS\Maps\2219644_Hunter_PilotBiorefinery\2219644_SEE_0.aprx\2219644_SEE001_Locality_0
Print date: 29 Oct 2018 - 12:26

Data source: Commonwealth of Australia (Geoscience Australia): 250K Topographic Data Series 3, 2006. Created by: fmackay

2. Site description

2.1 Site location

The site is located five kilometres southwest of the Muswellbrook town centre and 108 kilometres north of Newcastle, NSW.

The proposal site is located at the end of Carramere Road within the Muswellbrook industrial area.

The site is bounded to the north by rural land and then the town of Muswellbrook, to the east by Ramrod Creek and rural land, to the south by rural land and to the east by Thomas Mitchell Drive and the Mount Arthur Coal Mine.

The location of the proposal site is shown in Figure 1-1.

2.2 Real property description

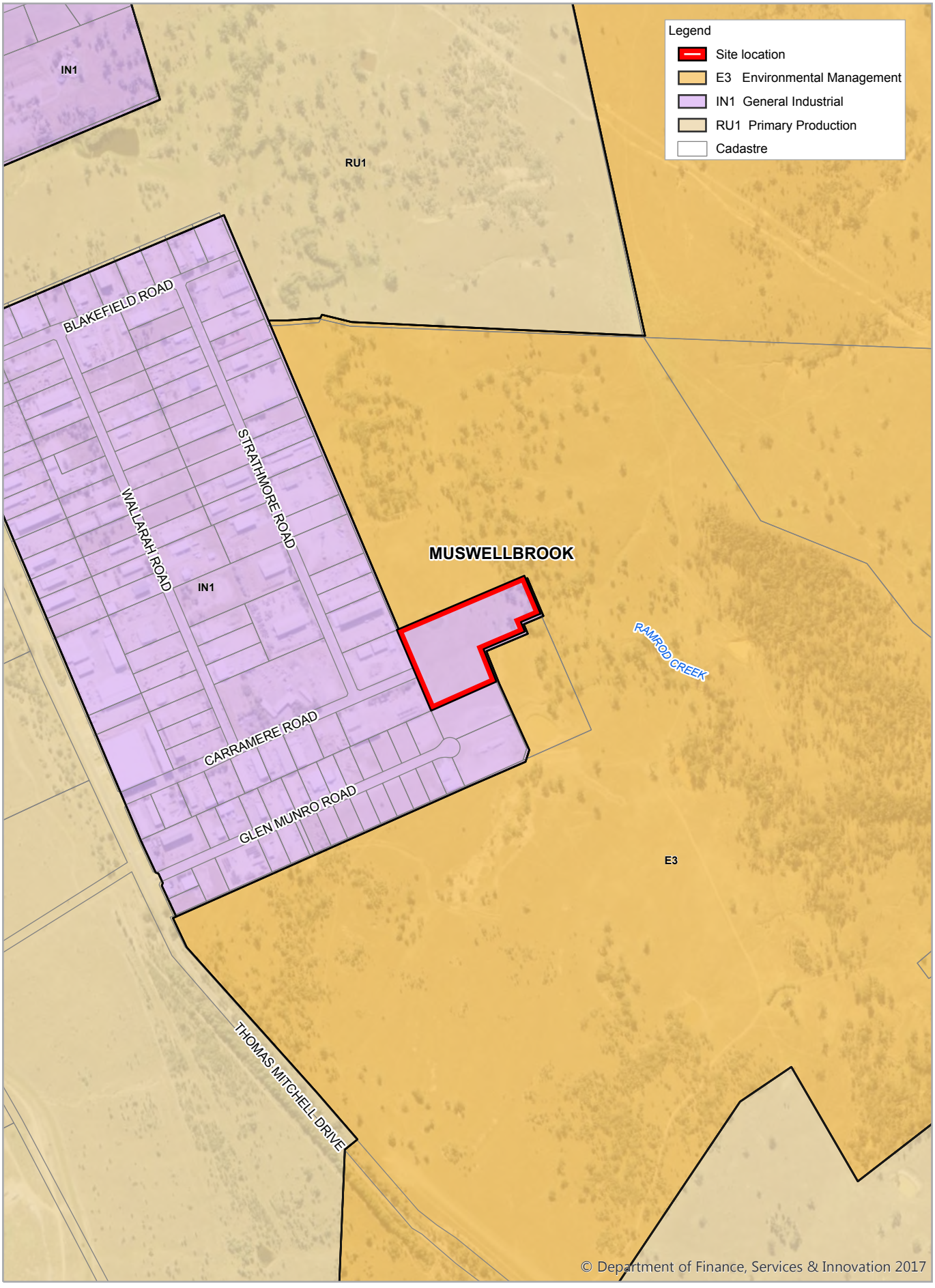
The proposal site encompasses Lot 22 DP1131270, 24 Carramere Road, Muswellbrook NSW.

2.3 Land ownership

The land is owned by Council and leased by Apace, for the purpose of constructing, developing and operating the proposal.

2.4 Land use zones

The proposal site is zoned IN1 – General Industrial under the *Muswellbrook Local Environmental Plan 2009* (LEP) (refer to Figure 2-1).



Paper Size ISO A4

0 75 150 225 300 375

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Ethanol Technologies Limited
Hunter Pilot Biorefinery Project
Statement of Environmental Effects

Project No. **22-19644**
Revision No. **0**
Date **29/10/2018**

Land use zones

FIGURE 2-1

G:\22\19644\GIS\Maps\2219644_Hunter_PilotBiorefinery\2219644_SEE_0.aprx\2219644_SEE002_LandUse_0
Print date: 29 Oct 2018 - 12:25

Data source: LPI: DTDB/DCDB, 2017. DoPI: Land use zones, 2016. Created by: fmackay

2.5 Description of the site and surrounds

2.5.1 Traffic and access

The proposal site is situated off Thomas Mitchell Drive, which connects to the New England Highway in the south and Denman Road, which travels into Muswellbrook, to the north. Thomas Mitchell Drive is a two-lane road signposted at 80 kilometres per hour (km/hr).

Access to the proposal site is via Carramere Road, which has direct access to Thomas Mitchel Drive.

The local road network is displayed in Figure 1-1.

A driveway entrance at the end of the Carramere Road has been constructed to enable safe and appropriate access to the construction site.

2.5.2 Topography, geology and soils

Site topography is relatively flat with a slight slope towards the east to Ramrod Creek. The elevation of the proposal site is between 168 and 173 metres Australian Height Datum (AHD). Contours across the site are shown in Figure 2-4.

The *Singleton 1:250,000 Geology Sheet* (Rose et al., 1966) indicates that the proposal site is underlain by the Branxton Formation, comprising mudstone sandstone and conglomerate.

The *Soil Landscapes of the Singleton 1:250,000 Sheet* (Kovac & Lawrie, 1991) shows the proposal sites is located within the Bayswater soil landscape. The Bayswater (bz) soil landscape is characterised by undulating low hills with slopes generally 3-10 percent and a local relief of 40–60 metres. The soil landscape originates from the Singleton Coal Measures and consists of yellow solodic soils, brown and yellow earths and prairie soils. Moderate sheet and gully erosion is common on slopes.

Australian Soil Resource Information System (ASRIS) mapping indicates acid sulfate soil (ASS) has a low probability of occurring within the proposal site.

The proposal site is not within a mine subsidence district.

2.5.3 Hydrology

The proposal site is located in the Hunter River catchment. The Hunter River is located approximately 4.2 kilometres north of the proposal site. Ramrod Creek, which is approximately 100 metres east of the proposal site is a tributary of the Hunter River.

The site is not within the flood planning area mapped under the LEP.

Site drainage occurs as surface runoff towards Ramrod Creek, with some infiltration into the sandy topsoil layer. The western corner of the proposal site is likely to drain into the existing dam located on the northern lot boundary.

During the geotechnical field survey undertaken by Qualitest (2017), groundwater was not encountered in any of the 13 test pits within the proposal site. Test pits were excavated to depths of between 3 and 3.2 metres. The geotechnical assessment is provided in Appendix A.

2.5.4 Visual landscape

The locality is visually consistent with an industrial area, with industrial businesses surrounding the site.

The proposal site is on the eastern extent of the industrial areas. Stands of vegetation associated with the riparian zone of Ramrod Creek are located to the north and east of the site, with cleared grassed located to the south.

There are no sensitive receptors within the vicinity of the proposal.

2.5.5 Noise

The existing noise environment is dominated by industrial activities and the surrounding road network. There will also be some background and intermittent noise generated from the Mount Arthur Coal Mine.

2.5.6 Ecology

The proposal site is predominantly cleared grassland. There is minimal habitat for terrestrial fauna within the site.

Ramrod Creek would provide ephemeral habitat for aquatic and terrestrial flora and fauna. The creek and riparian area are mapped as 'terrestrial biodiversity' under the LEP. The proposal would not impact on this area.

The proposal site is located within the area of the Hunter Central Rivers Catchment Management Authority (CMA). Mapping for the Hunter Central Rivers CMA shows an area of Hunter Valley River Oak Forest to the east of the proposal site. This area corresponds with the area mapped as 'terrestrial biodiversity' under the LEP and is shown in Figure 2-4.

The closest protected area to the site is the Goulburn River National Park, located about 50 kilometres west of the proposal site.

The proposal site is not mapped (or adjacent to land mapped) as bush fire prone land.

2.5.7 Land use

The proposal site is located within an industrial area. The land surrounding the site to the north, east and south is zoned E3 Environmental Management (see Figure 2-1).

2.5.8 Socio-economic

Australian Bureau of Statistics data from the 2016 census demonstrates the following characteristics of the Muswellbrook LGA:

- A total of 16,086 people reside in the Shire. 51.3% are make and 48.7% are female. The median age is 35.
- 8.3% of the population identify as Aboriginal or Torres Strait Islander.
- 84.7% of the population was born in Australia.
- 86% of the population of working age was employed full or part time. 8.2% were unemployed.
- Technicians and Trades Workers, Machinery Operator and Drivers, and Labourers were 50.8% of the workforce.

- 20% of the workface was employed in coal mining. The next most common industry was horse farming at 3%.
- The median weekly income was $640, which is only slightly less than that for NSW and Australia.

2.5.9 Air quality

The proposal site is located within a rural landscape dominated by open cut mining and within an industrial area. A range of pollutants and metrological variables are monitored at the Muswellbrook and Muswellbrook north-west air quality monitoring stations.

Annual exceedances recorded at the Muswellbrook station (Lorne Street Muswellbrook) are reproduced in Figure 2-2. Exceedances are primarily for particulate matter (PM10 and PM2.5).

Air quality for the month of July 2018 is shown in Figure 2-3. Air quality ranges between very good and fair for the month.

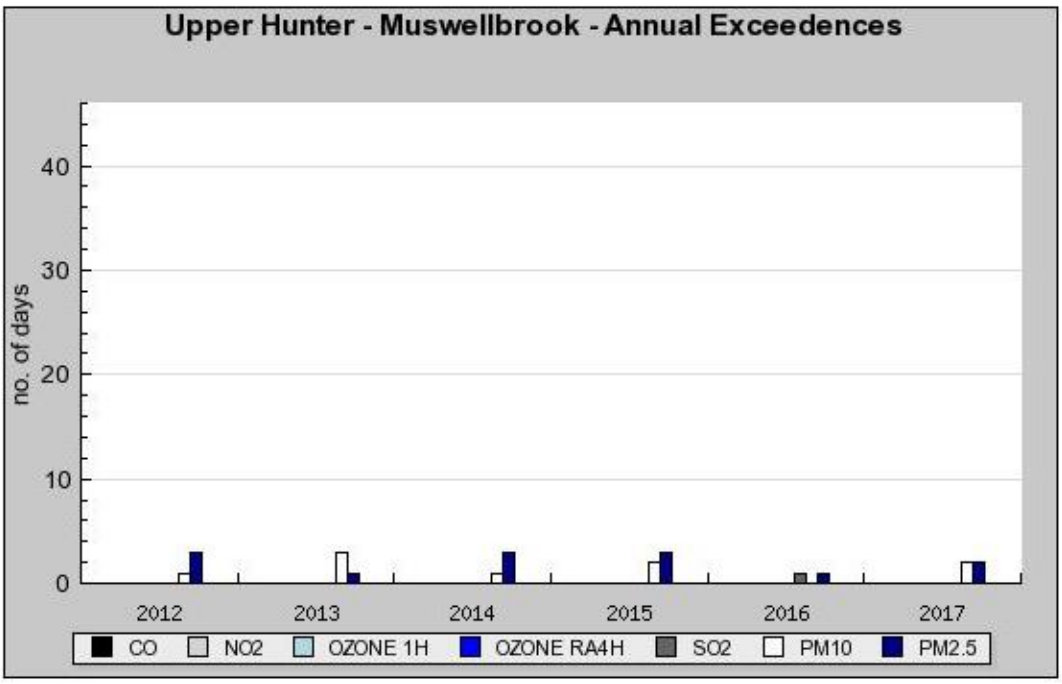


Figure 2-2 Annual air pollutant exceedances for Muswellbrook 2012 – 2017

(source: https://www.environment.nsw.gov.au/aqms/excmap.htm)

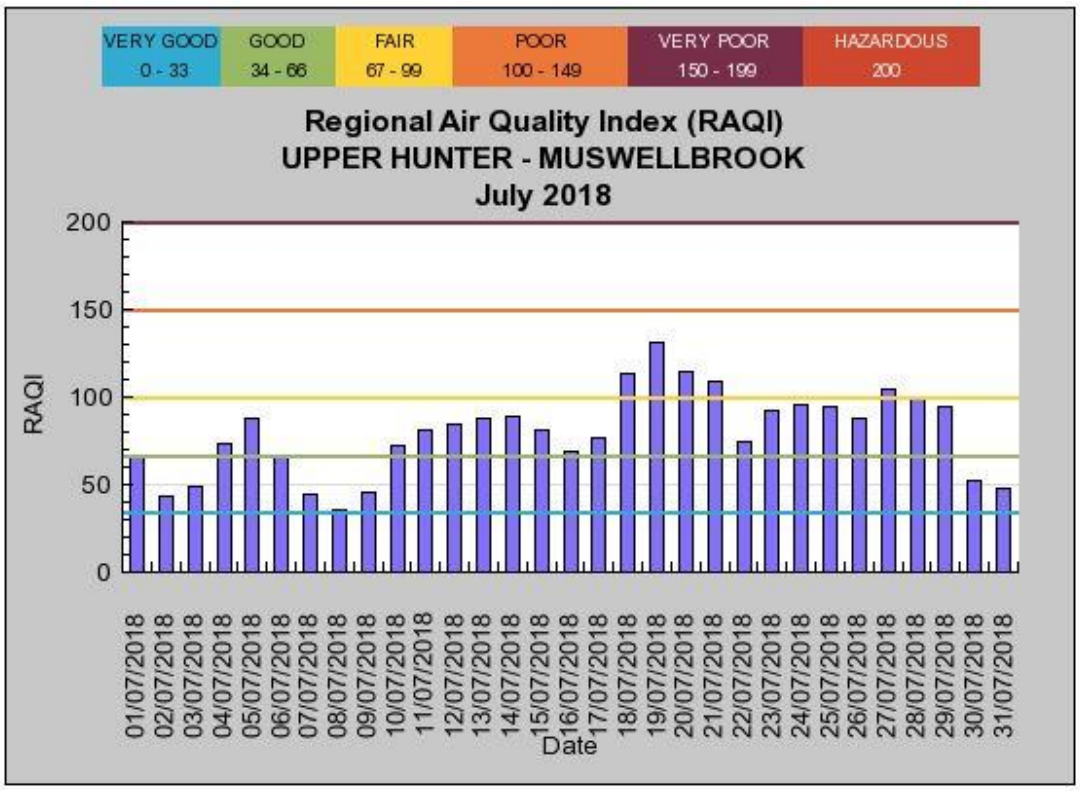
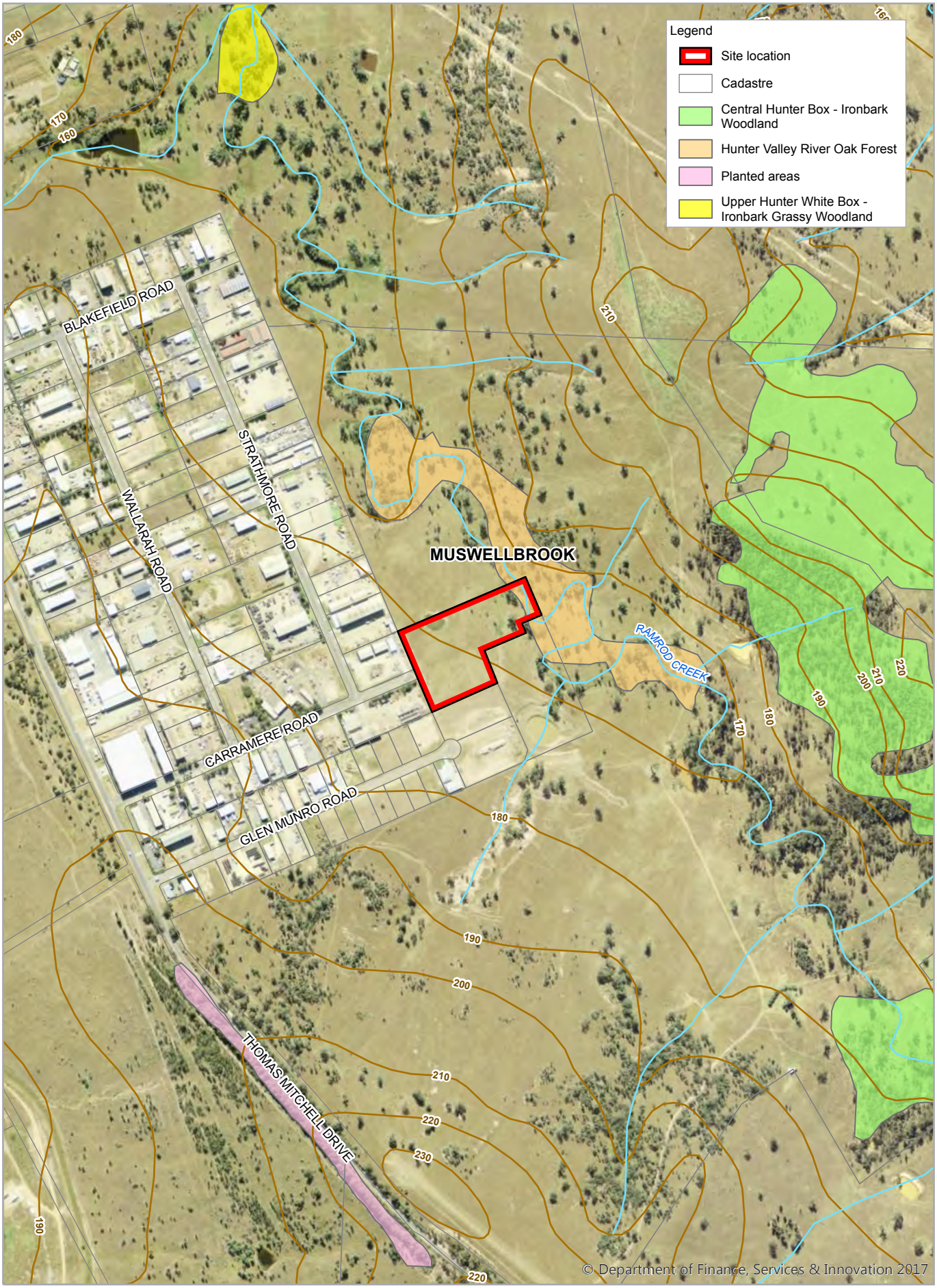


Figure 2-3 Air quality for Muswellbrook July 2018

(source: https://www.environment.nsw.gov.au/aqms/aqimonthlygraph.htm)



Paper Size ISO A4

0 75 150 225 300 375

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Ethanol Technologies Limited
Hunter Pilot Biorefinery Project
Statement of Environmental Effects

Project No. **22-19644**
Revision No. **0**
Date **29/10/2018**

Site analysis

Figure 2-4

G:\22\19644\GIS\Maps\2219644_Hunter_PilotBiorefinery\2219644_SEE_0.aprx\2219644_SEE003_SiteDescription_0
Print date: 29 Oct 2018 - 12:26

Data source: LPI: DTDB/DCDB, 2017. HCR-CMA: Vegetation communuities, 2009. Created by: fmackay

3. Proposed development

3.1 Overview of the proposal

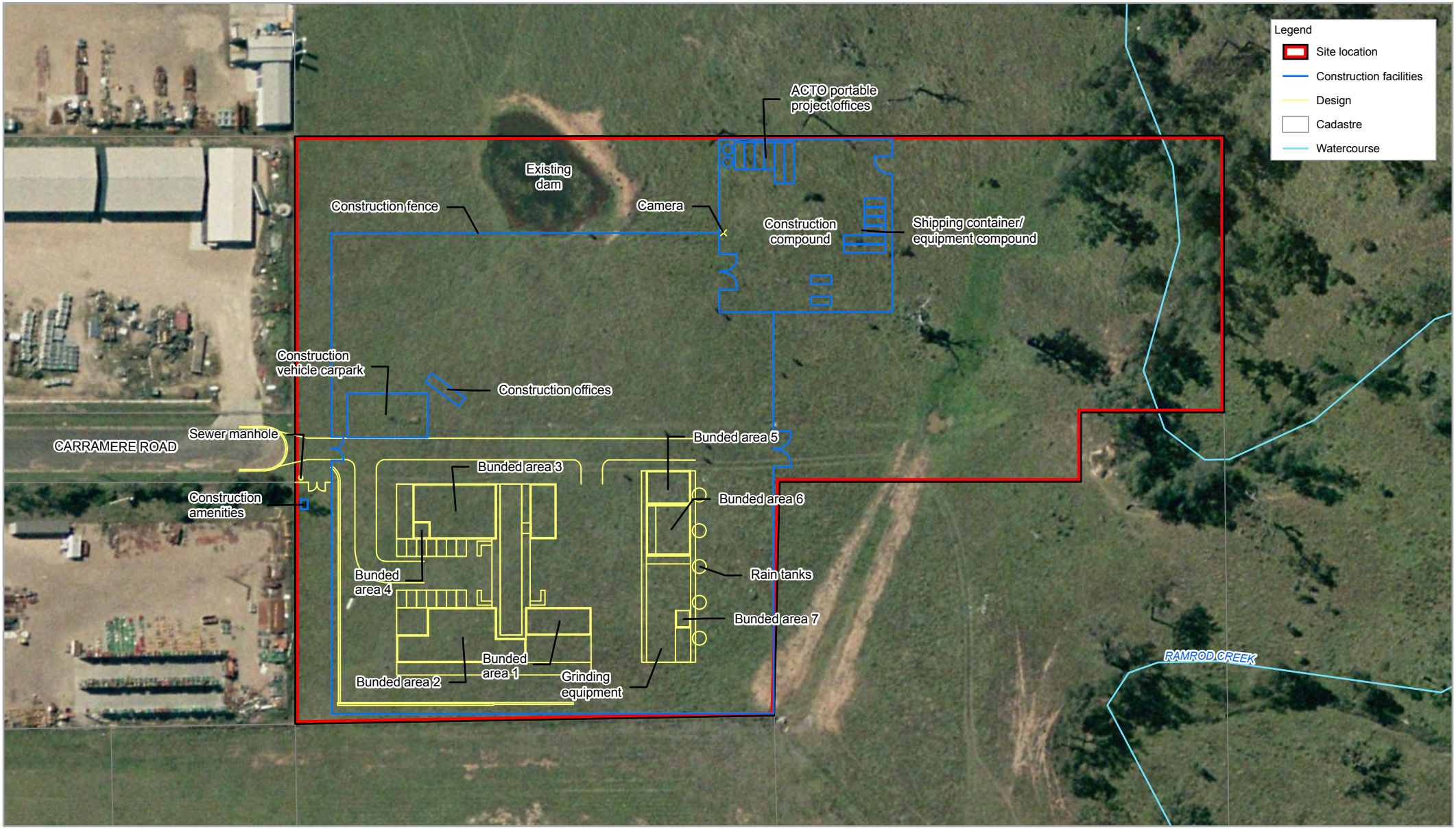
The proposal would involve the construction of two separate portal frame industrial buildings on the site. The facility would include:

- Facility centre: Approximate overall foot print including carpark and loading areas is 55 x 55 metres – 3025 m^2
- Auxiliary awning: Approximate overall foot print including onsite rainwater buffer system is 18 x 55 m – 990 m^2
- Associated pavement for carparks and hardstands
- Construction project offices and staff amenities.

The fit-for-purpose construction would contain the following key elements:

- Bunded industrial floor space comprising eight compartmentalised zones to accommodate a variety of pilot skid system operations.
- Lignocellulosic biomass stockpiling and storage area.
- Lignocellulosic biomass handling and processing area.
- Large scale physical containment (PC) 2 accredited dedicated floor space.
- Small scale PC 2 accredited and analytical laboratory floor and bench space.
- Open-access research equipment.
- Conference and teaching workspace.
- Air-conditioned open plan workspace.
- Amenities, lunch room and consumables storage.
- Equipment maintenance and service area.
- Designated loading/unloading and assembly area.
- Driveway and 14 car parking spaces.
- Retaining wall.
- Security fencing, monitoring and designated compounds.
- Utility connections and allowances:
  - Trade/sewer drainage systems and connection
  - Electrical connection and distribution
  - Telecommunications connection and distribution
  - Potable water, fire main connection and distribution
  - Five rainwater tanks and connection
- Laboratory general services - benches, heating and cooling, backflow prevention, fire safety showers and waste treatment.

An overview of the proposed development is provided in Figure 3-1. Design plans are provided in Appendix B.



Paper Size ISO A4

0 10 20 30 40 50

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Ethanol Technologies Limited
Hunter Pilot Biorefinery Project
Statement of Environmental Effects

Project No. **22-19644**
Revision No. **0**
Date **29/10/2018**

Overview of the proposal

FIGURE 3-1

G:\22\19644\GIS\Maps\2219644_Hunter_PilotBiorefinery\2219644_SEE_0.aprx
\2219644_SEE004_Overview_0
Print date: 29 Oct 2018 - 12:26

Data source: LPI: DTDB/DCDB, 2017. Ethanol Technologies: Design, 2018. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017. Created by: fmackay

3.2 Design standards

The design for the proposal has been prepared in accordance with the following key standards and guidelines:

- Building Code of Australia (NCC 2016)
- AS 1428.1 – 2009 – Design for Access and Mobility
- AS 3780 – Storage and handling of corrosive substances
- AS 1940 – Storage and handling of flammable liquids
- Muswellbrook Development Control Plan 2009 (DCP):
  - Section 10 – Industrial Development
  - Section 16 – Car Parking and Access
  - Section 20 – Erosion and Sediment Control
  - Section 24 – Waste Minimisation and Management
  - Section 25 – Stormwater Management

3.3 Construction of the proposal

The following construction methodology has been prepared for the purposes of this SEE and would be confirmed by the construction contractor and approved by Council prior to any works commencing.

3.3.1 Construction sequence

Pre-construction

Key activities during this stage of work would include:

1. Mobilise to site
2. Establish temporary erosion and sediment control measures
3. Setup site compound, project offices and material storage areas
4. Delivery of construction materials
5. Utility services location

Construction

Key activities during this stage of work would include:

1. Minor earthworks in the form of grading and levelling of the proposal site prior to formwork and pouring of concrete with topsoil stripped and stockpiled for site restoration post-construction.
2. Construction of pavements for carparks and hardstands.
3. Establish metered water and electrical utilities.
4. Construction of the auxiliary awning.
5. Construction of facility centre including offices and laboratory.
6. Installation of distributed utility systems and associated connections.

Post construction

Key activities during this stage of work would include:

1. Clean up and landscaping/rehabilitation of disturbed areas
2. Demobilisation of all site resources not required post-construction
3. Disposal of any waste material to an appropriately licensed facility

3.3.2 Excavation

Earthworks would be required during construction to clear and grade the site and to connect to required utilities. Excavations are not expected to exceed a depth of approximately two metres below ground level.

3.3.3 Duration and hours of construction

Duration

It is anticipated that construction would commence in late 2018 and take approximately 18 months to complete.

Construction hours

Construction works will be undertaken during standard construction hours as follows:

- 7:00 am to 6:00 pm, Monday to Friday
- 8:00 am to 1:00 pm, Saturday
- No works on Sundays or public holidays

Approval for out of hours work would be sought from Council if and as the need arises.

3.3.4 Ancillary facilities

A site compound would be located in a cleared area to the north of the proposed facility (refer to Figure 3-1). This area has been previously cleared and no additional vegetation would need to be removed for the compound.

The compound would include, as a minimum, ablutions, secure material and equipment storage, demountable offices and shipping containers. The site would be secured with a 1800 millimetres high mesh and triple barbed wire fence. Signage would be erected advising the general public of access restrictions and a remote security camera would be installed. Upon completion of construction the site would be cleared of all rubbish and associated materials. The wire fencing would remain in place to restrict access to the no go zones at the rear of the site and for use in future expansion projects.

A site amenities unit will be installed on the front boundary for use by up to 20 personnel during construction.

3.3.5 Construction workforce

The construction workforce is expected to fluctuate, depending on the stage of construction and associated activities. The workforce would be expected to be between about 15 and 20 personnel at any given time during the construction period. The final number of construction workers would be determined by the construction contractor.

3.3.6 Plant and equipment

Table 3-1 lists the plant and equipment that would likely be required during construction. This would be confirmed by the construction contractor.

Table 3-1 Typical construction plant and equipment

Plant/equipment	Number	Use
20T excavators	2	Excavating topsoil and cut material, loading tip trucks
Concrete truck/agitator	1	Laying of concrete foundation
Dozer	1	Grading formation layers
Crane	1	Lifting heavy material
15T pad foot roller	1	Compaction of formation materials
15T smooth drum roller	2	Compaction of formation materials
Water Cart	1	Damping down for dust and during hot works
Positrack	1	Movement of material and loading
Grader	1	Clearing and grading
Backhoe	1	Movement of material and loading
Asphalt machine	1	Laying pavement
Pneumatic tyred roller	1	Compaction of pavement materials

3.3.7 Traffic management and access

Construction traffic is estimated at no more than 10 vehicle movements per day. Traffic will be managed during construction of the driveway access point, with no disruption to surrounding businesses or general traffic flow.

Appropriate notification of oversized loads will be provided if required.

Off street parking is available for construction vehicles on the proposal site and additional on street parking is also available if needed.

3.4 Operation of the proposal

Operation of the proposal would be consistent with University scale laboratories or workshops with research equipment and programs operating within the capabilities of the buildings and containment areas. While the ongoing and exact specification of all possible pilot equipment and research is unknown at this time, the scale of the demonstration programs and experiments would be approved on a case by case basis by Apace who will ensure each proposal will operate within the boundary, processing limits and capacity of the approved facility. This approach will ensure there are no effects on the local environment outside the property and on-site effects are controlled and managed through appropriate procedures, risk assessments and planning. Significant proposals that require a change in operational scope or the construction of additional buildings/erection of new structures outside the footprint of the proposed facility would seek additional development consent where appropriate.

The key operational outputs from the proposed facility would be knowledge generation. The focus of user agreements would therefore be to conduct experiments, develop technologies and produce data and designs for the foundation of larger, industry building projects. Users would have the option to make equipment available for open-access research programs on a cost recovery basis and to promote knowledge sharing. Users would have rightful ownership and protection over any intellectual property generated from conducting their activities.

Ethtec will be the primary and founding facility user and proposes to occupy part of the facility for a period of up to 10 years, including the development and operation of pilot scale processing equipment under the ARENA co-funded development work programmes.

Typical biomass processing research equipment anticipated to be installed by Ethtec and available in the facility would include:

- Ancillaries:
  - Small skid steer loader
  - Forklift
  - Compressed air plant
  - Water purification and reverse osmosis equipment
- Facility fixtures:
  - Variable speed belt and screw conveying systems
  - Grinding and size reduction equipment
  - Various enclosed hoppers and bins
  - Tray and rotary drying equipment
  - Chemical resistant tanks and piping systems
- Pilot skid systems:
  - Heat exchangers and chemical resistant evaporators
  - Steam generation and water cooling equipment
  - Chromatography systems
  - Various filtration equipment
  - Fermentation vessels and supporting equipment of varying scale
  - Distillation equipment.

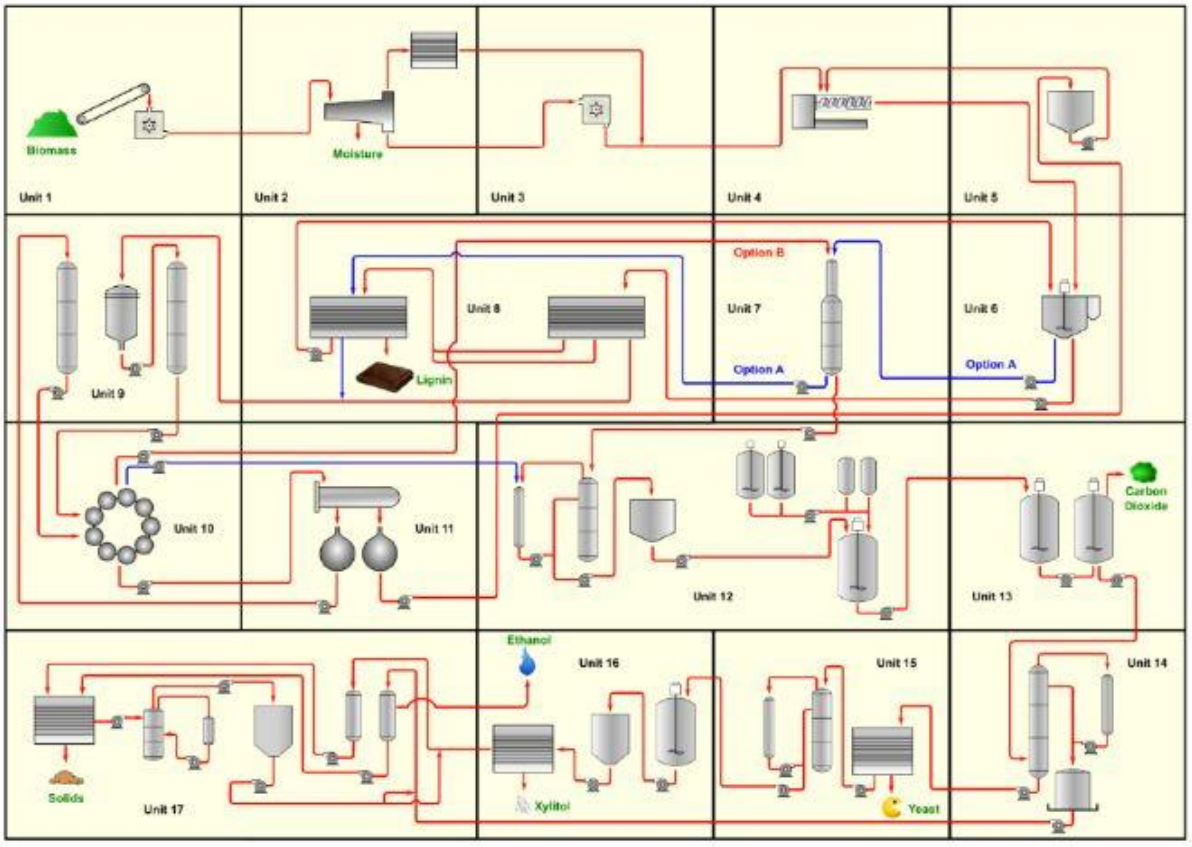
A statement of capacity of the equipment and facility will be available on the Hunter Pilot Biorefinery website once established.

Following installation and commissioning, Ethtec will operate the biomass processing equipment for continuous trialling periods of up to 28 days. The annual duty cycle of the pilot equipment is considered to be low, with trialling periods only occurring four times per year. This experimental approach allows for process stability and significant data generation. Downtime periods allow for process equipment modification, servicing and repairs, analysis of results, re-stocking, planning and reporting. During operational periods, the facility would be occupied by up to 20 staff, 24 hours a day. Average continual occupancy is expected to be 10 staff.

Cellulosic ethanol production at the proposal would be undertaken in a four-stage process. The first two stages produce sugar from hydrolysis of biomass at a maximum processing capacity of two tonnes per day. The latter stages convert the sugar solution to ethanol and other by-products. This process offers resilience from process upsets and can withstand mixed input material stream, whereas other similar technologies can accept only one type of input material. A 300 litres per dry tonne limit is proposed to be applied to production (see Appendix C). Any ethanol produced during the experimentation will be consumed on site for heat generation and biomass drying.

The main leftover materials from the process are lignin, in the form of a brittle dark brown cake, and dry inactivated yeast cells. The lignin/yeast mixture can be added to a composting matrix as a source of carbon or applied directly to land.

The proposed operational process flow chart is illustrated in Figure 3-2.



KEY:

- Unit Process 1 – Biomass Receiving
- Unit Process 2 – Biomass Drying
- Unit Process 3 – Final Size Reduction
- Unit Process 4 – Twin Screw Extrusion
- Unit Process 5 – Acid Delivery System
- Unit Process 6 – Homogenisation
- Unit Process 7 – Hydrolysis Reaction
- Unit Process 8 – Filtration Scheme
- Unit Process 9 – Fines Filtration and Oxygen Removal
- Unit Process 10 – SMB Separation System
- Unit Process 11 – Acid Reconcentration
- Unit Process 12 – Media Preparation
- Unit Process 13 – 2nd Generation Fermentation
- Unit Process 14 – Stripping/Distillation
- Unit Process 15 – Yeast Filtration and Underflow Conc.
- Unit Process 16 – Crystal Production
- Unit Process 17 – Waste Treatment System

Figure 3-2 Proposed process flow

(source: pitt&sherry 2018)

Approximately 3,000 litres per day of wastewater could also be generated during the production cycle of 28 days over a period of three months. Wastewater will require treatment prior to discharge to local sewerage network. The wastewater is generated from batch trials with individual equipment operations, washdowns and floor washdowns and may include components from different stages of the process and is therefore not generated as a continuous stream. Since suitable wastewater treatment systems require a relatively continuous flow of wastewater the treatment system will require buffering. The wastewater will comprise the following:

1. 15% raffinate (15% sugar solution)
2. 10% raffinate (10% sugar solution)
3. 15% raffinate plus nutrients (15% raffinate supplemented with N, P, vitamins, trace elements as nutrients added at the pre-fermentation stage)
4. 10% raffinate plus nutrients (10% raffinate supplemented with N, P, vitamins, trace elements as nutrients added at pre-fermentation stage)
5. 15% raffinate plus nutrients (15% raffinate supplemented with nutrients post-fermentation)
6. 10% raffinate plus nutrients (10% raffinate supplemented with nutrients post-fermentation)
7. A more dilute washwater stream

The first two streams are the raw process input as sugars solutions at different concentrations. Streams 3 and 4 are the sugar solutions supplemented with the nutrients required for fermentation (nitrogen, phosphorus, vitamins, trace elements), while streams 5 and 6 are the results following fermentation of 3 and 4. Streams 5 and 6 therefore only have residual sugars in them.

The proposal would be operated in accordance with an operational management plan, which would address and comply with all required legal requirements.

3.5 Capital investment value

As already stated, the proposal has received funding from the NSW Government ($4.6 million) to supplement original funding of $11.9 million from ARENA.

Capital investment value, including construction and operational costs, is summarised in Table 3-2. A construction cost estimate is provided in Appendix D.

Table 3-2 Capital investment value estimate

Stage		Value (ex GST) $
Construction		
A1	Construction estimate (as per Appendix D)	4,636,045
A2	Previous DA 62/2017	300,000
A3	Temporary buildings and amenities	30,000
A4	Project office and compound	100,000
	Sub-total	**4,446,045**
Operation – equipment and fixtures		
B1	Water purification system	100,000
B2	Trade waste system	250,000
B3	Raw biomass handling equipment	500,000
B4	Utility process heating and cooling	150,000
B5	Design, installation and commissioning B1-B4	50,000
	Sub-total	**1,050,000**
Operation – pilot systems and research equipment		
C1	Sugars production pilot equipment	9,500,000
C2	Fermentation pilot equipment	6,000,000
C3	Laboratory and office equipment	1,000,000
C4	Design, modifications and integration C1-C3	4,000,000
	Sub-total	**20,500,000**
	Total	**26,016,045**

4. Assessment of environmental effects

The EP&A Act is the principal planning legislation in NSW. Division 4.1 of the EP&A Act outlines the requirements for development that requires consent.

The matters to be considered by a consent authority when determining a DA are provided under Section 4.15 of the EP&A Act and include:

(a) the provisions of:

(i) any environmental planning instrument, and

(ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Director-General has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and

(iii) any development control plan, and

(iiia) any planning agreement that has been entered into under section 93F, or any draft planning agreement that a developer has offered to enter into under section 93F, and

(iv) the regulations (to the extent that they prescribe matters for the purposes of this paragraph), and

(v) any coastal zone management plan (within the meaning of the Coastal Protection Act 1979), that apply to the land to which the development application relates,

(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,

(c) the suitability of the site for the development,

(d) any submissions made in accordance with this Act or the regulations,

(e) the public interest.

These matters are addressed in the following sections.

4.1 The provisions of any environmental planning instrument

Environmental planning instruments (EPIs) are made under Part 3 of the EP&A Act. The relevant EPIs are discussed in the following sections.

4.1.1 State environmental planning policies

State Environmental Planning Policy (State and Regional Development) 2011

State Environmental Planning Policy (State and Regional Development) 2011 (SEPP SRD) identifies development that is state significant development (SSD), state significant infrastructure (SSI) and critical SSI and confers functions on joint regional planning panels to determine development applications for such development and development considered regionally significant.

The proposal does not fit the definition of SSD, as listed under Schedule 1 and 2, or SSI, as listed under Schedule 4, or critical SSI, as listed under Schedule 5, of the policy.

Regionally significant development is defined under Schedule 7 of SEPP SRD. The proposal meets the definition for regionally significant development as the development has a capital investment value of more than $5 million (see Section 3.5) and is on land owned by Council (Schedule 7, Clause 3(b)).

As regionally significant development, the proposal will be determined by the joint regional planning panel (JRPP). This SEE will be submitted to Council for display and assessment.

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the state through increased regulatory certainty and improved efficiency and flexibility in the location of infrastructure and service facilities while providing adequate stakeholder consultation.

The proposal is described as a resource recovery facility under Clause 120 of ISEPP. Clause 121 states:

(1) Development for the purpose of waste or resource management facilities, other than development referred to in subclause (2), may be carried out by any person with consent on land in a prescribed zone.

Clause 120 defines a prescribed zone as*:*

(a) RU1 Primary Production,

(b) RU2 Rural Landscape,

(c) IN1 General Industrial,

(d) IN3 Heavy Industrial,

(e) SP1 Special Activities,

(f) SP2 Infrastructure.

The proposal site is zoned IN1 and therefore is permissible with consent.

State Environmental Planning Policy No. 55 – Remediation of Land

The object of State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55) is to provide for a Statewide planning approach to the remediation of contaminated land. In particular, it aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment:

(a) by specifying when consent is required, and when it is not required, for a remediation work, and

(b) by specifying certain considerations that are relevant in rezoning land and in determining development applications in general and development applications for consent to carry out a remediation work in particular, and

(c) by requiring that a remediation work meet certain standards and notification requirements.

A search of the contaminated land record of notices and sites notified to the NSW Environment Protection Authority (EPA) indicates there are no known contaminated sites within the Muswellbrook LGA. It is considered unlikely, given the site location and surrounding land use, that the proposal site is contaminated, therefore further assessment in accordance with SEPP 55 is not required.

State Environmental Planning Policy No. 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 - Koala Habitat Protection (SEPP 44) aims to encourage the proper conservation and management of areas of natural vegetation that provides habitat for koalas to ensure a permanent free-living population over their present range. It aims to reverse the current trend of koala population decline by:

(a) requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and

(b) encouraging the identification of areas of core koala habitat, and

(c) encouraging the inclusion of areas of core koala habitat in environment protection zones.

The Muswellbrook LGA is listed under Schedule 1 of SEPP 44. Therefore the policy applies to the proposal site. However, no vegetation is found on the site and none would be removed as part of the proposal. The SEPP 44 does not apply to the proposal.

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33) aims to define hazardous and offensive development and identifies the requirements of these developments in relation to EPIs, development consent, mitigation measures, and advertising.

Clause 3 of SEPP 33 defines potentially hazardous and offensive industry. A Preliminary Hazard Analysis (PHA, Viridis Consultants, 2018) has been prepared for the proposal in accordance with SEPP 33 (see Appendix F). The PHA includes a screening against SEPP 33 thresholds and found that the proposal does not meet the definition of either potentially hazardous or offensive industry. Therefore SEPP 33 does not apply to the proposal.

This is discussed further in Section 4.7.2.

4.1.2 Muswellbrook Local Environmental Plan 2009

As stated in Section 2.4, the proposal site is zoned IN1 General Industrial under the Muswellbrook LEP. Resource management facilities are permitted with consent in the IN1 zone.

The objectives and permissibility of the zone is summarised in Table 4-1.

Table 4-1 Objectives of LEP zone

Zone	Objectives	Consistency against objectives
IN1	To provide a wide range of industrial and warehouse land uses.	The proposal would provide the first pilot biorefinery in the Hunter which is permissible within the IN1 land use zone.
	To encourage employment opportunities.	The pilot biorefinery would employ up to 20 full-time scientific or engineering and trade qualified jobs in Muswellbrook.
	To minimise any adverse effect of industry on other land uses.	The mitigation measures outlined in Section 4.7 would minimise any adverse impacts on surrounding land uses.
	To support and protect industrial land for industrial uses.	The proposed development is an appropriate industrial use.

Zone	Objectives	Consistency against objectives
	To recognise existing industries and to encourage the establishment of new industries so as to expand the local employment base, and to minimise any adverse effects of industry on residential communities.	The pilot biorefinery would be the first within the Hunter. The facility has a focus on advancing and promoting the commercialisation of biomass based technologies and developing new regional industries.
	To accommodate larger industries or those which potentially could create nuisance in locations separated from residential areas but accessible to the workforce.	The proposal would be located within a suitably zoned area.
	To enable development that is associated with, ancillary to, or supportive of industry or industrial employees.	The proposal would be supportive to a range of industries.

Other relevant provisions of the LEP are addressed in the following sections.

4.3 Height of buildings

The height of a building on any land is not to exceed the maximum height of 15 metres as shown for the land on the Height of Buildings Map in the LEP.

4.4 Floor space ratio

The maximum floor space ratio for a building on any land is not to exceed the floor space ratio of 1.00 as shown for the land on the Floor Space Ratio Map in the LEP.

7.1 Terrestrial biodiversity

Development consent must not be granted for development on land to which this clause applies unless the consent authority is satisfied that the development satisfies the objective of this clause and:

(a) the development is designed and will be located and managed to avoid any potential adverse environmental impact, or

(b) if a potential adverse environmental impact cannot be avoided, the development:

(i) is designed and located so as to have minimum adverse impact, and

(ii) incorporates effective measures to remedy or mitigate any adverse impact caused.

An area of land approximately 100 metres east of the proposed works is mapped 'terrestrial biodiversity' under the LEP. The proposal would not impact on this land. This is further discussed in Section 4.7.1.

7.6 Earthworks

Development consent is required for earthworks under this clause unless:

(a) the earthworks are exempt development under this Plan or another applicable environmental planning instrument, or

(b) the earthworks are ancillary to development that is permitted without consent under this Plan or to development for which development consent has been given.

Earthworks required for the proposal are ancillary to the development for which consent is sought. Therefore specific consent under this clause is not required.

4.2 The provisions of any proposed instrument

There are no draft instruments that pertain to the site or proposal.

4.3 The provisions of any development control plan

4.3.1 Muswellbrook Development Control Plan 2009

The primary purpose of the DCP is to specify Council's requirements for quality development and sustainable environmental outcomes on land to which the Muswellbrook LEP applies.

Relevant sections of the DCP that apply to the proposal are listed below and addressed in detail in Appendix F.

- Section 10 – Industrial Development
- Section 16 – Car Parking and Access
- Section 20 – Erosion and Sediment Control
- Section 24 – Waste Minimisation and Management
- Section 25 – Stormwater Management

4.4 The provisions of any planning agreement

There are no planning agreements that pertain to the site or the proposal.

4.5 The provisions of the regulations

This SEE has been prepared in accordance with the relevant requirements of the *Environmental Planning and Assessment Regulation 2000*, in particular those provided under Part 6 and in Schedule 1.

4.6 The provisions of any coastal zone management plan

The proposal is not located in the coastal zone.

4.7 The likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality

The likely impacts of the proposed development are discussed in the following sections. Where relevant, mitigation measures are recommended to avoid or minimise identified impacts.

4.7.1 Ecology

Existing environment

The vegetation within the proposal site is highly disturbed as the site has previously been cleared. Existing vegetation consists of grassy groundcover only.

To the east of the proposal site, land is zoned E3 Environmental Management and mapped as Hunter Valley River Oak Forest (HCRCMA, 2009; see Figure 2-4). This area is also mapped as terrestrial biodiversity under the LEP.

Database searches were undertaken on 9 July 2018 to identify the presence of threatened flora, fauna and communities within the study area as follows:

- A search of the online Department of the Environment and Energy (DEE) Protected Matters Search Tool (DEE, 2017) was undertaken to identify matters of national environmental significance listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) predicted to occur within the search area (see report in Appendix G). The search found:
  - One wetland of international importance (Ramsar) - Hunter Estuary Wetlands - which occurs over 100 km away from the proposal site.
  - Four threatened ecological communities.
  - 19 species of threatened fauna, including eight birds, eight mammals, one reptile and two frogs.
  - 10 species of threatened flora.
  - 14 species listed as migratory.
- A search of the Office of Environment Heritage (OEH), Atlas of NSW Wildlife database was undertaken to identify threatened species listed under the *Biodiversity Conservation Act 2016* (BC Act) previously recorded within the study area (see report in Appendix G). The search found:
  - 14 birds, 14 mammals and one reptile.
  - Two threatened flora species and four threatened flora populations.
- A search of the Department of Primary Industries (DPI) freshwater threatened species distribution maps to identify the distribution of threatened species listed under the *NSW Fisheries Management Act 1994* (FM Act). The search found the Purple Spotted Gudgeon (*Mogurnda adspersa*) exists within waterways of the Muswellbrook LGA.

Potential impacts

Construction

No threatened species or communities or significant areas of habitat occur at the proposal site. Due to the previous disturbance of the site and the surrounding development, it is considered unlikely that the proposal site provides significant habitat for any native species. It is possible that vegetation to the east of the proposal site provides habitat for threatened species, however works would not occur within or in the vicinity of this vegetation.

The proposed works would result in clearing of the grassy groundcover at the site. No woody vegetation would be removed as part of the proposed works. No large hollow bearing trees, nesting trees or other significant fauna habitat would be impacted by the proposed development.

As this proposal is within an already modified environment, it is unlikely to result in significant adverse impacts on the quality of habitats in the broader locality through spread of weeds, fragmentation of habitat and the disruption of fauna movement corridors.

The proposal would not directly disturb natural water bodies, drainage lines or natural freshwater wetlands. However potential indirect impacts on Ramrod Creek as a result of earthworks could include sedimentation and water pollution generated by runoff of soil and contaminants from the site.

Indirect impacts from construction activities could also include dust and vehicle exhaust emissions generated from construction vehicles and the potential for vehicle strike.

Operation

There is the potential for vehicle strike during operation of the proposed development and lighting could affect the behaviour of fauna using nearby areas. No other impacts are considered likely.

Mitigation measures

The recommended measures include the following.

Construction

- All fuel and chemical storage and equipment refuelling must be at least 50 metres away from drainage lines and all fuel and chemical storages would be bunded.
- The site would be revegetated within two weeks of completion of construction, provided suitable weather. This will prevent wind erosion and decrease chances of weed invasion in disturbed areas. Revegetation may be via laying of turf or direct seeding.
- An erosion and sediment control plan would be prepared and implemented, which would include:
  - Installation of erosion and sediment control measures prior to construction.
  - Regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality.
  - Restriction of stockpiles to identified areas and management of these stockpiles to ensure no off-site impacts through dust generation or sedimentation.
- No go zones would be identified on site to prevent accidental incursion into nearby vegetated areas. This would be completed prior to construction commencing.
- All weeds encountered during site works would be disposed of at an appropriately licenced facility.
- Wildlife would not be handled by personnel. Construction staff would only handle wildlife in an emergency situation. Wildlife encountered would be gently encouraged to leave the site. WIRES would be contacted if injured fauna is noted on 1300 094 737.
- The detailed design would include signposting and appropriate speed limits on the site to reduce the likelihood of vehicle strikes for native fauna.
- Lighting would be designed to minimise light spill into adjacent areas of vegetation.
- Landscaping would incorporate native endemic species wherever possible. Extensive native tree planting is proposed along the site's northern boundary.
- Measures would be implemented to reduce the production of dust and other emissions during construction (refer Section 4.7.5).

Operation

- Speed limits on the surrounding road network and within the facility would be observed at all times.
- Wildlife would not be handled by personnel. Staff would only handle wildlife in an emergency situation. Wildlife encountered would be gently encouraged to leave the site. WIRES would be contacted if injured fauna is noted on 1300 094 737.

4.7.2 Contamination and hazardous materials

Existing environment

A search of the contaminated land record of notices and sites notified to the EPA indicates there are no known contaminated sites within the Muswellbrook LGA (see Appendix G).

The proposal site is located within an industrial area. It is expected that a number of sites within this area would use and store a range of chemicals on site.

There is no evidence of potential contamination within the proposal site.

Potential impacts

Construction

Potential spills from chemicals, machinery and light vehicles may occur during construction.

Operation

A PHA (Viridis Consultants, 2018) has been prepared for the proposal in accordance with SEPP 33 (see Appendix F). The PHA was prepared to assess the risks associated with the proposal due to use, storage and production of hazardous materials. A summary of the findings of the PHA is provided below.

The proposal would store and make use of hazardous materials as defined by the *Australian Dangerous Goods Code* (ADG; National Transport Commission 2018). All hazardous materials would be stored within designated bunded storage areas. The bund capacity would exceed the volume of chemicals that would be stored to ensure that there is sufficient capacity for various users of the proposal. Material safety datasheets will be available alongside each storage area for each chemical stored.

The chemical storage and processing areas are indicated on Figure 3-1. The chemicals to be stored on site, their hazardous material are identified in Table 4-2.

Table 4-2 Primary chemical storage onsite

Material name	Hazard	ADG class*	Packing group (PG)#
Sulphuric Acid	Corrosive	8	II
Sodium Hydroxide	Corrosive	8	II
Hydrogen Peroxide	Oxidising Agent	5	II
Ethanol	Flammable Liquid	3	II

*ADG Class: 3: Flammable and Combustible Liquids; 5: Oxidizing Substances, Organic Peroxides; 8: Corrosives.

#PG: II: medium degree of danger, flash point < 23 ˚C, initial boiling point > 35 °C.

The quantities for each storage area are provided in Table 4-3. The quantities of chemicals stored are unlikely to present any elevated level of risk to neighbouring sites.

Table 4-3 Quantity of hazardous chemical bunded areas

Bunded storage area	Class	PG	Storage quantity (kg)	Bund containment volume (L)
1	8, 5	II, II	8,000 and 2,000	16,000
2	8	II	6,000	30,000
3	8, 5	II, II	6,000 and 2,000	30,000
4	3	II	200	1,000
5	8, 3	II, II	2,000 and 4,500	24,000
6	8	II	2,000	30,000
7	-	-	500	2,000
8	-	-	20,000	30,000

Lignocellulosic biomass would also be stockpiled on site, on a concrete slab, undercover and tarped to minimise dust and contaminations. Typical biomass feedstocks include timber, bagasse, wheat straw, grasses and cotton waste. Feedstocks would be storage in areas 7 and 8.

Class 8 basic and Class 8 acidic substances would be stored and handled separately to avoid accidental mixing. Accidental mixing of these would produce heat but no toxic compounds would be produced.

The Class 5 chemical, hydrogen peroxide, can be stored with the Class 8 Acidic and Basic as no adverse reactions would result from accidental mixing.

During operation of the proposal, the maximum amount of ethanol produced during a 28 day operational cycle would be 4.5 tonnes. The ethanol would be denatured and stored as per the Australian Standards.

Mitigation measures

The recommended measures include:

Construction

- An emergency management procedure would be developed. Spills kits would be located at accessible locations throughout the site and all staff would be trained in their use.
- Vehicle refuelling would occur only in a designated bunded area within the construction compound.
- All hazardous materials would be stored in bunded containers within the compound.
- The construction site and compound would be fenced and contained to prevent unauthorised public access.

Operation

- An emergency management procedure would be developed. Spills kits would be located at accessible locations throughout the site and all staff would be trained in their use.
- Refuelling would only occur within a designated hardstand area in the facility.
- All chemicals and hazardous materials would be stored and decanted only in the designated bunded storage area.

- Safe work method statements, material safety data sheets and the emergency management procedure would be accessible at all times throughout the facility. All workers would be trained in their implementation.
- Guests of the facility will be inducted on the storage areas and hazards of the facility. These will be isolated by way of clear barriers, signage and fencing.
- Limited access to storage areas would be allowed during facility tours. Guests will be accompanied by facility staff at all times.

4.7.3 Traffic and access

Existing environment

The proposal site is situated off Thomas Mitchell Drive, which connects to the New England Highway in the south and Denman Road, which travels into Muswellbrook, to the north. Thomas Mitchell Drive is a two-lane road signposted at 80 kilometres per hour (km/hr).

Access to the proposal site is via Carramere Road, which has direct access to Thomas Mitchel Drive.

The local road network is displayed in Figure 1-1.

Potential impacts

Construction

During construction, the proposal is expected to generate:

- Heavy vehicle movements for delivery of construction materials and equipment
- Delivery of plant (excavators) to site, which would remain on site during construction
- Light vehicle movements for construction workers during the construction period

Traffic during construction would be intermittent, with a maximum of 10 light vehicle movements per day. Construction parking would be within the proposal site or on the surrounding streets if needed. Traffic would be managed during construction of the driveway, with no disruption to surrounding businesses or general traffic flows.

No adverse road safety impacts are foreseen for the proposal during construction as:

- The proposed development is not expected to generate significant additional traffic onto the surrounding road network.
- There is sufficient sight distance available at the proposed site access.

Operation

The proposal would be occupied by up to 20 staff. Average continual occupancy is expected to be 10 staff. There would be 14 onsite undercover car parking areas available.

The lignocellulosic biomass would arrive by truck approximately four times during the 28 day operational cycle. The operational cycles would occur up to four times per year.

The increase in traffic described above is relatively small and would have a negligible impacts on the road capacity within the surrounding network.

Mitigation measures

The recommended measures include:

Construction

- A traffic control pan would be prepared if required and approved by Council.
- Worker parking would be contained within the proposal site wherever possible.
- Access to all private properties adjacent to the works would be maintained during construction.

Operation

No mitigation measures required.

4.7.4 Water quality and flooding

Existing environment

The site is located within the catchment of the Hunter River. The Hunter River catchment is approximately 22,000 square kilometres in size and consists of a number of major tributaries over its approximate 300 kilometre length. Ramrod Creek, a tributary of the Hunter River, is located along the eastern boundary of the proposal site, however works would be located 100 metres west of the creek. Surface water runoff at the site would be to the east towards Ramrod Creek (refer to Figure 1-1).

The Hunter River maintains an average daily flow of 420 megalitres per day at Muswellbrook. Downstream flows decrease to approximately 358 megalitres per day due to the significant irrigation and diversions into effluent channels (Water NSW, 2018).

There is a small manmade dam to the north of the site that would be retained.

The proposal site is not located within the flood planning area mapped under the LEP.

Groundwater was not encountered at the site at a depth of three metre below ground level.

Potential impacts

Construction

The proposal would involve earthworks as described in Section 3.3.2. Excavations and stockpiling of spoil during construction, if not adequately managed, could potentially have the following impacts:

- Erosion of exposed soil and stockpiled materials
- An increase in sediment loads entering Ramrod Creek

With the implementation of erosion and sedimentation controls outlined in the following section, potential construction related erosion and sedimentation impacts would be appropriately managed and are not expected to be significant.

It is not anticipated that works would impact on groundwater.

Operation

The proposal once constructed would increase the amount of impervious surface by approximately 1.8 hectares, which is considered a minor increase in the context of the surrounding industrial area.

Up to five 22,000 litre tanks will be installed to catch roof stormwater for use in the biorefinery operation. These tanks will contain a 20,000 litre retention system, which will release excess water at a rate equivalent natural run-off. Overflows from the tank/retention system will be piped to the existing discharge area to the east of the proposal site.

A stormwater management plan is available in Appendix H. The plan complies with all relevant engineering and Council requirements.

Mitigation measures

The recommended measures include:

Construction

- An erosion and sediment control plan would be prepared and implemented in accordance with the requirements of *Soils and Construction – Managing Urban Stormwater* Volume 1 'the Blue Book' (Landcom, 2004) and Volume 2 (DECC, 2008). The plan would include as a minimum:
  - Erosion and sediment controls would be installed before any construction starts and inspected regularly, particularly after a rainfall event. Maintenance work would be undertaken as needed.
  - Site stabilisation of disturbed areas would be undertaken progressively as stages are completed. Controls would not be removed until areas are stabilised.
  - All stockpiles would be located away from drainage lines. Appropriate erosion and sediment controls would be established and maintained for stockpiles.
  - Controls would be implemented at work site exit points to minimise the tracking of soil and particulates onto pavement surfaces.
  - Any material transported onto pavement surfaces would be swept and removed at the end of each working day.
- A fully equipped emergency spill kit would be kept on-site at all times.
- All fuels, chemicals, and liquids would be stored at least 50 metres away from Ramrod Creek.
- Refuelling of plant and equipment is to occur in impervious bunded areas located a minimum of 50 metres from Ramrod Creek.
- Vehicle wash downs and/or concrete truck washouts would be undertaken within a designated bunded area on an impervious surface or undertaken off-site.
- Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) would be undertaken on a regular basis to identify potential spills or the effects of sediment-laden runoff. If visual inspection identifies concerns, water quality monitoring should be considered. Data would be assessed against the *Australian Water Quality Guidelines for Fresh and Marine Wate*rs (ANZECC 2000).
- Vehicles and plant would be properly maintained and regularly inspected for fluid leaks.
- If groundwater is encountered during earthworks, it would be managed in accordance with the NSW State Groundwater Policy Framework (DLWC 1997) and NSW Aquifer Interference Policy (NOW, 2012) as relevant.

Operation

No mitigation measures required.

4.7.5 Topography, geology and soils

Existing environment

Site topography is relatively flat with a slight slope towards the east to Ramrod Creek. The elevation of the proposal site is between 168 and 173 metres Australian Height Datum (AHD). Contours across the site are shown in Figure 2-4.

The *Singleton 1:250,000 Geology Sheet* (Rose et al., 1966) indicates that the proposal site is underlain by the Branxton Formation, comprising mudstone sandstone and conglomerate.

The *Soil Landscapes of the Singleton 1:250,000 Sheet* (Kovac & Lawrie, 1991) shows the proposal sites is located within the Bayswater soil landscape. The Bayswater (bz) soil landscape is characterised by undulating low hills with slopes generally 3-10 percent and a local relief of 40–60 metres. The soil landscape originates from the Singleton Coal Measures and consists of yellow solodic soils, brown and yellow earths and prairie soils. Moderate sheet and gully erosion is common on slopes.

Australian Soil Resource Information System (ASRIS) mapping indicates ASS has a low probability of occurring within the proposal site.

The proposal site is not within a mine subsidence district.

Potential impacts

Construction of the proposal would require excavation for stripping, subgrade preparation and footings. Deep excavation and major earthworks are not anticipated. The proposal is unlikely to significantly impact on topography, geology or soil during construction or operation.

Mitigation measures

The recommended measures include the following.

Construction

- The area of ground disturbance would be kept to a minimum.

Operation

No mitigation measures required.

4.7.6 Air quality

Existing environment

No residential or sensitive areas are located within proximity to the proposal site.

As discussed in Section 2.5.9, existing air quality is generally fair to good and would be influenced by the surrounding industrial land uses, coal mines, local road network and agricultural activities.

A search of the DEE National Pollutant Inventory in July 2018 revealed three scheduled industries operating within the study area:

- Mt Arthur Coal – emits a range of substances including antimony, arsenic, benzene, boron, cadmium, carbon monoxide, chromium compounds, cobalt, copper, fluoride, manganese, mercury, nitrogen oxide, particulate matter 10 and 2.5 um, sulphur dioxide, total volatile organic compounds, xylenes and zinc.
- Orica Bayswater Mining Services Plant – emits cumene and total volatile organic compounds.
- Drayton Coal Mine – emits antimony, arsenic, beryllium, boron, cadmium, carbon monoxide, chromium, cobalt, copper, cumene, fluoride, lead, manganese, mercury nickel, nitrogen oxide, particulate matter 10 and 2.5 um, sulphur dioxide, total volatile organic compounds and zinc.

Climate data was obtained from the Bureau of Meteorology (BoM) Scone monitoring site (site number 061089). The annual average maximum and minimum temperatures experienced at Scone are 24.3 degrees and 11.0 degrees respectively. On average, January is the hottest month with an average maximum temperature of 31.4 degrees. July is the coldest month, with average minimum temperature of 4.7 degrees. Most of the 640.1 millimetres of annual rainfall occurs in summer and spring.

The main impact to air quality during construction and operation is expected to arise from the generation of airborne dust and particulate matter. Wind speeds, which are of particular importance when determining the potential for dust impacts, are typically greater in spring and summer. Annual wind rose data for the five year period from August 2013 to August 2018 shows that winds are predominantly from the south (Willy Weather, 2018). Calm, light and gentle winds occur for majority of the time (79.13%), with moderate winds (19.8-28.8 km/hr) occurring 15.71% of the time. Strong winds (greater than 28.8 km/hr) occur 5.16 % of the time. The minimum wind speed required to create dust is about 30 kilometres per hour (BoM, 2006).

Impacts of the proposal

Construction

Air quality impacts during construction of the proposal are possible due to dust generation and vehicle and machinery emissions. Dust emission sources are likely to include:

- Material handling during earthworks
- Loading and dumping of material
- Levelling, grading and compacting of disturbed soil surfaces
- Wind erosion of exposed unstable soil surfaces and stockpiles

Vehicle exhaust emissions during the construction phase have the potential to impact on air quality. However the impact is likely to be negligible given the limited amount of equipment, distance to sensitive receptors and the short-term construction period.

Operation

During operation of the proposal, it is not anticipated the biorefinery would result in significant air pollution. The process and scale of the operation would result in negligible impacts.

Mitigation measures

The recommended measures include the following.

Construction

- Exposed surfaces would be watered as required to minimise dust emissions.
- During periods of high winds, dust generating activities would be revaluated and ceased if significant dust is produced.
- Stabilisation of disturbed surfaces would take place as soon as practicable after works are completed.
- All construction vehicles would obey speed limits on unsealed roads/surfaces to minimise dust generation.
- Plant and machinery would be turned off when not in use and would be fitted with emission control devices complying with Australian Standards.
- Construction plant and equipment would be maintained in a good working condition in order to limit impacts from emissions.
- During transportation, loads would be covered to avoid loss of material.
- Stockpiles or areas which may generate dust would be watered or covered wherever practical to reduce dust emissions.

Operation

No mitigation measures required.

4.7.7 Visual amenity

Existing environment

The land surrounding the proposal site is generally visually consistent with an industrial area. Industrial businesses and existing roads are located to the wests. Stands of vegetation associated with the riparian vegetation of Ramrod Creek are visible to the east, with cleared grassed areas visible to the north and south.

Clear views of the proposal site are possible from Carramere Road, Glen Munro Road, Strathmore Road and businesses within the industrial area. The proposal is not expected to be visually prominent from the east.

The proposal is considered compatible with the character of surrounding development on Carramere Road.

Potential impacts

Construction

The proposed works would include earthworks and the removal of some groundcover vegetation within the boundaries of the proposal site. This would have temporary visual impacts during construction until the works are complete and disturbed areas rehabilitated. Construction plant and equipment would also result in minor, temporary visual impacts.

Operation

The proposal would constitute a permanent change to the visual landscape of the locality once constructed. Given the context of the site and the visual receivers, this visual change is not considered significant.

During trial periods, the facility would be operational for 24 hours per day. A trial period is expected to run for up to 28 consecutive days and could occur up to four times in a year. Lighting of the facility during trial periods could result in visual impacts to nearby receivers. However receivers within the vicinity of the proposal are limited to industrial businesses therefore, the visual impacts of lighting are not likely to be significant.

Mitigation measures

The recommended measures include the following.

Detailed design

- The detailed design of infrastructure and facilities would consider the current visual landscape and land use context to ensure that the proposed development is visually consistent with the existing environment.
- Lighting design would avoid light spill on to neighbouring areas.

Construction

- The work site would be tidied and all rubbish removed at the end of each day.
- Work areas would be restored progressively and maintained until established.
- Landscaping would be provided around facility entrance.
- Site restoration would be commenced as soon as possible after completion of the works.
- All temporary structures and equipment are to be removed at the completion of works.

4.7.8 Noise and vibration

Existing environment

The existing noise environment at the proposal site is dominated by industrial activities. There would also be some background and intermittent noise generated from Mount Arthur Coal Mine and the local road network.

There are no sensitive or residential receivers within the vicinity of the proposal site.

Potential impacts

Construction

Construction noise is assessed and managed in accordance with the *Interim Construction Noise Guideline* (ICNG) (DECC 1999). The proposed construction works would be undertaken in accordance with the ICNG as follows:

- Monday to Friday: 7:00 am to 6:00 pm
- Saturday: 8:00 am to 1:00 pm
- Sundays and public holidays: no work

The proposed works are anticipated to take 18 months to complete. The ICNG recommends a noise goal of background + 10 dB(A) for major construction projects i.e. those over three weeks duration.

Construction activities are generally considered to be high noise generating when heavy machinery is used. The isolated nature of the proposal site from residential and sensitive receivers and the high background noise level due to the surrounding environment, would provide some buffering of construction noise. It is not expected that construction noise would contribute to any loss of amenity, over and above that already generated by surrounding businesses and facilities.

Operation

The *Noise Policy for Industry* (EPA 2017) provides guidance on assessment and management of noise from industry. The Policy sets an amenity noise level of 70 LAeq, dB(A) for industrial premises.

During operation of the proposal, noise would be generated from the grinding of biomass. The grinders would be small machines (45 kilowatt) and would have a sound proof enclosure. Grinding activities would occur up to two hours per day, during business hours, with a low annual occurrence. Given the isolated nature of the proposal site from residential and sensitive receivers and the high background noise level due to the surrounding environment, noise impacts are not expected to be significant during operation.

Mitigation measures

The recommended measures include the following.

Detailed design

- Noisy machinery and grinders would be sited so as to maximise the distance to neighbouring properties.

Construction

- Construction equipment and machinery would be maintained regularly to ensure efficient operation.
- A staff and sub-contractor induction would be undertaken to outline work site responsibilities with regard to noise. Staff would be trained to use equipment in such a way so as to minimise noise.
- Where possible, dropping of materials from heights into or out of trucks would be minimised.
- Fixed equipment (pumps, generators, compressors) would be located as far as possible from potential receivers.
- Appropriate personal protective equipment, including ear plugs, would be used by all staff working on site.
- Noise complaints would be responded to immediately. This may include conducting noise monitoring and adjusting work practices accordingly, as directed by Council.

Operation

- Noise complaints would be responded to immediately. This may include conducting noise monitoring and adjusting work practices accordingly, as directed by Council.

4.7.9 Heritage

Existing environment

Aboriginal heritage

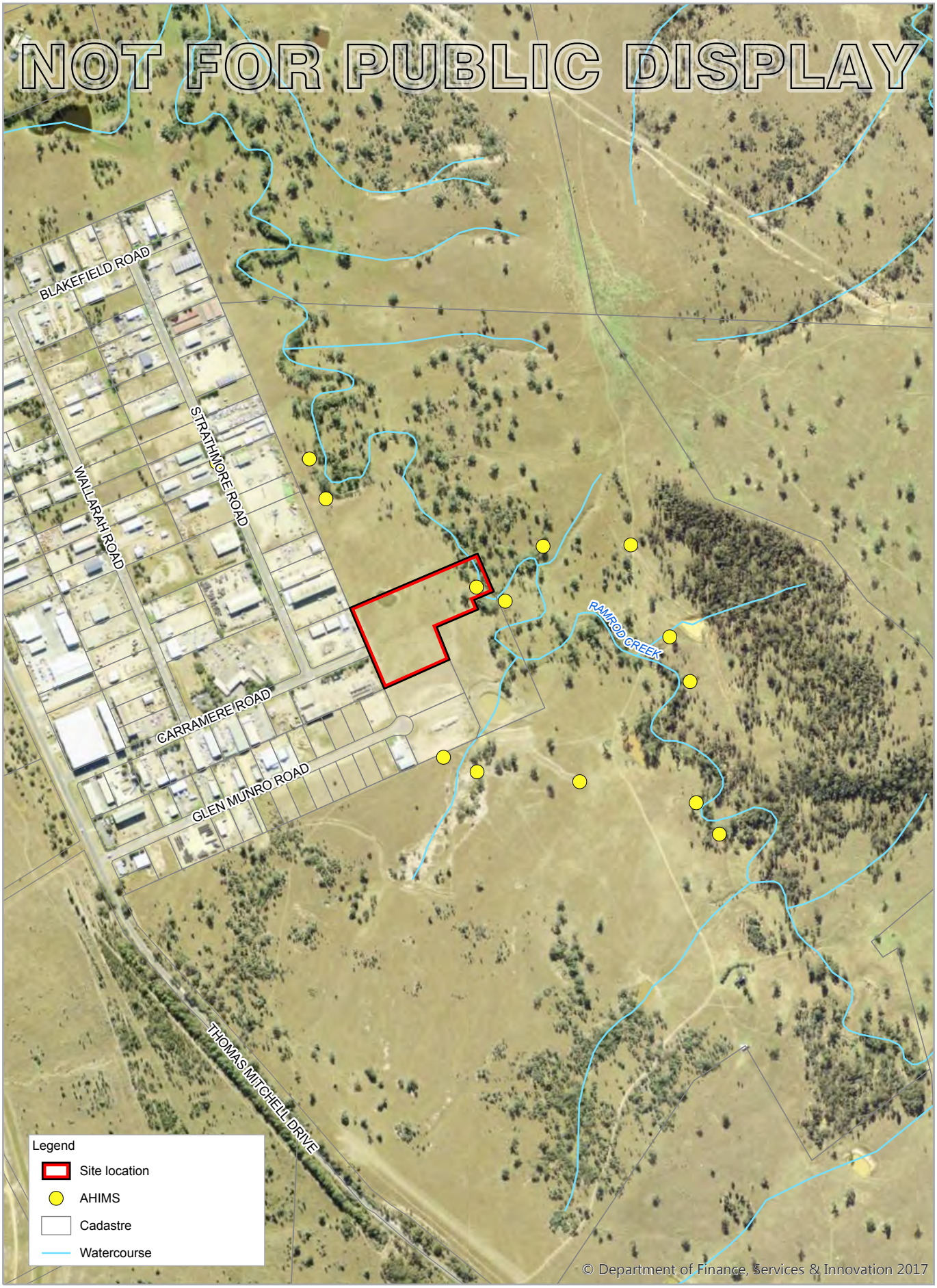
The proposal site is located within the traditional lands of the Wonnarua people and the area administered by the Wanaruah Local Aboriginal Land Council (LALC). The site is located approximately 100 metres west of Ramrod Creek. Watercourses are landscape features known to have a higher presence of Aboriginal activity due to food and water resources which they provide. Therefore, they are considered to be culturally sensitive.

A search of the Aboriginal heritage information management system (AHIMS) on 9 July 2018 recorded no known Aboriginal sites or places within the area of works. However the search identified 14 Aboriginal sites recorded near the proposal site, including one within the lot (refer to Appendix G). A search of the State Heritage Register and Inventory did not identify any Aboriginal Places within proximity to the proposal site.

Site types are summarised in Table 4-4 and shown in Figure 4-1. The most common AHIMS site feature recorded within the search area are artefacts.

Table 4-4 Summary of AHIMS Features

Site type	Frequency	Percent of sites recorded (%)
Artefact	12	86
Open camp site	2	14
Total	14	100



Paper Size ISO A4

0 75 150 225 300 375

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Ethanol Technologies Limited
Hunter Pilot Biorefinery Project
Statement of Environmental Effects

Project No. **22-19644**
Revision No. **0**
Date **29/10/2018**

Sites recorded in AHIMS

FIGURE 4-1

G:\22\19644\GIS\Maps\2219644_Hunter_PilotBiorefinery\2219644_SEE_0.aprx\2219644_SEE005_AHIMS_0
Print date: 29 Oct 2018 - 12:26

Data source: LPI: DTDB/DCDB, 2017. OEH: NPWS Wildlife Atlas data. Office of Environment and Heritage (NSW). (Data supplied by OEH Wildlife Data Unit, July 2018), 2018. Created by: fmackay

Non-Aboriginal heritage

Six heritage sites are listed in Muswellbrook under the State Heritage Register (see Appendix G) including:

- Eatons Hotel and St Vincent De Paul Group
- Edinglassie
- Loxton House
- Muswellbrook Railway Station and Yard Group
- St Alban's Anglican Church
- Weidmann Cottage

All the above items are also listed under the LEP.

None of the above sites are within the proposal site and would not be impacted by the proposal.

A search of the Australian Heritage Database for sites at Muswellbrook (see Appendix G) found one site, the Muswellbrook Post Office (Commonwealth Heritage List). Muswellbrook Post Office is not located within the vicinity of the proposal site and would not be impacted by the proposal.

Potential impacts

Construction

Excavation or disturbance of the land during construction has the potential to uncover previously unidentified Aboriginal or non-Aboriginal items.

The proposal site is cleared of woody vegetation and has been subject to disturbance. The potential for presence of Aboriginal or non-Aboriginal sites or relics is considered very low.

Operation

There would be no impacts on heritage during operation.

Mitigation measures

The recommended measures include:

Construction

- An exclusion area would be established west of the line of vegetation adjacent to Ramrod Creek. No access for personnel, plant or machinery is permissible in this area or along the creek.
- All staff and contractors would be made aware of their responsibilities under the *National Parks and Wildlife Act 1974* (NPW Act) and *Heritage Act 1977* (Heritage Act) with respect to heritage in NSW.
- If Aboriginal or non-Aboriginal objects are uncovered during ground works, all works would cease, the area wold be cordoned off and secured, and Council and OEH would be contacted for advice on a course of action. Works would not recommence until formal approval to proceed has been received.
- In the unlikely event that suspected human remains are found, all work must cease, the site secured and the NSW Police notified. If the remains are found to be archaeological, Council and OEH would be contacted to assist in determining appropriate management. Works would not recommence until formal approval to proceed has been received.

4.7.10 Waste

Existing environment

The site currently exists as a vacant lot. No waste exists at the site and is not currently generated at the site.

Potential impacts

Construction

Activities that would generate waste or have the potential generate waste during construction of the proposal include:

- Vegetation removal
- Earthworks
- General site activities by workers

Waste streams likely to be generated include:

- Excess spoil. This is not considered likely as all excavated material (amounts would be minimal), would be reused on-site as fill.
- Green waste as a result of vegetation clearing.
- Packaging and general waste from staff (lunch packaging, portable toilets).
- Chemicals and oils.
- Redundant erosion and sediment controls.

Inappropriate waste management has the potential to lead to the following environmental impacts:

- Increased demand on local landfill
- Depletion of natural resources
- Increased energy use associated with recycling of waste
- Increased fuel consumption associated with transport of waste
- Water, air or soil contamination through incorrect waste disposal

Operation

A trade waste system concept design has been prepared for the proposal (see Appendix C). As described in Section 3.4, the waste produced during operation of the proposal would be generated by:

- Use of kitchen/amenities
- Packaging and general waste
- Ethanol production process

Solid waste will be segregated (metals, cardboard, green waste, timber, hazardous materials containers and general waste), collected and disposed of at the Muswellbrook Waste Management Facility using a suitably qualified contractor.

The production process will generate 6.5 tonnes of lignin cake during the 28-day run time. This equates to an expected maximum generation of approximately 26 tonnes of solid waste per year. In addition, there would be biosolids generated from the wastewater treatment process and fermentation processes. These solids would be disposed via licenced contractors to further treatment at an appropriate licensed facility.

All liquid waste (sewage and liquid waste from operations) would be treated onsite prior to discharge to the sewage system. Given the sporadic rate of generation of liquid waste at up to 3,000 litre per day for 28 days, a buffering tank is required to provide uniform flow to the treatment system. This would provide ten days of storage and achieve a normalised flow loading of about 1000 litres per day to the system across the 90-day period (i.e. allowing for four 28 day operational periods per year). This would ensure that the addition to the sewer network is not too high. The concept for the proposed onsite treatment system is summarised in Figure 4-2 and discussed further in Appendix C. The final design for the onsite system would be prepared and submitted for the construction certificate application.

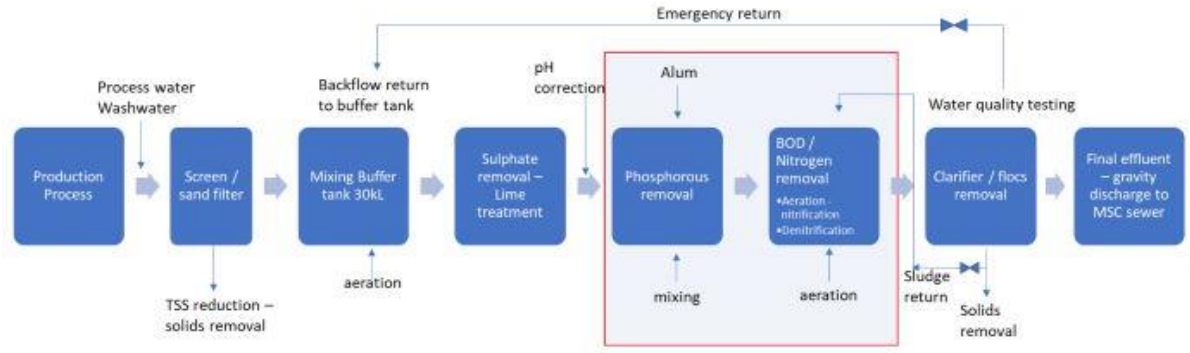


Figure 4-2 Conceptual onsite waste water treatment system

(source: pitt&sherry 2018)

Mitigation measures

The recommended measures include:

Detailed design

- The final design and type of onsite waste water management system to be confirmed with Council.

Construction

- Waste produced would be managed in accordance with the waste management hierarchy, within which waste avoidance is a priority, followed by reuse and recycling/reprocessing, with disposal as a last resort.
- A daily site clean-up would be undertaken.
- Procurement would endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.
- Excess excavated material would be reused appropriately for fill or disposed of at an appropriate facility. Excess material requiring waste disposal would first be assessed against the *Waste Classification Guidelines* (DECCW, 2009) and disposed of appropriately with supporting waste classification documentation, if required.
- Garbage receptacles would be provided and recycling of materials encouraged. There would be no disposal or re-use of construction waste on to other land.

- Waste would not be burnt on-site.
- Liquid waste is to be contained in appropriate sealed containers.
- Portable toilets would be provided for construction workers and would be managed by the service provider to ensure the appropriate disposal of sewage.
- Site inductions would ensure staff are aware of waste disposal protocols and attendance would be recorded by the site supervisor.
- A site waste minimisation and management plan (SWMMP) would be prepared to include the preceding measures as a minimum. The plan would be prepared in accordance with the relevant requirements of the DCP and relevant EPA guidelines.

Operation

- A waste water sampling procedure would be prepared to ensure waste water constituents are regularly tested and confirmed against the relevant trade waste parameters. Sampling would be undertaken prior to transfer to the sewer pump station.
- A contingency plan would be prepared for any waste water system failure.

4.7.11 Socio-economic

Existing environment

The proposal site is located in the Muswellbrook industrial area.

As described in Section 2.5.8, the socio-economic characteristics of the Muswellbrook LGA in 2016 include:

- A population of 16,086 people with a median age of 35
- There are 8,252 males and 7,834 females
- There are 4,095 families with an average of two children per family
- The average household has three people
- About 66 percent of people were either English or Australian
- 85 percent of adults worked full or part time
- The most common occupation was technician or trade workers
- Coal mining was the biggest industry of employment
- About 58 percent of people owned their home outright or had a mortgage

Potential impacts

Construction

The proposal would not generate significant adverse socio-economic impacts. Minor social impacts associated with the proposed development would include potential visual, noise, traffic and dust impacts during construction activities. Mitigation measures provided in this SEE would aim to minimise these impacts.

Operation

The proposal would result in long term economic benefits to the community through the generation of jobs. The facility would employ up to 20 full time scientific, engineering and trade-qualified jobs in Muswellbrook. Based on the experience of similar facilities abroad, it is anticipated dozens of research and educations projects will be undertaken annually, attracting researchers and educators from around Australia to Muswellbrook, bringing with it a boost to the local hospitality, hardware and manufacturing industries.

Mitigation measures

Safeguards and measures identified in previous sections of this SEE would mitigate social and economic impacts. Refer to the following sections for these measures:

- For traffic impacts refer to measures described in Section 4.7.3.
- For air quality impacts refer to measures outlined in Section 4.7.5.
- For visual impacts refer to measures outlined in Section 4.7.7.
- For noise impacts refer to measures outlined in Section 4.7.8.
- In addition, locally sourced personnel, equipment and materials should be used during construction and operation wherever possible.

4.7.12 Energy use and greenhouse gases

Existing environment

The site is currently vacant and does not use energy or produce greenhouse gases.

The proposal is a green initiative that would provide a foundation for sustainable fuel production and reduction of use of fossil fuels in the Hunter Region and across NSW.

Potential impacts

Construction

Activities that consume energy or fuel and/or have the potential to generate greenhouse gas emissions during construction include:

- Use of fuel through vehicle, plant and equipment operation, and generator use during construction
- Loss of vegetation cover

Operation

Activities that consume energy or fuel and/or have the potential to generate greenhouse gas emissions during operation include:

- Use of electricity through lighting (internal, external, car park), air conditioning, refrigeration, laboratory equipment etc.
- Use of fuel through vehicle, plant and equipment operation.
- Direct production of carbon dioxide during 28 day operational periods (up to four times a year). It is expected that 4.5 tonnes of carbon dioxide would be produced during operational periods. Vents from fermentation vessels are filtered.

Climate change and increasing temperatures have the potential to reduce asset life and increase the maintenance requirements of infrastructure, increase energy requirements and costs (e.g. air conditioning), stress vegetation and fauna, create human health impacts, and increase fire risks.

Whilst the proposal would have some minor impacts on greenhouse gases and energy use during both construction and operation, it would result in a long term positive impact for the future of renewable energy by enabling research into the production of biofuel.

Mitigation measures

The recommended measures include:

Detailed design

- Light emitting diode (LED) lights should replace higher electricity consuming lights wherever possible.

Construction

- Fuel use would be reduced whenever possible. This could include:
  - Turning vehicles, machinery and equipment off when not in use.
  - Planning movements of personnel, equipment and materials to minimise trips.
  - Ordering equipment and material to minimise trips to site.
  - Encouraging staff to car pool.
- Modern vehicles, equipment and machinery only would be used (including, where possible, those that use biofuels). These are more fuel efficient and have better emission controls than older models.
- All vehicles, machinery and equipment would be adequately maintained.

Operation

- Fuel use would be reduced whenever possible. This could include:
  - Turning vehicles, machinery and equipment off when not in use.
  - Planning movements of personnel, equipment and materials to minimise trips.
  - Ordering equipment and material to minimise trips to site.
  - Encouraging staff to car pool.
- Modern vehicles, equipment and machinery only would be used (including, where possible, those that use biofuels). These are more fuel efficient and have better emission controls than older models.
- All vehicles, machinery and equipment would be adequately maintained.
- Where possible, timed energy-efficient street lighting would be used, allowing certain lights to turn-off during low traffic periods.
- Where appropriate, sensor lighting would be used for external lighting.

4.8 The suitability of the site for the development

The site is considered suitable for the proposal as it is free of woody vegetation, located within an industrial area and located close to the transport network and the town centre of Muswellbrook. Further discussion around the proposal's suitability is provided throughout the SEE.

Having regard to the characteristics of the site and its location, the proposed development is appropriately located in that:

- It is permissible with development consent pursuant to Clause 121 of ISEPP.
- The proposal would enable research, development and education to advance and promote the commercialisation of biomass based technologies.
- The proposal is not likely to result in any significant adverse impact to the natural or human environment.

4.9 Any submissions made in accordance with this Act or the regulations

Any submissions received as a result of this application would be dealt with by Council on their merits during the assessment process.

4.10 The public interest

The proposal is considered to be in the public interest as it would provide a facility to allow for research, development and education to advance and promote the commercialisation of biomass based technologies and develop new regional industries.

The proposal has been designed following investigations and consultation with appropriate stakeholders. Provided the mitigation measures in Section 4.7 are implemented, the proposal would have minimal adverse environmental, social or economic impact for Muswellbrook and the region. When completed, it would provide significant positive environmental, social and economic benefits for the region.

5. Other legislative or policy considerations

5.1 Commonwealth legislation

5.1.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act, a referral is required to the Australian Government for proposed '*actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land*.'

A search of the Protected Matters Search Tool was undertaken on 9 July 2018 for matters of national significance and other matters protected by the EPBC Act (the report is included in Appendix G) reported or predicted in the search area. Results of the search and commentary on the relevance to the proposal are summarised in Table 5-1.

Table 5-1 EPBC Act protected matters search summary

Matter	Number	Details	Comment
Matters of national environmental significance			
World Heritage properties	None	N/A	N/A
National Heritage Places	None	N/A	N/A
Wetland of International Importance	1	Hunter Estuary Wetlands	The Hunter Estuary Wetlands occurs over 100 kilometres away from the project area.
Great Barrier Reef Marine Park	None	N/A	N/A
Commonwealth Marine Areas	None	N/A	N/A
Listed Threatened Ecological Communities	4	Central Hunter Valley Eucalypt Forest and Woodland Lowland Rainforest of Subtropical Australia Hunter Valley Weeping Myall (Acacia pendula) Woodland White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	None of these communities are found within or in the vicinity of the proposal site. Referral under the EPBC Act on this matter is not required.
Listed Threatened Species	29	eight birds, eight mammals, one reptile, two frogs and 10 threatened plant species Refer report	Potential impacts on relevant threatened species are addressed in Section 4.7.1. The proposal would not have a significant impact on any threatened species or their habit. Referral under the EPBC Act on this matter is not required.
Listed Migratory Species	14	Refer report	Potential impacts on relevant migratory species are addressed in Section 4.7.1.

Matter	Number	Details	Comment
Other Matters			
Commonwealth Land	7	Commonwealth Land Australian Postal Commission Australian Telecommunications Commission Commonwealth Bank of Australia Commonwealth Trading Bank of Australia Defence Housing Authority Muswellbrook Gres Depot	The proposal is not located on Commonwealth land. Referral under the EPBC Act on this matter is not required.
Commonwealth Heritage Places	1	Muswellbrook Post Office	Muswellbrook Post Office is located 4.8 kilometres northeast of the proposal site and would not be impacted by the proposal. Referral under the EPBC Act on this matter is not required.
Listed Marine Species	20	Refer report	The proposal would not impact on marine species. Referral under the EPBC Act on this matter is not required.
Whales and Other Cetaceans	None	N/A	N/A
Critical Habitats	None	N/A	N/A
Commonwealth Reserves Terrestrial	None	N/A	N/A
Commonwealth Reserves Marine	None	N/A	N/A

As summarised above, the proposal would not result in a significant impact on any matters of national environmental significance or other matters listed under the EPBC Act. Accordingly the proposed development is not considered likely to be a controlled action and therefore has not been referred to the Commonwealth Minister for the Environment.

5.1.2 Native Title Act 1993

The *Native Title Act 1993* recognises and protects native title and provides that native title cannot be extinguished contrary to the Act. Essentially, the Act covers actions affecting native title and the process for determining whether native title exists and compensation for actions affecting native title. It establishes the Native Title Registrar, the National Native Title Tribunal, the Register of Native Title Claims and the Register of Indigenous Land Use Agreements, and the National Native Title Register.

Native title is discussed in Section 4.7.9. The proposal would not impact on Native Title.

5.2 NSW legislation

The NSW legislation that could apply to the proposal is reviewed in Table 5-2.

Table 5-2 NSW legislation review

Legislation	Requirements
Roads Act 1993 (Roads Act)	The Roads Act sets out the requirements for the management and use of public roads. Section 138 of the Roads Act requires that a person obtain the consent of the appropriate roads authority for the erection of a structure, or the carrying out of a work in, on or over a public road, or the digging up or disturbance of the surface of a public road. No roads would be impacted by the proposal.
FM Act	Under Part 7 of the FM Act, a permit is required for dredging and reclamation, obstruction of fish passage, harm to marine vegetation and use of electrical or explosive devices in a waterway. No such activities are proposed. Threatened aquatic species, populations and communities are listed under the FM Act. The proposed development would not impact on these species.
NPW Act	The NPW Act aims to conserve nature, objects, places or features (including biological diversity) of cultural value within the landscape. If an impact to an Aboriginal heritage object or site is likely from a proposal, a permit must be sought under Section 90. Impacts to Aboriginal heritage are not considered likely. Approval must be sought for any activity on national park estate under this Act. The closest protected area to the site is the Goulburn River National Park, located about 50 kilometres west of the proposal site. The proposal would not directly or indirectly impact on the park.
BC Act	The BC Act lists the threatened species, populations or ecological communities to be considered when deciding if a significant impact on threatened biota, or their habitats, is likely as the result of an activity. The proposal would not impact on threatened species, populations and communities or their habitat.
Heritage Act	The Heritage Act 1977 is administered by the Heritage Division of OEH and aims to ensure that the heritage of NSW is adequately identified and conserved. Under Section 57, a permit must be obtained for works, which have the potential to interfere with a heritage item or place, which is either listed on the State Heritage Register or the subject of an interim heritage order. There are no state listed heritage items in or near the proposal site.

Legislation	Requirements
Water Management Act 2000 (WM Act)	The WM Act aims to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. It also provides formal protection and enhancement of the environmental quality of waterways and in-stream uses as providing protection of catchment conditions. The WM Act applies where a water sharing plan, issued under the Act, has commenced. The proposal is located within the areas subject to the *Hunter Unregulated and Alluvial Water Sharing Plan 2009*. Section 56 of the Act establishes access licences for the taking of water within a water management area. Construction activities that require the extraction of more than 0.5 megalitres of water a year (as per the exemption under Schedule 5 of the WM Regulation) must obtain a water access licence (WAL) under this Act. It is not anticipated that dewatering would be required for the construction of the proposal. If it is identified that dewatering is required, volumes would be measured and a WAL obtained if necessary.
Protection of the Environment Operations Act 1999 (POEO Act)	Under Section 48 of the Act, an environmental protection licence (EPL) relating to air, water and noise pollution and waste management is required for scheduled activities as listed under Schedule 1 of the Act. The proposal could fit the definition of a scheduled activity under either of the following clause: **Clause 34 Resource recovery** (a) involves having on site at any time more than 1,000 tonnes or 1,000 cubic metres of waste, or (b) involves processing more than 6,000 tonnes of waste per year **Clause 41 Waste processing (non-thermal treatment)** (a) involves having on site at any time more than 1,000 tonnes or 1,000 cubic metres of waste, or (b) involves processing more than 6,000 tonnes of waste per year Based on the quantity of material processing to occur within the scope of the proposal, an EPL is not required.
Contaminated Land Management Act 1997 (CLM Act)	Section 59(2) of the CLM Act requires notification of contaminated sites. Section 60 of the CLM Act requires landowners to report any contamination that represents a significant risk of harm to human health or the environment to the EPA. There is no known contamination at the proposal site.
Biosecurity Act 2015	Priority weeds are classified under this Act. Under Section 13, public authorities and land owners are required to control priority weeds in accordance with their classification. Mitigation measures to control the spread of priority weeds are discussed in Section 4.7.1.
Waste Avoidance and Resource Recovery Act 2000	This Act provides a framework to identify and implement the most efficient use of resources in order to reduce the potential for environmental harm arising from the generation of waste. The construction contractor would be required to conform to the provisions of the Act in relation to waste management by adopting the resource management hierarchy principals (in order of priority) of avoidance, resource recovery and disposal.

Legislation	Requirements
Crown Land Management Act 2016 (CL Act)	The CL Act provides for the ownership, use and management of Crown land of NSW. Carramere Road is Crown land. No works are proposed on Crown land.

5.3 Relevant plans and policy

5.3.1 Hunter Regional Plan 2036

The *Hunter Regional Plan 2036* is a 20 year blueprint for the future of the Hunter. The Plan identifies four goals:

- A leading regional economy in Australia
- A biodiversity–rich natural environment
- Thriving communities
- Greater housing choice and jobs

The Plan identifies renewable energy in its Vision of the Hunter as:

"A knowledge centre of excellence in health and education is providing world-class research into medical technologies, agricultural productivity, renewable energy and mining services".

Goal 1 Direction 5

Energy is identified in Goal 1 as an emerging industry with the Upper Hunter recognised in Direction 5 as a major supplier and a Strategic Centre (Figure 9). Following this, one identified action (5.3) is to

"Identify the land and infrastructure requirements to develop the Hunter's coal and ***alternative energy resources****"*

Goal 1 Direction 12

Direction 12 of the Plan outlines ways to diversity and grow the energy sector. In particular, action 12.1 states:

"Diversify and grow the energy sector by working with stakeholders, including councils, communities and industry, to identify and support ***opportunities for smaller-scale renewable energy initiatives*** *such as those using* ***bioenergy*** *or waste coalmine methane".*

The proposal is consistent with the vision and goals of the *Hunter Regional Plan 2036* as it enables growth of the energy section, in particular bioenergy and alternate energy resources.

5.3.2 Land Use Development Strategy

Council's *Land Use Development Strategy* is primarily an overarching internal policy framework to guide the long term strategic direction of the Shire and inform Council's policy position in regards to the various land uses within the shire. This is a document that will confirm a 'first principle' approach to land use, and will provide a key starting point for further detailed land use planning investigations.

This Strategy identifies the importance of energy as a key resource in the LGA. In particular, from an economic context. *"Muswellbrook Shire has been experiencing a steady economic growth during last two decades, due to the significant developments in the coal, energy, equine and wine industries".*

The proposal is consistent with the *Land Use Development Strategy* by providing further energy resources in the region.

5.3.3 Muswellbrook Industrial Lands Audit

The Industrial Lands Audit was endorsed in December 2015 and provides a detailed analysis of supply and demand characteristics for industrial development within the Muswellbrook LGA and identifies future industrial land needs (amount, type, location, opportunities, 'drivers of change', appropriate controls), consistent with the regional strategies to inform future planning.

Section 9.3.2 of the Audit identifies industries to target to broaden the provision of industries in the Muswellbrook Shire. This includes green energy production.

The proposal is broadly consistent with the findings of the Audit.

6. Conclusion

GHD was engaged by Ethtec to prepare an SEE for the proposed development of the Hunter Pilot Biorefinery at Carramere Road, Muswellbrook, NSW. This SEE will accompany a DA to Council to seek consent.

This SEE provides a description of the subject site, the proposed development, a review of relevant statutory planning controls, an assessment of potential environmental impacts and recommended mitigation measures. The assessment has been prepared in accordance with the matters for consideration under Section 4.15 of the EP&A Act.

The proposal is classified as regionally significant development under Schedule 7, Clause 3(b) of SEPP SRD. Therefore, the proposal will be determined by the Hunter and Central Coast JRPP.

The proposal would advance the development of biomass technologies and new regional industries. It would provide a state-of-the-art research, development and education facility with a focus on advancing and promoting sustainable economic renewal in the Hunter Region and across NSW.

As discussed throughout this report, it is considered that the proposal is appropriate and should be supported by council as:

- The proposal is permissible under ISEPP and complies with the relevant provisions of the LEP and DCP.
- The proposal complies with relevant state planning policies.
- The proposal would not have a significant adverse environmental, social or economic impact.

Mitigation and management measures are proposed in this SEE to assist in minimising any potential impacts of the proposal. Prior to construction, these mitigation measures would be incorporated into a construction environmental management plan or safe work method statement, which would be implemented by the construction contractor to minimise any impact on the local environment and community.

Ethtec respectfully request the approval of this application. Detailed designs and additional information are currently being prepared, and would be refined in response to Council's conditions of consent, for submission with the application for the construction certificate.

7. References

Australian Bureau of Meteorology (BoM), 2006, *About Dust – test*. Available online from http://www.bom.gov.au/nsw/sevwx/facts/dust.shtml

Australian Bureau of Statistics 2018, *2016 Census Quickstats Muswellbrook.* Available online from http://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/LGA15650?opendocument

Department of Environment and Energy (DEE) 2017 *EPBC Online Protected Matters Search Tool.* Online resource http://www.environment.gov.au/erin/ert/epbc/index.html queried July 2018. Department of Sustainability, Environment, Water, Population and Communities

Department of Environment and Climate Change (DECC), 2008, *NSW Soils and Construction – Managing Urban Stormwater* Volume 2

Department of Environment, Climate Change and Water, (DECCW), 2009, *Waste Classification Guidelines*

Department of Land and Water Conservation (DLWC) 1997 *NSW State Groundwater Policy Framework*

Environment Protection Authority (EPA) 2017 *Noise Policy for Industry*

Hunter Central Rivers Catchment Management Area (HCRCMA) 2009, *Hunter Central Rivers Catchment Management Area Vegetation Community Map*

Kovac M and Lawrie JM, 1991, Soil Landscapes of the Singleton 1:250,000 Sheet, Soil Conservation Service of NSW, Sydney

Landcom, 2004, *NSW Soils and Construction – Managing Urban Stormwater* Volume 1

National Transport Commission, 2018, *Australian Dangerous Goods Code*

NSW Office of Water (NOW), 2012 *NSW Aquifer Interference Policy*

Qualtest, 2017, *Proposed Industrial Development – Geotechnical Assessment*

Safe Work Australia, 2009, *Managing Noise and Preventing Hearing Loss At Work: Code of Practice*

The Commission, 1984, Flood inundation map. Available online from http://nla.gov.au/nla.obj-232818536/view

Willy Weather, 2018, Muswellbrook Wind Data. Available online from https://wind.willyweather.com.au/nsw/hunter/muswellbrook.html

Appendices

Appendix A – Geotechnical assessment

Proposed Industrial Development - Geotechnical Assessment

Lot 22 Carramere Road, Muswellbrook

NEW17P-0022-AA
2 May 2017

Qualtest
LABORATORY (NSW) PTY LTD

GEOTECHNICAL I LABORATORY I EARTHWORKS I QUARRY I CONSTRUCTION MATERIAL TESTING

2 May 2017

Ethanol Technologies Limited
C/- NSW Sugar Milling Co-operative Ltd
Mill Road
Harwood NSW 2465

Attention: Mr Andrew Reeves

Dear Andrew,

RE: PROPOSED INDUSTRIAL DEVELOPMENT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK
GEOTECHNICAL ASSESSMENT

Please find enclosed our geotechnical report for the proposed industrial development to be located at Lot 22 Carramere Road, Muswellbrook, NSW.

The report includes recommendations for Site Classification in accordance with AS2870-2011, "*Residential Slabs and Footings*", design parameters for shallow foundations, earthworks, and provides pavement thickness designs and construction recommendations for the associated carparks and hardstands.

If you have any questions regarding this report, please do not hesitate to contact Shannon Kelly or the undersigned.

For and on behalf of Qualtest Laboratory (NSW) Pty Ltd

Jason Lee
Principal Geotechnical Engineer

Table of Contents:

1.0 Introduction 1
2.0 Field Work 2
3.0 Site Description 2
3.1 Surface Conditions 2
3.2 Subsurface Conditions 3
4.0 Laboratory Testing 5
5.0 Discussion and Recommendations 5
5.1 Site Classification to AS2870-2011 5
5.2 Pavement Design 7
5.2.1 Design Subgrade CBR Value 7
5.2.2 Design Traffic Loadings 7
5.2.3 Flexible Pavement Thickness Design 8
5.2.4 Rigid (Concrete) Pavement Thickness Design 11
5.3 Excavation Conditions 12
5.4 Site Preparation 13
5.5 Fill Construction Procedures 14
5.6 Suitability of Site Materials for Re-Use as Fill 14
5.7 Foundation Design Parameters 15
5.8 Design Parameters 16
5.9 Special Requirements for Construction Procedures 17
6.0 Limitations 17

Attachments:

Figure AA1: Approximate Test Locations

Appendix A: Results of Field Investigations

Appendix B: Results of Laboratory Testing

Appendix C: CSIRO Sheet BTF 18

1.0 Introduction

Qualtest Laboratory NSW Pty Ltd (Qualtest) is pleased to present this report to Ethanol Technologies Limited (ETL) for the proposed industrial development to be located at Lot 22 Carramere Road, Muswellbrook.

Based on the brief and drawings provided in emails from McKenzie Burridge & Associates (MBA) dated 14 and 15 July 2016, subsequent email from ETL dated 9 December 2016 including an updated concept site layout plan, and subsequent phone discussions, the proposed development is understood to comprise of:

- Three new buildings:
    - A roughly 'U' shaped building in the southern part of the site, with a maximum length of about 71m and a maximum width of about 57.5m, with heights varying from about 7.8m to 10.3m;
    - A rectangular shaped curved roof building in the southern part of the site, to be positioned to the east of the 'U' shaped building. It is proposed to have dimensions of about 55.8m by 14.5m, and about 6.2m high, with a 5m x 25m by 3m deep sump;
    - A square building to be positioned to the northeast of the rectangular building, with dimensions of about 15m by 15m.
- Associated pavements for carparks and hardstands;
- Area of 'possible future construction site' on the north-western side of the lot, assumed to comprise similar type development.

No further details of proposed site developments are known in terms of potential building column loads, footing types, or locations and traffic loadings for pavements and hardstands. It is understood that geotechnical investigations are to cover both the area of proposed buildings shown, and the area of possible future construction site, with shallow foundations to be assumed at this stage.

The scope of work for the geotechnical assessment included providing discussion and recommendations on the following:

- Site preparation;
- Excavation conditions and depth to rock (if encountered);
- The suitability of the site soils for use as fill and fill construction procedures;
- Site classification to AS2870-2011, "Residential Slabs and Footings";
- Foundation design parameters;
- Pavement design and construction (flexible and rigid concrete pavements);
- Special requirements for construction procedures and or site drainage.

This report presents the results of the field work investigations and laboratory testing, and provides recommendations for the scope outlined above.

2.0 Field Work

The field work investigations were carried out on 22 March 2017 and comprised of:

- DBYD search of the site was undertaken to check proposed test locations for the presence of underground services;
- Site walkover to make observations of surface features at the property and in the immediate surrounding area;
- Excavation of 13 test pits (TP01 to TP13) in the area of proposed development using a 12-tonne excavator equipped with a 600mm wide bucket. Test pits were terminated at depths of between 3.00m and 3.20m;
- Undisturbed samples (U50 tubes) and bulk disturbed samples were taken for subsequent laboratory testing;
- Test pits were backfilled with the excavation spoil and compacted using the excavator bucket and tracks.

Investigations were carried out by an experienced Geotechnical Engineer from Qualtest who located the test pits, carried out the testing and sampling, produced field logs of the test pits, and made observations of the site surface conditions.

Approximate test pit locations are shown on the attached Figure AA1. Test pits were located in the field by handheld GPS and relative to existing site features including topographic features, lot boundaries, existing developments and trees.

Engineering logs of the test pits are presented in Appendix A. Approximate surface levels shown on the engineering logs have been interpolated from a survey plan provided by the client.

3.0 Site Description

3.1 Surface Conditions

The site is located at Lot 22, DP1131270, at the eastern end of Carramere Road, Muswellbrook, NSW. The Lot comprises an irregular shaped parcel of land of about 3.6 hectares (ha) as shown in Figure AA1. The site of the proposed development area is generally located on the south-western side of the lot, and covers an area of about 1.8ha.

The site is bound by undeveloped grass lands to the north, and south of the site, with some scattered trees and dams present. The site is bounded by Ramrod Creek to the east, and is bounded by industrial properties to the west, with access to the site via Carramere Road to the west.

The site is located on the northeast facing lower slopes of a northwest trending spur. The site generally slopes towards the northeast at between about 1° and 3°. The slope steepens and varies locally on the eastern side of the site in the vicinity of Ramrod Creek, and at an existing roughly 50m wide dam located on the north-western side of the lot. Based upon the survey data provided to Qualtest, as prepared by MM Hyndes Bailey and Co. (Job Ref: 216167, sheet 1 of 1, dated 06/03/2017), the surface levels of the site are understood to vary between about RL 173.93m and RL 164.28m (AHD).

Drainage is judged to be primarily by way of surface runoff towards Ramrod Creek, with some infiltration into the sandy topsoil layer. The western corner of the site is likely to drain into the existing dam located beside the north-western boundary. The remainder of the site is likely to flow to Ramrod Creek to the north-east of the site.

No exposed bedrock was observed during the site inspection. There are no existing structures or pavements on the site.

Photographs of the site taken on the day of the site investigations are shown below.

Photograph 1: Facing northwest from near TP13. Excavator visible at TP12 in background.

Photograph 2: Facing northeast from near TP13.

Photograph 3: Facing south from near TP01.

Photograph 4: View facing southwest from near TP01. Spoil of TP01 visible.

3.2 Subsurface Conditions

Reference to the 1:25,000 Geological Sheet 9033-II-N for Muswellbrook indicates the site to be underlain by the Branxton Formation of the Maitland Group, which is characterised by sandstone, siltstone and conglomerate rock types. The site is situated near the base of a broad gully with Ramrad Creek passing through the rear of the lot; therefore, some deeper localised alluvial deposits may be encountered on site.

Table 1 presents a summary of the typical soil types encountered at test pit locations during the field investigation, divided into representative geotechnical units.

Table 2 contains a summary of the distribution of the above geotechnical units at the test pit locations.

TABLE 1 – SUMMARY OF GEOTECHNICAL UNITS AND SOIL TYPES

Unit	Soil Type	Description
1	Topsoil	(SM) Silty SAND – fine grained, dark brown, root affected.
2	Slopewash	(SC) Clayey SAND – fine to medium grained, grey, with some silt, trace of fine gravel, sub-rounded. (SP) SAND – fine to medium grained, grey, trace clay, trace fine to medium grained gravel, sub-rounded. Gravelly in places.
3	Alluvium / Residual Soil	(CI) Sandy CLAY – medium plasticity, becoming low to medium plasticity at depth in places, various colour combinations of orange-brown, red-brown and grey-brown, mostly fine to medium grained sand, with trace fine grained gravel, sub-rounded to sub-angular in places. Mostly of hard consistency, becoming stiff to very stiff consistency with depth in places.

TABLE 2 – SUMMARY OF GEOTECHNICAL UNITS ENCOUNTERED AT EACH TEST PIT LOCATION

Location	Unit 1 Topsoil	Unit 2 Slopewash	Unit 3 Alluvium / Residual Soil
	Depth (m)		
TP01	0.00 – 0.17	0.17 – 0.35	0.35 – 3.10
TP02	0.00 – 0.10	0.10 – 0.25	0.25 – 3.00
TP03	0.00 – 0.15	0.15 – 0.28	0.28 – 3.20
TP04	0.00 – 0.15	0.15 – 0.37	0.37 – 3.10
TP05	0.00 – 0.07	0.07 – 0.32	0.32 – 3.10
TP06	0.00 – 0.13	0.13 – 0.35	0.35 – 3.10
TP07	0.00 – 0.23	0.23 – 0.40	0.40 – 3.10
TP08	0.00 – 0.15	0.15 – 0.30	0.30 – 3.10
TP09	0.00 – 0.14	0.14 – 0.23	0.23 – 3.10
TP10	0.00 – 0.15	0.15 – 0.28	0.28 – 3.00^
TP11	0.00 – 0.17	0.17 – 0.47	0.47 – 3.00
TP12	0.00 – 0.40	0.40 – 0.60	0.60 – 3.10
TP13	0.00 – 0.25	0.25 – 0.32	0.32 – 3.10^
Notes:	^ = Slow to very slow progress, close to practical refusal of 12 tonne excavator.		

No groundwater levels or inflows were encountered in the test pits during the limited time that they remained open on the day of the field investigations.

It should be noted that groundwater conditions can vary due to rainfall and other influences including regional groundwater flow, temperature, permeability, recharge areas, surface condition, and subsoil drainage.

4.0 Laboratory Testing

Samples collected during the current field investigations were returned to our NATA accredited Warabrook Laboratory for testing which comprised of:

- (4 no.) California Bearing Ratio (CBR, 4 day soaked) & Standard Compaction;
- (2 no.) Shrink / Swell tests;

Results of the laboratory testing are presented in Appendix B, with a summary of the CBR, and Shrink/Swell test results presented in Tables 3 and 4.

TABLE 3 – SUMMARY OF CBR TESTING RESULTS

Location	Sample Depth (m)	Field Moisture Content (%)	Optimum Moisture Content (%)	Relationship of Field MC to OMC (%)	CBR (%)
TP01	0.40 – 0.60	16.6	19.1	2.5 dry	6
TP05	0.40 – 0.70	13.2	16.9	3.7 dry	4.0
TP07	0.80 – 1.00	9.1	11.8	2.7 dry	8
TP13	0.60 – 0.90	11.7	14.8	3.1 dry	8

TABLE 4 – SUMMARY OF SHRINK / SWELL TESTING RESULTS

Location	Depth (m)	Material Description	I_{ss} (%)
TP04	0.50 – 0.76	(CI) Sandy CLAY	1.2
TP12	0.95 – 1.20	(CI) Sandy CLAY	1.5

5.0 Discussion and Recommendations

5.1 Site Classification to AS2870-2011

Based on the results of the field work and laboratory testing, the site of proposed development located at Lot 22, DP1131270, at the eastern end of Carramere Road, Muswellbrook, as shown on the attached Figure AA1, is classified in its current condition in accordance with AS2870-2011 *'Residential Slabs and Footings'*, as **Class 'H1-D'**.

A characteristic free surface movement of 40mm to 60mm is estimated for areas classified as **Class 'H1-D'** in their existing condition.

The effects of changes to the soil profile by additional cutting and filling and the effects of past and future trees should be considered in selection of the design value for differential movement.

The area of the existing dam on the north-western side of the site is classified as **Class 'P'** due to the presence of uncontrolled fill, and probable abnormal moisture conditions associated with prolonged wet conditions within the dam.

If site re-grading works involving cutting or filling are performed after the date of this assessment the classification may change and further advice should be sought.

As a preliminary guide, areas filled with site won Unit 3 Alluvium/Residual Soil or similar material, carried out to 'Level 1' criteria as defined in Clause 8.2 – Section 8, of AS3798-2007, are likely to be classified as Class 'H1-D' or Class 'H2-D'. A characteristic free surface movement of 60mm to 75mm would apply for areas classified as Class 'H2-D'. Areas filled with imported material of higher reactivity may potentially be classified as Class 'E-D'.

Final site classification will be dependent on a number of factors, including depth of topsoil, depth of cut / fill, reactivity of the natural soil and any fill material placed, and the level of supervision carried out. Re-classification of lots should be confirmed by the geotechnical authority at the time of construction following any site re-grade works.

Footings for the proposed development should be designed and constructed in accordance with the requirements of AS2870-2011.

The classification presented above assumes that:

- All footings are founded in controlled fill (if applicable) or in the natural clayey soils or rock (if encountered) below all non-controlled fill, topsoil material and root zones, and fill under slab panels meets the requirements of AS2870-2011, in particular, the root zone must be removed prior to the placement of fill materials beneath slabs.
- The performance expectations set out in Appendix B of AS2870-2011 are acceptable, and that site foundation maintenance is undertaken to avoid extremes of wetting and drying.
- Footings are to be founded outside of or below all zones of influence resulting from existing or future service trenches.
- The constructional and architectural requirements for reactive clay sites set out in AS2870-2011 are followed.
- Adherence to the detailing requirement outlined in Section 5 of AS2870-2011 '*Residential Slabs and Footings*' is essential, in particular Section 5.6, 'Additional requirements for Classes M, H1, H2 and E sites' including architectural restrictions, plumbing and drainage requirements.
- Site maintenance complies with the provisions of CSIRO Sheet BTF 18, "Foundation Maintenance and Footing Performance: A Homeowner's Guide", a copy of which is attached in Appendix C.

All structural elements should be supported on footings founded beneath all uncontrolled fill, layers of inadequate bearing capacity, soft/loose, or other potentially deleterious material.

If any areas of uncontrolled fill of depths greater than 0.4m are encountered during construction, footings should be designed in accordance with engineering principles for Class 'P' sites.

5.2 Pavement Design

5.2.1 Design Subgrade CBR Value

Based on the results of the field work and laboratory testing, the following design California Bearing Ratio (CBR) value has been adopted for pavement thickness design for the proposed internal subdivision roads.

- Design Subgrade CBR = 4.0%

Fill placed at road subgrade level should be assessed by a geotechnical authority. If the fill is assessed to have CBR different to that of the design CBR, then a revised pavement design will be required for that section.

Subgrade should be prepared in accordance with the site preparation requirements presented in Section 5.4.

5.2.2 Design Traffic Loadings

In the absence of detailed traffic data for the site, an estimate has been made in terms of equivalent standard axles (ESA's) based on the proposed use of the site, with respect to Muswellbrook Shire Council (MSC) Development Design Specification - 0042 Pavement Design, Rev_2 2013.

Two options have been provided, based on anticipated traffic volumes and usage. A summary of the design traffic loading adopted for the proposed access roads and car park areas is presented in Table 5.

TABLE 5 – FLEXIBLE PAVEMENT DESIGN TRAFFIC LOADING

Road Section	Equivalent Classification (Muswellbrook Shire Council)	Design Traffic (ESA's)
Access Roads – Option 1	Urban Residential – Local Street	3×10^5
Access Roads – Option 2	Urban Residential – Access Street	6×10^4

Option 1 - Based upon a 25 year design life, the estimated traffic of 3×10^5 ESA's comprises an average of about 32 ESA's per day if it is assumed that the site operates 7 days per week. Based on an assumption of about 2.5 ESA's per heavy vehicle; the design traffic could be equated to about 10 heavy vehicles per day plus a number of smaller commercial and private vehicles of staff / visitors per day.

Option 2 - Based upon a 25 year design life, the estimated traffic of 6×10^4 ESA's has been provided for areas of possible lower design traffic, which allows for some smaller commercial vehicles and occasional heavy vehicles such as garbage trucks (about 2 per day or less).

MSC recommends a design traffic loading of 5×10^6 ESA's for a 'Commercial and Industrial' street type. This is for subdivision roads as opposed to internal pavements, therefore is likely to be significantly higher than proposed site usage. There is currently no information available on anticipated traffic loads, volumes, percentage of heavy vehicles, and/or non-standard axle loads such as for forklifts, cranes, etc. In the event that a different design traffic loading is applicable, then the pavement thickness designs presented in this report should be reviewed and or specific structural assessment for pavements and hardstand areas carried out.

Rigid pavement design to Austroads is based on design traffic in terms of Heavy Vehicle Axle Groups (HVAG). Muswellbrook Shire Council requires design traffic based on a 40 year design life for rigid pavements compared to a 25 year design life for flexible pavements. Based on an adopted ESA per heavy vehicle axle group of 0.5, the design traffic in terms of HVAG is assessed to be as follows:

TABLE 6 – RIGID PAVEMENT DESIGN TRAFFIC LOADING

Road Section	Equivalent Classification (Muswellbrook Shire Council)	Design Traffic (HVAG)
Access Roads – Option 1	Urban Residential – Local Street	1×10^6
Access Roads – Option 2	Urban Residential – Access Street	2×10^5

In the event that a different design traffic loading is applicable, then the pavement thickness designs presented in this report should be reviewed; in particular, if heavy vehicle movements may exceed those described above, or if the site is to be trafficked by vehicles which exceed normal road load limits.

The onus is on the owner, potential owner, or interested party to decide whether the assessed level of risk (dependent on pavement thickness option adopted) is acceptable taking into account the likely consequences of the risk and the balance of initial construction costs versus potential future maintenance costs.

5.2.3 Flexible Pavement Thickness Design

Flexible pavement thickness design has been based on the procedures outlined in:

- Muswellbrook Shire Council - Development Design Specification - 0042 Pavement Design, Rev_2 2013;
- Austroads, "Guide to Pavement Technology, Part 2: Pavement Structural Design";

Flexible Pavement Thickness Designs are presented in Table 7.

Pavement Material Specification and Compaction Requirements are presented in Table 8.

It is recommended that each construction length be boxed out to the minimum subgrade level required by the relevant pavement thickness design. Prior to pavement construction, the exposed subgrade should be assessed by the geotechnical authority to confirm the pavement thickness requirement for that section.

A bridging layer should be allowed for beneath the pavement where road pavement crosses any areas where poor, wet or saturated subgrade conditions are encountered.

TABLE 7 – FLEXIBLE PAVEMENT THICKNESS DESIGN SUMMARY

Road Classification	Option 1 (MSC - Local Street)	Option 2 (MSC - Access Street)
Design Traffic Loading (ESA's)	3×10^5	6×10^4
Subgrade Material	Natural Clay Subgrade	Natural Clay Subgrade
Design Subgrade CBR (%)	4.0	4.0
Wearing Course (mm)	40	40
Base Course (mm)	120	100
Subbase (mm)	240	180
Select Fill (mm)	-	-
Total Thickness (mm)	400	320

Notes:

1) A 7mm primer should be placed over the base course prior to placement of the asphaltic concrete.
2) An allowance for subgrade replacement should be anticipated in any areas where poor, wet or saturated subgrade conditions are encountered.
3) The requirement for, and depth and extent of any subgrade replacement / select filling, should be confirmed by the geotechnical authority at the time of construction.
4) If rock subgrade materials are encountered, the rock should be ripped and re-compacted for a minimum depth of 300mm to break-up preferential drainage paths and provide a dense homogenous surface on which to construct the pavement.
5) Prior to pavement construction, the exposed subgrade should be assessed by the geotechnical authority to confirm the pavement thickness requirement for that section.

TABLE 8 – PAVEMENT MATERIAL SPECIFICATION AND COMPACTION REQUIREMENTS

Pavement Course	Material Specification	Compaction Requirements
Wearing Course (AC)	Muswellbrook Shire Council Specification	Muswellbrook Shire Council Specification
Base Course	RMS - R73 Bound Material (e.g. Stabilstone, ERMB20, or equivalent) Or CBR ≥ 80%, PI ≤ 6% - bound with 5% cementitious binder	98% Modified (AS1289 5.2.1)
Subbase	CBR ≥ 30%, PI ≤ 12%	95% Modified (AS1289 5.2.1)
Select Fill / Stabilised Subgrade	Select, CBR ≥ 15%, PI ≤ 15%, max particle size 75mm Or * 2% cement stabilised subbase material Or * Stabilised Subgrade - lime stabilised with either 3% quicklime or 4% hydrated lime	95% Modified (AS1289 5.2.1)
Subgrade (top 300mm)	Minimum CBR = 4.0%	100% Standard (AS1289 5.1.1)
Subgrade / Fill Below	Minimum CBR = 4.0%	95% Standard (AS1289 5.1.1)

Notes:

1) A Polymer Modified Bitumen (PMB) wearing course is recommended in vehicle braking and turning zones.
2) Pavement materials for base course and subbase shall also comply with Muswellbrook Shire Council construction specifications.
3) CBR = California Bearing Ratio, PI = Plasticity Index.
4) Select Fill / Stabilised Subgrade options if required and/or adopted will be dependent on subgrade moisture conditions.

5.2.4 Rigid (Concrete) Pavement Thickness Design

Rigid (concrete) pavement design has been carried out in accordance with:

- Muswellbrook Shire Council - Development Design Specification - 0042 Pavement Design, Rev_2 2013;
- Austroads, "Guide to Pavement Technology, Part 2: Pavement Structural Design";

Rigid Pavement Thickness Designs are presented in Table 9.

Pavement Material Specification and Compaction Requirements are presented in Table 10.

TABLE 9 – RIGID PAVEMENT THICKNESS DESIGN SUMMARY

Equivalent Classification	Option 1 (MSC - Local Street)		Option 2 (MSC - Access Street)	
With Shoulder or No Shoulder	With	No	With	No
Design Traffic Loading (HVAG)	1×10^6	1×10^6	2×10^5	2×10^5
Design Subgrade CBR (%)	4.0	4.0	4.0	4.0
Concrete Base (mm)	160	180	150	170
Sub-base (mm)	125 bound	125 bound	125 bound	125 bound
Total Thickness (mm)	285	305	275	295

Notes:

1) The requirement for, and extent of any subgrade replacement / select filling, should be confirmed by the geotechnical authority at the time of construction.
2) Where design is based on the option of "with" shoulder, the concrete shoulder must be either integral or structural in accordance with the requirements of Austroads.

The above designs assume jointed reinforced concrete pavements (JRCP). The base should comprise concrete with a 28-day characteristic compressive strength of not less than 40 MPa.

The concrete should be constructed over lightly bound sub-base (5% cement or equivalent). It would be preferred to have a lightly bound sub-base in all areas; however, unbound sub-base may be considered for lightly trafficked areas (less than 10^6 HVAG), provided the risk of reduced performance at joints is understood and accepted. Alternatively, the sub-base layer may be replaced by 100mm thickness of Lean Concrete Sub-base (LCS).

Dowels are required at all transverse contraction joints which should be designed by an experienced structural engineer.

It is recommended that each construction length be boxed out to the minimum subgrade level required by the relevant pavement thickness design. Prior to pavement construction, the exposed subgrade should be assessed by the geotechnical authority to confirm the pavement thickness requirement for that section.

TABLE 10 – RIGID PAVEMENT MATERIAL SPECIFICATION AND COMPACTION REQUIREMENTS

Pavement Course	Material Specification	Compaction Requirements
Concrete Base - Jointed Reinforced Concrete Pavement (JRCP)	Concrete with minimum characteristic compressive strength, fc = 40 MPa. Reinforced with SL92	
Lean Concrete Sub-base (LCS)	Concrete with minimum characteristic compressive strength, fc = 5 MPa (with fly ash) or 7MPa (without fly ash).	
Bound Sub-base	Conforming to ARRB SR41, CBR > 30%, PI < 12%, bound with 5% cementitious binder	95% Modified (AS1289 5.2.1)
Unbound Sub-base	Conforming to ARRB SR41, CBR > 30%, PI < 12%	95% Modified (AS1289 5.2.1)
Select Fill	CBR > 15%, PI< 15%, max particle size 75mm	95% Modified (AS1289 5.2.1)
Subgrade (top 300mm)	Minimum CBR = 3.5%	100% Standard (AS1289 5.1.1)
Subgrade / Fill Below	Minimum CBR = 3.5%	95% Standard (AS1289 5.1.1)
CBR = California Bearing Ratio PI = Plasticity Index.		

5.3 Excavation Conditions

The depths of topsoil, slopewash and alluvial / residual soils encountered in the tests pits are summarised in Table 2.

In terms of excavation conditions, site materials can generally be divided into:

- Clayey and Granular Soils (Units 1, 2, & 3). It is anticipated that these materials could be excavated by a conventional excavator or backhoe bucket;
- Weathered Rock - Not expected to be encountered within excavations to depths of up to about 3m as part of the proposed development. It is recommended that targeted investigations (deep boreholes with a drilling rig) are carried out if significant excavations are proposed where bedrock depth or excavatability is important to design or construction.
- It should be noted that if encountered, excavation in bedrock will be dependent on rock strength, depth, degree of weathering and number of defects within the rock mass, which can vary significantly.

Groundwater may exist at localised areas of the site such as within the topsoil / slopewash profile, from water perched above the alluvial clay / bedrock profile, and in lower lying areas of the site in the vicinity of watercourses and dams. It is possible that slow water inflow may be

encountered from such layers, particularly if earthworks are carried out during or following periods of wet weather.

Excavations should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected from erosion.

Temporary excavations should be battered at 1V:1H or flatter in cohesive soils, or 1V:1.5H or flatter in granular soils, and protected from erosion. Steeper excavations may be supported by means of temporary shoring.

Temporary excavations to depths of up to 1.2m in competent compact material with sufficient cohesion, such as clay of stiff consistency or better may be battered vertically, subject to inspection during excavation by the geotechnical authority.

The safe working procedures of Work Cover NSW Excavation work code of practice, dated July 2014 should be followed.

Care should be taken not to disturb or destabilise existing underground services or structures.

5.4 Site Preparation

Site preparation and earthworks suitable for pavement support and site re-grading should consist of:

- Following any bulk excavation to proposed subgrade level, all areas of proposed pavement construction or site re-grading should be stripped to remove all existing uncontrolled fill, vegetation, topsoil, root affected or other potentially deleterious materials;
- Stripping is generally expected to be required to depths of about 0.1m to 0.4m (deeper in places) to remove existing topsoil and slopewash material where required;
- Additional stripping may be required in any areas where uncontrolled fill or poor, wet or saturated subgrade conditions are encountered;
- Following stripping, the exposed subgrade should be proof rolled (minimum 10 tonne static roller), to identify any wet or excessively deflecting material. Any such areas should be over excavated and backfilled with an approved select material;
- The moisture content of the subgrade materials and therefore the need for moisture conditioning or over-excavation and replacement, will be largely dependent on pre-existing and prevailing weather conditions at the time of construction;
- Subgrade preparation should be carried out using a tracked excavator equipped with a smooth sided ('gummy') bucket to minimise the risk of over-disturbance of soils;
- Protect the area after subgrade preparation to maintain moisture content as far as practicable. The placement of subbase gravel would normally provide adequate protection;
- Site preparation should include provision of drainage and erosion control as required, as well as sedimentation control measures.

At the time of the field investigation, moisture content for the clay subgrade material tested varied from 2.5% dry to 3.7% dry of standard Optimum Moisture Content (OMC). It should be anticipated that moisture conditioning of the subgrade may be necessary prior to compaction and placement of pavement materials.

The required time period to prepare the subgrade is likely to be dependent on the prevailing weather conditions at the time of construction.

If over-wet subgrades exist at the time of construction or deleterious materials are encountered at subgrade level, these materials should be over-excavated and be replaced with a minimum depth of 250mm of well graded granular select material with CBR of 15% or greater, or other material approved by the geotechnical authority as appropriate to the site conditions. The requirement for, and extent of subgrade replacement, should be confirmed by the geotechnical authority at the time of construction.

5.5 Fill Construction Procedures

Earthworks for pavement construction or support of foundations should consist of the following measures:

- Approved fill beneath pavements should be compacted in layers not exceeding 300mm loose thickness to the compaction requirements provided in Table 8;
- The top 300mm of natural subgrade below pavements or the final 300mm of road subgrade fill should be compacted to provide a subgrade that is within the moisture range of 60% to 90% of Optimum Moisture Content (OMC);
- Site fill beneath structures should be compacted to a minimum density ratio of 98% Standard Compaction within ±2% of OMC in cohesive soils;
- All fill should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion;
- Earthworks should be carried out in accordance with the recommendations outlined in AS3798-2007 '*Guidelines for Earthworks for Commercial and Residential Developments*'.

5.6 Suitability of Site Materials for Re-Use as Fill

The following comments are made with respect to suitability of site materials for re-use as fill:

- Unit 1 - Topsoil materials are expected to be suitable for landscaping purposes only;
- Unit 2 - Slopewash may be suitable for re-use as general fill for engineering purposes, except where root affected or in areas susceptible to wetting and softening such as at pavement subgrade level. These materials may require some moisture conditioning and/or blending with other materials to improve engineering properties;
- Unit 3 – Alluvium / Residual Soil is generally expected to be suitable for re-use as general fill for engineering purposes. These materials may require some moisture conditioning.

Final selection of fill materials should consider properties such as reactivity which is typically moderate for site won Unit 3 Alluvium / Residual Soil.

The suitability of material for re-use should be assessed and confirmed by the geotechnical authority at the time of construction.

5.7 Foundation Design Parameters

Strip / pad footings, raft slabs, and conventional bored piles are considered to be suitable foundation options for the proposed development.

Shallow footings founded on stiff or better residual clay, or approved controlled fill (placed under Level 1 supervision in accordance with AS3798-2007) may be proportioned for a maximum allowable vertical bearing pressure of 100kPa and a maximum allowable horizontal bearing pressure of 50kPa, provided they are founded below any existing uncontrolled fill, topsoil, or potentially deleterious material.

The recommended allowable (serviceability) bearing pressures assume that elastic settlements will be less than about 1% of least footing width; although, relevant ground movements related to reactive clay would also apply.

Table 11 presents a summary of founding parameters for deep footings (founding depth greater than 3 times maximum footing width) that have been adopted for the relevant materials.

TABLE 11 – SUMMARY OF DEEP FOOTING DESIGN PARAMETERS

Soil Description	Serviceability (Allowable) End Bearing Capacity (kPa)	Serviceability (Allowable) Shaft Adhesion (kPa)	Ultimate End Bearing Capacity (kPa)	Ultimate Shaft Adhesion (kPa)
Unit 1, & 2 – Topsoil & Slopewash	-	-	-	-
Unit 3 – Alluvium / Residual (stiff or better)	150	25	450	50

Notes:

1) Ultimate values occur at large settlements (>5% of minimum footing dimensions).
2) The ultimate pile parameters presented should be used in limit state pile design in accordance with Australian Standard AS 2159-2009, *Piling – Design and Installation*.
3) A geotechnical strength reduction factor should be adopted for use with the above ultimate soil and rock parameters. A geotechnical strength reduction factor of 0.45 is recommended based on available information at this stage.
4) Piles should be no closer than 2.5 pile diameters apart.
5) It is expected that the settlement of deep footings proportioned as recommended above should not exceed about 1% of the effective pile diameter.

The base of the pile should be cleaned using a suitable bucket to remove spoil, as open flight augers usually cannot remove sufficient spoil to expose the majority of the pile base. If seepage occurs, piles should be dewatered prior to pouring concrete.

A suitably experienced geotechnical engineer should inspect the pile excavations prior to pouring concrete.

Higher pile foundation capacities may be achievable for piles founded in weathered rock; however rock was not encountered within the depth of the test pit excavations.

If high column loads requiring deepened pier footings and higher capacities are required, additional drilling rig investigation should be carried out to assess depth to rock and subsequent foundation design parameters for footing taken to rock.

5.8 Design Parameters

Indicative parameters for generalised site materials are provided in Table 12.

TABLE 12 – GEOTECHNICAL SOIL PARAMETERS

Soil Description	γ (kN/m³)	S_u (kPa)	c' (kPa)	ϕ' (°)	E_v (MPa)	E_h (MPa)	ν
Compacted Fill - Cohesive	19	50	4	27	10	7.5	0.4
Compacted Fill - Granular	20	-	0	35	15 to 30	11 to 22	0.3
Alluvium / Residual Soil - stiff or better clay	19	50	5	27	10	7.5	0.4

Notes:

γ = Unit Weight S_U = Undrained Shear Strength c' = Effective Cohesion

ϕ' = Effective Friction Angle E_v = Vertical Young's Modulus E_h = Young's Modulus

ν = Poisson's Ratio

Retaining walls backfilled with a free draining granular material may be designed for an active earth pressure coefficient (k_a) of 0.33 and a passive earth pressure coefficient (k_p) of 3.0 and a total density of 1.9 t/m³, or the values shown in Table 12 may be adopted where applicable.

An at rest earth pressure coefficient (k_0) should be used instead of an active earth pressure coefficient (K_a) behind the retaining structures for any walls that are relatively rigid and/or propped.

Allowance should be made for in the design of retention measures to resist hydrostatic pressures due to groundwater build-up in addition to earth pressures.

Due to the potential for variability of the soil parameters, appropriately conservative parameters should be selected based on the particular application. In applications where potential variation in the parameters is critical, further testing should be undertaken on representative materials based on trials or similar.

5.9 Special Requirements for Construction Procedures

The enclosed pavement thickness designs assume the provision of adequate surface and subsurface drainage of the pavement and adjacent areas to prevent moisture ingress into the pavement materials and subgrade. As a minimum, it is recommended that subsoil drains be installed:

- Along the high side of roads aligned across site slopes;
- Along both sides of roads aligned down slope.

It is recommended that surface and subsoil drainage be installed in line with the above advice, and in accordance with Council specifications.

Adequate surface and subsurface drainage should be installed and connected to the stormwater disposal system.

Inspection should be carried out by a geotechnical authority during construction to confirm the conditions assumed in this report and in the design.

6.0 Limitations

The findings presented in the report and used as the basis for recommendations presented herein were obtained using normal, industry accepted geotechnical design practices and standards. To our knowledge, they represent a reasonable interpretation of the general conditions of the site.

The extent of testing associated with this assessment is limited to discrete test locations. It should be noted that subsurface conditions between and away from the test locations may be different to those observed during the field work and used as the basis of the recommendations contained in this report.

If subsurface conditions encountered during construction differ from those given in this report, further advice should be sought without delay.

Data and opinions contained within the report may not be used in other contexts or for any other purposes without prior review and agreement by Qualtest. If this report is reproduced it must be in full.

If you have any further questions regarding this report, please do not hesitate to contact Shannon Kelly

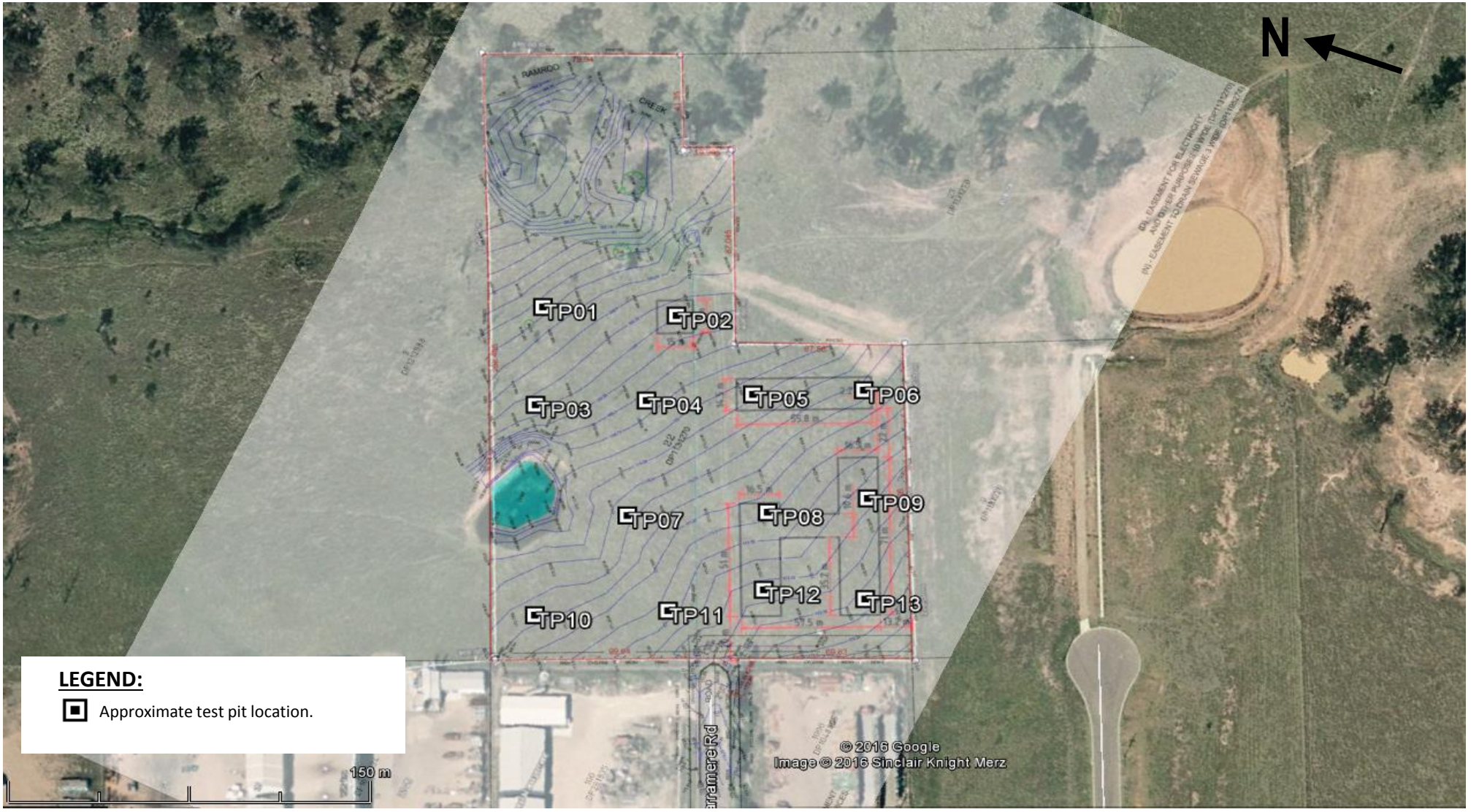
For and on behalf of Qualtest Laboratory (NSW) Pty Ltd.

Jason Lee
Principal Geotechnical Engineer

FIGURES

FIGURE AA1:

Approximate Test Locations



Based on drawing (Job No. 216167, Plan Title: 'Detail & Contour Survey, Lot 22 in DP1131270, Carramere Road, Muswellbrook', Dated 06.03.17, by MM Hyndes Bailey & Co.) and updated site layout plan provided by client, overlayed over Google Earth Image.

Qualtest LABORATORY (NSW) PTY LTD

Client:	ETHANOL TECHNOLOGIES LIMITED	Drawing No:	FIGURE AA1
Project:	PROPOSED INDUSTRIAL DEVELOPMENT	Project No:	NEW17P-0022
Location:	LOT 22 CARRAMERE ROAD, MUSWELLBROOK	Scale:	AS SHOWN
Title:	TEST LOCATION PLAN	Date:	27/04/2017

APPENDIX A:

Results of Field Investigations

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP01
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 167.9 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered					SM	Silty SAND - fine grained, dark brown, root affected.	M				TOPSOIL
							0.17m					
						SC	Clayey SAND - fine to medium grained, grey, with some silt, trace fine grained gravel, sub-rounded.					SLOPE WASH
							0.35m					
		0.40m	167.5				Sandy CLAY - medium plasticity, orange-brown and dark brown, fine to medium grained sand.					ALLUVIUM
		B 0.60m		0.5		CI				HP	>600	
							0.70m					
		0.80m					Sandy CLAY - medium plasticity, red-brown and grey-brown, fine grained sand, with some pockets of Sandy GRAVEL, fine to medium grained.			HP	>600	
		B 1.00m	167.0	1.0								
			166.5	1.5						HP	>600	
						CI		M < w_P	H			
			166.0	2.0								
			165.5	2.5								
		2.70m					2.70m					
		D	165.0	3.0		CL	Sandy CLAY - low to medium plasticity, orange-brown and grey, fine grained sand, with fine to medium grained gravel, rounded to sub-rounded.	M ~ w_P	VSt	HP	280	ALLUVIUM possibly RESIDUAL SOIL
		3.10m					3.10m					
			164.5				Hole Terminated at 3.10 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP02
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 168.9 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		168.9	0.0		SM	Silty SAND - fine grained, dark brown, root affected.					TOPSOIL
				0.10m		SC	Clayey SAND - fine to medium grained, grey, with some silt, trace fine grained gravel, sub-rounded.	M				SLOPE WASH
			168.5	0.25m		CI	Sandy CLAY - medium plasticity, orange-brown to dark grey, fine to medium grained sand.	M ~ w_P	VSt - H	HP	350	ALLUVIUM
				0.5						HP	400	
				0.70m						HP	>600	
			168.0				Sandy CLAY - medium plasticity, red-brown and grey-brown, fine to medium grained sand.			HP	>600	
				1.0								
			167.5							HP	>600	
				1.5			Becoming grey-brown with some orange-brown.	M < w_P	H			
			167.0									
				2.0								
			166.5									
				2.5								
				2.50m			Sandy CLAY - medium plasticity, grey-brown with some orange-brown, fine to medium grained sand.					ALLUVIUM possibly RESIDUAL SOIL
			166.0			CL		M > w_P	St - VSt	HP	150 - 250	
				3.0								
				3.00m			Hole Terminated at 3.00 m					
			165.5									

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP03
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 168.8 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		168.5	0		SM	Silty SAND - fine grained, dark brown, root affected.	M				TOPSOIL
							0.15m					
						SC	Clayey SAND - fine to medium grained, grey, with some silt, trace fine grained gravel, sub-rounded.					SLOPE WASH
							0.28m					
							Sandy CLAY - medium plasticity, orange-brown to red-brown and dark grey, fine grained sand.					ALLUVIUM
				0.5						HP	>600	
			168.0			CI						
										HP	>600	
				1.0								
							1.10m					
							Sandy CLAY - low to medium plasticity, orange-brown and grey, with some black streaks, fine grained sand, with silt, trace of fine grained gravel, sub-rounded to sub-angular.	M < w_P	H			ALLUVIUM possibly RESIDUAL SOIL
			167.5									
				1.5								
			167.0							HP	420	
										HP	390	
				2.0		CL						
			166.5									
				2.5				M ~ w_P	VSt			
										HP	340	
			166.0									
				3.0								
							3.20m			HP	220	
			165.5				Hole Terminated at 3.20 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP04
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 169.6 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		169.5			SM	Silty SAND - fine grained, dark brown, root affected.					TOPSOIL
							0.15m					
						SC	Clayey SAND - fine to medium grained, grey, fines of medium plasticity, with some silt, trace of fine grained gravel, sub-rounded.	M				SLOPE WASH
							0.37m					
		0.50m		0.5		CI	Sandy CLAY - medium plasticity, orange-brown and dark grey, fine grained sand.			HP	>600	ALLUVIUM
		U50	169.0									
		0.76m					0.70m					
							Sandy CLAY - medium plasticity, red-brown and grey-brown, fine grained sand.			HP	>600	
				1.0				M < w_P	H			
			168.5									
				1.5		CI						
			168.0							HP	>600	
										HP	550	
										HP	460	
				2.0						HP	320	
			167.5									
							2.40m					
				2.5			Sandy CLAY - low to medium plasticity, orange-brown and grey, fine grained sand, with fine to medium grained gravel, rounded to sub-rounded.	M ~ w_P	VSt			ALLUVIUM possibly RESIDUAL SOIL
			167.0			CL						
				3.0								
			166.5				3.10m					
							Hole Terminated at 3.10 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP05
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 170.2 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.07m	170.0	0		SM	Silty SAND - fine grained, dark brown, root affected.					TOPSOIL
						SC	Clayey SAND - fine to medium grained, grey to dark grey, fines of medium plasticity, with some silt, trace of fine grained gravel, sub-rounded.	M				SLOPE WASH
				0.32m								
		0.40m					Sandy CLAY - medium plasticity, orange-brown to dark grey, fine grained sand.					ALLUVIUM
		B		0.5		CI				HP	>600	
		0.70m	169.5							HP	>600	
		0.80m					Sandy CLAY - medium plasticity, red-brown and grey-brown, fine to medium grained sand, trace fine grained gravel, sub-angular.					
		B										
		1.00m		1.0				$M < w_P$	H			
			169.0			CI						
				1.5						HP	>600	
			168.5									
				2.0								
				2.00m			Sandy CLAY - medium plasticity, grey-brown, with some orange-brown, fine to medium grained sand, trace of fine grained gravel.					ALLUVIUM possibly RESIDUAL SOIL
			168.0									
				2.5		CI		$M \sim w_P$	VSt	HP	300	
			167.5									
				3.0						HP	310	
				3.10m								
			167.0				Hole Terminated at 3.10 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP06
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 170.9 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		170.9	0.0		SM	Silty SAND - fine grained, dark brown, root affected.					TOPSOIL
							0.13m					
						SC	SAND - fine to medium grained, grey, with some clay, trace of fine grained gravel, sub-rounded.	M				SLOPE WASH
			170.5	0.5			0.35m					
						CI	Sandy CLAY - medium plasticity, orange-brown and dark grey, fine to medium grained sand.			HP	>600	ALLUVIUM
										HP	>600	
			170.0	1.0			0.90m					
							Sandy CLAY - medium plasticity, red-brown, fine to medium grained sand.			HP	>600	ALLUVIUM possibly RESIDUAL SOIL
			169.5	1.5				M < w_P	H	HP	>600	
			169.0	2.0		CI						
			168.5	2.5			Becoming dark grey with some orange.			HP	290	
		2.80m						M ~ w_P	VSt			
		D	168.0	3.0						HP	320	
		3.10m					3.10m					
			167.5				Hole Terminated at 3.10 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP07
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 170.6 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		170.5			SM	Silty SAND - fine grained, dark brown, root affected.	M				TOPSOIL
							0.23m					
						SC	Clayey SAND - fine to medium grained, grey, with some silt, trace of fine to medium grained gravel, sub-rounded.					SLOPE WASH
							0.40m					
				0.5		CI	Sandy CLAY - medium plasticity, orange-brown to dark grey, with some pale grey, fine grained sand.			HP	>600	ALLUVIUM
			170.0							HP	>600	
		0.80m					0.80m					
		B 1.00m					Sandy CLAY - medium plasticity, red-brown and grey-brown, fine grained sand, trace of fine to medium grained gravel, sub-angular to sub-rounded.					ALLUVIUM / RESIDUAL SOIL
				1.0						HP	>600	
			169.5									
				1.5								
			169.0					M < w_P	H			
				2.0		CI				HP	>600	
			168.5									
				2.5								
			168.0									
				3.0								
			167.5				3.10m					
							Hole Terminated at 3.10 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP08
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 171.4 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		171.0	0.5		SM	Silty SAND - fine grained, dark brown, root affected.	M		HP	>600	TOPSOIL
							0.15m					
						SC	Clayey SAND - fine to medium grained, grey, fines of medium plasticity, with some silt, trace of fine grained gravel.					SLOPE WASH
							0.30m					
						CI	Sandy CLAY - medium plasticity, orange brown to brown and dark grey, fine grained sand.			HP	>600	RESIDUAL SOIL / ALLUVIUM
							0.70m					
			170.5	1.0			Sandy CLAY - medium plasticity red-brown to brown, fine to medium grained sand, with some trace of fine to medium grained gravel, sub-rounded to sub-angular.			HP	>600	
			170.0	1.5						HP	>600	
			169.5	2.0		CI		M < w_p	H			
			169.0	2.5								
			168.5	3.0								
							3.10m					
			168.0				Hole Terminated at 3.10 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP09
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 172.2 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		172.2	0		SM	Silty SAND - fine grained, dark brown, root affected.	M				TOPSOIL
				0.14m								
			172.0			SC	Clayey SAND - fine to medium grained, grey, fines of low to medium plasticity, with some silt, trace of fine to medium grained gravel, sub-rounded.					SLOPE WASH
				0.23m								ALLUVIUM
						CL	Sandy CLAY - low to medium plasticity, grey-brown and orange-brown, fine grained sand, with fine to medium grained gravel, sub-rounded to sub-angular.	M > w_P	VSt	HP	330	
				0.5						HP	380	
				0.50m						HP	420	
							Sandy Clayey GRAVEL - fine to coarse grained, sub-rounded to angular, red-brown and grey-brown, fines of medium plasticity, fine to medium grained sand.					ALLUVIUM / RESIDUAL SOIL
			171.5							HP	>600	
										HP	>600	
				1.0		GC		M	D			
			171.0									
		1.30m										
		D					Sandy CLAY - medium plasticity, grey-brown and orange-brown, with some fine to medium grained gravel.					
		1.50m		1.5								
			170.5									
				2.0								
			170.0			SC		M < w_P	H			
				2.5								
			169.5									
		2.80m										
		D										
		3.00m		3.0								
				3.10m								
			169.0				Hole Terminated at 3.10 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP10
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 170.9 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		170.9	0.0		SM	Silty SAND - fine grained, dark brown, root affected.	M				TOPSOIL
				0.15m		SC	Clayey SAND - fine to medium grained, grey, with some silt, trace fine grained gravel, sub-rounded.	M - W				SLOPE WASH
			170.5	0.28m		CH	Sandy CLAY - high plasticity, brown to grey-brown, with some orange-brown, trace fine to medium grained gravel, sub-rounded to sub-angular.	M > w_P	St - VSt	HP HP HP HP	180 280 250 230	ALLUVIUM
				0.5								
				0.60m			Sandy CLAY - medium plasticity, oange-brown, fine to medium grained sand.			HP HP	480 >600	ALLUVIUM / RESIDUAL SOIL
			170.0	1.0			Becoming Sandy CLAY / Clayey SAND, red-brown.					
			169.5	1.5								
			169.0	2.0		CI		M < w_P	H			
			168.5	2.5								
			168.0	3.0								
				3.00m			Hole Terminated at 3.00 m Slow progress					
			167.5									

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP11
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 171.7 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.60m U50 0.76m	171.5	0.0		SM	Silty SAND - fine grained, dark brown, root affected.					TOPSOIL
							0.17m					
						SP	SAND - fine to medium grained, grey, trace clay.	M				SLOPE WASH
				0.5			0.47m					
						CL	Sandy CLAY / Clayey SAND - low plasticity, pale orange and pale grey, fine to medium grained sand.					ALLUVIUM
							0.60m					
			171.0				Sandy CLAY - medium plasticity, orange-brown with some red-brown and grey, fine to medium grained sand.			HP	>600	ALLUVIUM / RESIDUAL SOIL
										HP	>600	
				1.0						HP	>600	
		1.20m D 1.40m	170.5				Becoming red-brown.					
				1.5								
			170.0			CI		M < w_P	H			
				2.0								
			169.5									
				2.5								
			169.0									
				3.0			3.00m					
			168.5				Hole Terminated at 3.00 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1 GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP12
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 172.3 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		172.0			SM	Silty SAND - fine grained, dark brown, root affected in top 100mm.	M				TOPSOIL
				0.5		SP	0.40m Gravelly SAND - fine to medium grained, grey, fine to medium grained gravel, angular to sub-angular.		MD			SLOPE WASH
							0.60m Sandy CLAY - medium plasticity, orange-brown with some red-brown and pale grey, fine to medium grained sand.			HP	>600	ALLUVIUM / RESIDUAL SOIL
			171.5									
		0.95m		1.0			Becoming red-brown and grey-brown.			HP	>600	
		U50										
		1.20m								HP	>600	
			171.0									
				1.5								
			170.5			CI		M < W_P	H			
				2.0								
			170.0									
				2.5								
			169.5									
				3.0			3.10m					
			169.0				Hole Terminated at 3.10 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

CLIENT: ETHANOL TECHNOLOGIES LIMITED
PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
LOCATION: LOT 22 CARRAMERE ROAD, MUSWELLBROOK

TEST PIT NO: TP13
PAGE: 1 OF 1
JOB NO: NEW17P-0022
LOGGED BY: BE
DATE: 22/3/17

EQUIPMENT TYPE: 12 TONNE EXCAVATOR
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.6 m
SURFACE RL: 172.9 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		172.9	0.0		SM	Silty SAND - fine grained, dark brown, root affected.	M				TOPSOIL
							0.25m					
						SP	0.32m SAND - fine to medium grained, grey, trace clay.					SLOPE WASH
			172.5	0.5		CI	Sandy CLAY - medium plasticity, orange-brown to dark brown, fine grained sand.			HP	>600	ALLUVIUM
		0.60m					0.60m					
		B					Sandy CLAY - medium plasticity, orange-brown and pale grey, with some red-brown, fine to medium grained sand.			HP	>600	ALLUVIUM / RESIDUAL SOIL
		0.90m	172.0	1.0			Becoming red-brown and grey-brown.	M < w_P	H	HP	>600	
			171.5	1.5						HP	>600	
							1.80m					
			171.0	2.0			Gravelly Clayey SAND - fine to medium grained, red-brown and grey-brown, fine to medium grained gravel, sub-angular.					
			170.5	2.5		SC		D - M	D - VD			
			170.0	3.0			3.10m					
			169.5				Hole Terminated at 3.10 m Slow progress					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW17P-0022 - TEST PIT LOGS.GPJ <<DrawingFile>> 27/04/2017 17:26 8.30.003 Datgel Lab and In Situ Tool

APPENDIX B:

Results of Laboratory Testing

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

California Bearing Ratio Test Report

Report No: CBR:NEW17W-1306--S01
Issue No: 1

Client:	Ethanol Technologies Limited C/- NSW Sugar Milling Co-operative Ltd Mill Road, Harwood NSW 2465
Principal:	
Project No.:	NEW17P-0022
Project Name:	Proposed Industrial Development

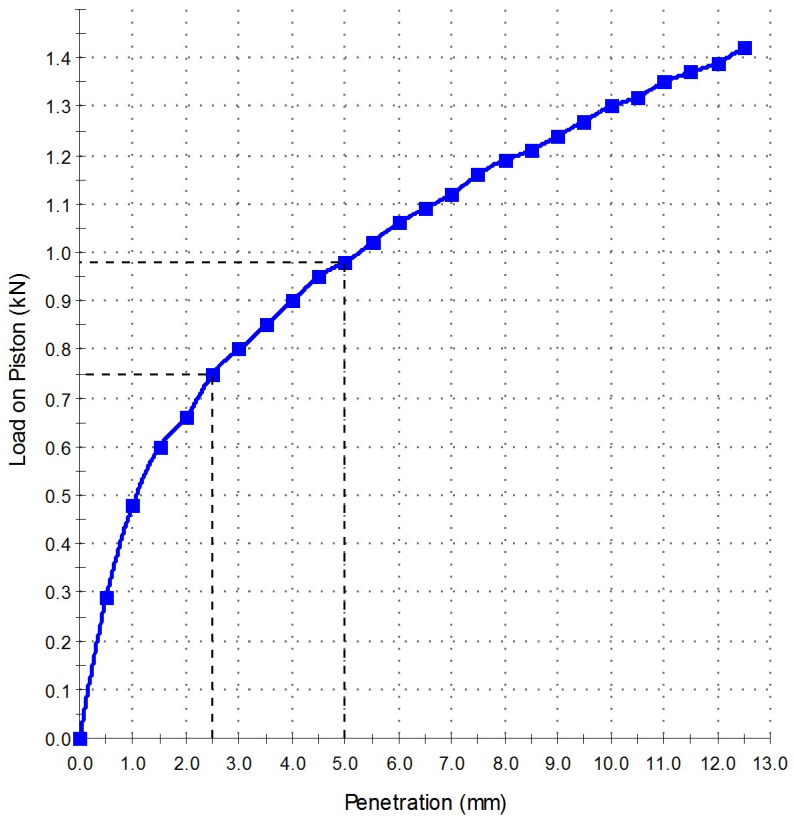
Accredited for compliance with ISO/IEC 17025
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

Approved Signatory: Brent Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 11/04/2017

Sample Details

Sample ID:	NEW17W-1306--S01	Date Sampled:	22/03/2017
Sampling Method:	AS1289.1.2.1 cl 6.4b		
Specification:	No Specification	Source:	On-Site
Location:	TP01 - (0.40 - 0.60m)	Material:	Sandy Clay
Project Location:	Lot 22 Carramere Road, Muswellbrook, NSW		

Load vs Penetration



Test Results

AS 1289.6.1.1

CBR At 2.5mm (%):	6
Maximum Dry Density (t/m³):	1.68
Optimum Moisture Content (%):	19.1
Dry Density before Soaking (t/m³):	1.68
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	18.9
Moisture Ratio before Soaking (%):	99
Dry Density after Soaking (t/m³):	1.69
Density Ratio after Soaking (%):	101
Swell (%):	-0.5
Moisture Content of Top 30mm (%):	24.7
Moisture Content of Remaining Depth (%):	20.5
Compactive Effort:	Standard
Surcharge Mass (kg):	9.00
Period of Soaking (Days):	4
Oversize Material (%):	0.0

Moisture Content

Field Moisture Content (%):	16.6

Comments

Moisture Content Method Performed as Per AS1289.2.1.1.
Laboratory Moisture Ratio (LMR): 99.0% Laboratory Density Ratio (LDR): 100.0%

© 2000-2013 QESTLab by SpectraQEST.com

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

California Bearing Ratio Test Report

Report No: CBR:NEW17W-1306--S02
Issue No: 1

Client: Ethanol Technologies Limited
C/- NSW Sugar Milling Co-operative Ltd
Mill Road, Harwood NSW 2465

Principal:
Project No.: NEW17P-0022
Project Name: Proposed Industrial Development

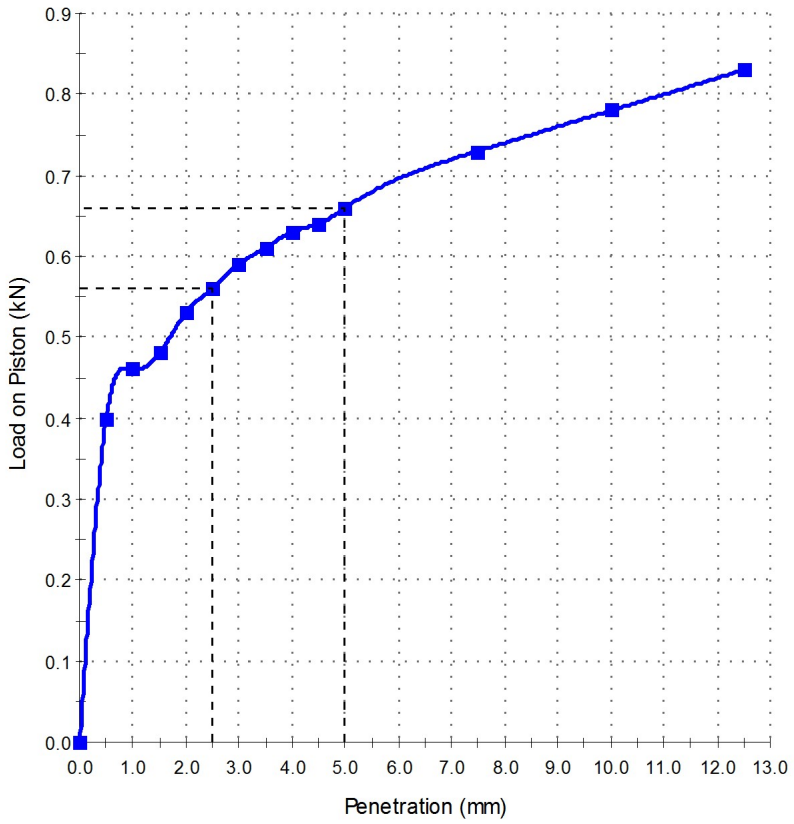
Accredited for compliance with ISO/IEC 17025
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

Approved Signatory: Brent Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 12/04/2017

Sample Details

Sample ID:	NEW17W-1306--S02	Date Sampled:	22/03/2017
Sampling Method:	AS1289.1.2.1 cl 6.4b		
Specification:	No Specification	Source:	On-Site
Location:	TP05 - (0.40 - 0.70m)	Material:	Sandy Clay
Project Location:	Lot 22 Carramere Road, Muswellbrook, NSW		

Load vs Penetration



Test Results

AS 1289.6.1.1

CBR At 2.5mm (%):	4.0
Maximum Dry Density (t/m³):	1.71
Optimum Moisture Content (%):	16.9
Dry Density before Soaking (t/m³):	1.72
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	16.8
Moisture Ratio before Soaking (%):	100
Dry Density after Soaking (t/m³):	1.68
Density Ratio after Soaking (%):	98
Swell (%):	2.0
Moisture Content of Top 30mm (%):	26.4
Moisture Content of Remaining Depth (%):	19.0
Compactive Effort:	Standard
Surcharge Mass (kg):	9.00
Period of Soaking (Days):	4
Oversize Material (%):	0.0

Moisture Content

Field Moisture Content (%):	13.2

Comments

Moisture Content Method Performed as Per AS1289.2.1.1.
Laboratory Moisture Ratio (LMR): 100.0% Laboratory Density Ratio (LDR): 99.5%

© 2000-2013 QESTLab by SpectraQEST.com

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

California Bearing Ratio Test Report

Report No: CBR:NEW17W-1306--S03
Issue No: 1

Client: Ethanol Technologies Limited
C/- NSW Sugar Milling Co-operative Ltd
Mill Road, Harwood NSW 2465

Principal:
Project No.: NEW17P-0022
Project Name: Proposed Industrial Development

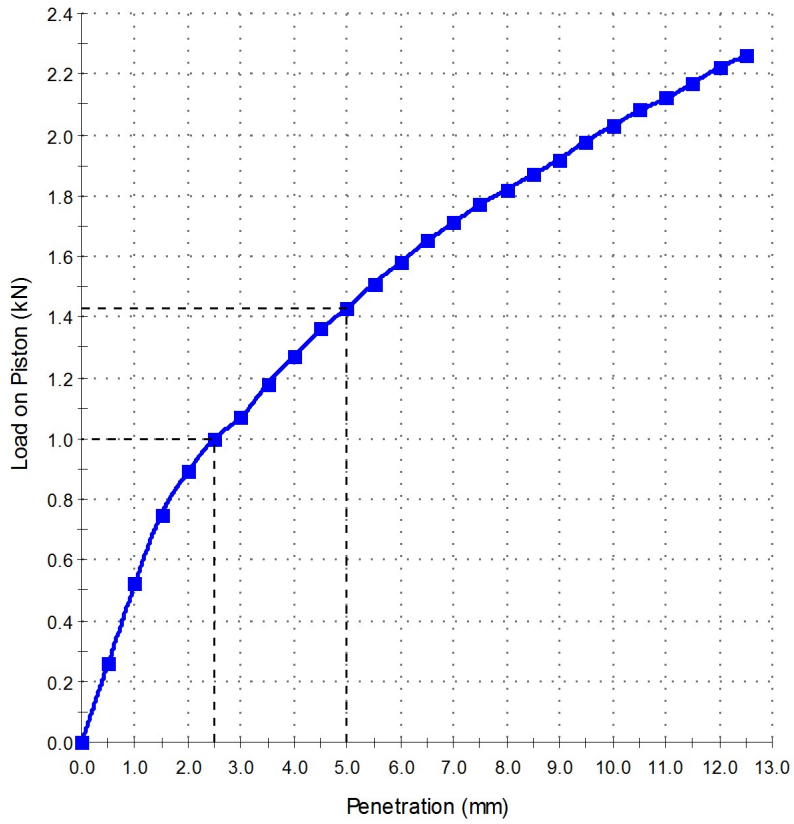
Accredited for compliance with ISO/IEC 17025
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

Approved Signatory: Brent Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 11/04/2017

Sample Details

Sample ID:	NEW17W-1306--S03	Date Sampled:	22/03/2017
Sampling Method:	AS1289.1.2.1 cl 6.4b		
Specification:	No Specification	Source:	On-Site
Location:	TP07 - (0.80 - 1.00m)	Material:	Sandy Clay
Project Location:	Lot 22 Carramere Road, Muswellbrook, NSW		

Load vs Penetration



Test Results

AS 1289.6.1.1

CBR At 2.5mm (%):	8
Maximum Dry Density (t/m³):	1.87
Optimum Moisture Content (%):	11.8
Dry Density before Soaking (t/m³):	1.87
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	11.9
Moisture Ratio before Soaking (%):	101
Dry Density after Soaking (t/m³):	1.86
Density Ratio after Soaking (%):	100
Swell (%):	0.5
Moisture Content of Top 30mm (%):	15.0
Moisture Content of Remaining Depth (%):	13.7
Compactive Effort:	Standard
Surcharge Mass (kg):	9.00
Period of Soaking (Days):	4
Oversize Material (%):	0.0

Moisture Content

Field Moisture Content (%):	9.1

Comments

Moisture Content Method Performed as Per AS1289.2.1.1.
Laboratory Moisture Ratio (LMR): 101.0% Laboratory Density Ratio (LDR): 100.0%

© 2000-2013 QESTLab by SpectraQEST.com

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

California Bearing Ratio Test Report

Report No: CBR:NEW17W-1306--S04
Issue No: 1

Client: Ethanol Technologies Limited
C/- NSW Sugar Milling Co-operative Ltd
Mill Road, Harwood NSW 2465

Principal:
Project No.: NEW17P-0022
Project Name: Proposed Industrial Development

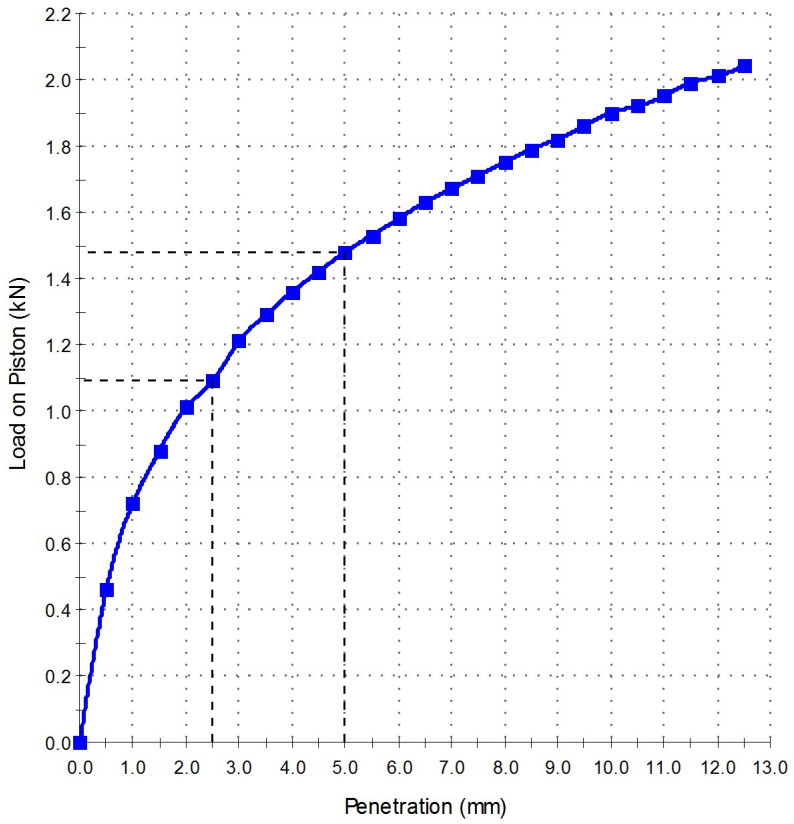
Accredited for compliance with ISO/IEC 17025
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

Approved Signatory: Brent Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 11/04/2017

Sample Details

Sample ID:	NEW17W-1306--S04	Date Sampled:	22/03/2017
Sampling Method:	AS1289.1.2.1 cl 6.4b		
Specification:	No Specification	Source:	On-Site
Location:	TP13 - (0.60 - 0.90m)	Material:	Sandy Clay
Project Location:	Lot 22 Carramere Road, Muswellbrook, NSW		

Load vs Penetration



Test Results

AS 1289.6.1.1

CBR At 2.5mm (%):	8
Maximum Dry Density (t/m³):	1.78
Optimum Moisture Content (%):	14.8
Dry Density before Soaking (t/m³):	1.79
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	14.5
Moisture Ratio before Soaking (%):	98
Dry Density after Soaking (t/m³):	1.77
Density Ratio after Soaking (%):	99
Swell (%):	1.0
Moisture Content of Top 30mm (%):	18.9
Moisture Content of Remaining Depth (%):	16.5
Compactive Effort:	Standard
Surcharge Mass (kg):	9.00
Period of Soaking (Days):	4
Oversize Material (%):	0.0

Moisture Content

Field Moisture Content (%):	11.7

Comments

Moisture Content Method Performed as Per AS1289.2.1.1.
Laboratory Moisture Ratio (LMR): 98.5% Laboratory Density Ratio (LDR): 100.5%

© 2000-2013 QESTLab by SpectraQEST.com

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW17W-1306--S05
Issue No: 1

Shrink Swell Index Report

Client: Ethanol Technologies Limited
C/- NSW Sugar Milling Co-operative Ltd
Mill Road, Harwood NSW 2465

Principal:
Project No.: NEW17P-0022
Project Name: Proposed Industrial Development

Accredited for compliance with ISO/IEC 17025
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 6/04/2017

Sample Details

Sample ID:	NEW17W-1306--S05	Client Sample ID:	
Test Request No.:		Sampling Method:	AS1289.1.2.1 cl 6.4b
Material:	Sandy Clay	Date Sampled:	22/03/2017
Source:	On-Site	Date Submitted:	30/03/2017
Specification:	No Specification		
Project Location:	Lot 22 Carramere Road, Muswellbrook, NSW		
Sample Location:	TP04 - (0.50 - 0.76m)		
Borehole Number:	TP04		
Borehole Depth (m):	0.5 - 0.76		

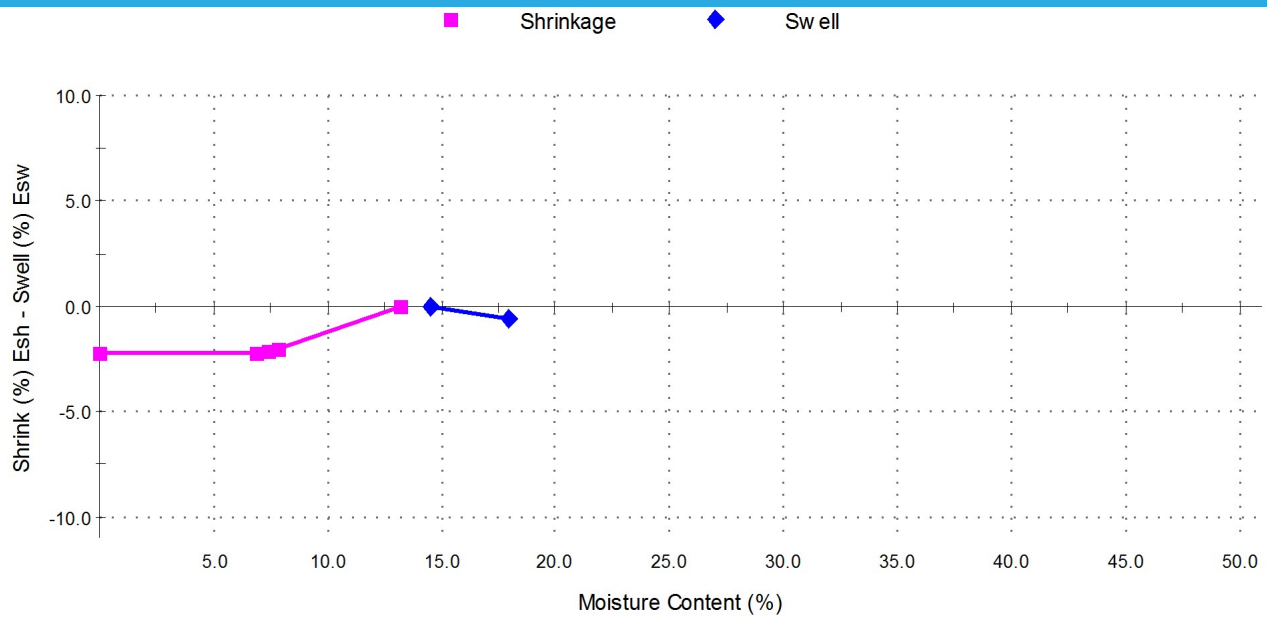
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-0.6
Moisture Content before (%):	14.5
Moisture Content after (%):	17.9
Est. Unc. Comp. Strength before (kPa):	600
Est. Unc. Comp. Strength after (kPa):	400

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	2.2
Shrinkage Moisture Content (%):	13.2
Est. inert material (%):	1%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 1.2

Comments

© 2000-2013 QESTLab by SpectraQEST.com

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW17W-1306--S06
Issue No: 1

Shrink Swell Index Report

Client: Ethanol Technologies Limited
C/- NSW Sugar Milling Co-operative Ltd
Mill Road, Harwood NSW 2465

Principal:
Project No.: NEW17P-0022
Project Name: Proposed Industrial Development

Accredited for compliance with ISO/IEC 17025
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 6/04/2017

Sample Details

Sample ID:	NEW17W-1306--S06	Client Sample ID:	
Test Request No.:		Sampling Method:	AS1289.1.2.1 cl 6.4b
Material:	Sandy Clay	Date Sampled:	22/03/2017
Source:	On-Site	Date Submitted:	30/03/2017
Specification:	No Specification		
Project Location:	Lot 22 Carramere Road, Muswellbrook, NSW		
Sample Location:	TP12 - (0.95 - 1.20m)		
Borehole Number:	TP12		
Borehole Depth (m):	0.95 - 1.20		

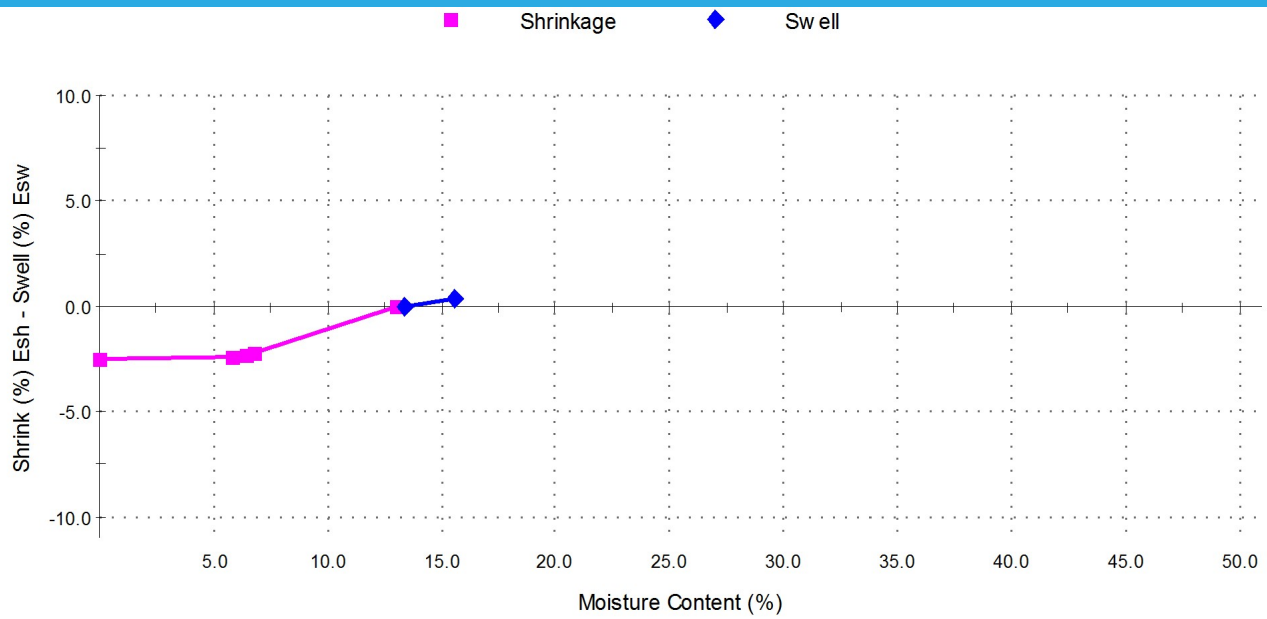
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	0.4
Moisture Content before (%):	13.3
Moisture Content after (%):	15.5
Est. Unc. Comp. Strength before (kPa):	600
Est. Unc. Comp. Strength after (kPa):	400

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	2.5
Shrinkage Moisture Content (%):	13.0
Est. inert material (%):	1%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 1.5

Comments

© 2000-2013 QESTLab by SpectraQEST.com

APPENDIX C:

CSIRO Sheet BTF 18

Foundation Maintenance and Footing Performance: A Homeowner's Guide

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

CSIRO

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction
There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion
All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation
This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil
All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure
This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

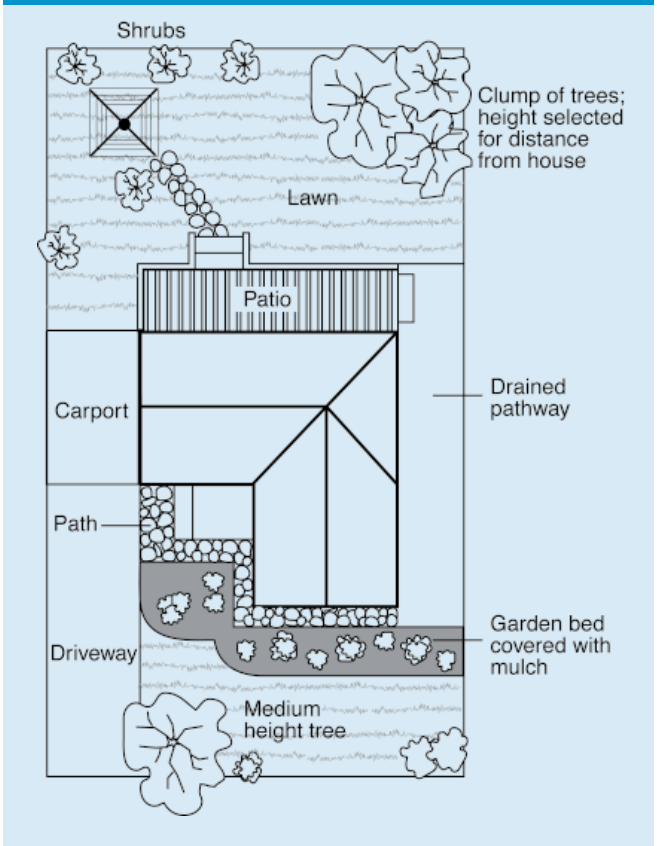
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

The information in this and other issues in the series was derived from various sources and was believed to be correct when published.

The information is advisory. It is provided in good faith and not claimed to be an exhaustive treatment of the relevant subject.

Further professional advice needs to be obtained before taking any action based on the information provided.

Distributed by

CSIRO PUBLISHING PO Box 1139, Collingwood 3066, Australia

Freecall 1800 645 051 Tel (03) 9662 7666 Fax (03) 9662 7555 www.publish.csiro.au

Email: publishing.sales@csiro.au

© CSIRO 2003. Unauthorised copying of this Building Technology file is prohibited

Appendix B – Designs

Existing Dam

106m

27.0m

ACTO Portable Project Offices

Shipping Container Equipment Compound

50m

Camera

65.6m

Sims Metal Management

102m

71.8m

15.5m

50m

49.3m Offset

ATCO Contractor Portable Construction Offices

Construction Vehicle Carpark

Carramere Rd

8.9m

SMH

Construction Amenities

Ramrod Ck

115.8m

Theiss Plus Fleet Co

68.1m

>30m Offset

>100m Offset

Grinding Equipment

69.6m

Ramrod Ck

Position taken from https://maps.six.nsw.gov.au 04/04/2018

>115m Offset

127.4m

2.6m

0.5m

Sensitive Area	Minimum Building Offset (m)
Terrestrial Biodiversity	120
Ramrod Creek	>120

0 10 20 30 40 50 60 70 80 90 100m

Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 07/08/2018

North

Lot Layout Plan 1

Drawing No:
BA023A1 DRAFT NFC

Bund Area	Class	PG	Storage Quantity (kg)	Bund Containment Volume (L)
1	8, 5	II, II	8,000 and 2,000	15,000
2	8	II	6,000	40,000
3	8, 5	II, II	6,000 and 2,000	31,000
4	3	II	200	2,500
5	8, 3	II, II	2,000 and 4,500	12,000
6	8	II	2,000	18,000
7	Non	Non	-	2,200
8	Non	Non	-	12,000

ATCO Contractor Portable Construction Offices

Construction Vehicle Carpark

Carramere Rd

SMH

Construction Amenities

24.1m

7.6m

12.8m

5.0m

Bunded Area 3

15.9m

5.0m

Bunded Area 4

Bunded Area 8

15.9m

Bunded Area 5

9.7m

Bunded Area 6

14.6m

Bunded Area 2

8.0m

8.0m

Bunded Area 1

8.0m

7.0m

9.0m

8.6m

37.3m

18.9m

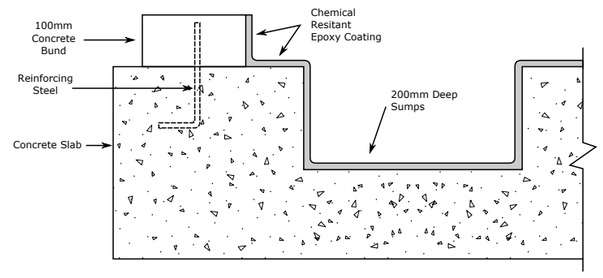
4.5m

Bunded Area 7

5.0m

0 10 20 30 40 50 60 70 80 90 100m

Typical Bunding Detail



Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 08/08/2018

Building Layout Plan 3

North

Drawing No:
BA029A1 DRAFT NFC

ATCO Contractor Portable
Construction Offices

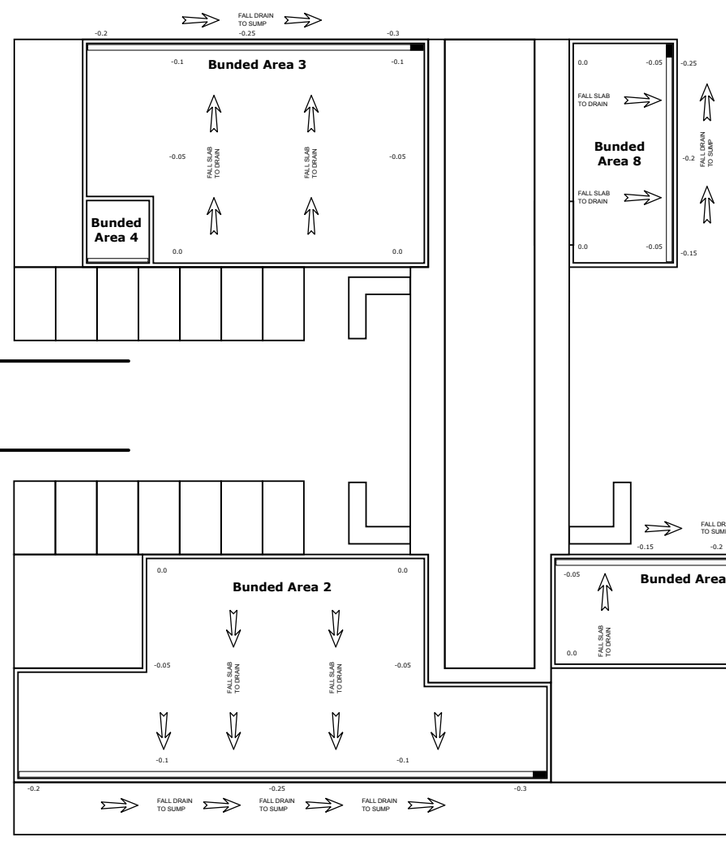
Construction
Vehicle
Carpark

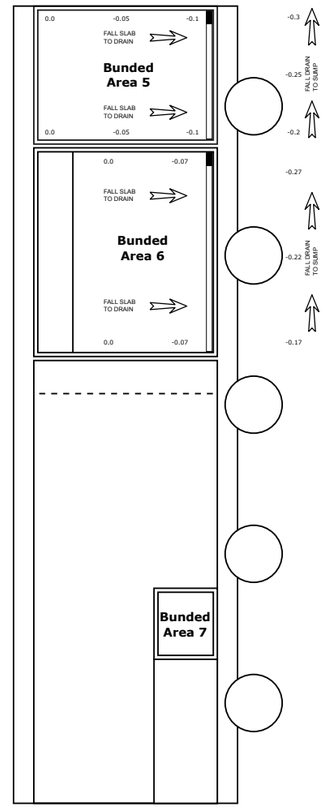
Security
Fence

Carramere Rd

SMH

Construction
Amenities





Boundary Legend

- Security Fence
- Lot Boundary
- Sewer Line
- Electrical Easement
- Retaining Wall

0 10 20 30 40 50 60 70 80 90 100m

Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 08/08/2018

Building Layout Plan 2

North

Drawing No:
BA028A1 DRAFT NFC

ATCO Contractor Portable Construction Offices

Construction Vehicle Carpark

Security Fence

Carramere Rd

SMH

Construction Amenities

Yeast Storage

Bunded Area 3

Unit 14 Stripping/ Distillation

Unit 13 2nd Gen Fermentation

Unit 16 Crystal Production

Unit 15 Yeast Filtration/ Underflow Conc.

Unit 17 Waste Treatment System

Bunded Area 4

Car Parking 7 Spaces

Stairs

Upper Walkway

Lift

Unit 12 Media Preparation

Bunded Area 8

Unloading Area

Lignocellulosic Biomass Stockpile

Car Parking 7 Spaces

Stairs

Upper Walkway

Stairs

Service Area

Bunded Area 2

Unit 10 SMB System

Unit 9 Fines Filtration/ O2 Removal

Unit 8 Filtration

Unit 6 Homogenisation

Unit 4 Twin Screw Extrusion

Bunded Area 1

Unit 5 Acid Delivery System

Unit 11 Acid Reconcentration

Unit 7 Hydrolysis Reaction

Unit 2 Biomass Drying

Unit 3 Final Size Reduction

Operating Access

Bunded Area 5

Caustic IBC Storage

Trade Waste System

Rain Tank 1

Neut IBC Storage

Bunded Area 6

Rain Tank 2

Cooling Water

RO System

Rain Tank 3

Ø ≈ 8m (height ≈ 1m)

Unit 1 Biomass Receiving

Rain Tank 4

Non-Hazardous Lignin Cake Storage

Bunded Area 7

Feedstock Size Reduction

Enclosed Area Switch-boards

Rain Tank 5

0 10 20 30 40 50 60 70 80 90 100m

Boundary Legend

- Security Fence
- Lot Boundary
- Sewer Line
- Electrical Easement
- Retaining Wall

Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 08/08/2018

Building Layout Plan 1

North

Drawing No:
BA027A1 DRAFT NFC

Existing
Dam

ACTO Portable
Project Offices

Shipping Container
Equipment Compound

Camera

Native Tree Plantation

Native Tree Preservation

Ramrod Ck

ATCO Contractor Portable
Construction Offices

Construction
Vehicle
Carpark

Carramere Rd

SMH

Construction
Amenities

Shrub Garden

Ramrod Ck

0 10 20 30 40 50 60 70 80 90 100m

Boundary Legend

- Security Fence
- Lot Boundary
- Sewer Line
- Electrical Easement
- Retaining Wall

Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 07/08/2018

North

Lot Layout Plan 4

Drawing No:
BA026A1 DRAFT NFC

ATCO Contractor Portable Construction Offices

Construction Vehicle Carpark

Security Fence

Carramere Rd

SMH

Construction Amenities

Bunded Area 1

Bunded Area 2

Bunded Area 3

Bunded Area 4

Bunded Area 5

Bunded Area 6

Bunded Area 7

Bunded Area 8

46.0m
24.1m
7.6m
24.8m
15.6m
12.8m
24.3m Offset
5.0m
15.9m
15.9m
5.0m
15.9m
9.7m
14.6m
20.0m
55.4m
4.5m
30.9m
5.0m
8.0m
15.9m
19.5m
8.0m
8.0m
7.0m
12.6m Offset
9.0m
8.6m
37.3m
18.9m
22.8m Offset
15.8m Offset
30m Offset
37.3m
18.9m
14.6m
15.6m
56.2m

0 10 20 30 40 50 60 70 80 90 100m

Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 08/08/2018

Lot Layout Plan 3

North

Drawing No:
BA025A1 DRAFT NFC

ATCO Contractor Portable
Construction Offices

Construction
Vehicle
Carpark

Security
Fence

Carramere Rd

SMH

Construction
Amenities

0 10 20 30 40 50 60 70 80 90 100m

Legend

Traffic	Areas
Visitor Vehicles	Visitor/Staff Parking
Heavy Vehicles	Forklift Operation
Combined Traffic	Skidsteer Operation
	Combined Loading/ Unloading

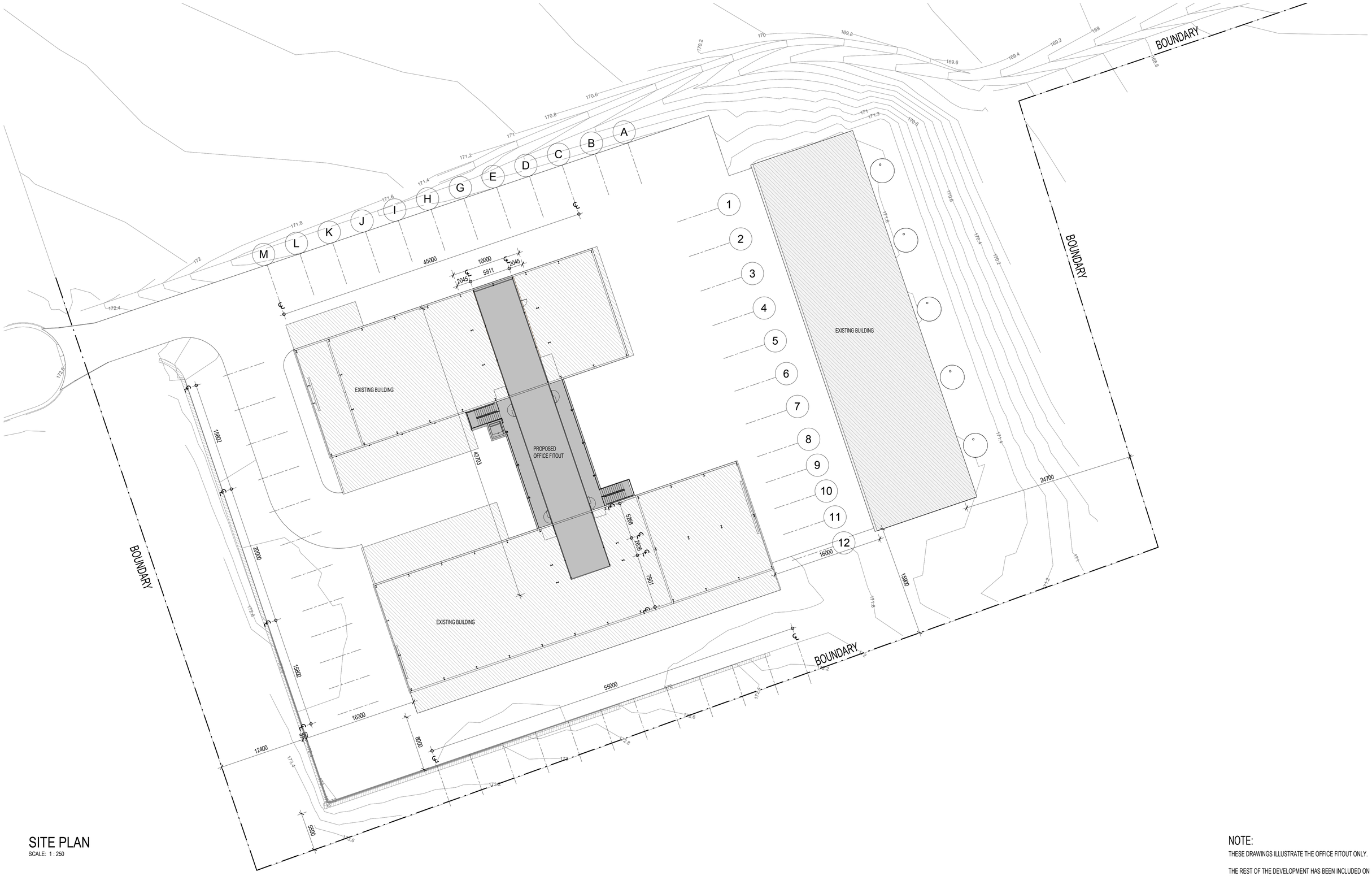
Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 08/08/2018

Lot Layout Plan 2

North

Drawing No:
BA024A1 DRAFT NFC



SITE PLAN

SCALE: 1 : 250

revision	date	details	initials	checked
C	29/8/18	DEVELOPMENT APPLICATION	AF	WS
B	27/8/18	SKETCH UPDATE	AF	WS
A	31/7/18	SKETCH DESIGN	AF	WS

APPROVED..... DESIGN MANAGER DATE / /

1:100 0 10 20 30 40 50 60 70 80 90 100

A1 @ 1:200 0 20 40 60 80 100 200

HUNTER PILOT BIOREFINERY
OFFICE FITOUT

LOT 22, DP 1131270, CARRAMERE ROAD
MUSWELLBROOK, NSW, 2333

DRAARCHITECTS PTY LTD

Adrian Borsato NSW 4172 Warren Steele NSW 6526

44 Park Beach Road (PO Box 6425)
Coffs Harbour NSW 2450
(02) 6651 4905
dracoffs@draarchitects.com.au
www.draarchitects.com.au

Member Australian Institute of Architects
ABN 12 096 929 387

DRA Architects Pty Ltd accept no responsibility for the usability, completeness, or accuracy of the data transferred electronically. Recipients should, when necessary, request a hard copy version for verification. Use figured dimension in preference to scale. all dimensions to be verified on site.

© Copyright

These drawings and designs and the copyright thereof are the property of DRA Architects Pty Ltd and must not be used, retained or copied without the written permission of DRA Architects Pty Ltd A.B.N. 120 9692 9387

north

Drawing: SITE PLAN

scale	1 : 250	plotted	Issue Date	job No	drawing number	revision
approved	WS	drawn	AF	18026	A01	C

NOTE:

THESE DRAWINGS ILLUSTRATE THE OFFICE FITOUT ONLY.

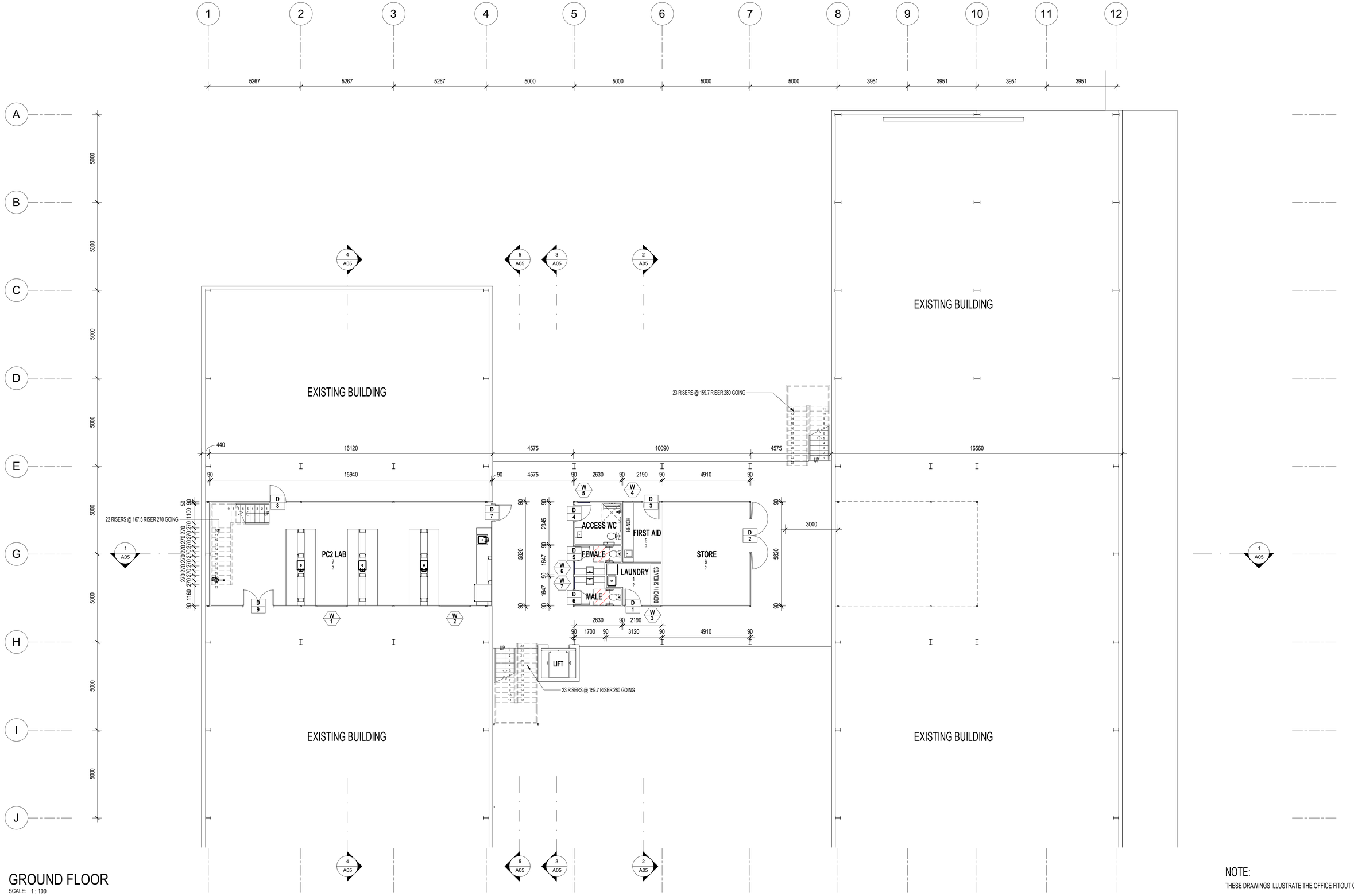
THE REST OF THE DEVELOPMENT HAS BEEN INCLUDED ON THESE DRAWINGS FOR CONTEXT PURPOSES.

DEVELOPMENT APPLICATION

30/08/2018 12:00:36 PM

CONTROLLED DOCUMENT - CHANGES WILL BE ADVISED

CONTROLLED DOCUMENT - CHANGES WILL BE ADVISED



GROUND FLOOR

SCALE: 1 : 100

NOTE:

THESE DRAWINGS ILLUSTRATE THE OFFICE FITOUT ONLY.

THE REST OF THE DEVELOPMENT HAS BEEN INCLUDED ON THESE DRAWINGS FOR CONTEXT PURPOSES.

DEVELOPMENT APPLICATION

30/08/2018 12:00:40 PM

revision	date	details	initials	checked
C	29/8/18	DEVELOPMENT APPLICATION	AF	WS
B	27/8/18	SKETCH UPDATE	AF	WS
A	31/7/18	SKETCH DESIGN	AF	WS

APPROVED..... DESIGN MANAGER DATE / /

1:100 0 10 20 30 40 50 60 70 80 90 100

A1 @ 1:200 0 20 40 60 80 100 200

HUNTER PILOT BIOREFINERY OFFICE FITOUT

LOT 22, DP 1131270, CARRAMERE ROAD
MUSWELLBROOK, NSW, 2333

DRAARCHITECTS PTY LTD
Adrian Borsato NSW 4172
Warren Steele NSW 6526
44 Park Beach Road (PO Box 6425)
Coffs Harbour NSW 2450
(02) 6651 4905
dracoffs@draarchitects.com.au
www.draarchitects.com.au
Member Australian Institute of Architects
ABN 12 096 929 387

DRA Architects Pty Ltd accept no responsibility for the usability, completeness, or accuracy of the data transferred electronically. Recipients should, when necessary, request a hard copy version for verification. Use figured dimension in preference to scale. all dimensions to be verified on site.

© Copyright

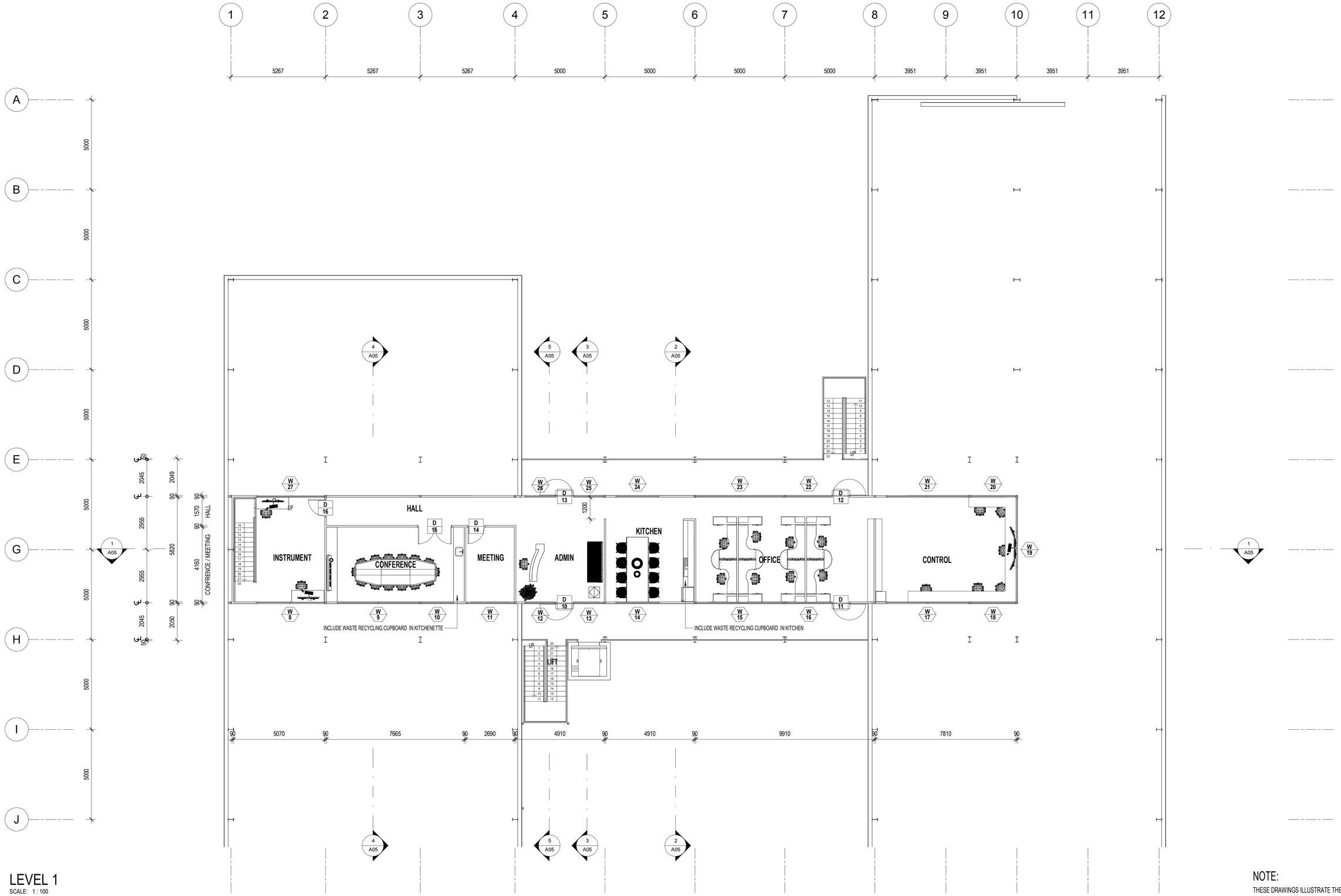
These drawings and designs and the copyright thereof are the property of DRA Architects Pty Ltd and must not be used, retained or copied without the written permission of DRA Architects Pty Ltd A.B.N. 120 9692 9387

north

Drawing: GROUND FLOOR PLAN

scale	1 : 100	plotted	Issue Date	job No	drawing number	revision
approved	WS	drawn	AF	18026	A02	C

CONTROLLED DOCUMENT - CHANGES WILL BE ADVISED



LEVEL 1
SCALE: 1 : 100

NOTE:
THESE DRAWINGS ILLUSTRATE THE OFFICE FITOUT ONLY.

THE REST OF THE DEVELOPMENT HAS BEEN INCLUDED ON THESE DRAWINGS FOR CONTEXT PURPOSES.

DEVELOPMENT APPLICATION 30/08/2018 12:00:48 PM

revision	date	details	initials	checked
C	29/8/18	DEVELOPMENT APPLICATION	AF	WS
B	27/8/18	SKETCH UPDATE	AF	WS
A	31/7/18	SKETCH DESIGN	AF	WS

APPROVED..... DESIGN MANAGER DATE / /

1:100 0 10 20 30 40 50 60 70 80 90 100
A1 @ 1:200 0 20 40 60 80 100 200

HUNTER PILOT BIOREFINERY OFFICE FITOUT

LOT 22, DP 1131270, CARRAMERE ROAD
MUSWELLBROOK, NSW, 2333

DRAARCHITECTS PTY LTD
Adrian Borsato NSW 4172
Warren Steele NSW 6526
44 Park Beach Road (PO Box 6425)
Coffs Harbour NSW 2450
(02) 6651 4905
dracoffs@draarchitects.com.au
www.draarchitects.com.au
ABN 12 096 929 387

DRA Architects Pty Ltd accept no responsibility for the usability, completeness, or accuracy of the data transferred electronically. Recipients should, when necessary, request a hard copy version for verification. Use figured dimension in preference to scale. all dimensions to be verified on site.

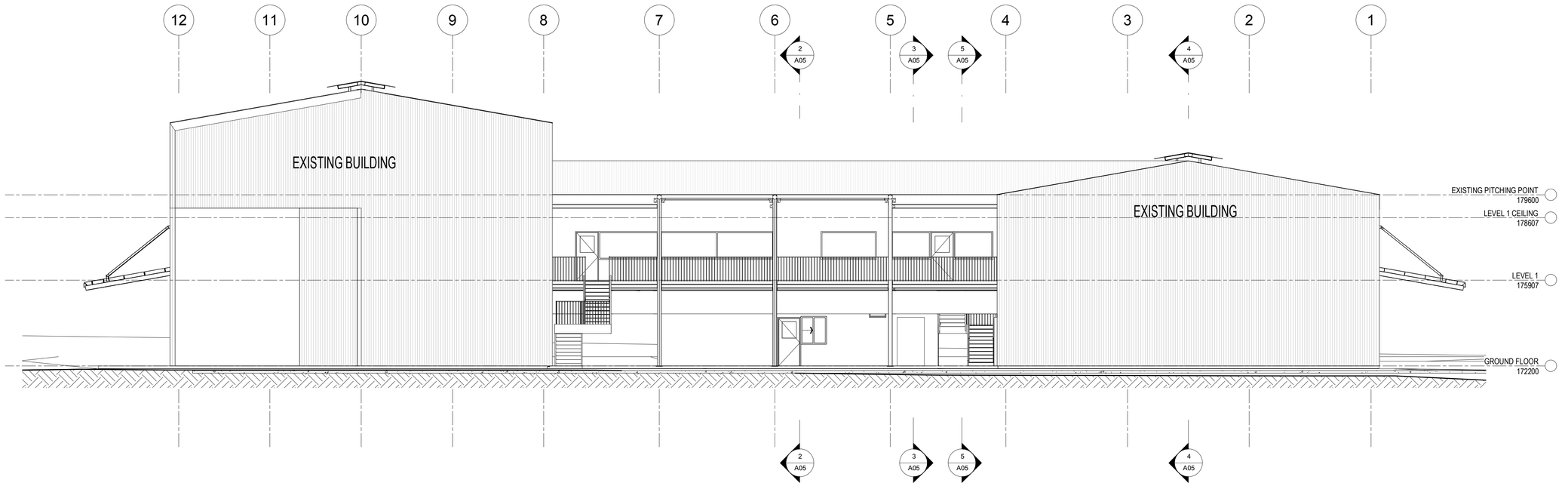
© Copyright

These drawings and designs and the copyright thereof are the property of DRA Architects Pty Ltd and must not be used, retained or copied without the written permission of DRA Architects Pty Ltd A.B.N. 120 9692 9387

north

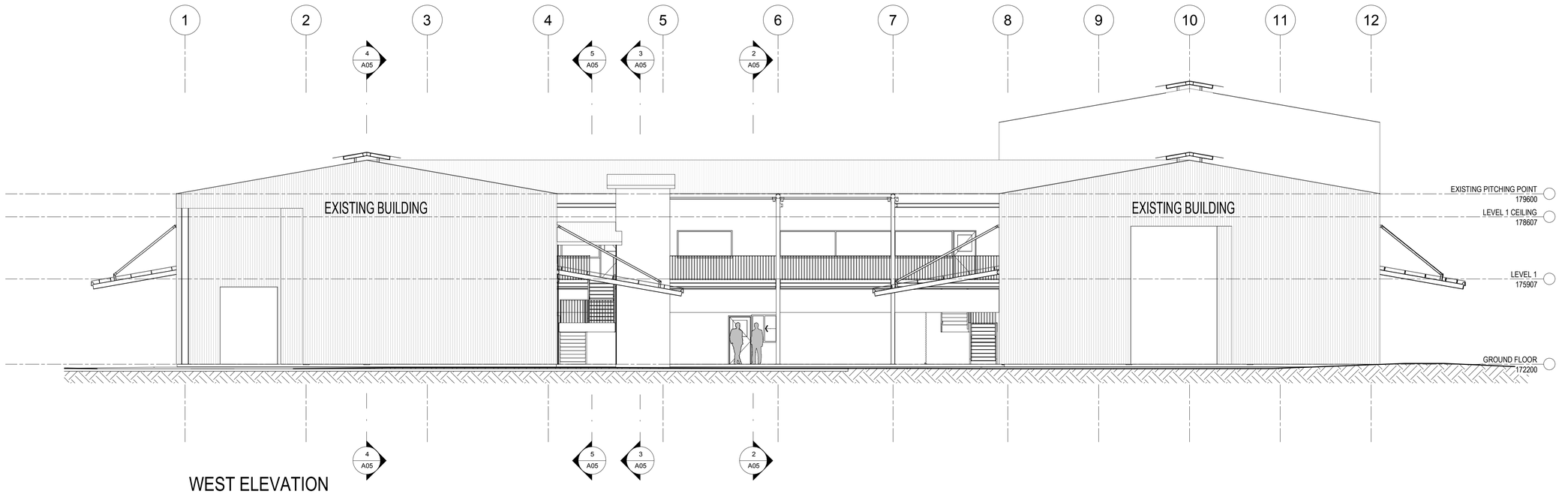
Drawing: FIRST FLOOR PLAN

scale	1 : 100	plotted	Issue Date	job No	drawing number	revision
approved	WS	drawn	AF	18026	A03	C



EAST ELEVATION

SCALE: 1 : 100



WEST ELEVATION

SCALE: 1 : 100

CONTROLLED DOCUMENT - CHANGES WILL BE ADVISED

30/08/2018 12:00:57 PM

DEVELOPMENT APPLICATION

NOTE:

THESE DRAWINGS ILLUSTRATE THE OFFICE FITOUT ONLY.

THE REST OF THE DEVELOPMENT HAS BEEN INCLUDED ON THESE DRAWINGS FOR CONTEXT PURPOSES.

revision	date	details	initials	checked
C	29/8/18	DEVELOPMENT APPLICATION	AF	WS
B	27/8/18	SKETCH UPDATE	AF	WS
A	31/7/18	SKETCH DESIGN	AF	WS

APPROVED..... DESIGN MANAGER DATE / /

1:100 0 10 20 30 40 50 60 70 80 90 100

A1 @ 1:200 0 20 40 60 80 100 200

HUNTER PILOT BIOREFINERY OFFICE FITOUT

LOT 22, DP 1131270, CARRAMERE ROAD
MUSWELLBROOK, NSW, 2333

DRAARCHITECTS PTY LTD

Adrian Borsato NSW 4172 Warren Steele NSW 6526

44 Park Beach Road (PO Box 6425)
Coffs Harbour NSW 2450
(02) 6651 4905
dracoffs@draarchitects.com.au
www.draarchitects.com.au

Member Australian Institute of Architects
ABN 12 096 929 387

DRA Architects Pty Ltd accept no responsibility for the usability, completeness, or accuracy of the data transferred electronically. Recipients should, when necessary, request a hard copy version for verification. Use figured dimension in preference to scale. all dimensions to be verified on site.

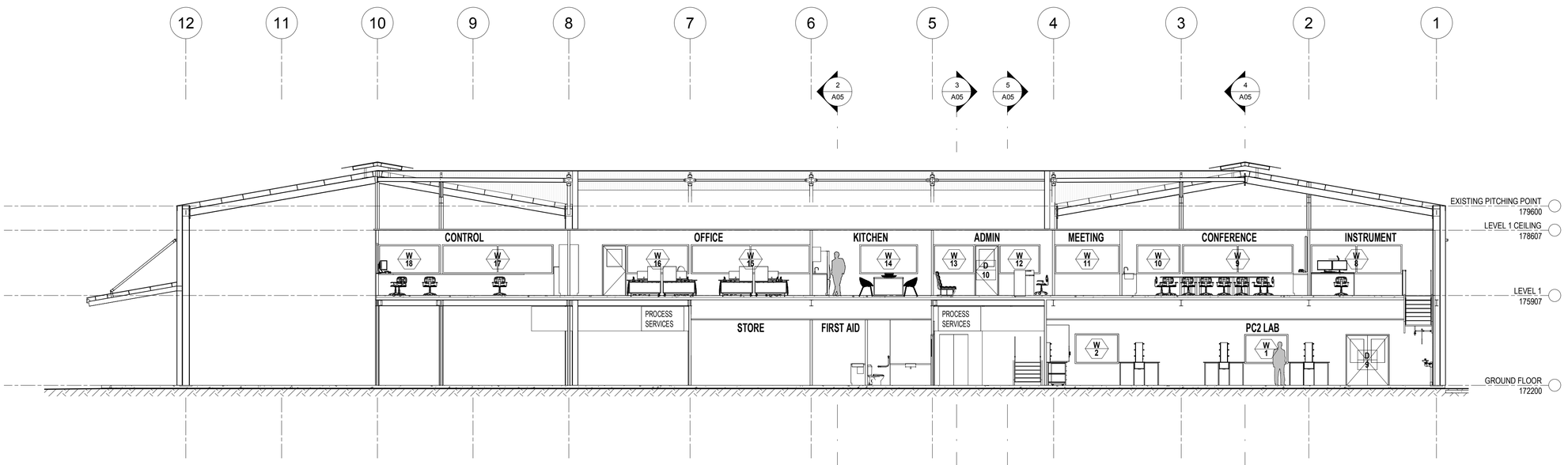
© Copyright

These drawings and designs and the copyright thereof are the property of DRA Architects Pty Ltd and must not be used, retained or copied without the written permission of DRA Architects Pty Ltd A.B.N. 120 9692 9387

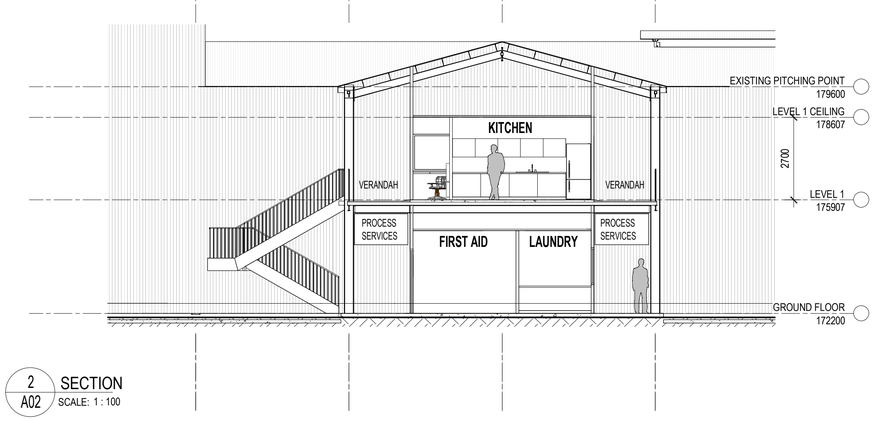
north

Drawing: ELEVATIONS

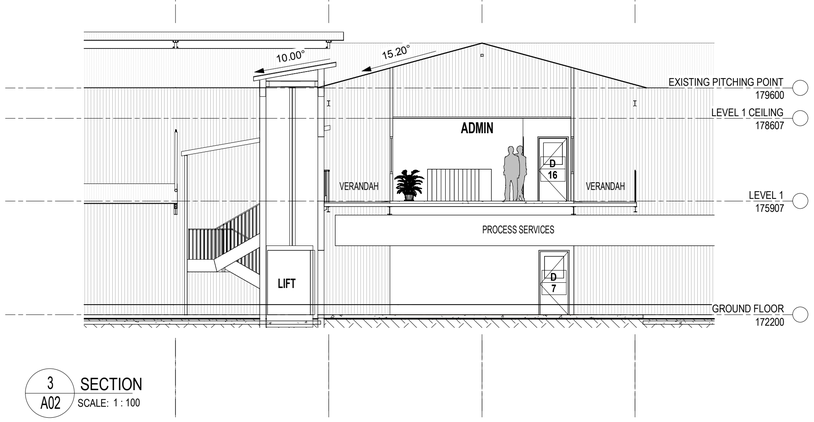
scale	1 : 100	plotted	Issue Date	job No	drawing number	revision
approved	WS	drawn	AF	18026	A04	C



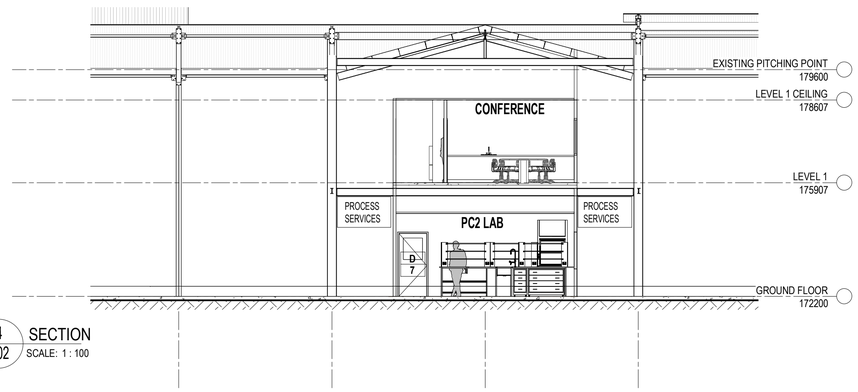
1 A02 SECTION
SCALE: 1 : 100



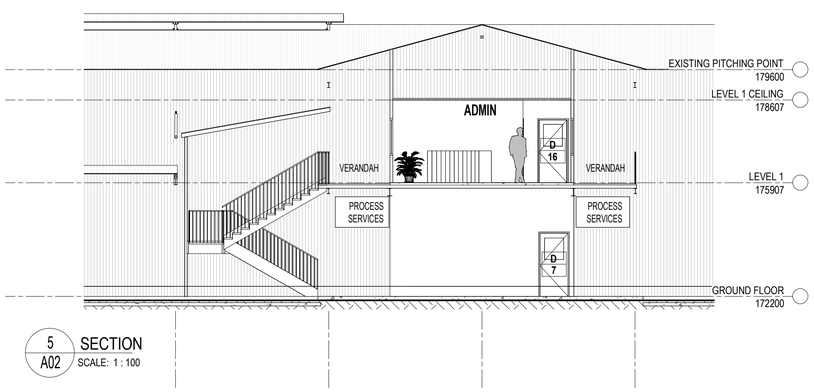
2 A02 SECTION
SCALE: 1 : 100



3 A02 SECTION
SCALE: 1 : 100



4 A02 SECTION
SCALE: 1 : 100



5 A02 SECTION
SCALE: 1 : 100

NOTE:
THESE DRAWINGS ILLUSTRATE THE OFFICE FITOUT ONLY.

THE REST OF THE DEVELOPMENT HAS BEEN INCLUDED ON THESE DRAWINGS FOR CONTEXT PURPOSES.

DEVELOPMENT APPLICATION
30/08/2018 12:01:15 PM

CONTROLLED DOCUMENT - CHANGES WILL BE ADVISED

revision	date	details	initials	checked
C	29/8/18	DEVELOPMENT APPLICATION	AF	WS
B	27/8/18	SKETCH UPDATE	AF	WS
A	31/7/18	SKETCH DESIGN	AF	WS

APPROVED..... DESIGN MANAGER DATE / /

1:100 0 10 20 30 40 50 60 70 80 90 100
A1 @
1:200 0 20 40 60 80 100 200

HUNTER PILOT BIOREFINERY
OFFICE FITOUT
LOT 22, DP 1131270, CARRAMERE ROAD
MUSWELLBROOK, NSW, 2333

DRA ARCHITECTS PTY LTD
Adrian Borsato NSW 4172
Warren Steele NSW 6526
44 Park Beach Road (PO Box 6425)
Coffs Harbour NSW 2450
(02) 6651 4905
dracoffs@draarchitects.com.au
www.draarchitects.com.au
ABN 12 096 929 387

DRA Architects Pty Ltd accept no responsibility for the usability, completeness, or accuracy of the data transferred electronically. Recipients should, when necessary, request a hard copy version for verification. Use figured dimension in preference to scale. all dimensions to be verified on site.

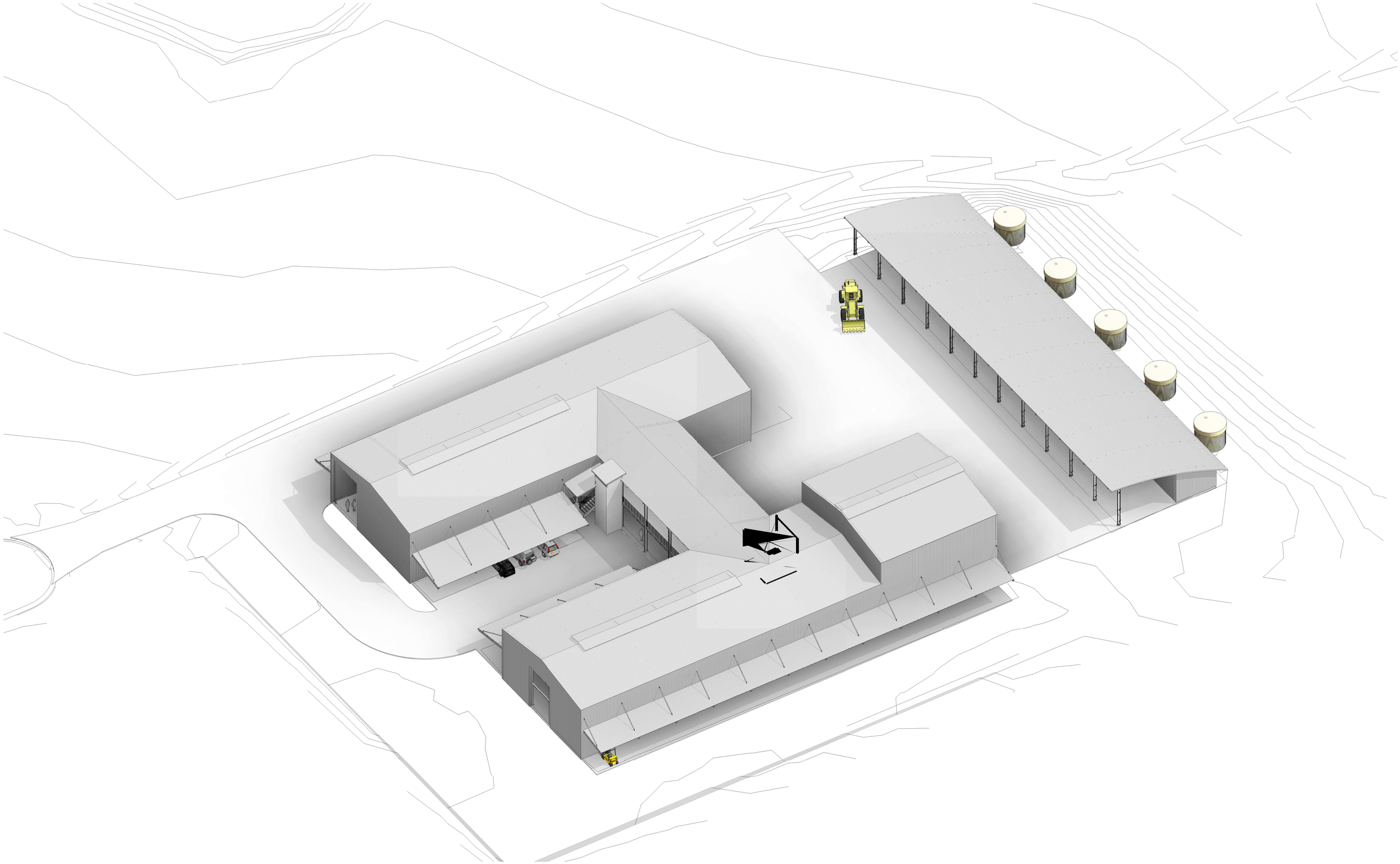
© Copyright

These drawings and designs and the copyright thereof are the property of DRA Architects Pty Ltd and must not be used, retained or copied without the written permission of DRA Architects Pty Ltd A.B.N. 120 9692 9387

north

Drawing: SECTIONS

scale	1 : 100	plotted	Issue Date	job No	drawing number	revision
approved	WS	drawn	AF	18026	A05	C



CONTROLLED DOCUMENT - CHANGES WILL BE ADVISED

30/08/2018 12:03:52 PM

DEVELOPMENT APPLICATION

SITE 3D

SCALE:

NOTE:

THESE DRAWINGS ILLUSTRATE THE OFFICE FITOUT ONLY.

THE REST OF THE DEVELOPMENT HAS BEEN INCLUDED ON THESE DRAWINGS FOR CONTEXT PURPOSES.

revision	date	details	initials	checked
C	29/8/18	DEVELOPMENT APPLICATION	AF	WS

APPROVED..... DESIGN MANAGER DATE __/__/__

1:100 0 10 20 30 40 50 60 70 80 90 100

A1 @ 1:200 0 20 40 60 80 100 200

HUNTER PILOT BIOREFINERY
OFFICE FITOUT

LOT 22, DP 1131270, CARRAMERE ROAD
MUSWELLBROOK, NSW, 2333

DRA ARCHITECTS PTY LTD

Adrian Borsato NSW 4172 Warren Steele NSW 6526

44 Park Beach Road (PO Box 6425)
Coffs Harbour NSW 2450
(02) 6651 4905
dracoffs@draarchitects.com.au
www.draarchitects.com.au

Member Australian Institute of Architects
ABN 12 096 929 387

DRA Architects Pty Ltd accept no responsibility for the usability, completeness, or accuracy of the data transferred electronically. Recipients should, when necessary, request a hard copy version for verification. Use figured dimension in preference to scale. all dimensions to be verified on site.

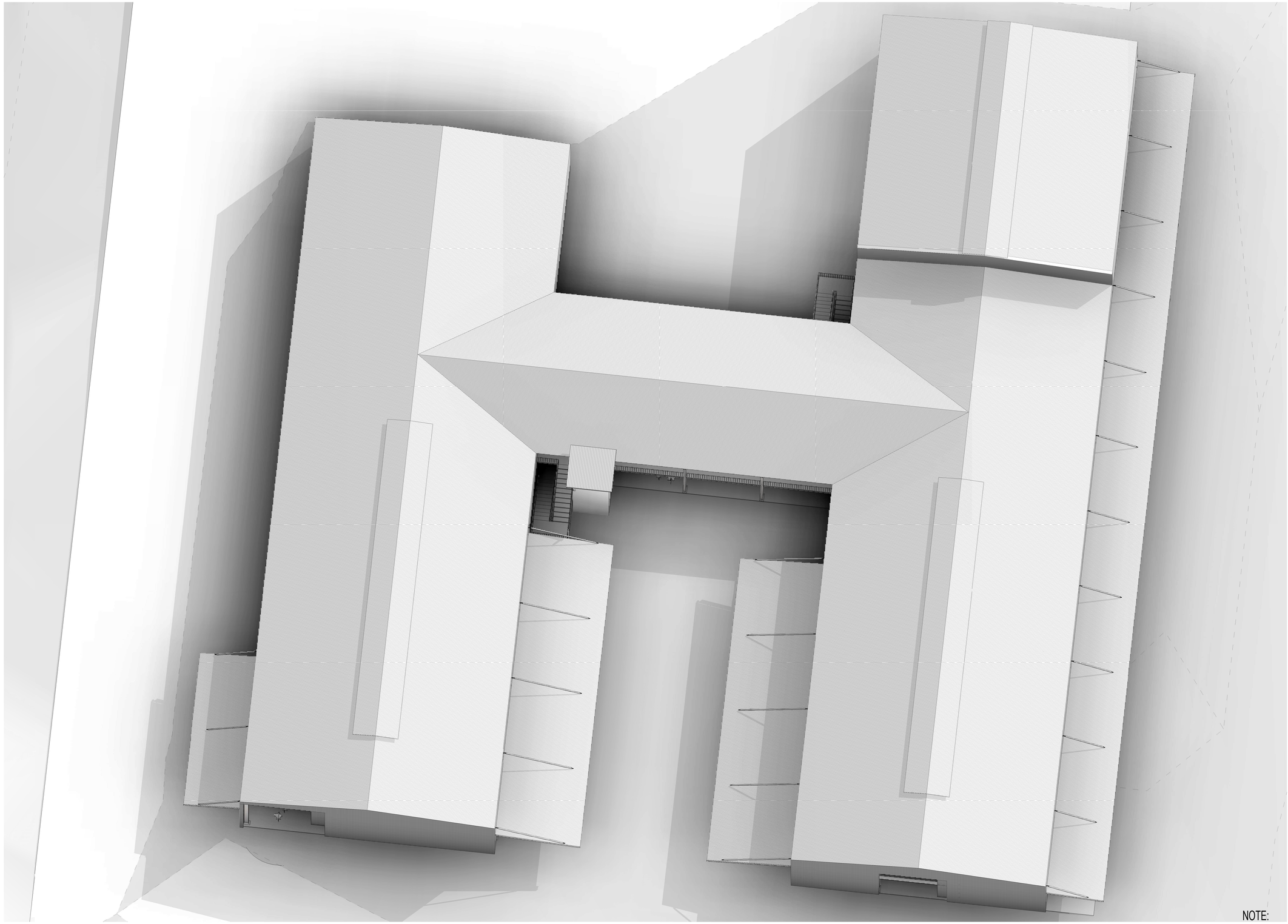
© Copyright

These drawings and designs and the copyright thereof are the property of DRA Architects Pty Ltd and must not be used, retained or copied without the written permission of DRA Architects Pty Ltd A.B.N. 120 9692 9387

north

Drawing: 3D SITE

scale		plotted	Issue Date	job No	drawing number	revision
approved	WS	drawn	AF	18026	A09	C



ENTIRE BUILDING ROOF
SCALE:

NOTE:
THESE DRAWINGS ILLUSTRATE THE OFFICE FITOUT ONLY.

THE REST OF THE DEVELOPMENT HAS BEEN INCLUDED ON THESE DRAWINGS FOR CONTEXT PURPOSES.

DEVELOPMENT APPLICATION
30/08/2018 12:05:29 PM

CONTROLLED DOCUMENT - CHANGES WILL BE ADVISED

revision	date	details	initials	checked
C	29/8/18	DEVELOPMENT APPLICATION	AF	WS
B	27/8/18	SKETCH UPDATE	AF	WS
A	31/7/18	SKETCH DESIGN	AF	WS

APPROVED..... DESIGN MANAGER DATE / /

1:100 0 10 20 30 40 50 60 70 80 90 100
A1 @ 1:200 0 20 40 60 80 100 200

HUNTER PILOT BIOREFINERY OFFICE FITOUT

LOT 22, DP 1131270, CARRAMERE ROAD
MUSWELLBROOK, NSW, 2333

DRAARCHITECTS PTY LTD
Adrian Borsato NSW 4172 Warren Steele NSW 6526
44 Park Beach Road (PO Box 6425)
Coffs Harbour NSW 2450
(02) 6651 4905
dracoffs@draarchitects.com.au
www.draarchitects.com.au
Member Australian Institute of Architects
ABN 12 096 929 387

DRA Architects Pty Ltd accept no responsibility for the usability, completeness, or accuracy of the data transferred electronically. Recipients should, when necessary, request a hard copy version for verification. Use figured dimension in preference to scale. all dimensions to be verified on site.

© Copyright

These drawings and designs and the copyright thereof are the property of DRA Architects Pty Ltd and must not be used, retained or copied without the written permission of DRA Architects Pty Ltd A.B.N. 120 9692 9387

north

Drawing: 3D ROOF

scale		plotted	Issue Date	job No	drawing number	revision
approved	WS	drawn	AF	18026	A10	C

ENTIRE BUILDING NO ROOF
SCALE:

NOTE:
THESE DRAWINGS ILLUSTRATE THE OFFICE FITOUT ONLY.

THE REST OF THE DEVELOPMENT HAS BEEN INCLUDED ON THESE DRAWINGS FOR CONTEXT PURPOSES.

DEVELOPMENT APPLICATION

30/08/2018 12:07:02 PM

CONTROLLED DOCUMENT - CHANGES WILL BE ADVISED

revision	date	details	initials	checked
C	29/8/18	DEVELOPMENT APPLICATION	AF	WS
B	27/8/18	SKETCH UPDATE	AF	WS
A	31/7/18	SKETCH DESIGN	AF	WS

APPROVED..... DESIGN MANAGER DATE / /

1:100 0 10 20 30 40 50 60 70 80 90 100
A1 @ 1:200 0 20 40 60 80 100 200

HUNTER PILOT BIOREFINERY OFFICE FITOUT

LOT 22, DP 1131270, CARRAMERE ROAD
MUSWELLBROOK, NSW, 2333

DRAARCHITECTS PTY LTD
Adrian Borsato NSW 4172 Warren Steele NSW 6526
44 Park Beach Road (PO Box 6425)
Coffs Harbour NSW 2450
(02) 6651 4905
dracoffs@draarchitects.com.au
www.draarchitects.com.au
Member Australian Institute of Architects
ABN 12 096 929 387

DRA Architects Pty Ltd accept no responsibility for the usability, completeness, or accuracy of the data transferred electronically. Recipients should, when necessary, request a hard copy version for verification. Use figured dimension in preference to scale. all dimensions to be verified on site.

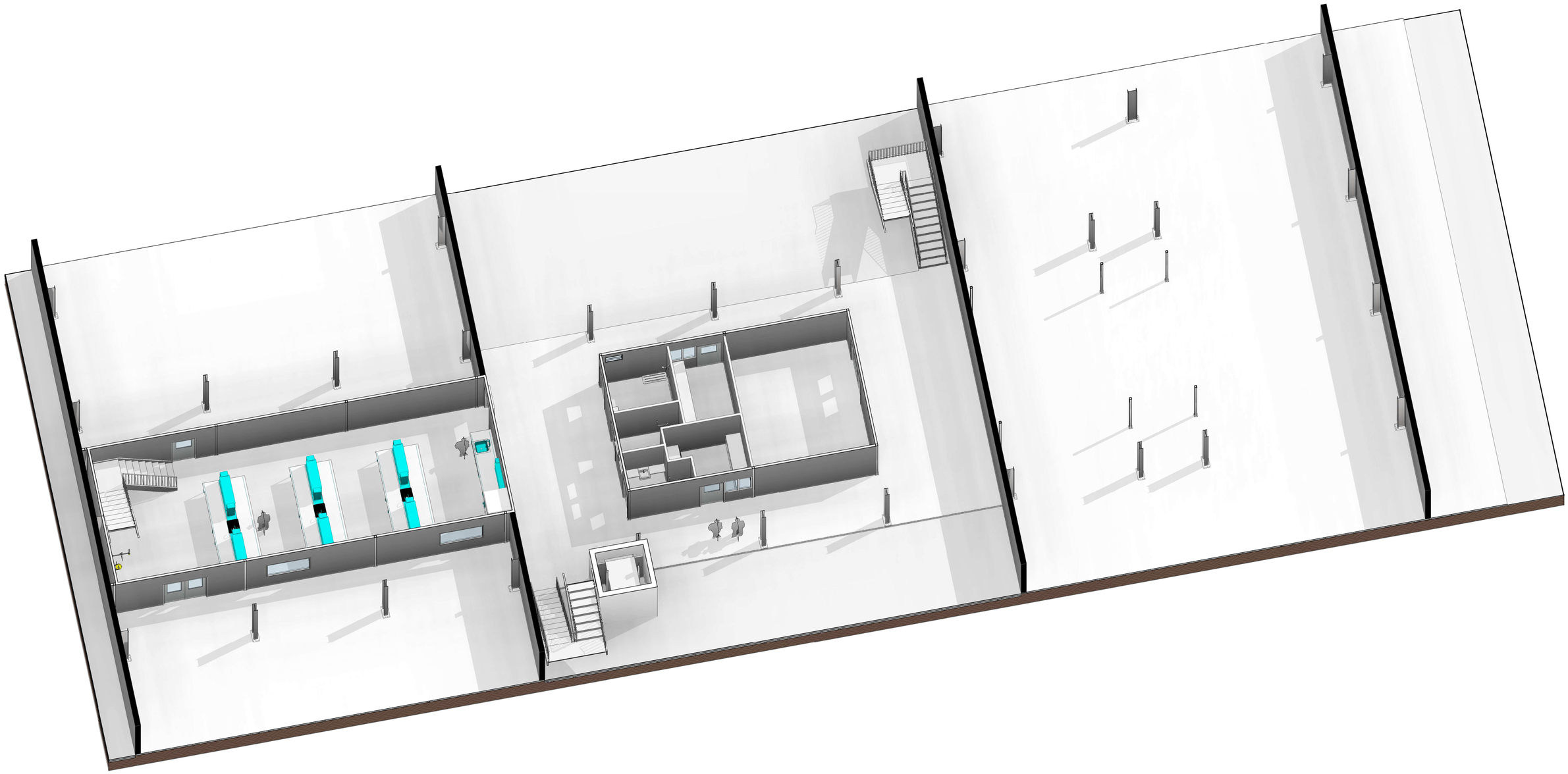
© Copyright

These drawings and designs and the copyright thereof are the property of DRA Architects Pty Ltd and must not be used, retained or copied without the written permission of DRA Architects Pty Ltd A.B.N. 120 9692 9387

north

Drawing: 3D NO ROOF

scale		plotted	Issue Date	job No	drawing number	revision
approved	WS	drawn	AF	18026	A11	C



GROUND FLOOR 3D

SCALE:

CONTROLLED DOCUMENT - CHANGES WILL BE ADVISED

30/08/2018 12:07:18 PM

DEVELOPMENT APPLICATION

NOTE:

THESE DRAWINGS ILLUSTRATE THE OFFICE FITOUT ONLY.

THE REST OF THE DEVELOPMENT HAS BEEN INCLUDED ON THESE DRAWINGS FOR CONTEXT PURPOSES.

revision	date	details	initials	checked
C	29/8/18	DEVELOPMENT APPLICATION	AF	WS
B	27/8/18	SKETCH UPDATE	AF	WS
A	31/7/18	SKETCH DESIGN	AF	WS

APPROVED..... DESIGN MANAGER DATE / /

1:100 0 10 20 30 40 50 60 70 80 90 100

A1 @ 1:200 0 20 40 60 80 100 200

HUNTER PILOT BIOREFINERY OFFICE FITOUT

LOT 22, DP 1131270, CARRAMERE ROAD
MUSWELLBROOK, NSW, 2333

DRAARCHITECTS PTY LTD

Adrian Borsato NSW 4172 Warren Steele NSW 6526

44 Park Beach Road (PO Box 6425)
Coffs Harbour NSW 2450
(02) 6651 4905
dracoffs@draarchitects.com.au
www.draarchitects.com.au

Member Australian Institute of Architects

ABN 12 096 929 387

DRA Architects Pty Ltd accept no responsibility for the usability, completeness, or accuracy of the data transferred electronically. Recipients should, when necessary, request a hard copy version for verification. Use figured dimension in preference to scale. all dimensions to be verified on site.

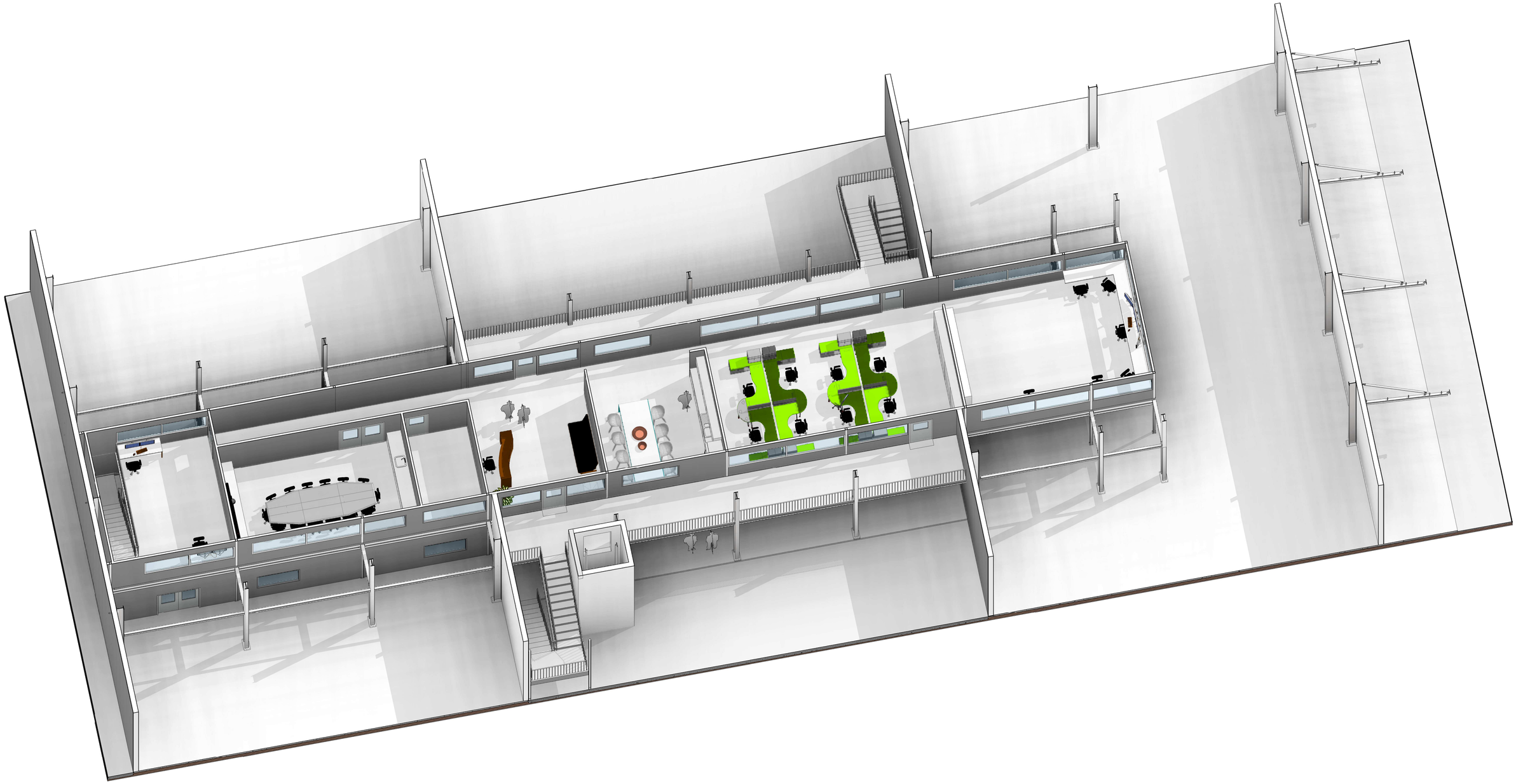
© Copyright

These drawings and designs and the copyright thereof are the property of DRA Architects Pty Ltd and must not be used, retained or copied without the written permission of DRA Architects Pty Ltd A.B.N. 120 9692 9387

north

Drawing: 3D GROUND FLOOR

scale		plotted	Issue Date	job No	drawing number	revision
approved	WS	drawn	AF	18026	A12	C



FIRST FLOOR 3D

SCALE:

CONTROLLED DOCUMENT - CHANGES WILL BE ADVISED

30/08/2018 12:07:49 PM

DEVELOPMENT APPLICATION

NOTE:

THESE DRAWINGS ILLUSTRATE THE OFFICE FITOUT ONLY.

THE REST OF THE DEVELOPMENT HAS BEEN INCLUDED ON THESE DRAWINGS FOR CONTEXT PURPOSES.

revision	date	details	initials	checked
C	29/8/18	DEVELOPMENT APPLICATION	AF	WS
B	27/8/18	SKETCH UPDATE	AF	WS
A	31/7/18	SKETCH DESIGN	AF	WS

APPROVED..... DESIGN MANAGER DATE / /

1:100 0 10 20 30 40 50 60 70 80 90 100

A1 @ 1:200 0 20 40 60 80 100 200

HUNTER PILOT BIOREFINERY OFFICE FITOUT

LOT 22, DP 1131270, CARRAMERE ROAD
MUSWELLBROOK, NSW, 2333

DRAARCHITECTS PTY LTD

Adrian Borsato NSW 4172 Warren Steele NSW 6526

44 Park Beach Road (PO Box 6425)
Coffs Harbour NSW 2450
(02) 6651 4905
dracoffs@draarchitects.com.au
www.draarchitects.com.au

ABN 12 096 929 387

DRA Architects Pty Ltd accept no responsibility for the usability, completeness, or accuracy of the data transferred electronically. Recipients should, when necessary, request a hard copy version for verification. Use figured dimension in preference to scale. all dimensions to be verified on site.

© Copyright

These drawings and designs and the copyright thereof are the property of DRA Architects Pty Ltd and must not be used, retained or copied without the written permission of DRA Architects Pty Ltd A.B.N. 120 9692 9387

north

Drawing: 3D FIRST FLOOR

scale		plotted	Issue Date	job No	drawing number	revision
approved	WS	drawn	AF	18026	A13	C

Appendix C – Trade waste system concept design

Technical note

NC18016 – Ethtec Ethanol Facility DA support – Trade Waste System Concept Design

1. Introduction

Ethanol Technologies Pty Ltd (Ethtec) is proposing to construct a multi-purpose, pilot scale, research, development and education facility (Hunter Pilot Biorefinery), which will include production of ethanol from agricultural waste materials. The process will produce a by-product in the form of lignin cake, that need to be safety disposed of. The method of disposal and overall process is in the development stage. Ethtec is preparing a Development Application (DA) to be submitted to Muswellbrook Shire Council (MSC). A presently running facility in Harwood will be moved to Muswellbrook depending on the outcome of a DA (Figure 1 indicates the potential location, in a predominantly industrial area). To inform the Development Application for Hunter Pilot Biorefinery, a review of proposed processes and systems have been undertaken as per available information. This letter provides our inferences, concepts and recommendations.

Figure 1 – site location

2. Scope of Services

For the development of facilities that manage hazardous materials including wastewater with high amounts of nutrients, an onsite trade waste system must be considered to treat the liquid waste prior to its release to sewer.

The scope of services undertaken by **pitt&sherry** is as follows:

- Review of available wastewater sample test results and determine nutrient loading
- Review local trade waste requirements and consult local authorities as relevant
- Investigate and develop concept design for trade waste system
- Prepare a brief report (this report) for the trade waste system design

Services which were excluded from the scope to be undertaken by **pitt&sherry**:

- Site visit
- Sampling and analysis of the wastewater samples
- Determination of measures to dispose of solids from the trade waste treatment
- Preparation of detailed designs and cost estimations.

3. Process Review

pitt&sherry undertook a review of the proposed pilot plant process including various infrastructure, process stages and outputs, and waste / wastewater generated.

Ethanol production at the proposed facility will be undertaken in a four-stage process. The first two stages produce sugar from hydrolysis of biomass at a maximum processing capacity of 2 tonnes/day. The latter stages convert the sugar solution to ethanol and other byproducts. This process offers resilience from process upsets and can withstand mixed input material stream whereas other similar technologies can accept only one type of input material. It is proposed that 300L per dry tonne limit is applied to production. The process takes 28 days for completion with 10g/L inactivated yeast cells as a process input.

The main leftover material from the process is lignin in the form of a brittle dark brown cake. When produced it has 50% moisture content. Detailed chemical testing of this material is being undertaken. Lignin can be added to a composting matrix as a source of carbon where an appropriate Environmental Protection License (EPL[1]) is held by the facility operator, or it can be landfilled as an inert material. There may also be potential for it to be applied directly to land under a Specific Resource Recovery Order and Exemption[2].

Approximately 3,000L per day of wastewater will also be generated during the production cycle of 28 days over a period of three months. Production cycles will occur no more than four times per year. This wastewater will require pre-treatment prior to discharge to local sewerage network. The wastewater is generated from batch trials with individual equipment operations, washdowns and floor washdowns and may include components from different stages of the process and is therefore not generated as a continuous stream. Since suitable wastewater treatment systems require a relatively continuous flow of wastewater the pre-treatment system will require buffering. The wastewater will comprise the below streams:

1. 15% raffinate (15% sugar solution)
2. 10% raffinate (10% sugar solution)
3. 15% raffinate plus nutrients (15% raffinate supplemented with N, P, vitamins, trace elements as nutrients added at the pre-fermentation stage)
4. 10% raffinate plus nutrients (10% raffinate supplemented with N, P, vitamins, trace elements as nutrients added at pre-fermentation stage)
5. 15% raffinate plus nutrients (15% raffinate supplemented with nutrients post-fermentation)
6. 10% raffinate plus nutrients (10% raffinate supplemented with nutrients post-fermentation)
7. A more dilute washwater stream

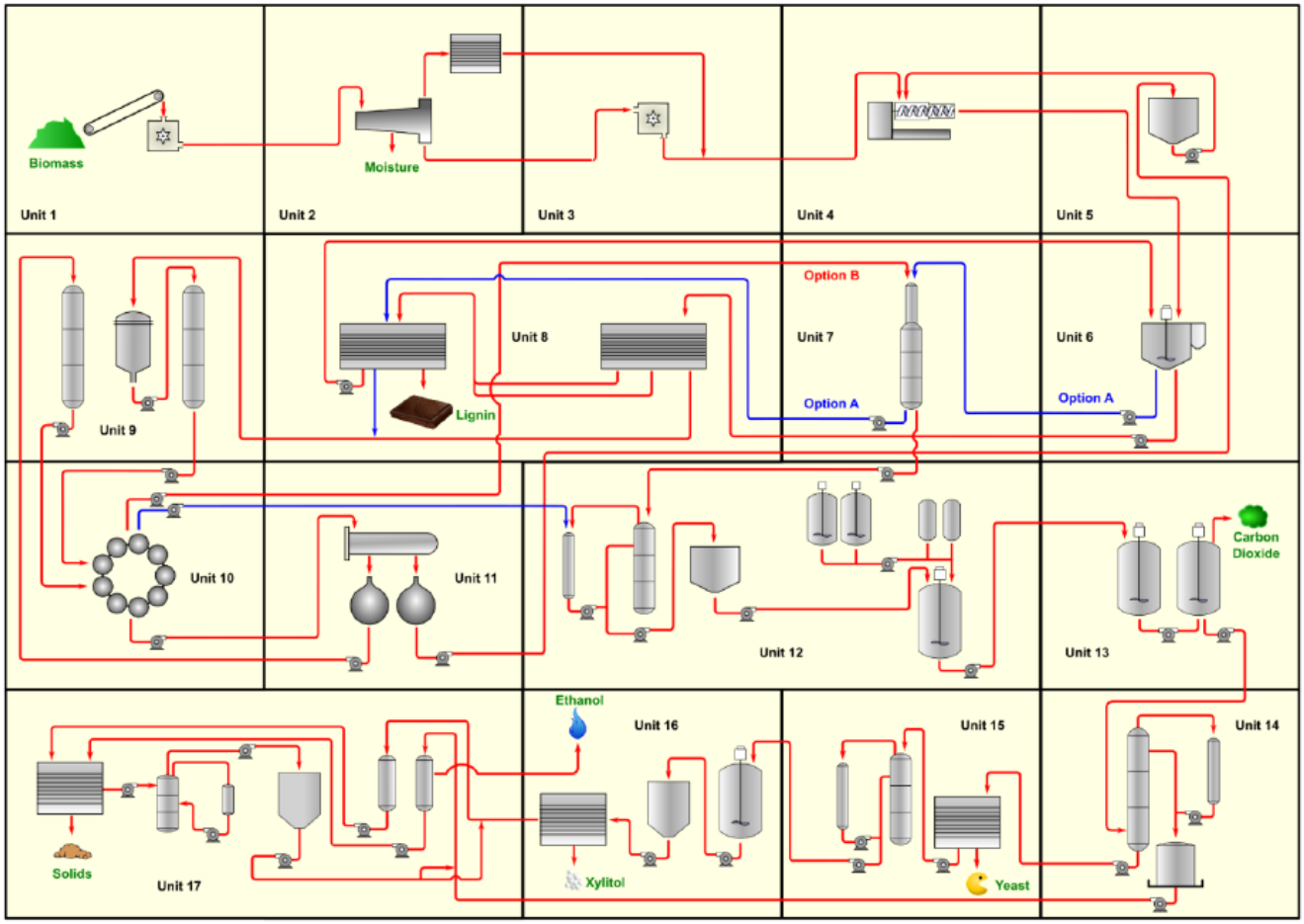
The first two streams are the raw process input as sugars solutions at different concentrations. Streams 3 and 4 are the sugar solutions supplemented with the nutrients required for fermentation (N, P, vitamins, trace elements), while streams 5 and 6 are the results following fermentation of 3 and 4. Streams 5 and 6 therefore only have residual sugars in them. As per the test results the parameters referred to in the

[1] https://apps.epa.nsw.gov.au/prpoeoapp/
[2] https://www.epa.nsw.gov.au/-/media/FA789C038AB8475FA64D407FE8D8640A.ashx

following section are above the trade waste limits set by MSC. To further assess the wastewater constitution, a review of the process flow is important.

a. Proposed Production Process

The proposed biorefinery demonstration project is indicated in the below process flow diagram.



KEY:

- **Unit Process 1 – Biomass Receiving**
- **Unit Process 2 – Biomass Drying**
- **Unit Process 3 – Final Size Reduction**
- **Unit Process 4 – Twin Screw Extrusion**
- **Unit Process 5 – Acid Delivery System**
- **Unit Process 6 – Homogenisation**
- **Unit Process 7 – Hydrolysis Reaction**
- **Unit Process 8 – Filtration Scheme**
- **Unit Process 9 – Fines Filtration and Oxygen Removal**
- **Unit Process 10 – SMB Separation System**
- **Unit Process 11 – Acid Reconcentration**
- **Unit Process 12 – Media Preparation**
- **Unit Process 13 – 2nd Generation Fermentation**
- **Unit Process 14 – Stripping/Distillation**
- **Unit Process 15 – Yeast Filtration and Underflow Conc.**
- **Unit Process 16 – Crystal Production**
- **Unit Process 17 – Waste Treatment System**

Figure 2 – Flow chart of the proposed process

4. Waste and Wastewater Management

There are two (2) components to wastewater generated at this site:

- Kitchen/amenities facilities – managed with sink basket wastes and a standard 1000L grease trap/arrester
- Ethanol production process – onsite treatment, as discussed in detail below.

Toilets and other amenities are being designed for 20 personnel on site, with an anticipated daily flow of 720L. The sewage will drain directly to a pump station tank via vented DN100 PVC with sufficient capacity (at grades between 1.65 and 5%) as per the maximum fixture loadings in AS3500 tables 3.3.1 and 8.2.2(A). The treated liquid waste stream from operations of the plant will also be introduced to the pump station tank via a vented DN100 PVC dedicated main. The combined waste water will then be pumped to the local sewage main running along the site boundary.

Trade waste is predominantly liquid waste with additional solid component in the form of lignin cake which will be managed separately. Raw wastewater from production would include components that are high in various elements especially including TSS, TDS, TKN, TP, BOD and COD, which will require pre-treatment prior to discharge into sewer as trade waste.

MSC is currently refurbishing the local wastewater treatment systems, replacing the current 2.6ML/day (average dry weather flow) Muswellbrook STP that has been in service for more than 85 years. In addition, there is an oxidation ditch (Pasveer) with treatment capacity of 400 KL/day. It was recommissioned in 2014-15 as an interim arrangement prior to commissioning of the new Muswellbrook Recycle Water Treatment Works (RWTW). The new plant is currently under construction and is expected to be fully operational by 2019 with the new IDEA (Intermittent Decanting Extended Aeration) tank process reactor of daily process capacity of 3.2ML/day with provision for upsizing to 3.9ML/day. Currently, treated effluent from the treatment works is recycled for irrigation on Muswellbrook Gold Club and industrial purposes at Mt Arthur Coal Mine.

5. Wastewater Quality Data Review

Waste generated from the operations at the proposed research facility will mainly be liquids comprising high levels of nutrients and trace elements, based on available wastewater sample test results from similar operations, tested at ALS Global. The samples were collected on 16 April 2018 and comprise all the six streams as noted earlier in this report.

Based on available test results, the below parameters are above MSC trade waste limits (all units in mg/L):

Parameter	15% raffinate	10% raffinate	15% raffinate + nutrients	10% raffinate + nutrients	15% fermented	10% fermented	MSC trade waste limits
Total Dissolved Solids	125000	78700	110000	79800	64800	35800	4000
Sulfate as SO_4	26800	16600	24900	15500	28000	18300	500
Aluminium	501	301	321	393	92.1	202	100
Chromium	23.9	15	16	21.3	17.8	14.2	3
Manganese	28.3	17.5	19.8	27	28	20.2	10
Molybdenum	0.882	0.563	0.767	0.988	1.04	0.645	0.01
Nickel	28.4	17.4	18.8	25.8	28.2	18.1	3
Zinc	15	9.75	11.6	15.7	14.8	8.46	5
Iron	573	348	311	382	299	214	100
Ammonia as N	76.1	66.9	88.1	179	849	<0.05	50
Total Kjeldahl Nitrogen as N	451	269	1530	1390	1100	167	100
Total Phosphorus as P	11.4	7.7	666	673	96.2	136	20
Chemical Oxygen Demand	19400	10400	17000	10800	12300	2500	Max 3 x BOD_5
Biochemical Oxygen Demand	13600	8370	11300	7440	6520	1700	300
TSS					10000	10000	300
pH	< 1	< 1	3.5	3.5	3.5	3.5	7-8

The limits on the trade waste effluents area as confirmed by the Environment section at MSC.

The main chemical constituents to reduce in the **worst-case** waste water sample, ignoring possible dilutions with various components as per above six streams are:

- TSS – 10,000 mg/L
- TDS – 125,000 mg/L
- Sulphates – 28,000 mg/L
- Ammonia N – 849 mg/L
- TKN – 1530 mg/L
- TP - 673 mg/L
- BOD – 13,600 mg/L

6. Proposed On-site Treatment System

As the proposed processes occur during a period of 28 days over a three-month duration, the generation of wastewater is considered sporadic in terms of volumes per day. Bio-chemical wastewater treatment systems require uniform flows for nutrient removal, depending on wastewater characteristics.

A primary wastewater treatment system would be required to reduce the physico-chemical parameters of the wastewater generated from the onsite processes.

a. Concept Design

Given the sporadic rate of generation at upto 3,000L/d for 28 days, a buffering tank is required to provide uniform flow to the treatment system. It is anticipated a ten-day worth of storage will be suitable, which equates to a 30,000L buffer tank. This can achieve a normalised flow loading of 933.33L/d (rounded to 1000L/d) across the 90-day period. As per verbal advice by MSC, this does not constitute a high-volume addition to the sewer network.

The daily generation rate of the pollutants of interest, at normalised 1,000L/d, are:

- TSS – 10kg/L
- TDS – 125 kg/d
- Sulphates – 28 kg/d
- Ammonia N – 1 kg/d
- TKN – 1.5 kg/d
- TP – 0.7 kg/d
- BOD – 13.6 kg/d

The concept design of an applicable trade waste treatment system based on chemical-biological nutrient removal is proposed in Figure 3 (reproduced in Appendix 1).

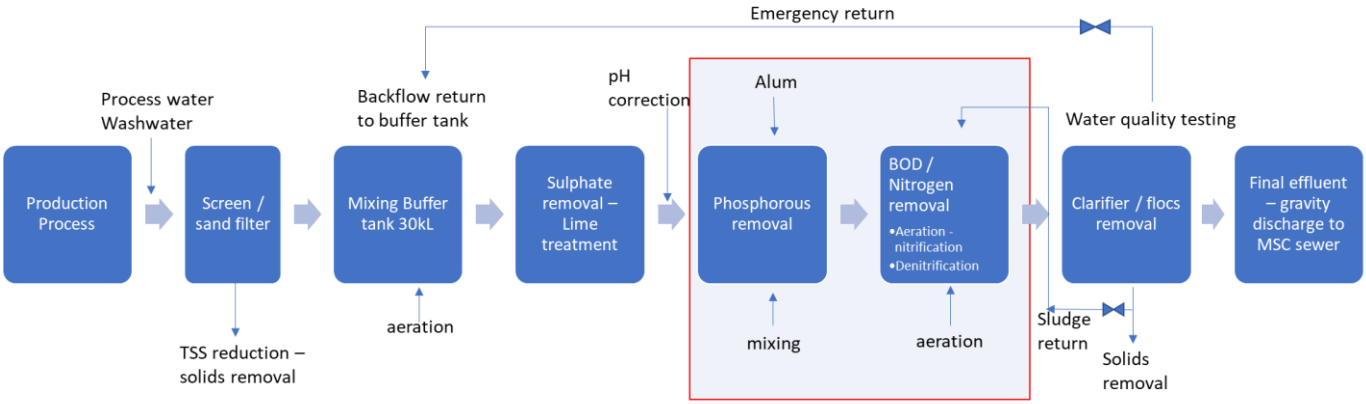


Figure 3 – Proposed Trade Waste Treatment System Concept

System components:

- A screening mechanism is required to remove the high TSS content. A sand filter is proposed to avoid the space requirements for a primary clarifier and due to the low flow.
- An aerated mixing tank is proposed as the buffer tank to normalise the flow to the rest of the treatment system.
- Sulphate removal will be via lime treatment. As this process will increase the pH of the wastewater stream, a pH correction will be required afterwards.

- Conventional alum coagulation and flocculation is proposed for removal of TP.
- BOD and Nitrogen removal is proposed via traditional aeration process where the growth of nitrophilic bacteria is promoted to consume the BOD and removal of Nitrogen through nitrification and denitrification process. Dissolved Oxygen (DO) is important for this process, therefore this tank will require aeration controlled via monitoring of DO. Options for this phase of the system include:
    - Membrane Bio Reactor (MBR) / Continuously Stirred Tank Reactor (CSTR)
    - Sequencing Batch Reactor (SBR)
    - Suspended growth activated sludge process – eg Biogill (Appendix 2)
- Sludge and flocs generated in the above steps is required to be removed via a secondary clarifier prior to discharge to sewerage.
- An emergency return flow line, from the clarifier back to the buffer tank, has been proposed in the design to restrict release of non-conforming effluent to the sewer network. Prior to daily release of effluent to the MSC sewerage system, a check of key parameters will be made to ensure conformance, if outside these limits then product will be diverted for further treatment.
- Appropriate pumping systems will be incorporated as required at detailed design stage.
- Gravity feed is envisaged for discharge to the sewer network from the final effluent tank via DN100 PVC pipe system.

The above system presents a concept that has been developed based on the one-off test results reviewed in section 5 of this report and need to be further developed with actual wastewater test results for relevant parameters for a true representation of the expected wastewater stream to be treated and discharged.

b. Monitoring and Maintenance Requirements

Wastewater samples will need to be analysed for key constituents on a regular basis. Testing and monitoring should be undertaken as per specific advice from MSC on trade waste discharge approval or as per the MSC adopted Liquid Trade Waste Policy document[3]. Maintenance of the pumps and other components of the flow management system should be undertaken as per manufacturer's instructions.

c. Placement of On-site Treatment System

Effluent of the system shall be regularly tested for specific parameters in comparison with the trade waste licence limits. The treated wastewater will be pumped, through an interim holding/equaliser tank as part of the treatment system to a sewer manhole on Carramere Road to alleviate issues related to variable flow volumes. Domestic sewage from the facility will also be directed to this manhole so testing for trade waste parameters (and metering) will be undertaken prior to transfer of treated waste to the pump station tank. A sampling program including locations will be developed for the system once design is finalised.

[3] Muswellbrook Shire Council – Policy for Discharge of Liquid Trade Waste into Council's Sewerage System

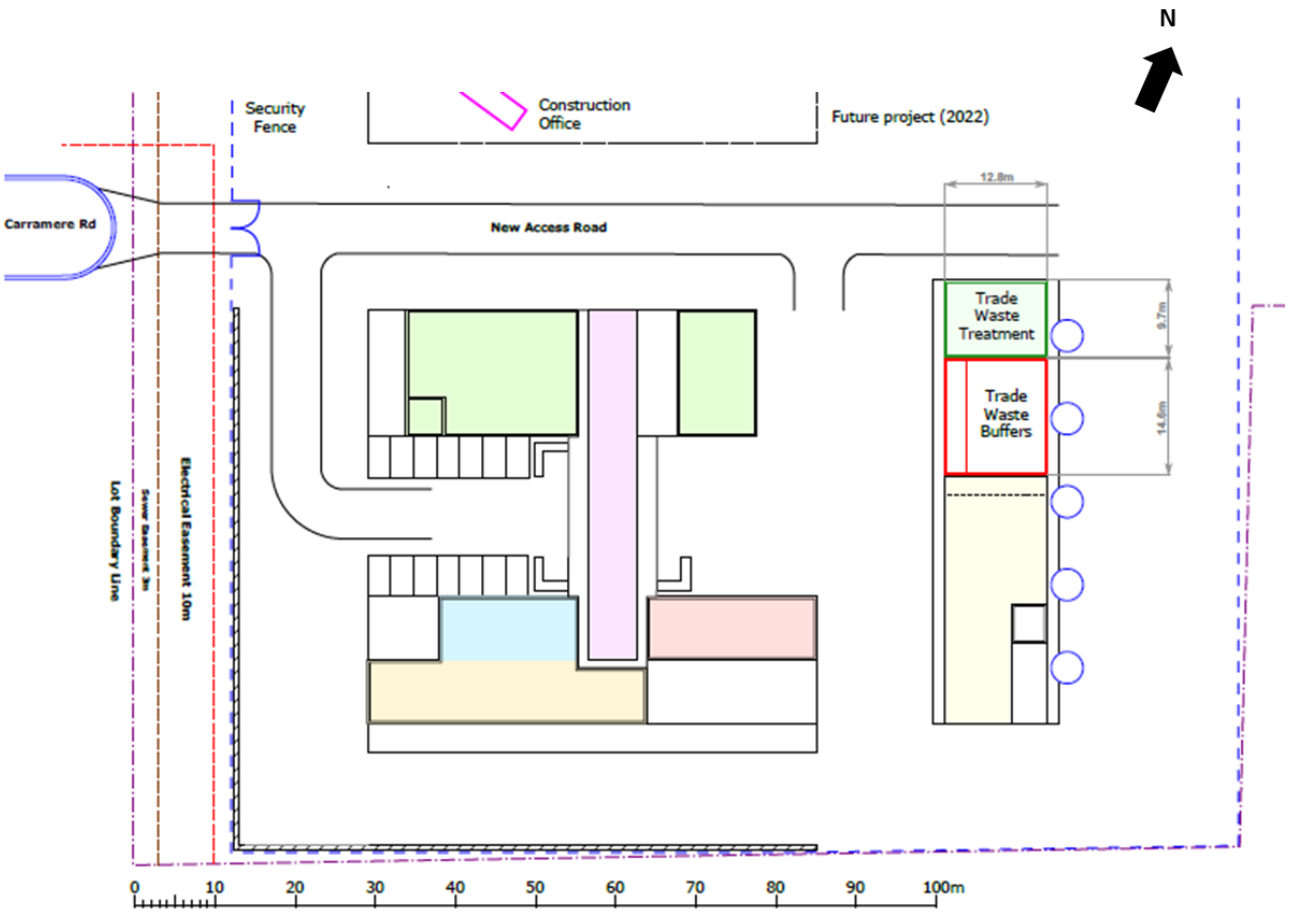


Figure 4 – Site layout and trade waste system

d. Solids Disposal

The production process will generate 6.5 tonnes of lignin cake during the 28-day run time.. This equates to an expected maximum generation of approximately 26 tonnes of solid waste per year. In addition, there would be biosolids generated from the wastewater treatment process and fermentation processes. These solids would be disposed via licenced contractors to further treatment at an appropriate licensed facility. At the time of generation, the lignin cake contains approximately 50% moisture content and the biosolids can be added to the lignin and managed as per agreement with MSC (Composting or landfilling)

e. Contingency Plan for liquid waste

Contingency plans should be in place for any system failure and during periods of long maintenance if required. A hazard analysis undertaken during the initial stages of project development should include a review of potential issues with the site operations and wastewater treatment system. Contingency plans should consider:

- Trucking off wastewater to a licenced treatment facility such as Cleanaway
- Temporary holding of wastewater in the 30kL buffer tank for a period of no more than 90 days (additional)
- Limit or cease operations that will generate wastewater
- Hiring of a package plant for short periods to cover the required period.

If, on the other hand, a new run of the process does not occur and the buffer tank runs empty due to a plant shut down or for maintenance, the wastewater treatment plant could be shut down temporarily. An

air-tight container should be filled with 20L of sludge from the sludge return valve for seeding the biological nutrient removal section of the liquid waste treatment plant at the next start-up of operations.

7. Summary / Conclusions

A review of the wastewater testing data was undertaken in relation to the proposed Hunter Pilot Biorefinery that will produce ethanol from biomass. Based on available data, a pre-treatment system is required to render the liquid waste safe for discharge to MSC sewer. The concept of a three-stage treatment system to remove excess sulphates, phosphorous, nitrogen and BOD will need to be further developed as more water quality test data becomes available from the pilot plant.

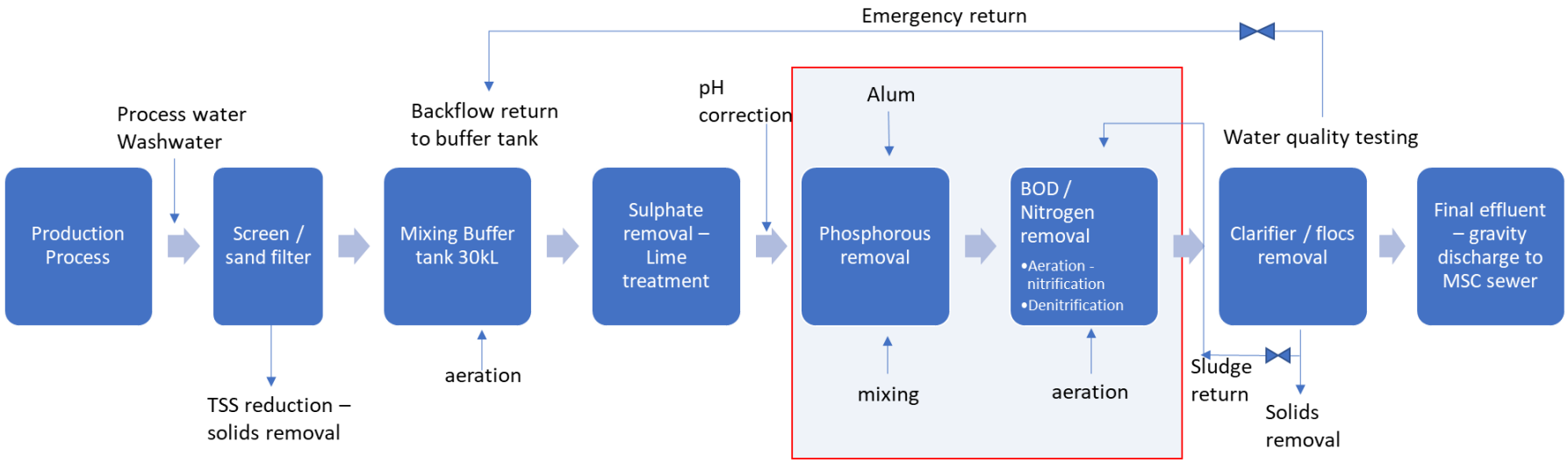
The expected wastewater generation quantity is very low and variable in nature – at 3000L/day for 28 days during a period of 3 months. To cater for the variable wastewater generation rate, which would not be conducive to a biological nutrient removal system, a buffer tank that will render a uniform flow of 1000L/day has been included prior to the treatment system components.

Continued water quality monitoring prior to discharge is required. An emergency return flow option from the clarifier outlet has been incorporated to restrict release of non-conforming effluent to the sewer network.

8. Further information

For further information contact Dr Avanish Panikkar in the Sydney office.
Email: apanikkar@pittsh.com.au
Phone: 02 9468 9300

APPENDIX 1 – PROPOSED TREATMENT SYSTEM Concept Design of Process



BIOGILL

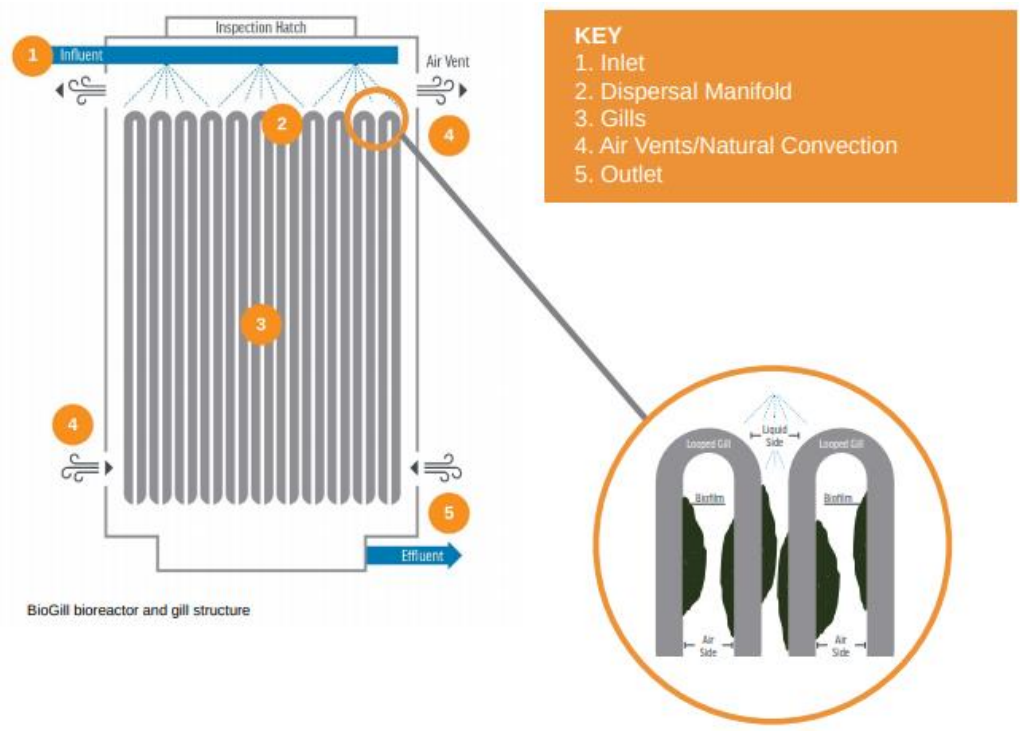
BioGill manufactures above ground, attached growth, bioreactors that deliver compact, affordable wastewater treatment solutions. Key to BioGill performance efficiency is the growth of healthy biomass on the patented nano ceramic media, known as “gills”.

Our technology relies on the availability of suitable nutrient mix in the wastewater and the availability of oxygen transfer to the gill structure. With these in place, BioGill units maximize the load of treating biology, which in turn consume the organic nutrients found in the waste stream. The gill structure means an above ground, non-submerged culture can attach to the gills as a biofilm.

The BioGill bioreactor is a secondary treatment process that removes soluble nutrients (BOD/COD) from the wastewater. The process also allows for a reduction in: Fat, Oil and Grease (FOG); Turbidity; Odor; and Suspended Solids through secondary functions.

Arranged in suspended vertical loops, each gill is folded over a support, creating two distinct sides: one in contact with the wastewater and the other in contact with the air. The liquid is dispersed over the top of the bioreactor and moves down between the gills. The biomass growing on the gills is supplied oxygen from the atmosphere via the air side and soluble nutrients from the water side.

As the biofilm develops and thickens, the outer layer becomes substrate limited and eventually dies and sloughs off. The bioreactor will naturally develop sufficient biomass to support the nutrient conditions of the system. This efficient process reduces sludge yield and the large particles readily settle in the treatment tank, reducing operator involvement while ensuring efficient nutrient removal.



BioGill bioreactor and gill structure

The configuration of the bioreactor decouples the need to aerate the water, as required in conventional activated sludge systems. This feature reduces the energy footprint of the technology by up to 80%.

INDICATIVE COST

- Designing for an influent of 10,000mgBOD/L @ 1m^3/day:
    - Two stage Tower System would yield an effluent <300mgBOD/L.
- Material Cost: 2 Stage Tower System: **$43,400**
    - 2 Towers Inline Package.
    - Includes Towers, Recirculation Tanks, Aluminium Stands, Electrical Termination Box, Connections.

Appendix D – Cost estimate

MCG QUANTITY SURVEYORS

DEVELOPMENT APPLICATION COST PLAN

YOUR PROPERTY / OUR EXPERTISE

PH: 1300 795 170

www.mcgqs.com.au

SYDNEY MELBOURNE BRISBANE ADELAIDE CANBERRA NEWCASTLE

MCG QUANTITY SURVEYORS

Your property, Our expertise

ABN: 40 1 0 4 4

S ite 1, 2 S it Street
C arle town NSW 22 0

1 00 7 170

w www.mcgqs.com.au

e steve.weeks@mcgqs.com.au

040 4 0 4

September 21, 2018

An rew Ree e

CA/- Lot 22, DP 11 1270, Carra ere Roa
Muswellbrook NSW 2333

RE: Development Application Cost Plan - Lot 22, DP 1131270, Carramere Road, Muswellbrook NSW 2333

Dear An rew,

MCG antit S r e or a e re are t e ollowing De elo ent A lication Co t Plan or An rew Ree e , an not in an ot er ca acit

1.0 Development Location

De elo ent T e:	In trial De elo ent
Client Detail :	An rew Ree e
A re :	Lot 22, DP 11 1270, Carra ere Roa
S r :	M well roo NSW 2

1.1 Development Summary

T e e elo ent con i t o an in trial e elo ent incl ing o ice ace an e ternal wor

Plea e note t e attac e In icati e De elo ent A lication Co t Plan a een calc late ro t e total e elo ent co t T ere ore t i onl ro i e a roa in ication o t e li el ercentage o t e total e elo ent co t again t eac o t e roject tra e ele ent

2.0 Financial Summary

MCG antit S r e or elie e t at t e attac e De elo ent A lication Co t Plan an e ent e elo ent co t, re lect a air an co etiti e co t to co lete t e ro o e e elo ent, a e on t e aterial ro i e to o r o ice

T e MCG antit S r e or De elo ent A lication Co t Plan or con tr ction co t total 4,41 ,2 1 e cl i e o GST or 4, , 0 incl i e o GST, wit a rt er 220,7 4 a a le in con ltant ee

Trade	Total GST Exclusive	Total GST Inclusive
Total Con tr ction Co t	4,41 ,2 1	4, , 0
Con ltant Fee	220,7 4	242, 40
Total	**4,636,045**	**5,099,649**

T e e elo ent con i t o a total gro loor area ll enclo e an nenclo e co ere area o , 7 are etre

3.0 Construction Program

MCG antit S r e or antici ate a erio o 12 ont to e a ro riate or t e con tr ction o a e elo ent o t i co e an nat re

4.0 Descriptive Summary

T e e elo ent in ol e t e con tr ction o an In trial De elo ent locate at Lot 22, DP 11 1270, Carra ere Roa , M well roo NSW 2

An a ro riate le el o ini e an alit a een allocate to t e e elo ent

Plea e re er to attac e Sc e le o Fini e an A tion w ic a e een incl e or wit in t e MCG antit S r e or De elo ent A lication Co t Plan

T e e elo ent con tr ction co t er are etre o gro loor area ll enclo e co ere area an nenclo e co ere area i 1,2 e cl i e o GST or 1,42 incl i e o GST

5.0 Disclaimer

MCG antit S r e or a e re are t i re ort on t e a i o in or ation lie An rew Ree e

W il t all ro e ional care an ill a e een e erci e to en re t e acc rac o t i re ort, MCG antit S r e or are na le to ro i e an g arantee on an e ti ate rel ing on in or ation ro i e t e client or ot er t ir art , an will not e lia le to an art or an lo ari ing a a re lt o an c in or ation e entl eing o n to e inacc rate or lac ing a t enticit

6.0 Report Conclusion

It i t e reco en ation o MCG antit S r e or t at t e content o t e a ore entione re ort e treate a a ice on t e li el con tr ction co t o t e e elo ent, an i not a re lection o t e c rrent ar et al ation o t e e elo ent

Plea e o not e itate to contact o r o ice o l o a e an rt er erie

o r Sincerel ,

Ste e Wee
antit S r e or
MCG antit S r e or

Schedule of Finishes

T e ollowing i a c e le o t e ini e a e MCG antit S r e or in t e re aration o t e De elo ent A lication Co t Plan

- E ca ation an retaining wall
- Wall an loor tile to wet area / 2 l
- Wall tile 2000 ig to ower , irting tile to all ot er area
- Al ini ra e win ow an li ing oor
- Car et to o ice area
- Tile to entr t re ol
- Preca t concrete e ternal wall
- Fire rate art wall te to all e eration wall
- Lig tweig t t internal wall , la ter oar line
- All er ice incl ing ewer, tor water, electrical, ec anical an ire
- Ser ice connection to ain
- Dri ewa an car ar ing
- Ba ic lan ca ing

Schedule of Information

T e ollowing i a c e le o t e in or ation e MCG antit S r e or in t e re aration o t e De elo ent A lication Co t Plan

- Written an er al in or ation ro i e An rew Ree e
- Arc itect ral Drawing - o N er: 1 02 Drawing N er: A01 to A0 , re i ion B, ate 27t o A g t 201 A10 to A1 , re i ion B, ate 27t o A g t 201 a re are DRA Arc itect
- Ci il Drawing - o N er: 1 -14 S eet N er: CN01, re i ion 0 , ate 2 t o ne 201 01 to 12, re i ion 0 , ate 2 t o ne 201 a re are McKen ie B rri ge A ociate Pt Lt

Schedule of Exclusions

T e ollowing i a c e le o t e e cl ion wit in t e MCG antit S r e or re aration o t e De elo ent A lication Co t Plan

- De ign contingenc
- Lan an legal co t
- Ri e an all
- Hol ing co t an intere t c arge
- Un nown gro n con ition
- Goo an er ice ta
- Lea ing an ar eting co t
- Finance co t
- Re o al o a ar o aterial an conta inate oil
- Staging, a ing or ela co t
- Co t increa e e on Se te er 201
- Wor not clearl note on t e ro i e lan oc entation
- Electrical S Station
- All a t orit ee

Indicative Development Application Cost Plan

Indicative Development Application Cost Plan

Development Type: In trial De elo ent
Development Address: Lot 22, DP 11 1270, Carra ere Roa , M well roo NSW
Gross Floor Area: , 7 2

No	Trade Description	% Job	Cost ($/m2)	Total Cost Excl GST	Total Cost Incl GST
	Trade Breakup				
1	Preli inarie Margin	10 00	10 70	70, 4	407,
2	S tr ct re	4 00	41 4	14 , 42	1 ,17
	Superstructure				
	Col n	1 0	1	, 7	,270
4	U er Floor	0	1 1	21 , 04	240, 4
	Stairca e	0 0	0	2 ,	2,
	Roo	0	1 2	2 , 2	, 7
7	E ternal Wall Win ow	1 10	1	7,07	,7 2
	E ternal Door	0 70	7 2	2 , 0	2 ,
	Internal Wall	70	7	1 7,21	1 0,
10	Internal Screen	0 40	4 1	14, 4	1 , 1
11	Internal Door	1 10	11 41	40,7 4	44, 7
	Finishes				
12	Wall Fini e	2 0	2	,422	10 ,0 4
1	Floor Fini e	4 0	4	1 , 4	1 , 7
14	Ceiling Fini e	4 10	42 2	1 2,0 0	1 7,2
	Fittings				
1	Fit ent	1 00	10 7	7,0	40,7 4
	Services				
1	Pl ing	4 0	4 77	17 ,010	1 , 11
17	Mec anical	17 0	1 4	0,120	72 ,1 2
1	Fire Protection	0 70	7 2	2 , 0	2 ,
1	Electrical	0	14	1 ,22	4 ,74
20	Tran ortation	1	14 00	0,0	,072
21	E ternal Ser ice	0 40	4 1	14, 4	1 , 1
22	B il er Contingenc	1 1	11 7	42,4	4 ,70
	Sub Total	**100.00**	**1,037**	**3,708,355**	**4,079,190**
	De olition incl argin			-	-
	E ca ation incl argin			1,407	7, 4
	E ternal Wor incl argin			4 , 1	710,071
	Con ltant Fee	00		220,7 4	242, 40
	De elo er Contingenc	0 00		-	-
	Totals		**1,296**	**4,636,045**	**5,099,649**

Indicative Development Application Cost Plan

Development Type: In trial De elo ent
Development Address: Lot 22, DP 11 1270, Carra ere Roa , M well ro
Gross Floor Area: , 7 2

Trade Description	Total Cost Excl GST	Total Cost Incl GST
Demolition & Site Prep	-	-
De olition Site Pre Co t er 2 Site Area	0	0
Excavation	**61,407**	**67,548**
E ca ation Co t er 2 Site Area	1 7	1 7
Construction - Commercial	**3,409,599**	**3,750,559**
Con tr ction - Co ercial Co t er 2 Co ercial Area	1002 4	1102 7
Construction - Residential	-	-
Con tr ction - Re i ential Co t er 2 Re i ential Area		-
Construction - Retail	-	-
Con tr ction - Retail Co t er 2 Retail Area		
Construction - Car Park	**91,875**	**101,063**
Con tr ction - Car Par Co t er 2 Site Area	2	2
Co t er ace		
Fit Out - Commercial	**852,400**	**937,640**
Fit O t - Co ercial Co t er 2 Co ercial Area		
Fit Out - Residential		-
Fit O t - Re i ential Co t er 2 Re i ential Area		-
Fit Out - Retail		-
Fit O t - Retail Co t er 2 Retail Area		
Sub Total	**4,415,281**	**4,856,809**
Consultant Fees	**220,764**	**242,840**
o Con tr ction Co t	00	00
o De elo ent Co t	4 7	4 7
Totals	**4,636,045**	**5,099,649**

Total GST	**463,604**

Mart Sa lier

Director - Senior antit S r e or A ociate Me er o t e A tralian In tit te o antit S r e or - AAI S- 74

MCG antit S r e or

Appendix E – Preliminary hazard analysis

Preliminary Hazard Analysis

Hunter Pilot Biorefinery

July 2018

VIRIDIS CONSULTANTS

Preliminary Hazard Analysis

Hunter Pilot Biorefinery

Viridis Consultants Pty Ltd
PO Box 131
Bulimba Qld 4171
Australia
www.viridis.net.au
ABN: 49 129 185 271

Telephone: 1300 799 310

Date: 16 July 2018
Reference: 18NS10
Status: Final

© Viridis Consultants Pty Ltd 2018

Citation: Karen Pither and Madison Wright 2018, Preliminary Hazard Analysis - Hunter Pilot Biorefinery, prepared for Ethanol Technologies by Viridis Consultants Pty Ltd.

Contents

Executive Summary **3**
1. Introduction **4**
1.1. Purpose 4
1.2. Scope 4
1.3. Applying the SEPP 33 Planning Guidelines 4
2. Hunter Pilot Biorefinery Plant **6**
2.1. Site Description 6
2.2. Process Description 6
2.2.1. Phase 1 6
2.2.2. Phase 2 6
2.2.3. Phase 3 7
2.2.4. Phase 4 7
2.3. Hazardous Materials Storage and Handling 7
2.4. Onsite Control Measures 8
3. Methodology **9**
3.1. Overview 9
3.2. Risk Criteria 9
3.2.1. Impacts to People 9
3.2.2. Impacts to Property 10
3.2.3. Impacts to the Environment 10
3.3. Qualitative Analysis 10
3.4. Quantitative Analysis 10
4. Hazard Identification **11**
4.1. Qualitative Analysis 11
4.1.1. Hazards 11
4.1.2. Hazardous scenarios 12
4.2. Frequency Assessment 12
4.3. Semi-Quantitative Consequence Analysis 15
5. Results and Discussion **16**
5.1. Ethanol Pool Fire 16
5.2. Overpressure (Blast Force) From Vapor Cloud Explosion 17
5.3. Toxic Exposure 17
6. Conclusion **18**
7. References **19**

Appendices

Bunded Area Locations ..... A
Biomass Stockpile Location ..... B

Figures

Figure 1 Ethanol Pool Fire Threat Zones 16

Tables

Table 1 Quantity of Hazardous Chemical and Bunded Areas 7
Table 2 Chemical Details 8
Table 3 Individual Fatality Risk Criteria 9
Table 4 Individual Injury Risk Criteria at Residential and Sensitive Use Areas 9
Table 5 Environmental Risk Criteria 10
Table 6 Potentially Hazardous Material Summary 11
Table 7 Hazard Identification Word Diagram 14
Table 8 Model Inputs and Assumptions 15
Table 9 Ethanol Pool Fire Model Results 16

Document History and Status

Revision	Date	Approved by	Initials	Details
0.1	11/7/18	Glen Luscombe	GL	Initial Draft to client
1.0	16/7/18	Karen Pither		Final

Author:	Karen Pither and Madison Wright
Project manager:	Karen Pither
Name of client:	Ethanol Technologies
Name of project:	Preliminary Hazard Analysis
Name of document:	Hunter Pilot Biorefinery
Document number	REC-18-100
Document version:	1.0
Project number:	18NS10

Executive Summary

Viridis Consultants Pty Ltd was engaged to prepare a Preliminary Hazard Analysis (PHA) to assess the risks associated with the proposed Hunter Pilot Biorefinery (HPB) in Muswellbrook, NSW. The HPB will develop methods to produce ethanol from a range of lignocellulosic biomass materials.

The HPB will include the handling and storage of classified chemicals and potentially hazardous materials. The *NSW State Environmental Planning Policy (SEPP) No: 33 Hazardous and Offensive Development* is the regulatory framework in place for the approval of development. Whilst assessment against the SEPP 33 framework indicates that the proposed HBP does not trigger the requirements, a PHA was undertaken to better understand the potential risk of the activity.

The PHA followed the requirements of the SEPP 33 framework and included initial screening against the criteria identified in *Applying SEPP 33* guideline, qualitative assessment and a further semi-quantitative assessment of the potential impacts of an ethanol release.

The qualitative assessment took into account the effectiveness of the proposed onsite control measures to estimate the risk of a range of hazardous scenarios. Following on from the qualitative assessment, a semi-quantitative assessment of the risk of an ethanol bund fire, overpressure explosion and toxic vapour release were modelled. The model predicted the treat zone for a range of scenarios for the two areas proposed to store ethanol. The model predicted that the impacts to people and property can be contained within the HPB site.

1. Introduction

Viridis Consultants (Pty Ltd) has been engaged by Ethanol Technologies Ltd (Ethtec) to undertake a Preliminary Hazard Analysis (PHA) for the Hunter Pilot Biorefinery (HPB), located at Muswellbrook, NSW.

Ethtec propose to construct, establish and operate the Pilot Biorefinery Facility in the Muswellbrook industrial estate on Thomas Mitchell Drive. . Apace Research has entered into a lease agreement with Muswellbrook Shire Council for the land on Lot 22, Carramere Road, for the exclusive purpose of developing this project. Ethtec is contracted by Apace Research to construct and operate the Pilot Biorefinery Facility.

The *NSW State Environmental Planning Policy (SEPP) No: 33 Hazardous and Offensive Development* is the regulatory framework in place for the approval of development. The NSW Government have prepared Planning Guidelines for the implementation of the SEPP, which include requirements for PHAs.

1.1. Purpose

The purpose of the PHA is to:

- Identify all potential hazards associated with the operating of the HPB
- Analyse all hazards in terms of their consequences (effects) to people and the biophysical environment and their likelihood of occurrence
- Quantify the analysis and estimate the resultant risks to surrounding land uses and the environment
- Assess the risks in terms of the location, land use planning implications and existing criteria and ensure that the proposed safeguards are adequate and thus demonstrate that the operating will not impose an unacceptable level of risk.

1.2. Scope

The scope of the project comprises a PHA as detailed in the SEPP 33 Planning Guidelines and will cover on site hazards and their effects. Key issues to be addressed by this PHA include:

- Documenting expected volumes of hazardous material
- Perceived risk to personnel and property
- Exclusion zones or distanced to other residential and commercial facilities
- Risk comparison with nominated risk criteria stared in the *NSW Hazardous Industry Planning Advisory Paper (HIPAP)*

The HPB has not been constructed, and the findings of this report are based on the preliminary information provided by Ethtec and may be limited by the level of detail in the preliminary information. Preliminary information includes:

- Draft Statement of Environmental Effects – Hunter Pilot Biorefinery
- Draft site layout plans

Findings of this report can only be considered an estimation of risk based on preliminary information.

1.3. Applying the SEPP 33 Planning Guidelines

State Environmental Planning Policy (SEPP) No 33: Hazardous and Offensive Development presents a systematic approach to the assessment of development proposals for potentially hazardous and offensive industry or storage. Through the policy, the permissibility of a proposal to which the policy applies is linked

to its safety and pollution control performance. SEPP 33 also aims to ensure that the merits of proposals are properly assessed (in relation to off-site risk and offence) before being determined.

SEPP 33 ensures that only those proposals that are suitably located, and able to demonstrate that they can be built and operated with an adequate level of safety and pollution control, can proceed. A number of HIPAPS and other guidelines have been published progressively by the Department to assist stakeholders in implementing the process.

HIPAPs relevant to this PHA include (but are not limited to):

- *Applying SEPP 33*
- *Multi Level Risk Assessment*
- *HIPAP 3: Risk Assessment*
- *HIPAP 4 - Risk Criteria for Land Use Planning*
- *HIPAP 6 - Guidelines for Hazard Analysis*

Applying SEPP 33 outlines the process where an initial screening of the proposed hazardous activity can be undertaken to determine if the SEPP 33 applies through checking screening tests such as dangerous goods quantity/distance thresholds nominated in the guidelines.

An initial screening of chemical use and storage on site indicates that volumes stored onsite is unlikely to meet the threshold values as follows:

- For ethanol, which is a Class 3 Packaging Group II chemical, assessment against screening thresholds is required if volumes are greater than 5 tonnes.
- For Class 8, packing group II, the threshold is 25 tonne and packing group III, the threshold is 25 tonne.
- For Class 5, the threshold is 5 tonne.

The Statement of Environmental Effects states that:

> *Less than 25 tonnes of Class 8 chemicals will be stored on site. Less than 5 tonnes of Class 5 chemicals will be stored on site.*
>
> *Less than 5 tonnes of Class 3 flammable liquids will be stored on-site. Distances from boundaries and other sensitive areas to bund wall exceed requirements of figure 9 for radiant heat effects.*
>
> *Chemicals stored within in the small scale laboratories are listed in attachment. Typically less than 1kg of each is stored.*

Based on the statement above, the proposed HPB will not trigger SEPP 33, however this hazard analysis was progressed to quantify the risk to people and property. It should be noted that should volumes be increased on site, preliminary screening should be revised.

2. Hunter Pilot Biorefinery Plant

2.1. Site Description

The HPB is located on Lot 22, Carramere Road, Muswellbrook NSW. Muswellbrook is located in the Upper Hunter Region of NSW, about 243 km north of Sydney. The dominant surrounding land uses includes general industrial, environmental management and primary production. No residential or sensitive areas are located adjacent to the site.

2.2. Process Description

For discussion purposes, the biorefinery process has been categorised into four (4) phases. The equipment will be installed and operated in segregated and bunded areas with enclosed sumps. The sumps use lift pumps to transfer spills or wash-down liquids to the trade waste systems.

2.2.1. Phase 1

The proposed plant processes for Phase 1 are as follows:

- Unit Process 1 -Biomass Recovery
- Unit Process 2 -Biomass Drying
- Unit Process 3 -Final Size Reduction
- Unit Process 4 -Twin Screw Extrusion
- Unit Process 5 -Acid Delivery system
- Unit Process 6 -Homogenisation
- Unit Process 7 -Hydrolysis reaction

Phase 1 involves granulating the feedstock to less than 2mm, followed by drying to a moisture content of less 10%. Feedstock is impregnated with concentrated sulphuric acid using a twin-screw extruder (TSE), which forms a paste. This paste is diluted to a slurry containing less than 30% sulphuric acid and retreated (Reactor) to release the sugars into solution. Completion of Phase 1 results in sugars and acid in solution, and lignin as a suspended solid.

2.2.2. Phase 2

The proposed plant processes for phase 2 are as follows:

- Unit Process 8 -Filtration
- Unit Process 9 -Fines Filtration and O_2 Removal
- Unit Process 10 -SMB System
- Unit Process 11 -Acid Re-concentration

Phase 2 involves clarifying the solution by removing the suspended lignin using a belt filter. The lignin cake is washed several times with process water, which results in a cake comprising mostly lignin, with some unreacted feedstock and less than 1% residual sulphuric acid. The process water is recycled internally.

The HPB will have small electric boilers for steam generation.

The acid/sugar solution then goes through a chromatography process (SMB_IEC) to separate the acid and the sugar. The acid component is re-concentrated and recycled to Phase 1 of the process. The Sugars Solution goes to Phase 3 for fermentation.

2.2.3. Phase 3

The proposed plant processes for Phase 3 are as follows:

- Unit Process 12 -Media Preparation
- Unit Process 13 -2nd Generation Fermentation

Phase 3 involves fermenting the sugars to ethanol using genetically modified (GM) yeast capable of consuming both 5- and 6-carbon sugars. The GM yeast will be rendered unviable before leaving Phase 3 by chemical and thermal treatment.

2.2.4. Phase 4

The proposed plant processes for Phase 4 are as follows:

- Unit Process 14 -Stripping/Distillation
- Unit Process 15 -Yeast Filtration and Underflow Conc.
- Unit Process 16 -Crystal Production
- Unit Process 17 -Waste Treatment System

Phase 4 is a novel ethanol recovery and waste treatment process resulting in 96% ethanol and flocculated solids which are filtered out. Fermentation beer is diluted with a potassium carbonate slurry resulting in phase separation of the ethanol component and simultaneous flocculation of the dissolved solids. The ethanol is decanted, and flocculated solids filtered out. The potassium carbonate solution is re-concentrated to a slurry for recycle and the resulting condensate returned as process water.

2.3. Hazardous Materials Storage and Handling

Hazardous material will be stored in designated within eight (8) bunded storage areas. The final volumes and locations have not yet been determined, however the types and maximum potential quantity of hazardous chemical and bunded areas are outlined in Table 1. Appendix A shows the bunded area locations and Appendix B shows the biomass stockpile locations.

Table 1 Quantity of Hazardous Chemical and Bunded Areas

Bunded Area	Class	PG	Storage Quantity (kg)	Bund Containment Volume (L)
1	8, 5	II, II	8,000 and 2,000	16,000
2	8	II	6,000	30,000
3	8, 5	II, II	6,000 and 2,000	30,000
4	3	II	200	1,000
5	8, 3	II, II	2,000 and 4,500	24,000
6	8	II	2,000	30,000
7	TBA	TBA	TBA	2,000
8	TBA	TBA	TBA	30,000

TBA – to be assigned

Hazardous chemicals are yet to be assigned to specific bunded areas, however bunded areas 7 and 8 are intended for storage of fermentation feedstocks, such as sugar solutions and nutrients not defined in the ADG code.

Details of chemicals are presented in Table 2.

Table 2 Chemical Details

Material Name	Hazard	Class	PG
Sulphuric Acid	Corrosive	8	II
Sodium Hydroxide	Corrosive	8	II
Hydrogen Peroxide	Oxidising Agent	5	II
Ethanol	Flammable Liquid	3	II

2.4. Onsite Control Measures

The Statement of Environmental Effects identifies the following onsite control measures:

- Operational within a risk management framework which includes safe work methods statements, operational procedures and competency assessments
- Formal training programs for faciliatory users
- Induction of site visitors
- Limited access to chemical storage areas
- Vehicle movements for deliveries, guests and staff will be controlled using signage.
- Deliveries of liquid chemicals to the site for operational purposes are to be by way of 1000L IBC's. Any decanting or transfer from IBC's occurs within bunded areas in case of accidental spills.
- Deliveries of solid chemicals are by way of 20kg bags. These are stored in designated areas by pallet. No more than 10 deliveries of chemicals are expected each year.

The site will also comply with the following Australian Standards:

- AS 3780 – Storage and handling of corrosive substances
- AS 1940 – Storage and handling of flammable liquids

3. Methodology

3.1. Overview

To first assess if the HPB triggers the thresholds for potentially hazardous development, the risk screening procedure detailed the *Applying SEPP 33* guideline was stepped through. Based on the screening process, the HPB does not trigger the requirements for potentially hazardous, however, to further understand the risk, and to determine important risk management strategies, a PHA was undertaken.

3.2. Risk Criteria

Risk criteria were sourced from the SEPP 33 Planning Guidelines *HIPAP No.4 Risk Criteria for Land Use Planning*, which provides criteria for consequence analysis. Risk criteria indicate the level of acceptable risk, and is calculated using consequence and likelihood to estimate risk.

3.2.1. Impacts to People

The units for individual risk are the probability (of fatality) per million per year. Table 3 identifies the suggested risk criteria for individual fatality for different land uses. *HIPAP No.4 Risk Criteria for Land Use Planning* states that at a thermal radiation of 35 mW/m^2 there is a significant chance of fatality for people exposed instantaneously. For effects of explosion overpressure, at 35 kPa, there is a 50% chance of fatality for a person in a building and 15% chance of fatality for a person in the open.

Based on the criteria in Table 3 the following risk criteria (for fatality) adopted were:

- 5.0×10^{-5} per year for risk to individuals in industrial areas
- 1.0×10^{-6} per year for risk to individuals in residential areas.

Table 3 Individual Fatality Risk Criteria

Land Use	Suggested Criteria (risk in a million per year)
Hospital, schools, child-care facilities, old age housing	0.5
Residential, hotels, motels, tourist resorts	1
Commercial development including retail centres, office and entertainment centres	5
Sporting complexes and active open space	10
Industrial	50

Table 4 identifies the injury risk criteria for individuals for types of impacts.

Table 4 Individual Injury Risk Criteria at Residential and Sensitive Use Areas

Impacts	Suggested Criteria (risk in a million per year)
Incident overpressure explosion should not exceed 7 kPa	50
Incident heat flux radiation should not exceed 4.7 kW/m^2	50
Toxic exposure should not exceed a level which would be seriously injurious	10
Toxic exposure should not exceed a level which would be cause irritation to the eyes, throat, coughing or other acute physiological response	50

3.2.2. Impacts to Property

HIPAP 4 identifies criteria for impacts for damage to property, which relate to the combustion of wood structure as a result of thermal radiation from a fire and over pressure explosion rendering a building inhabitable. Risk criteria adopted for damage to property are:

- 5.0×10^{-5} per year for risk to industrial areas at 23 kW/m^2 heat flux
- 5.0×10^{-5} per year for risk to industrial areas at 14 kPa explosion overpressure level

3.2.3. Impacts to the Environment

HIPAP 4 identifies suitable qualitative risk criteria for damage to the environment as provided in Table 5.

Table 5 Environmental Risk Criteria

Consequence Type	Description
Catastrophic	Irreversible alteration to one or more eco-systems or several component levels. Effects can be transmitted and can accumulate. Loss of sustainability of most resources. Life cycle of species impaired. No recovery. Area affected 100 km^2.
Very serious	Alteration to one or more eco-systems or component levels, but not irreversible. Effects can be transmitted and can accumulate. Loss of sustainability of selected resources. Recovery in 50 years. Area affected 50 km^2.
Serious	Alteration/disturbance of a component of an ecosystem. Effects not transmitted, not accumulating or impairment. Loss of resources but sustainability unaffected. Recovery in 10 years.
Moderate	Temporary alteration or disturbance beyond natural viability. Effects confined<5000 m^2, not accumulating or impairment. Loss of resources but sustainability unaffected. Recovery temporarily affected. Recovery < 5 years
Not detectable	Alteration or disturbance within natural viability. Effects not transmitted, not accumulating. Resources not impaired

3.3. Qualitative Analysis

In accordance with the multi-level risk assessment approach a qualitative analysis was undertaken to identify potential hazards and hazardous events and understand the effects on people and the environment. The process followed the recommended process outlined in *HIPAP 3: Risk Assessment*. Based on the outcomes of the qualitative assessment, important hazardous events were selected for quantitative assessment.

3.4. Quantitative Analysis

Following the principles of multi-level risk assessment, semi-quantitative analysis of risk levels to surrounding land uses and environment where hazard identification has indicated potential for significant off-site risk was undertaken.

Selected hazardous scenarios identified during the hazard identification process were further assessed to quantify the risk associated with each scenario. Consequences of the identified hazardous events were modelled using the version 5.4.7 of the ALOHA (Areal Locations of Hazardous Atmospheres) program developed by the US EPA for modeling chemical releases. ALOHA has the capability to model many release scenarios: toxic gas clouds, BLEVEs (Boiling Liquid Expanding Vapor Explosions), jet fires, vapor cloud explosions, and pool fires.

4. Hazard Identification

4.1. Qualitative Analysis

An initial hazard identification process was undertaken to assess hazards and identify hazardous scenarios that required quantification of risk. Table 7 identifies the hazardous scenarios that were assessed qualitatively for this PHA.

4.1.1. Hazards

An initial screening of the classified chemicals that will be stored and used on the site was undertaken, using the CAMEO Chemicals Database. The CAMEO Chemicals is a database, developed by the US EPA and National Oceanic and Atmospheric Administration (NOAA), of hazardous chemical datasheets that emergency responders and planners can use to get response recommendations and predict hazards, such as explosions or toxic fumes.

The information presented in Table 6 was sourced directly from the CAMEO datasheets for each chemical identified. Details of potential feedstock was sourced from the Statement of Environmental Effects prepared by Ethtec.

Table 6 Potentially Hazardous Material Summary

Potential Hazard	Properties
Ethanol	Flammable. Vapour irritating to eyes, nose and throat. *Mixtures with concentrated sulfuric acid and strong hydrogen peroxide can cause explosions.*
Hydrogen Peroxide	Spontaneous ignition may occur when contact with combustible materials is made. Oxygen released in decomposition will promote combustion. Strong irritant to skin, eyes, and mucous membranes.
Sulphuric Acid	It is highly reactive and capable of igniting finely-divided combustible materials on contact. When heated, it emits highly toxic fumes. Corrosive to all body tissues. Strongly acidic.
Sodium Hydroxide	Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes. Causes severe burns of eyes, skin, and mucous membranes.
Feedstock Materials (timber, bagasse, wheat straw, grasses and cotton waste)	Flammable if there was an ignition source. Dust may be an irritant.

The Statement of Environmental Effects identifies the following approach to chemical storage:

- Class 8 basic and class 8 acid substances are stored and handled separately to avoid effects of accidental mixing. Additional mixing of these would produce heat; however no toxic compound would be produced.
- The Class 5 chemical, hydrogen peroxide, can be stored with the Class 8 Acidic and Basic as no adverse reactions would result from accidental mixing.

A review of the chemical reactivity (U.S. National Library of Medicine) when mixing the proposed stored chemical indicates that mixing ethanol and sulphuric acid or hydrogen peroxide or sodium hydroxide can result in the following:

- produces an exothermic reaction at ambient temperatures (releases heat)
- polymerization reaction may become intense and may cause pressurisation
- reaction liberates gaseous products and may cause pressurisation
- reaction may be particularly intense, violent, or explosive
- reaction products may be explosive or sensitive to shock or friction
- reaction products may be flammable
- reaction products may be toxic.

Mixing hydrogen peroxide and sulphuric acid or sodium hydroxide can result in the following:

- produces an exothermic reaction at ambient temperatures (releases heat)
- reaction liberates gaseous products and may cause pressurisation
- reaction may be particularly intense, violent, or explosive
- reaction products may be explosive or sensitive to shock or friction
- reaction products may be flammable
- reaction products may be toxic.

Mixing sodium hydroxide and sulphuric acid can result in:

- produces an exothermic reaction at ambient temperatures (releases heat)
- reaction liberates gaseous products and may cause pressurisation
- reaction may be particularly intense, violent, or explosive
- reaction products may be corrosive.

The effects outlined above are directly related to the quantities, concentration, mixing rates and containment methods associated with these chemicals. Internal Hazop reviews during design and experimental planning will closely examine these variables and ensure implementation of appropriate controls.

4.1.2. Hazardous scenarios

The hazardous scenarios were assessed as detailed in Table 7:

- feed material fire impacting on people and property was considered low risk due to the absence of an ignition source and onsite firefighting capabilities
- pool fire emanating from the ethanol bund areas was considered to be the most likely hazardous scenario to occur, despite being considered a low risk and was identified for quantitative analysis. Risk of injury, fatality and property damaged from heat radiation were modelled for the two bunded areas proposed to store ethanol.
- overpressure from a vapour cloud explosion was considered a potential low risk but was modelled to understand the risk of ethanol vapour evaporation and explosion when exposed to an ignition source
- toxic exposure from a chemical spill was considered a potential low risk as there are no residential or sensitive areas adjacent to or near the site. All spills would be contained within the bunded areas and addressed using appropriate safe work methods.

4.2. Frequency Assessment

Frequencies were assessed qualitatively for this PHA (Table 7). A quantitative frequency analysis requires all parts of the system to be identified and counted and assessed for failure, based on published frequency

data. This level of detail was not available at the time of this report, therefore a quantitative frequency analysis has not been undertaken.

To apply the frequency component of the criteria, generic data was sourced from publicly available information. A Preliminary Risk Assessment for an Ethanol Biorefinery in Kwinana in Western Australia in 2006 adopted a conservative bund fire frequency of 7×10^{-6} (Risk Management Intercontinental Pty Ltd 2006). A paper by Davies *et al* 1995 estimated that the frequency of the catastrophic failure rate of atmospheric storage tanks at 1×10^{-6} per year, with an ignition probability of 0.3 and a probability of confinement (thereby leading to blast overpressures) of 0.5.

Based on the failure rates adopted by others, detailed above, the estimated frequency of a bund fire occurring, and further resulting in impacts to people (fatality and injury) and property is estimated to be below the criteria adopted for this PHA:

- 5.0×10^{-5} per year for risk to individuals in industrial areas
- 1.0×10^{-6} per year for risk to individuals in residential areas
- 5.0×10^{-5} per year for risk to property in industrial areas.

Table 7 Hazard Identification Word Diagram

Activity	Hazardous Scenario	Causes	Consequence	Likelihood	Safeguards	Actions/outcome
Storage and handling of feed materials	Feed material fire	Flame or spark causes ignition of feed stock	Potential thermal radiation causing injury or fatality	Feed materials will be stored in a suitable area at the rear of the site. Anecdotal evidence indicates that fire is highly unlikely and would require an ignition source and suitable environmental conditions.	Onsite fire-fighting equipment. Site security and access restrictions. Low volumes of feedstock kept on site. Absence of ignition source (Compliance with IEC 80079)	Risk considered low due to ability to apply safeguards and reduce or remove the risk.
Chemical handling and storage	Release of chemicals to the environment	• Failure of storage tank • Failure of valves or piping	Toxic exposure to residential or sensitive areas Potential to cause environmental impacts.	Low due to small volumes stored on site and all chemicals stored in bunded areas	All chemical storage and usage areas are fully bunded. Bund areas are sized to contain the volume of chemicals allocated to each bunded area. Compliance with relevant Australian Standards: • AS 3780 – Storage and handling of corrosive substances • AS 1940 – Storage and handling of flammable liquids Site is located in an industrial area, away from residential and sensitive areas.	Risk considered low due to ability to apply safeguards and reduce or remove the risk. Incompatible chemicals to be separated and provided in segregated bunded areas.
Ethanol distillation/storage	Ethanol vapour escaping from distillation process or storage and exposed to temperatures causing a vapour cloud explosion.	• Failure of valves or piping • Failure of condenser • Blockage in distiller	Potential overpressure (Blast force) causing injury, fatality or damage to property.	Low due to properties of ethanol and volumes stored on site.	Safe work method statements Compliance with AS 1940 - Storage and Handling of Flammable and Combustible Liquids. Onsite fire-fighting equipment. Site security and access restrictions. Absence of ignition source.	**Quantitative consequence modelling to be undertaken to estimate the impacts.**
Ethanol storage	Ethanol release from storage tank	• Failure of storage tank • Failure of valves or piping	Potential ignition of ethanol vapour resulting in a pool fire within bunded area causing thermal radiation.	Low due to an ignition source needed to cause the fire.	Ethanol storage area is bunded. Compliance with AS 1940 - Storage and Handling of Flammable and Combustible Liquids.	**Quantitative consequence modelling to be undertaken to estimate the impacts**

4.3. Semi-Quantitative Consequence Analysis

Based on the outcomes of the qualitative assessment, the impacts of an ethanol pool fire, overpressure and toxic exposure from a release of vapour were modelled:

- pool fire from the proposed bunded areas 4 and 5 relating to the ethanol storage causing thermal radiation
- overpressure (blast force) from vapor cloud explosion, ignited by spark or flame, from the proposed bunded areas 4 and 5.
- toxic release of ethanol vapour from bunded areas 4 and 5.

Consequence analysis considers the impact of possible accidents in terms of injury or fatalities, damage to property or damage to the biophysical environment. The most common events considered are fires, explosions and toxic releases. Two aspects in regard to these need to be considered:

1. the direct consequences (e.g. explosion overpressure, thermal radiation intensity or toxic concentration)
2. the effects of those consequences on people, property and the biophysical environment.

Table 8 identifies the inputs and assumptions in the model.

Table 8 Model Inputs and Assumptions

Parameter	Input	Details
Site data		
Site	Muswellbrook	Coordinates input to model
Building air exchanges per hour	0.38 (unsheltered single storied)	Assuming worst case
Floor type	Concrete	Assuming concrete bunded floor
Chemical Data		
Chemical	Ethanol	Model
Molecular Weight	6.07 g/mol	Model
Atmospheric Data		
Wind	6.75 knots at 3 metres height, Southerly direction	Anecdotal (Maximum monthly average - WillyWeather.com.au)
Ground roughness	urban or forest	Anecdotal
Cloud cover	50% (partly cloudy)	Anecdotal
Relative humidity	50%	Anecdotal
Stability Class	D	Model
Air Temperature	24°C	BOM Scone Airport

Specific inputs relating to the ethanol storage area included a number of scenarios to ensure that any potential site layouts have been assessed for the consequences of a pool fire, toxic vapour and overpressure.

Bunded Area	Class	PG	Storage Quantity (kg)	Bund area (m^2)	Bund Containment Volume (L)	Chemical
4	3	II	200	25	1,000	Ethanol
5	3	II, II	4,500	124.16	24,000	Ethanol

5. Results and Discussion

5.1. Ethanol Pool Fire

The results of the ALOHA model for an ethanol pool fire are presented in Table 9. The results predict that threats to both people and property from an ethanol pool fire can be contained wholly within the HPB site. The model does not model threat zones lower than 10 m^2.

Table 9 Ethanol Pool Fire Model Results

Bunded Area	Storage Quantity (kg)	Bund area (m^2)	Bund Containment Volume (L)	Threat of Fatality (35 km/m^2)	Threats of Injury (4.7 kW/m^2)	Threats to Property (23kw/m^2)
4	200	25	1,000	<10 m^2	11 m^2	< 10 m^2
5	4,500	124.16	24,000	< 10 m^2	24 m^2	13 m^2

The approximate extent of the threat zone of a pool fire from the bunded areas where ethanol is proposed to be stored are shown on Figure 1. The treat of fatality is contained within 10 m^2 of the treat source and was not mapped. The red threat zone refers to the criteria for impacts to people, the orange threat zone refer to impacts to property criteria for industrial areas. It should be noted that the treat zones are measured from the centre of the bunded area and not the perimeter of the bund, however threat zones can be contained within the HPB site when measured from the bund perimeter.

Figure 1 Ethanol Pool Fire Threat Zones

5.2. Overpressure (Blast Force) From Vapor Cloud Explosion

When a flammable chemical is released into the atmosphere, it forms a vapor cloud that will disperse as it travels downwind. If the cloud encounters an ignition source, the parts of the cloud where the concentration is within the flammable range will burn. Each scenario was modelled twice, to understand the impacts of overpressure ignited by spark or flame, and by detonation. The model predicted the releases over a one hour release duration of 1 hour:

- Bund 4 Max Average Sustained Release Rate: 1.61 kilograms/min (averaged over a minute or more) Total Amount Released: 78.8 kilograms
- Bund 5 Max Average Sustained Release Rate: 7.28 kilograms/min (averaged over a minute or more) Total Amount Released: 382 kilograms

The ignition time was entered as 'unknown' which allows for ALOHA to run explosion scenarios for a range of ignition times that encompass all of the possible ignition times for the scenario.

For both bund areas the model predicted that there no explosion is expected as no part of the cloud is over the lower explosion limit. This indicates that, at the estimated release rate, the vapor cloud may have already dispersed so much that there is no longer enough concentrated chemical vapor in the air to ignite.

5.3. Toxic Exposure

The risk of exposure to toxic vapour cloud for ethanol from both Bund 4 and Bund 5. The predictions of the impacts against Emergency Planning Response Guidelines (EPRG) developed by the American Industrial Hygiene Association (AIHA):

- ERPG–1: The maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odour.
- ERPG–2: The maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.
- ERPG–3: The maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

The following EPRGs are relevant for ethanol:

- EPRG-1 - 1800 ppm
- EPRG-2 - 3300 ppm
- EPRG-3 - Not applicable

The results of the model predict that for both bund areas, the treat zones for both EPRG-1 and 2 are less than 10 metres (and not mapped).

6. Conclusion

The proposed HPB will include the handling and storage of classified chemicals and potentially hazardous materials, however, when assessed against the threshold criteria identified for the SEPP 33, it does not trigger the requirements for a potentially hazardous activity. Despite not triggering the thresholds, a PHA was undertaken to better understand the potential risk of the activity. The PHA included initial screening against the criteria identified in *Applying SEPP 33* guideline (which indicated that the SEPP 33 requirements are not triggered), qualitative assessment and a further quantitative assessment of the potential impacts of an ethanol release.

The qualitative assessment took into account the application of onsite control measures. For this assessment to be relevant, the onsite control measures must be implemented including:

- onsite fire-fighting equipment
- site security, access restrictions and site inductions
- low volumes of feedstock kept on site
- absence of ignition sources, including compliance for all electrical systems to IEC 80079
- all chemical storage and usage areas are fully bunded. Bund areas are sized to contain the volume of chemicals allocated to each bunded area.
- incompatible chemicals to be provided separate bunded areas
- compliance with relevant Australian Standards including
    - AS 3780 – Storage and handling of corrosive substances
    - AS 1940 – Storage and handling of flammable liquids
- site is located in an industrial area, away from residential and sensitive areas
- safe work method statements and procedures.

The ALOHA Model predicted the impacts of an ethanol release from Bunds 4 and 5 resulting from pool fire within the bunds, overpressure and toxic vapour cloud based on the maximum proposed ethanol storage volumes. The impacts were assessed against the risk criteria identified in *HIPAP 4 Risk Criteria for Land Use Safety Planning* for fatalities, injury and impacts to property. The results of the ALHOA Model predicted that the impacts to people and property can be contained within the HPB site.

The risk estimations presented in this report are a starting point, and a risk assessment framework should be established and expanded as the project develops and site specific data becomes available to further understand the important control measures that should be implemented to manage risk.

7. References

Davies, T., Harding, AB., McKay, IP., Robinson, RGJ., Wilkinson, A., 1995 , *Bund Effectiveness in Preventing Escalation of Tank Farm Fires* IChemE Symposium Series No 139

Department of Planning NSW 2011 *Applying SEPP 33*, Sydney NSW

Department of Planning NSW 2011 *HIPAP 3: Risk Assessment*, Sydney NSW

Department of Planning NSW 2011 *HIPAP 4: Risk Criteria for Land Use Safety Planning*, Sydney NSW

Department of Planning NSW 2011 *HIPAP 6: Hazard Analysis*, Sydney NSW

Department of Planning NSW 2011 *Multi-level Risk Assessment*, Sydney NSW

Ethanol Technologies 2018 *BA019A2 Building Layout Biomass Stockpile Revision 1*

Ethanol Technologies 2018 *BA018A3 Building Layout Bund Dimensions Revision 2*

Ethanol Technologies 2018 *Draft Statement of Environmental Effects – Hunter Pilot Biorefinery*

Risk Management Intercontinental Pty Ltd 2006 *Report on Preliminary Risk Analysis of Proposed Primary Energy Ethanol Bio-Refinery*, Brisbane QLD.

U.S. National Library of Medicine, undated, *Hydrogen peroxide* accessed 11 July 2018. https://webwiser.nlm.nih.gov/getSubstanceData.do?substanceId=322&displaySubstanceName=Inhibine&STCCID=&UNNAID=&selectedDataMenuItemID=54&catId=63

Appendix A

Bunded Area Locations

Bund Area	Class	PG	Storage Quantity (kg)	Bund Containment Volume (L)
1	8, 5	II, II	8,000 and 2,000	17,000
2	8	II	6,000	40,000
3	8, 5	II, II	6,000 and 2,000	31,000
4	3	II	200	2,500
5	8, 3	II, II	2,000 and 4,500	12,000
6	8	II	2,000	18,000
7	Non	Non	-	2,200
8	Non	Non	-	15,000

Security Fence

Construction Office

Carramere Rd

21.6m

10.0m

12.8m

5.0m

Bunded Area 3

15.9m

Bunded Area 4

5.0m

Bunded Area 8

15.9m

Bunded Area 5

9.7m

Bunded Area 6

14.6m

4.5m

Bunded Area 7

5.0m

Bunded Area 2

8.0m

8.0m

Bunded Area 1

8.0m

7.0m

9.0m

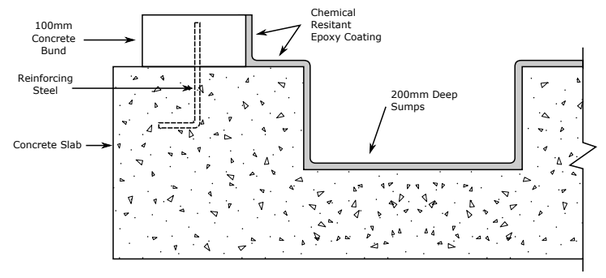
8.6m

34.9m

21.3m

0 10 20 30 40 50 60 70 80 90 100m

Bunding Detail



Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 27/06/2018

Bund dimensions and detail.

North

Drawing No:
BA018A3 DRAFT NFC

Appendix B

Biomass Stockpile Location

Security Fence

Construction Office

Carramere Rd

Bunded Area 3

Bunded Area 4

Bunded Area 8

Bunded Area 2

Bunded Area 1

Bunded Area 5

Bunded Area 6

Bunded Area 7

Lignocellulosic Biomass Stockpile

Ø ≈ 8m (height ≈ 1m)

0 10 20 30 40 50 60 70 80 90 100m

Boundary Legend

- Security Fence
- Lot Boundary
- Sewer Line
- Electrical Easement
- Retaining Wall

Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 28/06/2018

Lignocellulosic biomass stockpile.

North

Drawing No:
BA019A2 DRAFT NFC

www.viridis.net.au

Appendix F – Requirements of the DCP

Table F-1 Requirements of the DCP

DCP Chapter	Application	Response
Section 10 Industrial Development		
10.1.1 Setbacks	Buildings and structures should be setback at least 10.0 m from the front (or principal) boundary alignment.	All proposed buildings and structures are setback from boundary alignments by 10 metres.
	Front setbacks can be varied based on assessment of the following criteria: • Minimum 6 metres landscaping across the frontage of the site. • Provision of car parking facilities (refer to Section 17). • Building height, bulk and layout. Setbacks may be increased for buildings of substantial height, bulk etc. • The nature and needs of the industrial activity. • The existing character of the streetscape.	
10.1.2 Building design	The façade of the building to the primary road frontage shall be constructed in a contrasting material to a height of 2.5 metres and returned along the side for a distance of 2 metres. (A change in the colour of the material is not adequate).	The building façade is not visible from the primary road frontage or public areas. Buildings are only visible from driveway road crossing due to offset on the property.
	Council will consider deletion of the 2.5 metre brick or masonry wall along the frontage of the building as required above, if the applicant provides satisfactory relief and contrast materials within the front façade to soften its visual appearance and form and reduce its bulk.	
	External walls of buildings shall be profiled factory colour treated cladding or masonry material, or a combination of both with low reflective properties.	External walls would be cladded with metal sheeting in keeping with the majority of structurers within the industrial estate.

DCP Chapter	Application	Response
	Additional treatment will be required where building is in prominent position or close to street frontage or front main roads or in residential or commercial neighbourhoods.	Development is not considered to occur in prominent area.
	Signage complies with Section 14 of this DCP.	All signage to be installed at the development will comply with section 14.
10.2.1 Drainage and stormwater	Storm water runoff from roofs and paved areas is to be collected on site and disposed of to the street drainage system, drainage easement, natural drainage course or infiltration trench or other means as determined by Council or in accordance with an engineering design.	The storm water management plan is provided in Appendix H.
	A concept site drainage plan and calculations for storm water drainage, wash down areas and any other trade waste prepared by an appropriately qualified and practising civil engineer shall be submitted with the Development Application for approval.	
	Compliance with section 25 of this DCP.	
10.2.2 Landscaping	Minimum depth of 6.0 m for landscaping within the front setback area (excluding driveway) in unsewered areas.	Ausgrid and sewer easements extend across the front setback. Alternate landscaping is provided in design package in Appendix B.
	Minimum depth of 3.0 m for landscaping within the front setback area (excluding driveway) in sewered areas.	
	Landscaped area is to extend for the full frontage of the site (excluding driveway)	
	The side and rear setback if visible from a public area.	

DCP Chapter	Application	Response
	Large vehicle parking areas may be required to be landscaped to provide shade and to soften the visual impact of parking facilities.	Shaded vehicle parking areas provided away from road frontage.
	Security fencing should be located behind the front landscaped area.	Security fencing installed along retaining wall line to prevent falls.
	Garbage collection and storage areas are located at the rear of the building or in locations that are not visible from public places.	Designated areas for contract garbage collection available at rear of development and near site office during construction.
10.2.3 Visual amenity with regard to car parking and operational noise	Car parking areas are located behind the landscaped front setback.	Car parking areas are not visible from street or neighbouring areas.
	Large areas of paved parking areas in excess of operational and parking requirements are undesirable, and are discouraged.	Only one car parking space provided per anticipated staff member.
	Exposed parking under buildings is not provided.	No parking areas are located under buildings.
	On-site parking (not under buildings) is desirable provided that the area is visually screened from the street and landscaped properly.	Car parking areas are not visually prominent.
	Below grade parking is desirable and should be encouraged, because by comparison it is easy to landscape and by its nature will be screened from adjoining sites, provided that excavation is not excessive or unnecessary to undertake the development.	Car parking area is provided at ground level for operational requirements, such as access by emergency services.
	Car parking within the front building line (setback) from the street boundary and side boundary setbacks adjacent to fences will be discouraged as these areas should be utilised for landscaping.	Car parking is not within the front building line.

DCP Chapter	Application	Response
	All car-parking spaces are to be paved, adequately drained, marked and designated upon the site in accordance with the provisions of AS2890.1.	Engineering designs prepared in accordance with AS2890.1
10.2.4 Vehicular movements and access	Car parking on site is provided in accordance with Section 16 of this DCP.	Addressed in section 16.
	Access drives are to be designed to have a width in accordance with the provisions of AS2890.1 and RTA Guidelines which reflects the nature and needs of the particular land use.	Widths proposed exceed requirements in consideration of flexible facility operation.
	Access drives shall not be located within 10.0m of an intersection.	Driveway access is not near an intersection.
	Loading and unloading facilities appropriate to the particular development are to be provided on site such that service vehicles are located wholly within the site and do not impede planned pedestrian and traffic movements.	Loading and unloading areas proposed not visible from street and do not impede traffic movements
	Demonstrate that all traffic movements to and from the site can occur in a forward direction.	Traffic movements can occur in a forward direction (see Appendix I). Site layout designed for easy of traffic movements and operational flexibility.
	If a development falls under the categories specified in State Environmental Planning Policy (Infrastructure), it will be referred to the Regional Development Committee for consideration and comment. A copy of the State Environmental Planning Policy is available from Council.	Not applicable.

DCP Chapter	Application	Response
10.3.1 Water and sewer	In cases where trade wastes are to be discharged into the sewerage system, detailed plans and specifications of the work to be done, details of the equipment to be used, the nature, quantity and rates of discharge of the proposed effluent shall accompany the application (refer to Sections 23 &24 of this DCP for further information).	Trade waste concept design and expected discharge volumes and concentrations report provided in Appendix C.
	In cases where sewerage is not available, full details of trade wastes and the treatment thereof are required to be provided within the development application.	Connection to the sewerage main is available on front boundary and approval is sought for trade waste disposal.
	A separate on-site waste water application is required to be submitted to and approved by Council in areas not serviced by Council sewerage schemes (refer to Section 23 for further information).	No applicable
	Agreement with Council's Water and Waste Department is required for water connection. Details of the size and location of the service required, together with details of any fire service proposed to be installed.	Water services connections are provided in Appendix J.
10.3.2 Services	All industrial developments shall be serviced by an adequate supply of electricity in accordance with the requirements of Energy Australia.	Preliminary enquiry with Ausgrid states sufficient network capacity at the site. Electrical connection design has been submitted to Ausgrid for approval. Notification has been sent to neighbours.
Section 16 Car parking and access		
16.3 Non-residential development	Car parking is provided on site in accordance with the requirements of 16.6 of this section of the DCP.	Car parking provided as per plans in Appendix B.

DCP Chapter	Application	Response
	Onsite parking facilities are designed and constructed to comply with the provisions of AS2890.1/AS2890.2.	Parking facilities designed in accordance with the nominated standards.
	To ensure that traffic movements into and out of a site are made, whenever possible, in a forward direction. If a site layout does not permit forward movement for delivery vehicles, then the developer, owner or occupier must provide a risk management plan, to the satisfaction of Council, detailing the measures required to ensure that traffic movements are carried out in an adequate and safe manner.	All traffic movements from site can be made in a forward direction.
16.4.1 Access to the site	All works required to service the development are to be designed and constructed in accordance with the relevant provisions of AS2890	All works in accordance with AS2890
	Any works on public land or in the public road reserve that are to revert to the care and control of Council are to be designed and constructed in accordance with the relevant provisions of AUSPEC.	No works would occur on public land.
	A vehicular driveway must: • be located no closer than 1.5 metres from the boundary of the site and no closer than 6 metres to a corner boundary. • not be located within 12 metres on the approaches to a “stop” or “give way” sign. • cross the footpath or footway at right angles to the centreline of the road. • be located so that any vehicle entering or leaving the site can be readily seen by the driver of an approaching vehicle in the street; • be clear of obstructions which may prevent drivers having a timely view of pedestrians;	Conditions met in DA62/2017. Driveway installed June 2018.

DCP Chapter	Application	Response
	• be properly signposted by the use of “in” or “entrance” and “out” or “exit” signs, where appropriate; and • be designed and constructed to suit design traffic loads.	
16.4.2 Car park design	The minimum dimensions of each off street parking space and the distance separating parking spaces shall be in accordance with AS2890.1.	Design in accordance with AS2890.1.1
	Adequate on site manoeuvring and circulating areas shall be provided to ensure that all vehicles enter and leave the site do so in a forward direction.	Design in accordance with AS2890.1.1
	Parking spaces for visitors and customers should be provided where they are clearly visible from the street so their use is encouraged.	Use of signage to designate visitor parking will be provided.
	Parking spaces for employees and for longer duration parking may be located more remotely from the street.	Parking areas indicated in site layouts in Appendix B.
	All signage (whether viewed from internal areas on the site or form external areas) are to be provided in accordance with the provisions of AS2890.1, AS1742 (all relevant parts) and any relevant guidelines endorsed by the RTA.	Design in accordance with AS2890.1.1 where required.
	The location of the parking area on the site should be determined having regard to: • site conditions such as slope and drainage; • visual amenity; • the location of the building; and • the proximity to any neighbouring residential development.	Parking area is designed to be integral with facility layout and functionality.

DCP Chapter	Application	Response
16.4.3 Parking for people with disabilities	Special parking spaces for people with disabilities are to be provided at the rate of two percent (2%) of the overall spaces provided for a retail/business/industry development. These spaces must be clearly signposted and marked and have a minimum width of 3.2 metres, and comply with the provisions of AS2890.1.	Disabled parking space will be available with signage.
16.4.4 Loading/ unloading facilities	In the case of all commercial, retail and industrial development, adequate provision must be made on the development site for the loading and unloading of service vehicles.	Adequate unloading/loading service area and equipment is available within proposed development.
	The number and dimensions of loading bays required in any particular case will be assessed by Council having regard to the nature and scale of the proposed development, the estimated frequency of deliveries and the type of delivery vehicle likely to be involved. Details regarding the estimated size and frequency of goods delivery vehicles visiting the premises are required to be submitted with the development application.	
	Loading/unloading bays must be designed to ensure that vehicles can manoeuvre into and out of all loading/unloading areas without conflicting with the movement of vehicle and pedestrian traffic on site or in the adjacent streets.	Loading and unloading areas are separated from general vehicle movement and parking areas on site and adequate vehicle manoeuvring space is provided.
	The loading/unloading areas is to be designed to accommodate the turning path of appropriate service vehicles detailed in Table 3.	Turning path area is exceeded for intended medium and heavy rigid delivery vehicles.
	The loading/unloading areas must be designed to ensure that vehicles stand entirely within the site during loading and unloading operations.	Adequate provisions for vehicles to be enclosed within the site working area.
16.4.5 Internal roads	For internal roads between the driveway and the parking area the recommended minimum carriageway width depends on the number of	Length of parking area does not exceed 40m, roads and access paths are of adequate width.

DCP Chapter	Application	Response
	parking spaces and service bays. For 1-24 spaces the length must not exceed 40 m and the width must be at least 3.5 m.	
16.4.6 Construction materials	All parking areas and access ways shall be designed and constructed in accordance with AS2890.1 and AS2890.2.	Design is in accordance with AS2890.1 and AS2980.2 and the intended use and frequency.
	In choosing the most suitable pavement type the following factors should be considered: • anticipated vehicle loads; • run-off gradients and drainage requirements; and • construction constraints	
16.4.7 Landscaping	A minimum of 10% of the total area of the car park shall be appropriately landscaped.	Landscaping is achieved with feature sandstone block retaining wall.
	Long stretches of parking bays are to be dispersed with screen planting. A good rule of thumb would be to have no more than 10 parking bays before breaking with planting.	Planting cannot occur with the designated parking area due to building layout. Alternate planting areas are indicated in Appendix B.
	Plants should be selected and located to avoid maintenance problems such as interference with overhead wires, underground conduits, damage to paved areas by root systems, and leaf and branch litter.	Tress selection would be appropriate for the location on site.
	Trees with large surface roots, excessive girth, brittle limbs, fruits which drop and trees which attract large numbers of birds should be avoided in parking areas.	Not applicable.
Section 20 Erosion and sediment control		
	Areas of disturbance less than 250 m^2 which are environmentally sensitive (ie within 100 m of a water course), on steep sites (gradient	The erosion and sediment control plan is provided in Appendix H. Site levelling and

DCP Chapter	Application	Response
20 Erosion and sediment control	greater than 20^0) require the completion of an Erosion and Sediment Control Plan	excavation works have been granted consent and are included in DA62/2017. Controls would remain in place until all works are completed.
	Areas of disturbance 250 m^2 to 1000 m^2 must submit an Erosion and Sediment Control Plan and a schedule of works with a development application	
	Areas of disturbance 1000 m^2 to 2500 m^2 must submit an Erosion and Sediment Control Plan and Landscape Plan with a schedule of works with development application	Not applicable.
	Areas of disturbance greater than 2500 m^2 must submit Erosion and Sediment Control Plan, a Soil and Water Management Plan and a Landscape Plan with a schedule of works	Not applicable.
	All subdivisions which are proposed as staged developments must provide a staged Erosion and Sediment Control Strategy with an associated schedule of works	Not applicable.
	Completion of the Erosion and Sediment Control Plan must be undertaken by a suitably qualified person in accordance with this section of the DCP and contain all elements detailed by 22.2	See Appendix H provided by certified civil engineer.
	A regular maintenance program for all erosion and sediment controls must be submitted with any plan or strategy	Regular maintenance of erosion and sediment controls will be in accordance with the erosion and sediment control plan in Appendix H.
	Existing vegetation must not be cleared in areas not relevant to direct impact from the development	Only areas that would be directly impacted would be cleared as discussed in Section 4.7.1.
	Vegetation must not be cleared prior to development approval being granted or before erosion and sediment controls are fully installed	Erosion and sediment control measures would be installed prior to any clearing occurring. No

DCP Chapter	Application	Response
		works would be undertaken until consent is granted.
	All proposed controls must be consistent with this section of the DCP and the Managing Urban Stormwater: Soils and Construction manual prepared by Landcom.	See Appendix H.
Section 24 Waste Minimisation and Management		
Section 24.3.2 Construction of Buildings or Structures	A completed Site Waste Minimisation and Management Plan (SWMMP) shall accompany the development application. The SWMMP shall: • Identify all waste likely to result from the construction process, and the opportunities for the reuse and recycling of these materials. Incorporate the use of prefabricated components and recycled materials. • Allocate an area for the storage of materials for use, recycling and disposal (considering slope, drainage, location of waterways, stormwater outlets and vegetation). • Provide separate collection bins or areas for the storage of residual waste and clearly 'signpost' the purpose and content of the bins and storage areas. • Implement measures to prevent damage by the elements, odour and health risks, and windborne litter. • Ensure that all waste is transported to a place that can lawfully be used as a waste facility. • Retain all records demonstrating lawful disposal of waste and keep them readily accessible for inspection by regulatory	A SWMMP will be prepared by the contractor prior to construction and would be approved by Council.

DCP Chapter	Application	Response
	authorities such as council, Environment Protection Authority or WorkCover NSW.	
Section 24.4.5 Industrial	The SWMMP must include: • Plans showing: – The location of designated waste and recycling storage rooms or areas sized to meet the waste and recycling needs of all tenants. Waste should be separated into at least 4 streams, paper/cardboard, recyclables, general waste, industrial process type wastes. – The on-site path of travel for collection vehicles. • Evidence of compliance with any specific industrial waste laws/protocols. For example, those related to production, storage and disposal of industrial and hazardous wastes as defined by the Protection of the Environment Operations Act 1997. • There must be convenient access from each tenancy and/or larger waste producing area of the development to the waste/recycling storage room/s or area/s. There must be step-free access between the point at which bins are collected/emptied and the waste/recycling storage room/s or area/s. • Every development must include a designated general waste/recycling storage area or room/s as well as designated storage areas for industrial waste streams (designed in accordance with specific waste laws/protocols). • Depending upon the size and type of the development, it might need to include separate waste/recycling storage room/area for each tenancy and/or larger waste producing areas.	A SWMMP will be prepared by the contractor prior to construction and would be approved by Council. The SWMMP will be consistent with the requirements of Section 24.4.5 of the Muswellbrook DCP.

DCP Chapter	Application	Response
	• All tenants must keep written evidence on site of a valid contract with a licensed waste contractor for the regular collection and disposal of all the waste streams and recyclables which are generated on site. • Between collection periods, all waste/recyclable materials generated on site must be kept in enclosed bins with securely fitted lids so the contents are not able to leak or overflow. Bins must be stored in the designated waste/recycling storage room/s or area/s. • Arrangements must be in place in all parts of the development for the separation of recyclable materials from general waste and for the movement of recyclable materials and general waste to the main waste/recycling storage room/area. • The waste/recycling storage room/areas must be able to accommodate bins that are of sufficient volume to contain the quantity of waste generated between collections. • The type and volume of containers used to hold waste and recyclable materials must be compatible with the collection practices of the nominated waste contractor. • Waste management storage rooms/areas must be suitably enclosed, covered and maintained so as to prevent polluted wastewater runoff from entering the stormwater system. • A waste/recycling cupboard must be provided for each and every kitchen area in the development. Each waste/recycling cupboard must be of sufficient size to hold a minimum of a single day's waste and to hold separate containers for general waste and recyclable materials.	

DCP Chapter	Application	Response
	• Premises that discharge trade wastewater must do so only in accordance with a written agreement from the local sewer authority. Trade wastewater may be defined as “any liquid, and any substance contained in it, which may be produced at the premises in an industrial and commercial activity, but does not include domestic wastewater (e.g. from hand-basins, showers and toilets).” • Arrangements must be in place regarding the regular maintenance and cleaning of waste management facilities. Tenants and cleaners must be aware of their obligations in regards to these matters. • Production, storage and disposal of hazardous wastes (such as contaminated or toxic material or products) require particular attention. The appropriate laws and protocols should be observed.	
Section 25 Stormwater Management		
25.2.2 Existing drainage systems	New buildings are not to be constructed over or compromise the integrity of drainage lines or easements originating from outside the site.	Existing storm water line from end of Carramere road is undisturbed by the development and accessible.
	Where an existing drainage line runs under a proposed building, the drainage line and any associated easement is to be diverted around the building. Redundant easements are to be extinguished and new easements are to be created.	No construction proposed over existing storm water line. Full access maintained.
	Where an existing drainage system across the site is retained, access to the existing system is not to be affected by the proposed development.	

DCP Chapter	Application	Response
	Also, the development is to be designed so as not to degrade the structural integrity of the system.	
25.2.3 Flooding and runoff regimes	Development is to be designed so that runoff from low intensity, common rainfall is equivalent to the runoff from a natural catchment. This can be achieved by intercepting and storing runoff in extended storage detention basins and discharging at greatly reduced rates.	Storm water retained and detained in buffered tank system, as well as paved area collection, with integral controlled discharges.
	Alternatively, existing degraded downstream streams can be sympathetically engineered to re-establish a natural riparian eco system that can cope with the changed hydrological regime.	Final discharge sympathetically graded into existing stormwater discharge region on lower boundary toward natural drainage.
	Developments are to be designed in accordance with “Australian Rain Fall and Run off” and the NSW Floodplain Development Manual.	Rainfall data taken from NSW/MSC approved sources as per AUS-SPEC and designed accordingly. System is over capacity as per attached plan for 10 year event in consideration of criteria 4.1 of handbook (see Appendix J).
	Designs to be prepared in accordance with the Muswellbrook Shire Council Handbook for Drainage Design Criteria and the quality assurance requirements of AUS-SPEC are satisfied.	
25.2.4 Overflow disposal	Development is to be designed so that overflows do not adversely affect neighbouring properties by way of intensification, concentration or inappropriate disposal across property boundaries. This can be achieved by securing appropriate easements over downstream properties or discharging overflows directly to the street system where feasible.	Stormwater crosses lower property boundary as a controlled discharge from management system.
	Overflows from paved areas adjacent to the property boundary are to be directed by a kerb or formed gutter to drain away from neighbouring properties.	No adverse consequences for neighbouring properties due to location, site gradient and proposed stormwater management systems.

DCP Chapter	Application	Response
25.2.5 Pollutants	Stormwater systems are to be designed to capture and remove all litter larger than 5 mm in size.	Stormwater pits to be installed with filter grates to exclude rubbish. Cleaning part of facility maintenance scheme.
	The event mean concentration of specific pollutants is not to exceed that in the following table.	No pollutants present on site which can be introduced to stormwater.
25.4 Non-residential development	Stormwater drainage complies with AS 3500.3;	Installation will comply with plumbing code and AS 3500.3
	Development proposals for this type of development are to demonstrate compliance with AUSPEC D5 and the Muswellbrook Shire Council Drainage Design Criteria.	Proposed design meets AUSPEC drainage specification.
	Development applications comply with BASIX where it applies; Further information on commencement dates and details of types of development requiring a BASIX Certificate or to produce a certificate for your proposed development go to www.basix.nsw.gov.au or phone the BASIX Help Line on 1300 650 908;	
	Gutters and down pipes are installed to collect roof water	Roof water harvesting concept detailed in Appendix J.
	Pits are installed to collect water from the low points in yards	Stormwater pit layout detailed in Appendix H.
	Down pipes and pits are to be connected to the 'discharge controls' for the site	Integral discharge controls in pits.
	The site discharge indicator for the development is at least 0.5 determined under Water Smart Practice Note No. 11 – Site Discharge Indicator, and preliminary storm water design details demonstrating	All stormwater is managed and discharges through design controls.

DCP Chapter	Application	Response
	ability to comply with this requirement are to be submitted with the development application	
	Soil and erosion control plans are to be submitted in accordance with the provisions of section 20 of this DCP: • For non-residential development incorporating facilities to accommodate or employ more than 50 staff, or that involve the use of more than 1 hectare of land for commercial, industrial or special use purposes, a comprehensive water cycle management plan that responds to relevant issues and opportunities for achieving sustainable water cycle outcomes is required to be submitted with the development application	Erosion control plan provided in Appendix H.
	Soil and water management plans are required to be submitted with the development application for all non-residential development where site disturbance is greater than 1,000 m^2.	
	Industrial development buildings are to be provided with an onsite stormwater retention tank in accordance with the following: • Roof area equal or less than 500 m^2 are required to have a tank size of 10,000 L • Roof area more than 500 m^2 are required to have a tank size of 22,500 L	Five 22,500L tanks to be installed to collect and re-use stormwater from roof areas. Water to be used in research pilot equipment testing only, not for human consumption. Rain water is preferred for process due to lack of chlorine.

Appendix G – Database search results

Search results

Your search for:LGA: Muswellbrook Shire Council

Search Again
Refine Search

did not find any records in our database.

If a site does not appear on the record it may still be affected by contamination. For example:

- Contamination may be present but the site has not been regulated by the EPA under the Contaminated Land Management Act 1997 or the Environmentally Hazardous Chemicals Act 1985.
- The EPA may be regulating contamination at the site through a licence or notice under the Protection of the Environment Operations Act 1997 (POEO Act).
- Contamination at the site may be being managed under the planning process.

Search TIP

To search for a specific site, search by LGA (local government area) and carefully review all sites listed.

... more search tips

More information about particular sites may be available from:

- The POEO public register
- The appropriate planning authority: for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act.

See What's in the record and What's not in the record.

If you want to know whether a specific site has been the subject of notices issued by the EPA under the CLM Act, we suggest that you search by Local Government Area only and carefully review the sites that are listed.
This public record provides information about sites regulated by the EPA under the Contaminated Land Management Act 1997, including sites currently and previously regulated under the Environmentally Hazardous Chemicals Act 1985. Your inquiry using the above search criteria has not matched any record of current or former regulation. You should consider searching again using different criteria. The fact that a site does not appear on the record does not necessarily mean that it is not affected by contamination. The site may have been notified to the EPA but not yet assessed, or contamination may be present but the site is not yet being regulated by the EPA. Further information about particular sites may be available from the appropriate planning authority, for example, on a planning certificate issued by the local council under section 149 of the Environmental Planning and Assessment Act. In addition the EPA may be regulating contamination at the site through a licence under the Protection of the Environment Operations Act 1997. You may wish to search the POEO public register

10 July 2018

Data from the BioNet BioNet Atlas website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1Â°; ^^ rounded to 0.01Â°). Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Licensed Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Entities in selected area [North: -32.26 West: 150.84 East: 150.94 South: -32.36] returned a total of 821 records of 35 species.
Report generated on 9/07/2018 5:06 PM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records	Info
Animalia	Reptilia	Pygopodidae	2159	*Delma impar*		Striped Legless Lizard	V,P	V	5	
Animalia	Aves	Anseranatidae	0199	*Anseranas semipalmata*		Magpie Goose	V,P		1	
Animalia	Aves	Ciconiidae	0183	*Ephippiorhynchus asiaticus*		Black-necked Stork	E1,P		1	
Animalia	Aves	Accipitridae	0218	*Circus assimilis*		Spotted Harrier	V,P		1	
Animalia	Aves	Accipitridae	0226	*Haliaeetus leucogaster*		White-bellied Sea-Eagle	V,P	C	4	
Animalia	Aves	Accipitridae	0225	*Hieraaetus morphnoides*		Little Eagle	V,P		1	
Animalia	Aves	Falconidae	0238	*Falco subniger*		Black Falcon	V,P		1	
Animalia	Aves	Psittacidae	0260	*Glossopsitta pusilla*		Little Lorikeet	V,P		2	
Animalia	Aves	Climacteridae	8127	*Climacteris picumnus victoriae*		Brown Treecreeper (eastern subspecies)	V,P		2	
Animalia	Aves	Acanthizidae	0504	*Chthonicola sagittata*		Speckled Warbler	V,P		9	
Animalia	Aves	Meliphagidae	0603	*Anthochaera phrygia*		Regent Honeyeater	E4A,P	CE	1	
Animalia	Aves	Pomatostomidae	8388	*Pomatostomus temporalis temporalis*		Grey-crowned Babbler (eastern subspecies)	V,P		3	
Animalia	Aves	Neosittidae	0549	*Daphoenositta chrysoptera*		Varied Sittella	V,P		1	
Animalia	Aves	Artamidae	8519	*Artamus cyanopterus cyanopterus*		Dusky Woodswallow	V,P		5	
Animalia	Aves	Estrildidae	0652	*Stagonopleura guttata*		Diamond Firetail	V,P		2	
Animalia	Mammalia	Dasyuridae	1008	*Dasyurus maculatus*		Spotted-tailed Quoll	V,P	E	1	
Animalia	Mammalia	Dasyuridae	1017	*Phascogale tapoatafa*		Brush-tailed Phascogale	V,P		1	
Animalia	Mammalia	Phascolarctidae	1162	*Phascolarctos cinereus*		Koala	V,P	V	1	
Animalia	Mammalia	Petauridae	1137	*Petaurus norfolcensis*		Squirrel Glider	V,P		12	
Animalia	Mammalia	Pteropodidae	1280	*Pteropus poliocephalus*		Grey-headed Flying-fox	V,P	V	10	
Animalia	Mammalia	Emballonuridae	1321	*Saccolaimus flaviventris*		Yellow-bellied Sheathtail-bat	V,P		4	

Animalia	Mammalia	Molossidae	1329	*Mormopterus norfolkensis*	Eastern Freetail-bat	V,P		9
Animalia	Mammalia	Vespertilionidae	1353	*Chalinolobus dwyeri*	Large-eared Pied Bat	V,P	V	1
Animalia	Mammalia	Vespertilionidae	1372	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V,P		4
Animalia	Mammalia	Vespertilionidae	1346	*Miniopterus australis*	Little Bentwing-bat	V,P		5
Animalia	Mammalia	Vespertilionidae	1834	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V,P		17
Animalia	Mammalia	Vespertilionidae	1357	*Myotis macropus*	Southern Myotis	V,P		2
Animalia	Mammalia	Vespertilionidae	1361	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V,P		3
Animalia	Mammalia	Vespertilionidae	1025	*Vespadelus troughtoni*	Eastern Cave Bat	V,P		4
Plantae	Flora	Fabaceae (Mimosoideae)	3848	*Acacia pendula*	Acacia pendula population in the Hunter catchment	E2		26
Plantae	Flora	Myrtaceae	6360	*Eucalyptus camaldulensis*	Eucalyptus camaldulensis population in the Hunter catchment	E2		29
Plantae	Flora	Myrtaceae	4134	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	V,P	V	1
Plantae	Flora	Orchidaceae	6399	*^^Cymbidium canaliculatum*	Cymbidium canaliculatum population in the Hunter Catchment	E2,P,2		8
Plantae	Flora	Orchidaceae	4457	*^^Diuris tricolor*	Pine Donkey Orchid population in the Muswellbrook local government area	E2,V,P,2		322
Plantae	Flora	Orchidaceae	4457	*^^Diuris tricolor*	Pine Donkey Orchid	V,P,2		322

Search Results

34 results found.

Balmoral 310 Denman Rd	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Barber Shop (former) 7 Sydney St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Birralee 33 Brentwood St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Brighton Villa 12 Hunters Tce	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Eatons Hotel 180-188 Bridge St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Eatons Hotel Group 164-188 Bridge St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Edinglassie 710 Denman Rd	Muswellbrook, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Hennor and Garden 3 Lorne St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
House 178 Bridge St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)

House - St Vincent De Paul Shop 174-176 Bridge St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
House and Former Shop 164-166 Bridge St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Hunter River Road Bridge Kayuga Rd	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Loxton House 142-144 Bridge St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Masonic Hall 75 Bridge St	Muswellbrook, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Muswellbrook Post Office 7 Bridge St	Muswellbrook, NSW, Australia	(Listed place) Commonwealth Heritage List
Overdene 79 Bengalla Rd	Bengalla via Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Police Station William St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Presbyterian Church (original building) Hill St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Presbyterian Manse (former) 106 Hill St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Railway Cottage and Adjacent Fig Tree 27 Brook St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)

Railway Hotel 10-14 Market St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Railway Station Market St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Royal Hotel (former) 1 Sydney St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Shop (former) 172 Bridge St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Skellatar Tindale St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
St Albans Anglican Church & Grounds Brook St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
St Albans Precinct Brook St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
St Albans Rectory Brook St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
St Albans Sunday School 15 HuntersTce	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
St James Catholic Church 4 Brook St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)

St Johns Presbyterian Church Hill St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
St Johns Presbyterian Church Precinct Hill St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Trinity Uniting Church 110 Bridge St	Muswellbrook, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Weidmann Cottage (former) 132-134 Bridge St	Muswellbrook, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)

Report Produced: Tue Jul 10 08:41:35 2018

Accessibility | Disclaimer | Privacy | © Commonwealth of Australia (cc) BY

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : 2219644

Client Service ID : 356381

Emily Rindfleish

GHD Tower, Level 3, 24 Honeysuckle Drive
Newcastle New South Wales 2300

Attention: Emily Rindfleish

Email: emily.rindfleish@ghd.com

Date: 09 July 2018

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -32.3108, 150.8854 - Lat, Long To : -32.3088, 150.8877 with a Buffer of 50 meters, conducted by Emily Rindfleish on 09 July 2018.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

1	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

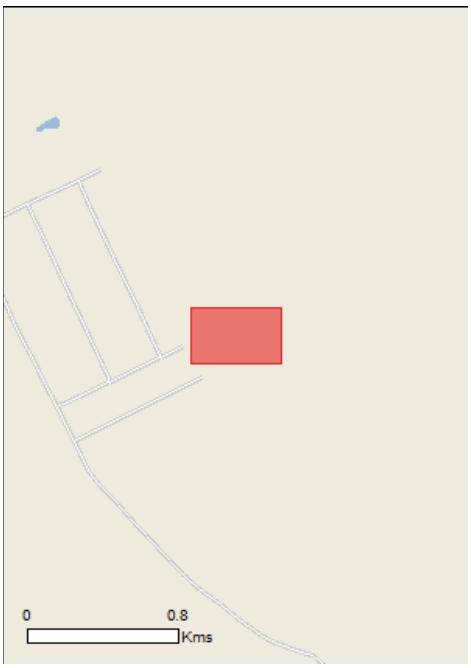
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 09/07/18 17:02:16

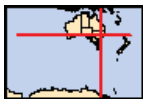
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	29
Listed Migratory Species:	14

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	7
Commonwealth Heritage Places:	1
Listed Marine Species:	20
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	31
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Hunter estuary wetlands	50 - 100km upstream

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Central Hunter Valley eucalypt forest and woodland	Critically Endangered	Community likely to occur within area
Hunter Valley Weeping Myall (Acacia pendula) Woodland	Critically Endangered	Community may occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Frogs		

Name	Status	Type of Presence
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Androcalva procumbens [87153]	Vulnerable	Species or species habitat may occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus glaucina Slaty Red Gum [5670]	Vulnerable	Species or species habitat likely to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area
Philotheca ericifolia [64942]	Vulnerable	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat likely to occur within area
Prostanthera cryptandroides subsp. cryptandroides Wollemi Mint-bush [68496]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Delma impar Striped Legless Lizard [1649]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Bank of Australia
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Defence Housing Authority
Defence - MUSWELLBROOK GRES DEPOT

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Muswellbrook Post Office	NSW	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.3087 150.88586,-32.3087 150.89019,-32.31091 150.89019,-32.31091 150.88586,-32.3087 150.88586

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

© Commonwealth of Australia
Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Office of Environment & Heritage

Home > Topics > Heritage places and items > Search for heritage

Search for NSW heritage

Return to search page where you can refine/broaden your search.

Statutory listed items

Information and items listed in the State Heritage Inventory come from a number of sources. This means that there may be several entries for the same heritage item in the database. For clarity, the search results have been divided into three sections.

- **Section 1** - contains Aboriginal Places declared by the **Minister for the Environment** under the National Parks and Wildlife Act. This information is provided by the Heritage Division.
- **Section 2** - contains heritage items listed by the **Heritage Council of NSW** under the NSW Heritage Act. This includes listing on the State Heritage Register, an Interim Heritage Order or protected under section 136 of the NSW Heritage Act. This information is provided by the Heritage Division.
- **Section 3** - contains items listed by **local councils** on Local Environmental Plans under the Environmental Planning and Assessment Act, 1979 and **State government agencies** under s.170 of the Heritage Act. This information is provided by local councils and State government agencies.

Section 1. Aboriginal Places listed under the National Parks and Wildlife Act.

Your search did not return any matching results.

Section 2. Items listed under the NSW Heritage Act.

Your search returned 8 records.

Item name	Address	Suburb	LGA	SHR
Eatons Hotel & St Vincent De Paul Group	178, 180-188 Bridge Street	Muswellbrook	Muswellbrook	00331
Edinglassie	710 Denman Road	Muswellbrook	Muswellbrook	00170
Loxton House	142-144 Bridge Street	Muswellbrook	Muswellbrook	00185
Merton	4883 Jerrys Plains Road	Denman	Muswellbrook	00159
Muswellbrook Railway Station and yard group	Main Northern railway	Muswellbrook	Muswellbrook	01208
Rous Lench	Denman Road	Edinglassie	Muswellbrook	00211
St. Alban's Anglican Church	Hunter Terrace	Muswellbrook	Muswellbrook	00458
Weidmann Cottage	132 Bridge Street	Muswellbrook	Muswellbrook	00260

Section 3. Items listed by Local Government and State Agencies.

Your search returned 205 records.

Item name	Address	Suburb	LGA	Information source
Armitage House	2 Armitage Avenue	Muswellbrook	Muswellbrook	LGOV
Army munitions base	495 Rosemount Road	Denman	Muswellbrook	LGOV
Atherstone	5 Sowerby Street	Muswellbrook	Muswellbrook	GAZ
Atherstone	5 Sowerby Street	Muswellbrook	Muswellbrook	LGOV
Baerami Creek Shale Mines and Retort	Baerami Creek Road	Baerami	Muswellbrook	LGOV
Baerami Homestead	Berami Road via Sandy Hollow	Denman	Muswellbrook	GAZ
Baerami Homestead (including pedestrian bridge)	300 Baerami Creek Road	Baerami	Muswellbrook	LGOV
Baerami School of Arts	1361 Bylong Valley Way	Baerami	Muswellbrook	LGOV
Bakery	49 Ogilvie Street	Denman	Muswellbrook	LGOV
Balmoral	310 Denman Road	Muswellbrook	Muswellbrook	LGOV
Balmoral	Denman Road	Muswellbrook	Muswellbrook	GAZ
Barber Shop	5 Sydney Street	Muswellbrook	Muswellbrook	GAZ
Beer Homestead	721 Edderton Road	Muswellbrook	Muswellbrook	LGOV
Belmont	721 Edderton Road	Muswellbrook	Muswellbrook	LGOV
Bengalla Homestead	183 Bengalla Road	Bengalla	Muswellbrook	LGOV
Billiards Building	36-40 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Birralee	33 Brentwood Street (Cnr Brecht Street)	Muswellbrook	Muswellbrook	LGOV
Birralee	Brecht Street	Muswellbrook	Muswellbrook	GAZ
Blunt's Butter Factory	179 Overton Road	Bengalla	Muswellbrook	LGOV
Brighton Villa		Muswellbrook	Muswellbrook	GAZ

	12 Hunter Street			
Brighton Villa	12 Hunter Terrace	Muswellbrook	Muswellbrook	LGOV
Brogheda	6 Yarraman Road	Manobalai	Muswellbrook	LGOV
Business Heritage Conservation Area		Muswellbrook	Muswellbrook	LGOV
Campbell & Co Store, Former	54	Muswellbrook	Muswellbrook	GAZ
Campbell's Corner	60 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Cordial Factory (Demolished)	Muswellbrook Road	Denman	Muswellbrook	LGOV
Courthouse & Police Station, Former	Palace Street	Denman	Muswellbrook	GAZ
Dalmar Stud	690 Bengalla Road	Bengalla	Muswellbrook	LGOV
Denman Bridge over Hunter River	Golden Highway	Denman	Muswellbrook	SGOV
Denman Conservation Area		Denman	Muswellbrook	GAZ
Denman Heritage Conservation Area		Denman	Muswellbrook	LGOV
Denman Hotel	1-5 Ogilvie Street (corner of Palace Street)	Denman	Muswellbrook	LGOV
Denman Masonic Lodge	18 Jerdan Street	Denman	Muswellbrook	LGOV
Denman Memorial Hall	30 Ogilvie Street	Denman	Muswellbrook	LGOV
Eatons Group	164-166,172, 174, 178, 180 and 188 Bridge Street	Muswellbrook	Muswellbrook	GAZ
Eatons Group - house	178 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Eatons Group - shop	172 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Eatons Group - St Vincent de Paul Society building	174-176 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Eatons Hotel	182-184 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Edderton Homestead	Edderton Road	Muswellbrook	Muswellbrook	LGOV

Edinglassie	710 Denman Road	Muswellbrook	Muswellbrook	LGOV
Edward Higgens Building	30-32 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Ellamara	1831 Merriwa Road	Sandy Hollow	Muswellbrook	LGOV
Fairview	Hebden Road	Liddell	Muswellbrook	LGOV
Farrells Auto One	5 Maitland Street	Muswellbrook	Muswellbrook	LGOV
Fitzgerald /Olympic Park Gates	Wilkinson Avenue	Muswellbrook	Muswellbrook	LGOV
Former Anglican Church Rectory	21 Palace Street	Denman	Muswellbrook	LGOV
Former barber shop	7 Sydney Street	Muswellbrook	Muswellbrook	LGOV
Former butter factory	14-15 Aberdeen Street	Muswellbrook	Muswellbrook	LGOV
Former Campbell's and Co store	52 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Former CBC Bank	35 Ogilvie Street	Denman	Muswellbrook	LGOV
Former Court House Group - police station, residence and lockup	32 Palace Street	Denman	Muswellbrook	LGOV
Former hospital	37 Sowerby Street	Muswellbrook	Muswellbrook	LGOV
Former picture theatre	17 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Former post office	3179 Bylong Valley Way	Kerrabee	Muswellbrook	LGOV
Former Presbyterian manse	106 Hill Street	Muswellbrook	Muswellbrook	LGOV
Former private hospital	5 Crinoline Street	Denman	Muswellbrook	LGOV
Former Royal Hotel	1 Sydney Street	Muswellbrook	Muswellbrook	LGOV
Former School and Residence	1828 Merriwa Road	Ginats Creek	Muswellbrook	LGOV
Former school residence	80 Palace Street	Denman	Muswellbrook	LGOV
Former St John's Presbyterian Church PREVIOUS/OTHER NAME St Johns Presb	Hill Street	Muswellbrook	Muswellbrook	LGOV
Gelston		Muswellbrook	Muswellbrook	LGOV

	409 Sandy Creek Road			
Glenmunro - slab kitchen	4372 Jerrys Plains Road	Denman	Muswellbrook	LGOV
Goulburn River National Park	Goulburn River	Baerami	Muswellbrook	LGOV
Hennor	18-20 Maitland Street	Muswellbrook	Muswellbrook	LGOV
Hennor	Maitland Road	Muswellbrook	Muswellbrook	GAZ
Hillcrest	311 Hebden Road	Liddell	Muswellbrook	LGOV
Holbrook Stud	2030 Widden Valley Road	Baerami	Muswellbrook	LGOV
Hollydeen Shop and Garage	1010 Merriwa Road (Cnr Reedy Creek Road)	Hollydeen	Muswellbrook	LGOV
Hospital, Former	37 Sowerby Street	Muswellbrook	Muswellbrook	GAZ
House	5 Midanga Avenue	Muswellbrook	Muswellbrook	LGOV
House	9-11 Hunter Terrace	Muswellbrook	Muswellbrook	LGOV
Item	15 Hunter Terrace	Muswellbrook	Muswellbrook	GAZ
Item	27 Brovic Street	Muswellbrook	Muswellbrook	GAZ
Jerrys Plains Official Residence	Doyle Street	Jerrys Plains	Muswellbrook	SGOV
Kayuga	731 Kayuga Road	Kayuga	Muswellbrook	LGOV
Kayuga Bridge	Kayuga Road	Muswellbrook	Muswellbrook	LGOV
Kayuga Bridge over Hunter River	Kayuga Road	Muswellbrook	Muswellbrook	SGOV
Kerb and Guttering - Brook Street	Brook Street (Bridge Street to railway line)	Muswellbrook	Muswellbrook	LGOV
Kerb and Guttering - Sydney Street	Sydney Street (Maitland Street to Haydon Street)	Muswellbrook	Muswellbrook	LGOV
Keys Family Private Cemetery	Bengalla Road	Bengalla	Muswellbrook	LGOV
Keys Family Private Cemetery	Bengalla Road	Bengalla	Muswellbrook	GAZ

Kildonan	208 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Koobahla Villa	Cook Street	Muswellbrook	Muswellbrook	GAZ
Koombahla Villa	23 Cook Street (Cnr Carl Street)	Muswellbrook	Muswellbrook	LGOV
Lime Kiln - E.I.E.I.O	540 Sandy Creek Road	Muswellbrook	Muswellbrook	LGOV
Loxton House	140-142 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Manobalai Nature Reserve	Yarraman Road	Manobalai	Muswellbrook	LGOV
Martindale	Martindale Road	Denman	Muswellbrook	GAZ
Martindale Homestead	1150 Martindale Road	Denman	Muswellbrook	LGOV
Masonic Hall		Muswellbrook	Muswellbrook	GAZ
Masonic Lodge	75 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Merton	4883 Jerrys Plains Road	Denman	Muswellbrook	LGOV
Merton Cemetery	5052 Jerrys Plains Road	Denman	Muswellbrook	LGOV
Merton Cemetery		Denman	Muswellbrook	GAZ
Minch's Wine Shop	18 Foley Street	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Ambulance	Market, William Streets	Muswellbrook	Muswellbrook	SGOV
Muswellbrook Brick Works	Muswellbrook Common	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Bridge	Kayuga Road	Muswellbrook	Muswellbrook	GAZ
Muswellbrook Cemetery	Bowman and Brecht Streets	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Conservation Area		Muswellbrook	Muswellbrook	GAZ
Muswellbrook High School	King Street	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Hotel	46 Market Street (Cnr Carl Street)	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Hunter River Underbridge	Railway Locations, Ulan Line, 289.304 &		Muswellbrook	SGOV

	327.079 Kms			
Muswellbrook Infants School	Dolahenty Street (corner of King Street)	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Police Station	William Street	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Police Station, Former	26 William Street	Muswellbrook	Muswellbrook	SGOV
Muswellbrook Post Office	7 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Muswellbrook Railway Precinct	Market Street	Muswellbrook	Muswellbrook	SGOV
Muswellbrook Railway Precinct	Market Street	Muswellbrook	Muswellbrook	SGOV
Muswellbrook Railway Station	Market Street	Muswellbrook	Muswellbrook	GAZ
Muswellbrook Railway Station	Market Street	Muswellbrook	Muswellbrook	LGOV
National Australia Bank building	46-50 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Negoa Homestead	92 Wiltons Lane	Kayuga	Muswellbrook	LGOV
Negoa Homestead	Kayuga Road	Muswellbrook	Muswellbrook	GAZ
Oak Milk Factory	Hunter Street	Muswellbrook	Muswellbrook	LGOV
Old Kayuga Cemetery	Kayuga Road	Kayuga	Muswellbrook	GAZ
Old Kayuga Cemetery	30 Stair Street	Kayuga	Muswellbrook	LGOV
Old Kerrabee Homestead	3179 Bylong Valley Way	Kerrabee	Muswellbrook	LGOV
Olinda		Denman	Muswellbrook	GAZ
Olinda (Demolished)	Merriwa Road	Denman	Muswellbrook	LGOV
Original buildings	Ogilvie,virginia Streets	Denman	Muswellbrook	SGOV
Overdene	79 Bengalla Road	Muswellbrook	Muswellbrook	LGOV
Overdene	Bengalla Road	Muswellbrook	Muswellbrook	GAZ
Pickering	Mangoola Road	Denman	Muswellbrook	GAZ
Pickering		Denman	Muswellbrook	LGOV

	221 Mangoola Road			
Piercefield and Outbuildings	1532-1618 Denman Road	Denman	Muswellbrook	LGOV
Plashett Homestead	Edderton Road	Muswellbrook	Muswellbrook	LGOV
Police Residence, Former	Palace Street	Denman	Muswellbrook	GAZ
Police Station	William Street	Muswellbrook	Muswellbrook	GAZ
Portable Timber Lockup	Palace Street	Denman	Muswellbrook	GAZ
Post Office		Muswellbrook	Muswellbrook	GAZ
Presbyterian Manse	106 Hill Street	Muswellbrook	Muswellbrook	GAZ
Prince of Wales Tavern	28-30 Sydney Street	Muswellbrook	Muswellbrook	LGOV
Railway Depot	Victoria Street	Muswellbrook	Muswellbrook	GAZ
Railway depot (roundhouse)	Bell Street	Muswellbrook	Muswellbrook	LGOV
Railway Hotel	10-14 Market Street	Muswellbrook	Muswellbrook	LGOV
Railway signal box	Market Street	Muswellbrook	Muswellbrook	LGOV
Railway Terminus Site	Turner Street	Denman	Muswellbrook	LGOV
Residence - Timber Cottage	12 Palace Street	Denman	Muswellbrook	LGOV
Residential Heritage Conservation Area		Muswellbrook	Muswellbrook	LGOV
Roman Catholic Church	Palace Street	Denman	Muswellbrook	GAZ
Rosemount Winery	659 Rosemount Road	Denman	Muswellbrook	LGOV
Rosevale Cottage	687 Kayuga Road	Kayuga	Muswellbrook	LGOV
Rous Lench	710 Denman Road	Muswellbrook	Muswellbrook	LGOV
Royal Hotel	10-16 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Royal Hotel	10 Ogilvie Street	Denman	Muswellbrook	LGOV

	(corner of Palace Street)			
Royal Hotel	Palace Street	Denman	Muswellbrook	GAZ
Royal Hotel (original)	Ogilvie Street	Denman	Muswellbrook	LGOV
Royal Hotel, Former	1 Sydney Street	Muswellbrook	Muswellbrook	GAZ
Rumbo Bush School	"Mayland"	Denman	Muswellbrook	LGOV
Rural Bank Buidling (Demolished - 1991)	45 Bridge Street (Cnr Brook Street)	Muswellbrook	Muswellbrook	LGOV
School of Arts	Main Road	Baerami	Muswellbrook	GAZ
School of Arts/Town Hall	3 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Shale Oil Retort Relics	1590 Merriwa Road	Sandy Hollow	Muswellbrook	LGOV
Shamrock Hotel	30 William Street	Muswellbrook	Muswellbrook	LGOV
Shop façade	34 Bridge Street	Muswellbrook	Muswellbrook	GAZ
Shop Front		Muswellbrook	Muswellbrook	LGOV
Shop front	34 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Simpson Park and Reserve	Market Street (corner of Sydney Street)	Muswellbrook	Muswellbrook	LGOV
Skellatar - St Mary's Catholic School	17 Fitzgerald Avenue	Muswellbrook	Muswellbrook	LGOV
Slab Cottage	Main Road	Kerrabee	Muswellbrook	GAZ
St Alban's Anglican Church	20 Brook Street	Muswellbrook	Muswellbrook	LGOV
St Alban's Anglican Church Rectory	Corner Hunter Terrace and Brook Street	Muswellbrook	Muswellbrook	LGOV
St Alban's Anglican Church Sunday School	15 Hunter Terrace	Muswellbrook	Muswellbrook	LGOV
St Alban's Group	Brook Street	Muswellbrook	Muswellbrook	LGOV
St Alban's Precinct	Brook Street and Hunter Terrace	Muswellbrook	Muswellbrook	GAZ

St Alban's Precinct	Brovic Street	Muswellbrook	Muswellbrook	GAZ
St Alban's Precinct	Hunter Terrace	Muswellbrook	Muswellbrook	GAZ
St Heliers	70 St Heliers Road	Muswellbrook	Muswellbrook	LGOV
St Heliers Correctional Centre	McCully's Gap Road	Muswellbrook	Muswellbrook	SGOV
St Heliers Correctional Centre - Admin & outbuildings	McCully's Gap Road	Muswellbrook	Muswellbrook	SGOV
St Heliers Correctional Centre - Officers Accommodation	McCully's Gap Road	Muswellbrook	Muswellbrook	SGOV
St Heliers Correctional Centre - Stables	McCully's Gap Road	Muswellbrook	Muswellbrook	SGOV
St James' Roman Catholic Church	Brook Street	Muswellbrook	Muswellbrook	LGOV
St James' Roman Catholic Church Convent	Brook Street	Muswellbrook	Muswellbrook	LGOV
St James' Roman Catholic Presbytery	4 Sowerby Street	Muswellbrook	Muswellbrook	LGOV
St John's Anglican Church	1824 Merriwa Road	Giants Creek	Muswellbrook	LGOV
St John's Presbyterian Church	Hill Street	Muswellbrook	Muswellbrook	LGOV
St Joseph's Hall	80 Palace Street	Denman	Muswellbrook	LGOV
St Matthias' Anglican Church	33-35 Palace Street	Denman	Muswellbrook	LGOV
St. Heliers	McCulleys Gap Road	Muswellbrook	Muswellbrook	GAZ
St. James Roman Catholic Church including surrounds	Brook Street	Muswellbrook	Muswellbrook	GAZ
St. John's Presbyterian Church Precinct	Hill Street	Muswellbrook	Muswellbrook	GAZ
St. Mary's School Skelletar	Tindale Street	Muswellbrook	Muswellbrook	GAZ
St. Matthias Anglican Church	Palace Street	Denman	Muswellbrook	GAZ
Stone Bridge	Grass Tree Road	Muswellbrook	Muswellbrook	GAZ
Stone Bridge	Muscle Creek Road	Muswellbrook	Muswellbrook	LGOV
Taskers Pharmacy	26 Bridge Street	Muswellbrook	Muswellbrook	LGOV

Timber Cottage	129 Hill Street	Muswellbrook	Muswellbrook	LGOV
Uniting Church		Muswellbrook	Muswellbrook	GAZ
Uniting Church - Upper Hunter Parish Trinity Uniting Church	110 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Valley Hotel/Motel	33 Sydney Street	Muswellbrook	Muswellbrook	LGOV
Water Pumping Station (Demolished)	Palace Street	Denman	Muswellbrook	LGOV
Weatherboard Hall	50 Palace Street (Cnr Turtle Street)	Denman	Muswellbrook	LGOV
Weidmann Cottage	126 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Westpac Bank building	19 Bridge Street	Muswellbrook	Muswellbrook	LGOV
Widden Stud	1650 Widden Valley Road	Widden	Muswellbrook	LGOV
Wollemi National Park	Wollemi	Baerami	Muswellbrook	LGOV
Woodlands Stud	Woodlands Road	Denman	Muswellbrook	GAZ
Woodlands Stud	3933 Woodlands Road	Denman	Muswellbrook	LGOV
Wybong Cemetery	Yarraman Road	Wybong	Muswellbrook	LGOV
Yammanie	307 Denman Road	Muswellbrook	Muswellbrook	LGOV
Yarrawa Bridge over Goulburn River	Yarrawa Road	Denman	Muswellbrook	SGOV
Yarrawa Bridge over Hunter River	Yarrawa Road	Denman	Muswellbrook	LGOV

There was a total of 213 records matching your search criteria.

Key:
LGA = Local Government Area
GAZ= NSW Government Gazette (statutory listings prior to 1997), HGA = Heritage Grant Application, HS = Heritage Study, LGOV = Local Government, SGOV = State Government Agency.
Note: While the Heritage Division seeks to keep the Inventory up to date, it is reliant on State agencies and local councils to provide their data. Always check with the relevant State agency or local council for the most up-to-date information.

Appendix H – Stormwater management plan

THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

CIVIL NOTES

EXISTING SERVICES

1. EXISTING SERVICES ARE NOT SHOWN ON THESE DRAWINGS. NO RESPONSIBILITY IS TAKEN BY THE ENGINEER OR THE PRINCIPAL FOR THIS INFORMATION. THE CONTRACTOR SHALL ASCERTAIN THE POSITION OF ALL UNDERGROUND SERVICES PRIOR TO EXCAVATION AND SHALL BE RESPONSIBLE FOR THE COST OF REPAIRS TO DAMAGES CAUSED AS A RESULT OF THE WORK

GENERAL NOTES

1. ALL WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH THE SPECIFICATION FOR THESE WORKS AND/OR AS DIRECTED BY THE SUPERINTENDENT.
2. ANY WORK TO BE UNDERTAKEN ON PUBLIC ROADS, PLACES, PARKS OR THE LIKE SHALL ONLY BE UNDERTAKEN WITH THE APPROVAL AND TO THE SATISFACTION OF THE AUTHORITY IN CONTROL OF THE AREA WHERE THE WORK IS TO BE UNDERTAKEN THE CONTRACTOR IS TO ENSURE THE NECESSARY APPROVALS ARE IN PLACE AND ANY FEES PAID.
3. ALL DIMENSIONS ARE TO BE CHECKED ON-SITE BEFORE WORK COMMENCES.
4. DIMENSIONS SHALL NOT BE OBTAINED BY SCALING THE DRAWING
5. THE CONTRACTOR SHALL LOCATE AND LEVEL ALL EXISTING SERVICES PRIOR TO COMMENCING CONSTRUCTION AND MAKE ARRANGEMENTS WITH THE RELEVANT AUTHORITY TO RELOCATE AND/OR ADJUST IF NECESSARY. INFORMATION GIVEN ON THE DRAWINGS IN RESPECT TO SERVICES IS FOR GUIDANCE ONLY AND IS NOT GUARANTEED TO BE CORRECT OR COMPLETE.
6. THE CONTRACTOR IS NOT TO ENTER OR DO ANY WORK WITHIN ADJACENT PROPERTIES WITHOUT THE PERMISSION OF THE LANDOWNER AND SUPERINTENDENT.
7. THE CONTRACTOR SHALL CLEAR THE SITE BY REMOVING ALL RUBBISH, FENCES AND DEBRIS, ETC TO THE EXTENT SPECIFIED.
8. ALL SITE REGRADING AREAS SHALL BE FINALLY GRADED TO THE SATISFACTION OF THE SUPERINTENDENT.
9. SURPLUS EXCAVATED MATERIAL SHALL BE PLACED WHERE DIRECTED.
10. ALL NEW WORKS SHALL MAKE A SMOOTH TRANSITION TO THE EXISTING SURFACE.
11. ALL CONDUITS AND SERVICES SHALL BE LAID PRIOR TO LAYING PAVEMENT.
12. DURING CONSTRUCTION BARRIERS, LIGHTS & SIGNS SHALL BE MAINTAINED TO ENSURE SAFE PASSAGE OF TRAFFIC AND PEDESTRIANS IN ACCORDANCE WITH THE REQUIREMENTS AS 1742.
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR NOTIFYING ALL RELEVANT AUTHORITIES AND PAYING ALL FEES NECESSARY BEFORE COMMENCING WORK, FOR LOCATING ALL EXISTING SERVICES AND FOR REPAIR OF ANY SERVICES DAMAGED AS A RESULT OF THE WORKS.
14. IF NECESSARY A TRAFFIC CONTROL PLAN IS TO BE PREPARED BY A SUITABLE QUALIFIED AND EXPERIENCED PERSON.

SUB GRADE NOTES

1. CLEARING, STRIPPING AND GRUBBING SHOULD BE CARRIED OUT IN AREAS SUBJECT TO EARTHWORKS. ALL SOILS CONTAINING ORGANIC MATER SHOULD BE STRIPPED FROM THE CONSTRUCTION AREA. THIS MATERIAL IS NOT CONSIDERED SUITABLE FOR USE AS STRUCTURAL FILL
2. DEPRESSIONS FORMED BY REMOVAL OF VEGETATION, UNDERGROUND ELEMENTS ETC. SHOULD HAVE ALL DISTURBED WEAKENED SOIL CLEANED OUT AND BE BACKFIELD WITH COMPACTED SELECT MATERIAL.
3. AFTER CLEARING, GRUBBING AND STRIPPING, THE EXPOSED SURFACE IN THE CONSTRUCTION AREAS, SHOULD BE PROOF ROLLED TO DETECT ANY SOFT OR LOOSE MATERIAL. WEAK SOILS ARE TO BE REMOVED AND REPLACED WITH COMPACTED FILL.
4. THE INSITU SOILS, WHERE FREE OF ORGANIC AND DELETERIOUS MATERIAL, MAY BE USED FOR STRUCTURAL FILL PROVIDED THE MOISTURE CONTENT OF THE SOILS ON PLACEMENT APPROXIMATES THE OPTIMUM MOISTURE CONTENT REQUIRED FOR COMPACTION.
5. IMPORTED FILL MUST HAVE A SOAKED CBR OF NOT LESS THAT 15% AND A MAXIMUM AGGREGATE SIZE OF NOT GREATER THAN 50mm, MAX. LIQUID LIMIT = 40 MAX. P.I. = 15, MAX. P.I. x % PASSING 425um =450.
6. GUIDELINES FOR MINIMUM RELATIVE COMPACTION VALUES FOR INSITU SOIL FILL AND IMPORTED FILL FOR SUB-GRADES ARE TO BE 98% STANDARD MAXIMUM DRY DENSITY (AS1289 E1.1, E4.1)

EARTHWORKS NOTES

1. CLEARING, STRIPPING AND GRUBBING SHOULD BE CARRIED OUT IN AREAS SUBJECT TO EARTHWORKS. STRIP TOP SOIL , AVERAGE 100mm THICK. STOCKPILE TOPSOIL FOR RE-USE. ALL SOILS CONTAINING ORGANIC MATER SHOULD BE STRIPPED FROM THE CONSTRUCTION AREA. THIS MATERIAL IS NOT CONSIDERED SUITABLE FOR USE AS STRUCTURAL FILL
2. DEPRESSIONS FORMED BY REMOVAL OF VEGETATION, UNDERGROUND ELEMENTS ETC. SHOULD HAVE ALL DISTURBED WEAKENED SOIL CLEANED OUT AND BE BACKFIELD WITH COMPACTED SELECT MATERIAL.
3. IN AREAS OF CUT OR IN EXISTING GROUND, PRIOR TO ANY FILLING, PROOF ROLL THE THE EXPOSED SURFACE WITH A ROLLER OF MINIMUM WEIGHT 8 TONNES WITH A MINIMUM OF 6 PASSES.
4. EXCAVATE AND REMOVE ANY SOFT SPOTS ENCOUNTERED DURING PROOF ROLLING AND REPLACE WITH APPROVED FILL COMPACTED IN LAYERS. THE WHOLE OF THE EXPOSED SUB-GRADE AND FILL SHALL BE COMPACTED TO 98% STANDARD MAXIMUM DRY DENSITY AT OPTIMUM MOISTURE CONTENT ± 2%.
COMPACTION TESTING SHALL BE CARRIED OUT IN ACCORDANCE WITH AS3798 BY A REGISTERED NATA LABORATORY. THE COSTS OF TESTING AND RE-TESTING ARE TO BE ALLOWED FOR BY THE BUILDER.
5. SOIL FILL SHALL COMPRISE CONTROLLED FILL AS DEFINED IN AS2870 (RESIDENTIAL SLABS AND FOOTINGS), AND BE PLACED COMPACTED AND TESTED IN ACCORDANCE WITH AS3798 (EARTHWORKS FOR COMMERCIAL AND RESIDENTIAL DEVELOPMENTS). CERTIFICATION OF THE BUILDING PLATFORM BY AN APPROVED GEOTECHNICAL OR STRUCTURAL ENGINEER SHALL BE ON A LEVEL 1 BASIS IN ACCORDANCE WITH AS3798.
6. FILL IN 200mm MAXIMUM (LOOSELY PLACED) LAYERS TO LEVELS INDICATED ON EARTHWORKS PLAN OR TO UNDERSIDE OF PAVEMENT. COMPACT TO 98% STANDARD (AS1289 5.1.1)
MAXIMUM DRY DENSITY AT OPTIMUM MOISTURE CONTENT ±2%.
7. BATTERS TO BE AS SHOWN.
8. ALL CONDUITS AND MAINS SHALL BE LAID PRIOR TO LAYING FINAL PAVEMENT.
9. ALL BATTERS AND FOOTPATHS ADJACENT TO ROADS SHALL BE TOP SOILED WITH 150mm APPROVED LOAM AND SEEDED UNLESS OTHERWISE SPECIFIED.
10. BACK FILLING FOR SERVICE TRENCHES, ETC SHOULD BE GOOD QUALITY MATERIAL FREE OF ORGANIC MATERIAL. THE BACKFILL SHOULD BE PLACED IN UNIFORM LAYERS OVER THE FULL WIDTH OF THE EXCAVATIONS WITH THE LAYERS NOT EXCEEDING 200mm THICKNESS, LOOSELY PLACED. THE BACKFILL MATERIAL SHOULD BE COMPACTED TO 98% STANDARD MAXIMUM DRY DENSITY.
11. BACK FILLING FOR SERVICE TRENCHES UNDER ROADWAYS SHALL BE WITH A QUALITY MATERIAL OF NOT LESS THAN CBR 15% (SOAKED) TO THE UNDERSIDE OF PAVEMENT, COMPACTED AT OPTIMUM MOISTURE CONTENT TO ACHIEVE 98% MODIFIED COMPACTION.
12. ALL NEW WORK SHALL MAKE A SMOOTH TRANSITION TO THE EXISTING SURFACES. ALL SITE REGRADING SHALL BE FINALLY GRADED TO THE SATISFACTION OF THE SUPERINTENDENT.
13. SURPLUS MATERIAL NOT REQUIRED ONSITE SHALL BE DISPOSED OF OFFSITE TO THE SUPERINTENDENTS SATISFACTION.

PAVEMENT NOTES

1. PAVEMENT TO BE CONSTRUCTED TO DEPTH AND LEVELS SHOWN ON THE DRAWINGS AS SPECIFIED IN THE GEOTECHNICAL REPORT BY QUALYTEST LABORATORY (NSW) PTY LTDREF NO. NEW17P-0022-AA.
2. BASE COURSE MATERIAL TO BE AS SPECIFIED IN THE GEOTECHNICAL REPORT.
3. SUB-BASE MATERIAL TO BE AS SPECIFIED IN THE GEOTECHNICAL REPORT.
4. PROVIDE TEST RESULTS OF PAVEMENT MATERIAL FROM A NATA REGISTERED TESTING AUTHORITY PRIOR TO PAVEMENT CONSTRUCTION.
5. PAVEMENT TO BE COMPACTED TO A MINIMUM RELATIVE COMPACTION OF 97% (MODIFIED) IN ACCORDANCE WITH AS1289.
6. PROVIDE A MINIMUM OF 4 COMPACTION TESTS OF THE FINISHED PAVEMENT PRIOR TO FINAL SEALING.
7. TEST TO BE UNDERTAKEN BY A NATA REGISTERED TESTING AUTHORITY.
8. PAVEMENT AND TESTING TO BE UNDERTAKEN IN ACCORDANCE WITH THE FOLLOWING SPECIFICATIONS:-
AUSTRALIAN STANDARDS AS 1141, AS 1289
RTA SPECIFICATIONS RTA FORM 744, T114, T116, T130, T131, T160, T171.

SEDIMENT MANAGEMENT NOTES

1. CONSTRUCTION OF ALL SEDIMENT MANAGEMENT DEVICES TO THE SATISFACTION OF THE COUNCIL'S SUBDIVISION ENGINEER SHALL BE COMPLETED AND EFFECTIVE PRIOR TO:-
   (a) STRIPPING OF TOPSOIL & GRASS.
   (b) BULK EARTHWORKS TO THE SITE.
   (c) SERVICES INSTALLATION.
   (d) ROAD PAVEMENT CONSTRUCTION.
2. ALL SEDIMENT MANAGEMENT MEASURES ARE TO REMAIN IN PLACE UNTIL INSTRUCTION IS RECEIVED IN WRITING FROM THE ENGINEER TO REMOVE ALL/PART OFF THE SILT CONTROL APPLICATIONS.
3. BOTH TEMPORARY AND PERMANENT SEDIMENT MANAGEMENT EROSION CONTROL DEVICES SHALL BE MAINTAINED AT A SUITABLE LEVEL/CONDITION THROUGHOUT CONSTRUCTION.
4. ALL WORK TO BE IN ACCORDANCE WITH COUNCILS REQUIREMENTS FOR URBAN EROSION & SEDIMENT CONTROL.
5. CARE IS TO BE EXERCISED AT ALL TIMES TO MINIMISE DISTURBANCE TO EXISTING TREES AND VEGETATION WITHIN THE LIMITS OF PROPOSED WORKS
6. THE CONTRACTOR IS TO PROVIDE WATER TRUCKS AS REQUIRED TO MINIMISE OR ELIMINATE THE DUST PROBLEMS CAUSED BY ON SITE TRAFFIC MOVEMENT.
7. ANY VEHICLE EXITING THE DEVELOPMENT SITE SHALL BE WASHED DOWN PRIOR TO EXITING SITE TO ENSURE NO MATERIAL IS DEPOSITED ONTO ROADWAYS.

CONCRETE PAVING

1. FOR PREPARATION OF SUBGRADE REFER TO SUB GRADE NOTES.
2. FOR PAVEMENT DETAILS REFER TO PAVEMENT NOTES.
3. CONCRETE PAVEMENT SLABS SHALL BE AS DETAILED ON THE DRAWINGS.
4. ALL WORKMANSHIP AND MATERIALS FOR CONCRETE WORK SHALL BE IN ACCORDANCE WITH AS3600 AND AS3610, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.
5. CONCRETE QUALITY
ALL CEMENT SHALL BE ACSE SPECIFICATION TYPE A.

ELEMENT	STRENGTH GRADE (MPa)	SLUMP (mm)	MAXIMUM AGGREGATE SIZE (mm)
DRIVEWAY	32	80	20

PROJECT CONTROL TESTING SHALL BE CARRIED OUT IN ACCORDANCE WITH AS3600.

6. NO ADMIXTURES SHALL BE USED IN CONCRETE UNLESS APPROVED IN WRITING.
7. CLEAR CONCRETE COVER TO ALL REINFORCEMENT SHALL BE 40mm.
8. THE CONCRETE SHALL BE MECHANICALLY VIBRATED TO ACHIEVE A DENSE HOMOGENEOUS MASS, COMPLETELY FILLIING THE FORMWORK THOROUGHLY EMBEDDING THE REINFORCEMENT AND FREE OF STONE POCKETS.
9. CURING OF ALL CONCRETE IS TO BE ACHIEVED BY KEEPING SURFACES CONTINUOUSLY WET FOR A PERIOD OF 3 DAYS, AND THE PREVENTION OF MOISTURE LOSS FOR A TOTAL OF 7 DAYS FOLLOWED BY A GRADUAL DRYING OUT.

ASPHALT PAVING NOTES

1. FOR PREPARATION OF SUBGRADE REFER TO EARTHWORKS NOTES.
2. FOR PAVEMENT DETAILS REFER TO PAVEMENT NOTES.
3. WEARING SURFACE SHALL BE ASPHALTIC CONCRETE TO STANDARD SPECIFICATION, MINIMUM THICKNESS = 40mm.

EROSION AND SEDIMENT CONTROL NOTES

GENERAL

1. ALL WORK IS TO BE IN ACCORDANCE WITH THE PLAN AND CONSISTENT WITH LANDCOM - MANAGING URBAN STORMWATER - BLUE BOOK 4TH EDITION.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE IMPLEMENTATION OF THE EROSION AND SEDIMENT CONTROL PLAN.
3. CONTROL MEASURES SHALL BE IN PLACE PRIOR TO EACH SITE DISTURBANCE.
4. SITE DISTURBANCE SHALL BE STAGED WHERE POSSIBLE AND RESTRICTED TO THE WORKS ZONE.
5. ALL WORKS TO BE INSPECTED, AND MAINTAINED WHERE NECESSARY ON A WEEKLY BASIS AND AFTER EACH RUNOFF EVENT.

TOPSOIL MANAGEMENT

1. TOPSOIL IS TO BE STRIPPED FROM ALL AREAS OF WORK AND STOCKPILED. AWAY FROM DRAINAGE FLOWPATHS OR STORMWATER INLETS.
2. TOPSOIL IS TO BE RE-SPREAD OVER ALL EXPOSED SOIL SURFACES WHERE VEGETATION IS REQUIRED.
3. WHERE CUT BATTERS ARE TO BE SEEDED, SLOPES EXCEEDING 1:2.5 (H:V) SHALL BE ROUGHENED HORIZONTALLY TO ENHANCE THE RETENTION OF TOPSOIL.
4. ALL EFFORTS SHALL BE MADE TO ESTABLISH VEGETATION ON EXPOSED SOIL SURFACES IMMEDIATELY EARTHWORKS ARE COMPLETED, THE MINIMUM REQUIREMENT SHALL BE ESTABLISHMENT OF A COVERCROP SPECIES WITH THE INCLUSION OF PERMANENT VEGETATION SPECIES AS APPROPRIATE.
5. STOCKPILE SITES, BORROW PITS ETC, SHALL BE REVEGETATED IMMEDIATELY UPON DECOMMISSION.

EROSION CONTROL

1. STORMWATER DRAINAGE AND CULVERTS NEED TO BE INSTALLED EARLY TO CATER FOR STORM RUNOFF.
2. SOIL MATERIAL STOCKPILES SHALL BE LOCATED AWAY FROM DEPRESSION FLOWLINES.
3. BARRIER OR SIMILAR FENCING IS TO BE USED TO PROTECT NON TRAFFICABLE AREAS.

REVEGETATION

1. REVEGETATION SHALL BE ONGOING AND PROGRESSIVE.
2. WHERE ANY BREAK IN OPERATIONS, OR WHERE WORK IS CEASED IN AN AREA FOR LONGER THAN 4 WEEKS, THE EXPOSED AREA SHALL BE STABILISED (eg.TEMPORARY TOPSOILING AND SEEDING WITH AN APPROPRIATE COVERCROP, MULCHES, BLANKETS/MATTINGS).
3. TOPSOILED AREAS ARE TO BE SEEDED WITH COVERCROP SPECIES SUITABLE FOR LOCAL CONDITIONS.
4. SOME SUGGESTED PERMANENT GRASS SPECIES INCLUDE:
   - COUCH (6kg/ha)
   - KIKUYU (4kg/ha)
   - WHITE CLOVER (3kg/ha)
5. AN NPK 11-34-11 FERTILISER OR SIMILAR AS APPROPRIATE IS TO BE APPLIED AT A RATE OF 200-400 kg/ha. CARE IS TO BE TAKEN TO AVOID ANY FERTILISER DIRECTLY ENTERING WATERCOURSES. SCARIFYING OR DIRECT DRILLING CAN IMPROVE SEED STRIKE RATES.
6. THE CONTRACTOR SHALL PROVIDE SUITABLE SEED BED PREPARATION PRIOR TO THE SOWING OF VEGETATION SEED SPECIES.
7. REVEGETATION WORKS SHALL BE MAINTAINED/ENHANCED UNTIL A MINIMUM OF 70% GROUND COVER IS ESTABLISHED.

SEDIMENT CONTROL

1. SEDIMENT FENCING IS TO BE INSTALLED TO THE MANUFACTURERS SPECIFICATIONS AND:
   - BE INSTALLED TO THE CONTOUR
   - HAVE ENDS TURNED UPWARDS WHERE APPROPRIATE TO CREATE STORAGE
2. SEDIMENT CONTROLS ARE TO BE LOCATED AS CLOSE TO DISTURBED AREAS AS PRACTICABLE.
3. TRAPPED SEDIMENT TO BE REMOVED TO AN APPROPRIATE LOCATION.
4. TEMPORARY CONTROL MEASURES SHALL REMAIN IN PLACE UNTIL CATCHMENT THEY ARE SERVING IS STABILISED (FOR GRASS, 70% GROUNDCOVER)
5. PROVIDE SEDIMENT BAGS IN KERB & GUTTER UPSTREAM OF EXISTING PITS UNTIL DISTURBED AREAS ARE ADEQUATELY STABILISED.

DRAWING LIST

CN01	CIVIL NOTES & DRAWING LIST
CIVIL	
01	SITE PLAN & TYPICAL DRAIN CROSS SECTIONS
02	PLAN
03	BULK EARTHWORKS PLAN
04	TYPICAL DRIVEWAY DETAIL, KERB INLET CAPACITIES & RETAINING WALL DETAILS
05	DRIVEWAY ACCESS LONGITUDINAL & CROSS SECTIONS SHEET 01
06	DRIVEWAY ACCESS CROSS SECTIONS SHEET 02
07	DRIVEWAY ACCESS CROSS SECTIONS SHEET 03
08	STRING 1 CROSS SECTIONS SHEET 01
09	STRING 1 CROSS SECTIONS SHEET 02
10	STORMWATER PLAN
11	STORMWATER LONGITUDINAL SECTIONS LINE 1 & LINE 2
12	EROSION & SEDIMENT CONTROL PLAN & DETAILS

NOTWITHSTANDING THE EXTENT OF WORKS SHOWN ON THE DRAWINGS THE CONTRACTOR SHALL UNDERTAKE ALL NECESSARY CONSTRUCTION REQUIRED TO ENABLE FINISHED WORKS TO COMPLY WITH THE INTENT OF THE DRAWINGS AND THE REQUIREMENTS OF THE LOCAL AUTHORITY.

THESE DRAWINGS ARE DIAGRAMMATIC ONLY AND ARE INTENDED TO INDICATE DESIGN IN ACCORDANCE WITH THE RELEVANT REGULATIONS AND REQUIREMENTS OF THE AUTHORITIES CONCERNED, AND TO THE RELEVANT AUSTRALIAN STANDARDS.
THEY DO NOT RELIEVE THE CONTRACTOR OR BUILDER FROM HIS RESPONSIBILITY TO COMPLY WITH THESE REQUIREMENTS, EVEN IF DRAWINGS ARE APPROVED BY THE AUTHORITY.

IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE THAT PROVISION IS MADE FOR THE INSTALLATION OF ALL SERVICES PRIOR TO THE CONSTRUCTION OF DRIVEWAYS, CARPARKS AND OTHER PAVED AREAS.

PRIOR TO COMMENCEMENT OF CONSTRUCTION, THE CONTRACTOR IS TO ASCERTAIN THE LOCATION AND LEVEL OF EXISTING SERVICES TO HIS SATISFACTION. SERVICES SHOWN ON PLANS ARE TAKEN FROM SURVEYORS FIELD NOTES ONLY AND MAY NOT NECESSARILY INDICATE ALL SERVICES WITHIN THE WORKS AREA.

No.	REVISION	DATE	DWN
03	GENERAL	28/06/18	AW
02	GENERAL	07/06/18	AW
01	BUILDING PADS & RETAINING WALL AMENDED	08/02/18	AW

LEGEND

© COPYRIGHT 2017
The design and details shown on these drawings are applicable to this project only and may not be reproduced in whole or in part or be used for any other project or purpose without the written consent of McKENZIE BURRIDGE & ASSOCIATES PTY LTD with whom copyright resides.

DO NOT SCALE THE STRUCTURAL DRAWINGS. DIMENSIONAL ERRORS MAY OCCUR DURING COPYING OR REPRODUCTION OF THE DRAWINGS.

APPROVED
I CERTIFY THAT THE WORKS SHOWN ON THIS PLAN HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS.

M. BURRIDGE M.I.E Aust., C.P. Eng.
(FOR McKENZIE BURRIDGE & ASSOCIATES PTY. LTD.)

McKenzie Burridge & Associates Pty Ltd
CIVIL & STRUCTURAL CONSULTING ENGINEERS
PO BOX 503
17 WEBBERS ARCADE
133 PRINCE STREET
GRAFTON NSW 2460
(02) 6643 2116
www.mckenzieburridge.com.au
office@mckenzieburridge.com.au
ABN 18 092 914 595

DRAWN	AW	SCALE	
DESIGNED		LEVELS	
CHECKED	MB	CONTOURS	
APPROVED	MB	DATUM	
SURVEY BY		DIMENSIONS	
SHEET SIZE	A1 (NOTE: DRAWING MAY BE REDUCED DO NOT SCALE)	DATE	NOVEMBER 2017

JOB DESCRIPTION
THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

DRAWING TITLE
TITLE AND NOTES

CLIENT
ETHANOL TECHNOLOGIES LTD

JOB No. 16-149
SHEET No. CN01
REVISION 03

LEGEND

- 172 — DESIGN MAJOR CONTOUR WITH LEVEL (2m INTERVAL)
- 170.2 — DESIGN MINOR CONTOUR WITH LEVEL (0.2m INTERVAL)
- 170 — EXISTING MAJOR CONTOUR WITH LEVEL (1m INTERVAL)
- 171.5 — EXISTING MINOR CONTOUR WITH LEVEL (0.5m INTERVAL)
- EXISTING STORMWATER LINE
- NEW STORMWATER PIT
- RETAINING WALL
- SMH — EXISTING SEWER MANHOLE
- SETOUT POINT

SITE PLAN
1:500

MAIN BUILDING SETOUT

SETOUT POINT	EASTING	NORTHING	DESIGN LEVEL
1	300974.286	6423213.107	172.120
2	300981.274	6423198.937	172.120
3	300990.120	6423180.999	172.120
4	300998.701	6423163.600	172.120
5	301049.105	6423188.458	172.120
6	301040.524	6423205.857	172.120
7	301018.225	6423217.159	172.120
8	301011.237	6423231.330	172.120
9	301005.965	6423211.113	172.120
10	301014.811	6423193.176	172.120
11	301020.417	6423195.940	172.120
12	301011.570	5423213.878	172.120

TANK FARM BUILDING SETOUT

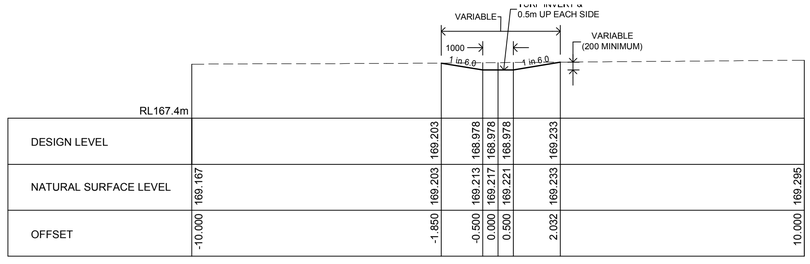
SETOUT POINT	EASTING	NORTHING	DESIGN LEVEL
13	301037.359	6423248.449	171.720
14	301061.862	6423198.763	171.720
15	301073.342	6423204.425	171.720
16	301048.838	6423254.111	171.720

RETAINING WALL SETOUT

SETOUT POINT	EASTING	NORTHING	DESIGN LEVEL
RW1	300959.188	6423206.917	172.000
RW2	300987.640	6423149.225	172.000
RW3	301042.580	6423176.320	172.000

DRIVEWAY SETOUT

CHAINAGE	EASTING	NORTHING	DESIGN LEVEL
10.000	300949.727	6423212.287	172.580
20.000	300958.704	6423216.694	172.076
30.000	300967.680	6423221.100	171.761
40.000	300976.657	6423225.507	171.681
50.000	300985.634	6423229.914	171.612
60.000	300994.610	6423234.320	171.542
70.000	301003.587	6423238.727	171.473
80.000	301012.564	6423243.134	171.404
90.000	301021.540	6423247.540	171.335
100.000	301030.517	6423251.947	171.218



TYPICAL DRAIN 1 CROSS SECTION
1:100 VERTICAL 1:100 HORIZONTAL

No.	REVISION	DATE	DWN
03	GENERAL AMENDMENTS	28/06/18	AW
02	GENERAL AMENDMENTS	07/06/18	AW
01	BUILDING PADS & RETAINING WALL AMENDED	08/02/18	AW

LEGEND

© COPYRIGHT 2017
The design and details shown on these drawings are applicable to this project only and may not be reproduced in whole or in part or be used for any other project or purpose without the written consent of McKENZIE BURRIDGE & ASSOCIATES PTY LTD with whom copyright resides.

DO NOT SCALE THE STRUCTURAL DRAWINGS. DIMENSIONAL ERRORS MAY OCCUR DURING COPYING OR REPRODUCTION OF THE DRAWINGS.

APPROVED
I CERTIFY THAT THE WORKS SHOWN ON THIS PLAN HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS.

M. BURRIDGE M.I.E Aust., C.P. Eng.
(FOR McKENZIE BURRIDGE & ASSOCIATES PTY. LTD.)

McKenzie Burridge & Associates Pty Ltd
CIVIL & STRUCTURAL CONSULTING ENGINEERS
PO BOX 503
17 WEBBERS ARCADE
133 PRINCE STREET
GRAFTON NSW 2460
(02) 6643 2116
www.mckenzieburridge.com.au
office@mckenzieburridge.com.au
ABN 18 092 914 595

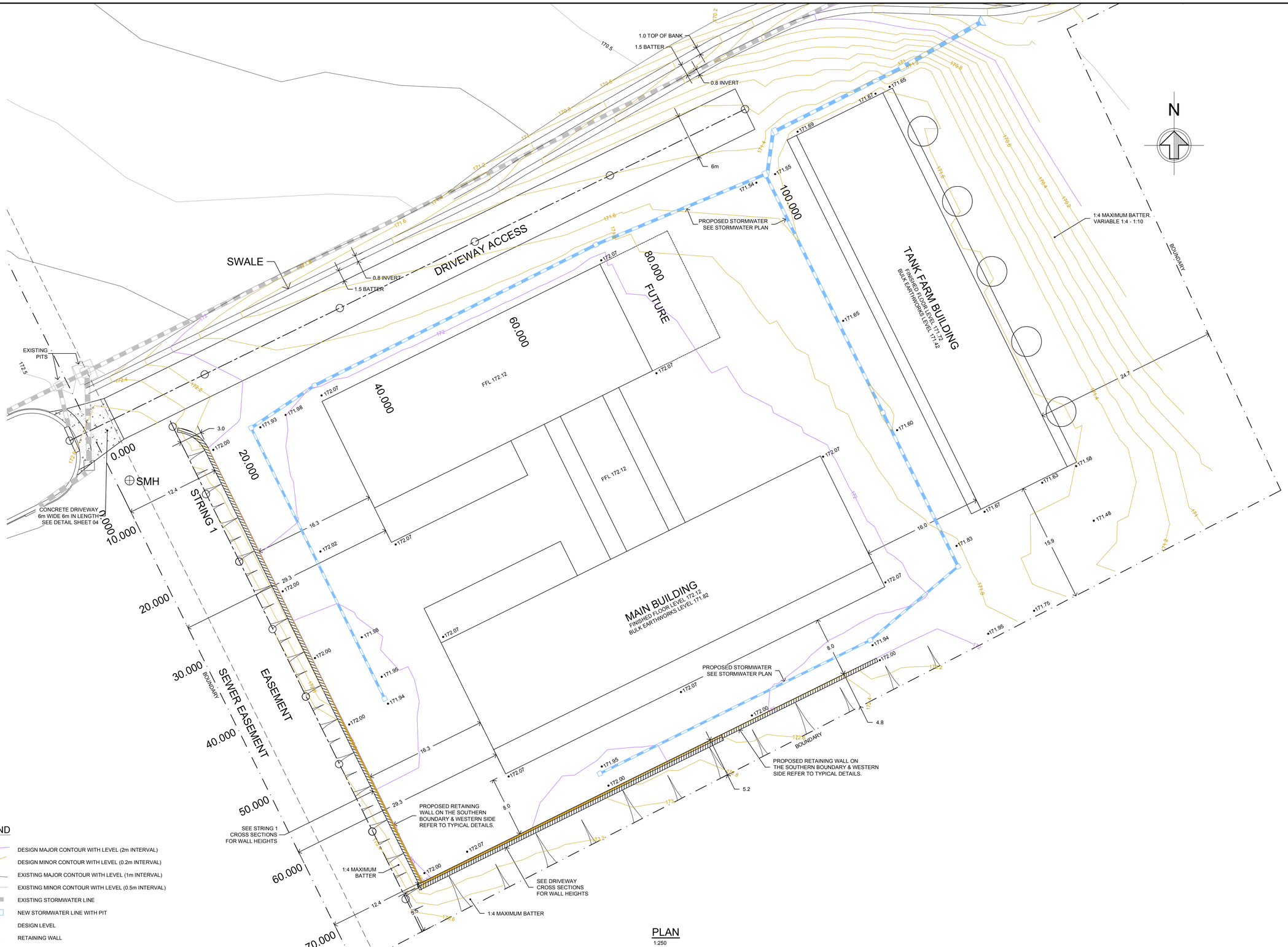
DRAWN	AW	SCALE	AS SHOWN
DESIGNED	SB	LEVELS	METRES
CHECKED	MB	CONTOURS	0.2m
APPROVED	MB	DATUM	AHD
SURVEY BY		DIMENSIONS	mm
SHEET SIZE	A1 (NOTE: DRAWING MAY BE REDUCED DO NOT SCALE)	DATE	NOVEMBER 2017

JOB DESCRIPTION
THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

DRAWING TITLE
SITE PLAN, SETOUT TABLES & TYPICAL DRAIN 1 CROSS SECTION

CLIENT
ETHANOL TECHNOLOGIES LTD

JOB No. 16-149
SHEET No. 01 (of 12)
REVISION 03



PLAN
1:250

LEGEND

- 172 — DESIGN MAJOR CONTOUR WITH LEVEL (2m INTERVAL)
- 170.2 — DESIGN MINOR CONTOUR WITH LEVEL (0.2m INTERVAL)
- 170 — EXISTING MAJOR CONTOUR WITH LEVEL (1m INTERVAL)
- 171.5 — EXISTING MINOR CONTOUR WITH LEVEL (0.5m INTERVAL)
- EXISTING STORMWATER LINE
- NEW STORMWATER LINE WITH PIT
- 171.90 — DESIGN LEVEL
- RETAINING WALL
- SMH — EXISTING SEWER MANHOLE

No.	REVISION	DATE	DWN
03	GENERAL AMENDMENTS	28/06/18	AW
02	GENERAL AMENDMENTS	07/06/18	AW
01	BUILDING PADS & RETAINING WALL AMENDED	08/02/18	AW

LEGEND

© COPYRIGHT 2017
The design and details shown on these drawings are applicable to this project only and may not be reproduced in whole or in part or be used for any other project or purpose without the written consent of McKENZIE BURRIDGE & ASSOCIATES PTY LTD with whom copyright resides.

DO NOT SCALE THE STRUCTURAL DRAWINGS. DIMENSIONAL ERRORS MAY OCCUR DURING COPYING OR REPRODUCTION OF THE DRAWINGS.

APPROVED
I CERTIFY THAT THE WORKS SHOWN ON THIS PLAN HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS.

M. BURRIDGE M.I.E Aust., C.P. Eng.
(FOR McKENZIE BURRIDGE & ASSOCIATES PTY. LTD.)

McKenzie Burridge & Associates Pty Ltd
CIVIL & STRUCTURAL CONSULTING ENGINEERS
PO BOX 503
17 WEBBERS ARCADE
133 PRINCE STREET
GRAFTON NSW 2460
(02) 6643 2116
www.mckenzieburridge.com.au
office@mckenzieburridge.com.au
ABN 18 092 914 595

DRAWN	AW	SCALE	AS SHOWN
DESIGNED	SB	LEVELS	METRES
CHECKED	MB	CONTOURS	0.2m
APPROVED	MB	DATUM	AHD
SURVEY BY		DIMENSIONS	mm
SHEET SIZE	A1 (NOTE: DRAWINGS MAY BE REDUCED DO NOT SCALE)	DATE	NOVEMBER 2017

JOB DESCRIPTION
THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

DRAWING TITLE
PLAN

JOB No.
16-149

SHEET No.
02 (of 12)

CLIENT
ETHANOL TECHNOLOGIES LTD

REVISION
03

LEGEND

- 172 — DESIGN MAJOR CONTOUR WITH LEVEL (2m INTERVAL)
- 170.2 — DESIGN MINOR CONTOUR WITH LEVEL (0.2m INTERVAL)
- 170 — EXISTING MAJOR CONTOUR WITH LEVEL (1m INTERVAL)
- 171.5 — EXISTING MINOR CONTOUR WITH LEVEL (0.5m INTERVAL)
- EXISTING STORMWATER LINE
- 171.90 — DESIGN LEVEL
- RETAINING WALL
- SMH — EXISTING SEWER MANHOLE

NOTE: 1. BULK EARTHWORKS LEVELS ARE GENERALLY -0.3m FROM THE LEVELS SHOWN HEREON.
2. PROVIDE NOMINAL LAYER OF BASE MATERIAL ON FINISHED BULK EARTHWORKS SURFACE. 50-100mm THICK

BULK EARTHWORKS CUT/FILL TABLE	
CUT	2664m³
FILL	2567m³
NET VOLUME	97m³ CUT

NOTE; FILL MATERIAL SHALL BE PLACED STRICTLY IN ACCORDANCE WITH THE GEOTECHNICAL REPORT BY QUALTEST LABORATORY (NSW) PTY LTD JOB NO. NEW17P-0022-AA. TESTING & CERTIFICATION TO BE UNDERTAKEN IN ACCORDANCE WITH THE NOTES AND GEOTECHNICAL REPORT

BULK EARTHWORKS PLAN

1:250

No.	REVISION	DATE	DWN
03	GENERAL AMENDMENTS	28/06/18	AW
02	GENERAL AMENDMENTS	07/06/18	AW
01	BUILDING PADS & RETAINING WALL AMENDED	08/02/18	AW

LEGEND

© COPYRIGHT 2017
The design and details shown on these drawings are applicable to this project only and may not be reproduced in whole or in part or be used for any other project or purpose without the written consent of McKENZIE BURRIDGE & ASSOCIATES PTY LTD with whom copyright resides.

DO NOT SCALE THE STRUCTURAL DRAWINGS. DIMENSIONAL ERRORS MAY OCCUR DURING COPYING OR REPRODUCTION OF THE DRAWINGS.

APPROVED

I CERTIFY THAT THE WORKS SHOWN ON THIS PLAN HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS.

M. BURRIDGE M.I.E Aust., C.P. Eng.
(FOR McKENZIE BURRIDGE & ASSOCIATES PTY. LTD.)

McKenzie Burridge & Associates Pty Ltd
CIVIL & STRUCTURAL CONSULTING ENGINEERS
PO BOX 503
17 WEBBERS ARCADE
133 PRINCE STREET
GRAFTON NSW 2460
(02) 6643 2116
www.mckenzieburridge.com.au
office@mckenzieburridge.com.au
ABN 18 092 914 595

DRAWN	AW	SCALE	AS SHOWN
DESIGNED	SB	LEVELS	METRES
CHECKED	MB	CONTOURS	0.2m
APPROVED	MB	DATUM	AHD
SURVEY BY		DIMENSIONS	mm
SHEET SIZE	A1 (NOTE: DRAWINGS MAY BE REDUCED DO NOT SCALE)	DATE	NOVEMBER 2017

JOB DESCRIPTION
THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

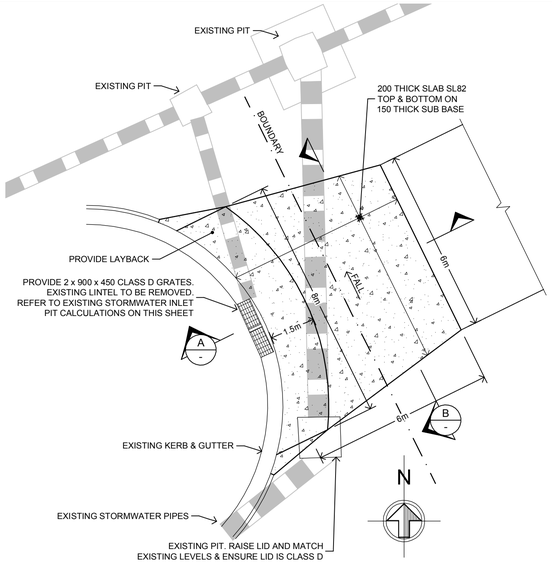
DRAWING TITLE
BULK EARTHWORKS PLAN

JOB No. 16-149

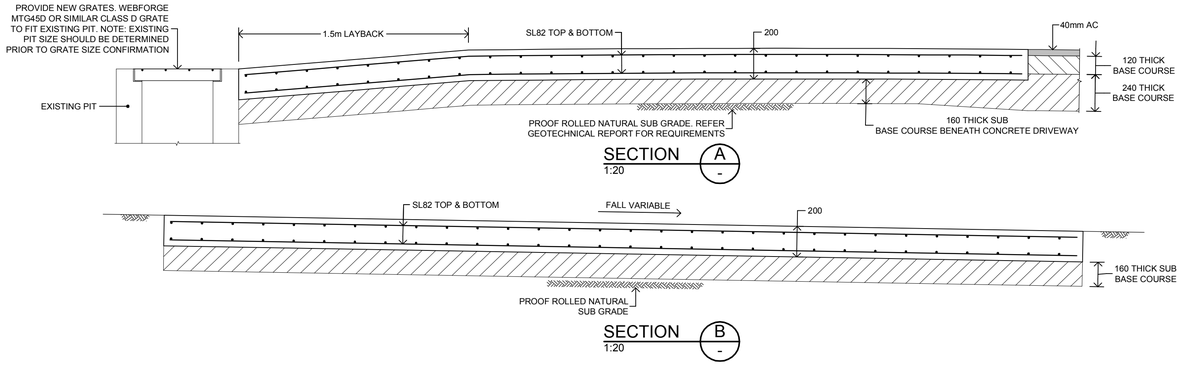
SHEET No. 03 (of 12)

REVISION 03

CLIENT
ETHANOL TECHNOLOGIES LTD



TYPICAL DRIVEWAY DETAIL
1:100



PAVEMENT COMPOSITIONS			
	FLEXIBLE	RIGID	COMPACTION
DESIGN TRAFFIC LOADING: (ESA)	3×10^5	1×10^6	-
WEARING COURSE THICKNESS: (mm)	40 (AC10 IN ACCORDANCE WITH MUSWELLBROOK COUNCIL SPECIFICATIONS)	-	-
BASECOURSE THICKNESS: (mm)	120 (RMS - R73 BOUND MATERIAL OR EQUIVALENT)	180 (40mPa CONCRETE REINFORCED WITH SL92)	98% MODIFIED (AS1289 5.2.1)
SUB-BASE THICKNESS: (mm)	240 (CONFORMING TO ARRB SR41)	125 BOUND (5% CEMENTITIOUS BINDER)	95% MODIFIED (AS1289 5.2.1)
TOTAL THICKNESS: (mm)	400	305	
CBR USED FOR DESIGN: (%)	4	3.5	

NOTE: REFER TO QUALTEST LABORATORY (NSW) PTY LTD REPORT ON GEOTECHNICAL INVESTIGATION AND PAVEMENT DESIGN, JOB NO. NEW17P-0022-AA FOR FURTHER DETAIL.

COMPACTION DEFINITIONS

MODIFIED:
MINIMUM REQUIRED DRY DENSITY RATIO AS1289 5.4.1-2007, CALCULATED USING FIELD DRY DENSITY DETERMINED BY AS1289 5.3.1-2004 OR EQUIVALENT AND THE MAXIMUM DRY DENSITY OBTAINED USING AS1289 5.2.1-2003 OR EQUIVALENT

STANDARD:
AS ABOVE, BUT MAXIMUM DRY DENSITY OBTAINED USING AS1589 5.1.1-2003 OR EQUIVALENT

DENSITY INDEX:
MINIMUM REQUIRED DENSITY INDEX AS1289 5.6.1-1998, CALCULATED USING FIELD DRY DENSITY DETERMINED BY AS1289 5.3.1-2004 OR EQUIVALENT AND LABORATORY VALUES OF MAXIMUM AND MINIMUM DENSITY OBTAINED BY AS1289 5.5.1-1998 OR EQUIVALENT.

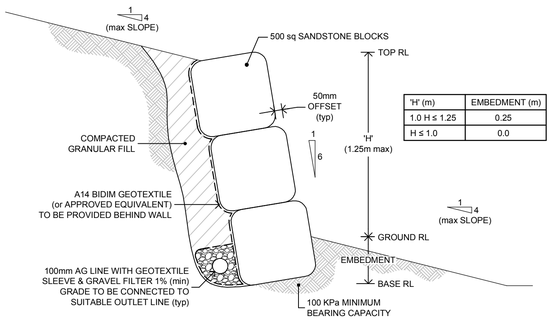
PROPOSED GRATE CAPACITY

1800mm x 450mm GRATE (P-50 x 100)		
	Eqn. 4-26	
DEPTH OF PONDING AT KERB (m)	GRATE WEIR CAPACITY (m3/s)	TOTAL INLET CAPACITY (m3/s)
0	0	0
0.02	0.004	0.004
0.04	0.0218	0.0218
0.06	0.048	0.048
0.08	0.0807	0.0807
0.1	0.1185	0.1185
0.12	0.1607	0.1607
0.14	0.207	0.207
0.15	0.231	0.231
0.175	0.2969	0.2969
0.2	0.3675	0.3675
0.25	0.5228	0.5228

EXISTING KERB INLET OPENING CAPACITY

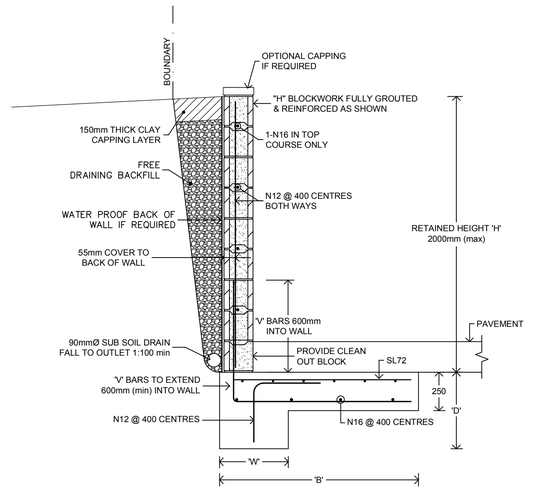
3000mm x 70mm KERB OPENING ONLY			
	Eqn. 4-30	Eqn. 4-31	
DEPTH OF PONDING AT KERB	KERB INLET WEIR CAPACITY	KERB INLET ORIFICE CAPACITY	TOTAL INLET CAPACITY (LESSER OF EQN 4-30 OR 4-31)
(m)	(m3/s)	(m3/s)	(m3/s)
0	0	0	0
0.02	0.014	0.000	0.014
0.04	0.038	0.044	0.038
0.06	0.071	0.098	0.071
0.08	0.109	0.132	0.109
0.1	0.152	0.159	0.152
0.12	0.200	0.182	0.182
0.14	0.251	0.202	0.202
0.15	0.279	0.211	0.211
0.175	0.351	0.233	0.233
0.2	0.429	0.253	0.253
0.25	0.600	0.289	0.289

NOTES:
1. AS CAN BE SEEN FROM THE ABOVE TABLES THE CAPACITY OF THE PROPOSED GRATES EXCEEDS THE CAPACITY OF THE KERB INLET WHEN THE WATER IS DEEPER THAN 140mm. WHICH IS LESS THAN THE DEPTH OF THE KERB.
2. THE VALUES IN THE TABLES WERE OBTAINED DIRECTLY FROM A SPREADSHEET PRODUCED BY GEOFFREY O'LOUGHLIN. THE VALUES PRODUCED BY THE SPREADSHEET ARE OBTAINED FROM EQUATIONS THAT ARE SOURCED FROM HYDRAULIC ENGINEERING CIRCULAR 22 (HEC 22). THE EQUATIONS ARE GENERALLY ACCEPTED AND ARE IN USE IN MANY ACCEPTED STORMWATER MODELLING PROGRAMS.



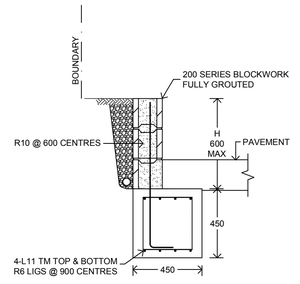
'H' (m)	EMBEDMENT (m)
1.0 H ≤ 1.25	0.25
H ≤ 1.0	0.0

TYPICAL RETAINING WALL DETAIL
1:20



ALTERNATE RETAINING WALL DETAIL FOR 'H' GREATER THAN 800mm & LESS THAN 2000mm (max)
1:20

'H'	'B'	'W'	'D'	'V' BARS	BLOCKWORK SERIES
800	600	450	500	N12 @ 400 cts	150 or 200
1000	800	450	500	N12 @ 400 cts	150 or 200
1200	1000	450	500	N12 @ 400 cts	150 or 200
1400	1200	450	500	N16 @ 400 cts or N12 @ 200 cts	200
1600	1400	450	600	N16 @ 400 cts or N12 @ 200 cts	200
1800	1600	450	700	N16 @ 400 cts or N12 @ 200 cts	200
2000	1800	600	700	N20 @ 400 cts or N16 @ 200 cts	200



ALTERNATE RETAINING WALL DETAIL FOR 'H' UP TO 600mm
1:20

No.	REVISION	DATE	DWN
03	GENERAL AMENDMENTS	28/06/18	AW
02	GENERAL AMENDMENTS	07/06/18	AW
01	RETAINING WALL AMENDED	08/02/18	AW

LEGEND

© COPYRIGHT 2017
The design and details shown on these drawings are applicable to this project only and may not be reproduced in whole or in part or be used for any other project or purpose without the written consent of McKENZIE BURRIDGE & ASSOCIATES PTY LTD with whom copyright resides.

DO NOT SCALE THE STRUCTURAL DRAWINGS. DIMENSIONAL ERRORS MAY OCCUR DURING COPYING OR REPRODUCTION OF THE DRAWINGS.

APPROVED
I CERTIFY THAT THE WORKS SHOWN ON THIS PLAN HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS.

M. BURRIDGE M.I.E Aust., C.P. Eng.
(FOR McKENZIE BURRIDGE & ASSOCIATES PTY. LTD.)

McKenzie Burridge & Associates Pty Ltd
CIVIL & STRUCTURAL CONSULTING ENGINEERS
PO BOX 503
17 WEBBERS ARCADE
133 PRINCE STREET
GRAFTON NSW 2460
(02) 6643 2116
www.mckenzieburridge.com.au
office@mckenzieburridge.com.au
ABN 18 092 914 595

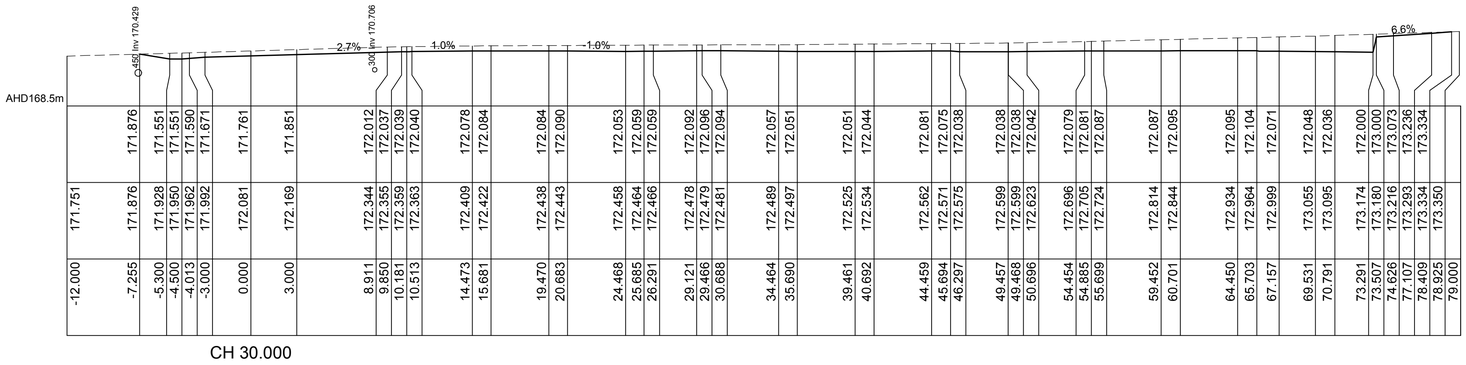
DRAWN	AW	SCALE	AS SHOWN
DESIGNED	SB	LEVELS	METRES
CHECKED	MB	CONTOURS	0.2m
APPROVED	MB	DATUM	AHD
SURVEY BY		DIMENSIONS	mm
SHEET SIZE	A1 (NOTE: DRAWINGS MAY BE REDUCED DO NOT SCALE)	DATE	NOVEMBER 2017

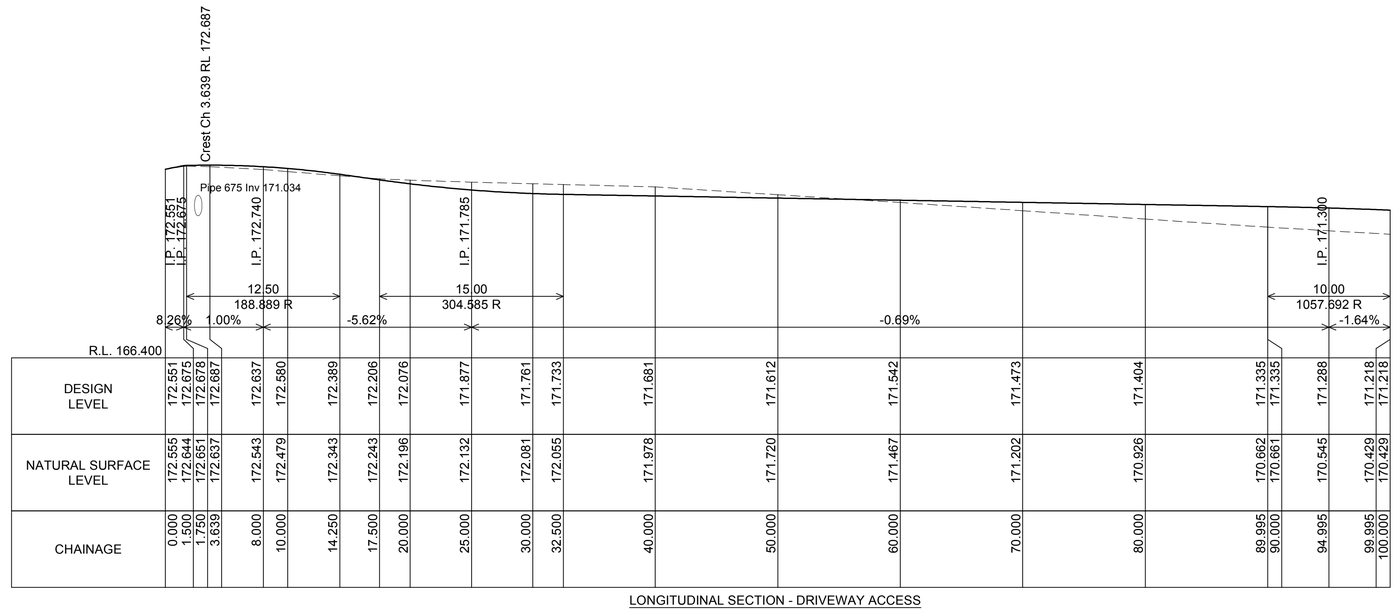
JOB DESCRIPTION
THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

DRAWING TITLE
TYPICAL DRIVEWAY DETAIL, KERB INLET CAPACITIES & RETAINING WALL DETAILS

CLIENT
ETHANOL TECHNOLOGIES LTD

JOB No. 16-149
SHEET No. 04 (of 12)
REVISION 03





LONGITUDINAL SECTION - DRIVEWAY ACCESS

HORIZONTAL SCALE 1:250 VERTICAL SCALE 1:100

No.	REVISION	DATE	DWN
03	GENERAL AMENDMENTS	28/06/18	AW
02	GENERAL AMENDMENTS	07/06/18	AW
01	CROSS SECTIONS AMENDED	08/02/18	AW

LEGEND

© COPYRIGHT 2017
The design and details shown on these drawings are applicable to this project only and may not be reproduced in whole or in part or be used for any other project or purpose without the written consent of McKENZIE BURRIDGE & ASSOCIATES PTY LTD with whom copyright resides.

DO NOT SCALE THE STRUCTURAL DRAWINGS. DIMENSIONAL ERRORS MAY OCCUR DURING COPYING OR REPRODUCTION OF THE DRAWINGS.

APPROVED

I CERTIFY THAT THE WORKS SHOWN ON THIS PLAN HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS.

M. BURRIDGE M.I.E Aust., C.P. Eng.
(FOR McKENZIE BURRIDGE & ASSOCIATES PTY. LTD.)

McKenzie Burridge & Associates Pty Ltd
CIVIL & STRUCTURAL CONSULTING ENGINEERS

PO BOX 503
17 WEBBERS ARCADE
133 PRINCE STREET
GRAFTON NSW 2460
(02) 6643 2116
www.mckenzieburridge.com.au
office@mckenzieburridge.com.au
ABN 18 092 914 595

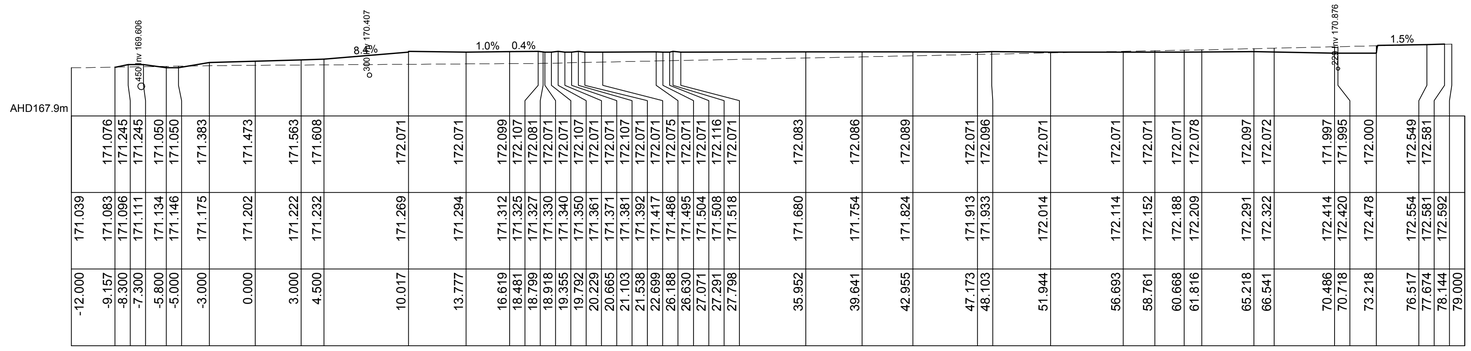
DRAWN	AW	SCALE	AS SHOWN
DESIGNED	SB	LEVELS	METRES
CHECKED	MB	CONTOURS	
APPROVED	MB	DATUM	AHD
SURVEY BY		DIMENSIONS	mm
SHEET SIZE	A1 (NOTE: DRAWINGS SCALED WHEN REDUCED DO NOT SCALE)	DATE	NOVEMBER 2017

JOB DESCRIPTION
THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

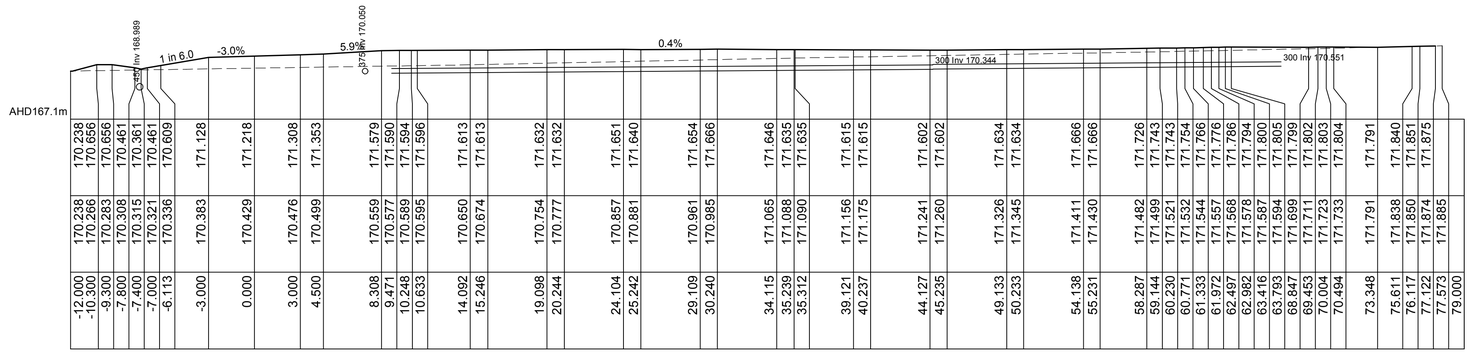
DRAWING TITLE
DRIVEWAY ACCESS LONGITUDINAL & CROSS SECTIONS SHEET 01

CLIENT
ETHANOL TECHNOLOGIES LTD

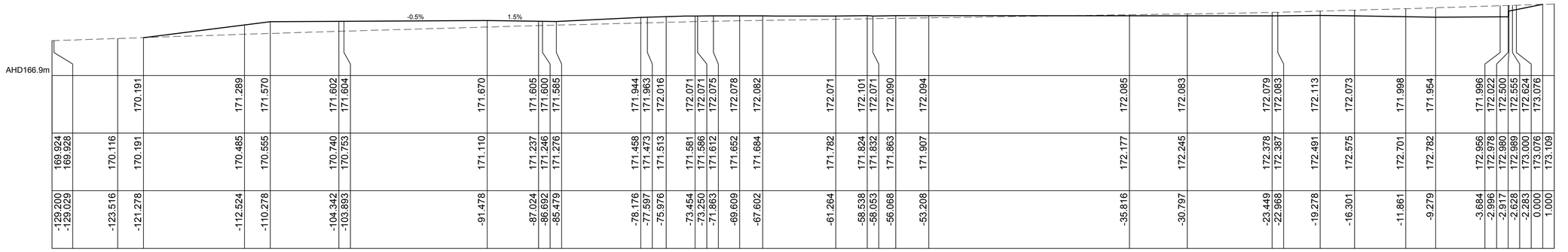
JOB No. 16-149
SHEET No. 05 (of 12)
REVISION 03


AHD167.9m
450 Inv 169.606
300 170.407
225 Inv 170.876
8.4%
1.0%
0.4%
1.5%

| | | |


AHD167.1m
450 Inv 169.869
1 in 6.0
-3.0%
5.9%
375 Inv 170.050
0.4%
300 Inv 170.344
300 Inv 170.551

| | | |



HORIZONTAL SCALE 1:200 VERTICAL SCALE 1:200

No.	REVISION	DATE	DWN
03	GENERAL AMENDMENTS	28/06/18	AW
02	GENERAL AMENDMENTS	07/06/18	AW
01	CROSS SECTIONS AMENDED	08/02/18	AW

LEGEND

© COPYRIGHT 2017
The design and details shown on these drawings are applicable to this project only and may not be reproduced in whole or in part or be used for any other project or purpose without the written consent of McKENZIE BURRIDGE & ASSOCIATES PTY LTD with whom copyright resides.

DO NOT SCALE THE STRUCTURAL DRAWINGS. DIMENSIONAL ERRORS MAY OCCUR DURING COPYING OR REPRODUCTION OF THE DRAWINGS.

APPROVED

I CERTIFY THAT THE WORKS SHOWN ON THIS PLAN HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS.

M. BURRIDGE M.I.E Aust., C.P. Eng.
(FOR McKENZIE BURRIDGE & ASSOCIATES PTY. LTD.)

McKenzie Burridge & Associates Pty Ltd
CIVIL & STRUCTURAL CONSULTING ENGINEERS

PO BOX 503
17 WEBBERS ARCADE
133 PRINCE STREET
GRAFTON NSW 2460
(02) 6643 2116
www.mckenzieburridge.com.au
office@mckenzieburridge.com.au
ABN 18 092 914 595

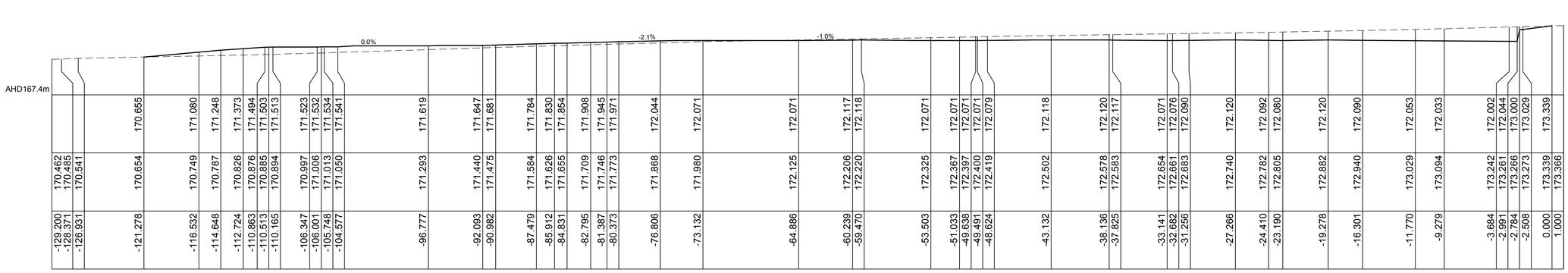
DRAWN	AW	SCALE	AS SHOWN
DESIGNED	SB	LEVELS	METRES
CHECKED	MB	CONTOURS	
APPROVED	MB	DATUM	AHD
SURVEY BY		DIMENSIONS	mm
SHEET SIZE	A1 (NOTE: DRAWING MAY BE REDUCED DO NOT SCALE)	DATE	NOVEMBER 2017

JOB DESCRIPTION
THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

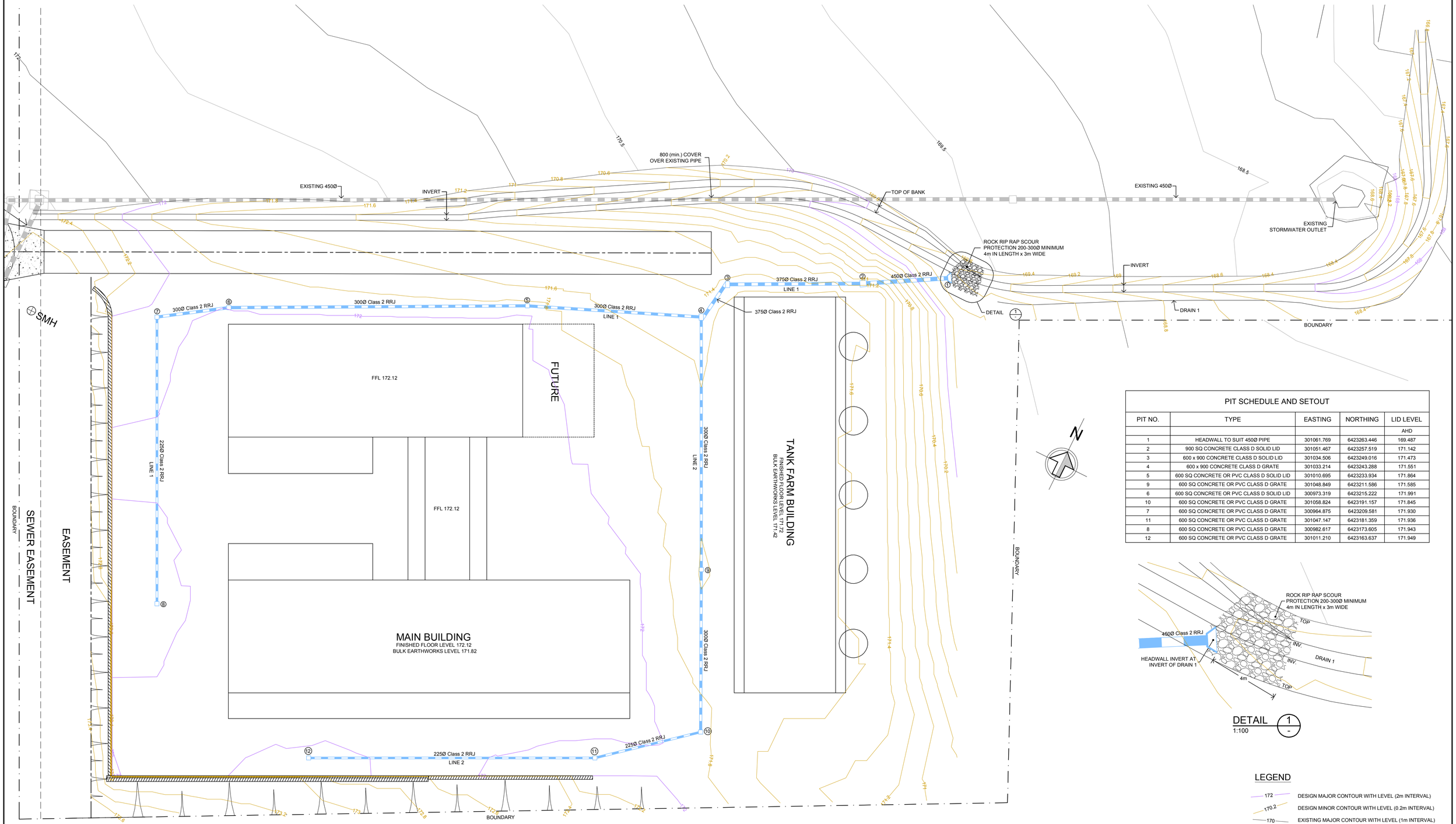
DRAWING TITLE
STRING 1 CROSS SECTIONS SHEET 01

CLIENT
ETHANOL TECHNOLOGIES LTD

JOB No. 16-149
SHEET No. 08 (of 12)
REVISION 03


0.0%
-2.1%
-1.0%
AHD167.4m

| | | |



PIT SCHEDULE AND SETOUT

PIT NO.	TYPE	EASTING	NORTHING	LID LEVEL
				AHD
1	HEADWALL TO SUIT 450Ø PIPE	301061.769	6423263.446	169.487
2	900 SQ CONCRETE CLASS D SOLID LID	301051.467	6423257.519	171.142
3	600 x 900 CONCRETE CLASS D SOLID LID	301034.506	6423249.016	171.473
4	600 x 900 CONCRETE CLASS D GRATE	301033.214	6423243.288	171.551
5	600 SQ CONCRETE OR PVC CLASS D SOLID LID	301010.695	6423233.934	171.864
9	600 SQ CONCRETE OR PVC CLASS D GRATE	301048.849	6423211.586	171.585
6	600 SQ CONCRETE OR PVC CLASS D SOLID LID	300973.319	6423215.222	171.991
10	600 SQ CONCRETE OR PVC CLASS D GRATE	301058.824	6423191.157	171.845
7	600 SQ CONCRETE OR PVC CLASS D GRATE	300964.875	6423209.581	171.930
11	600 SQ CONCRETE OR PVC CLASS D GRATE	301047.147	6423181.359	171.936
8	600 SQ CONCRETE OR PVC CLASS D GRATE	300982.617	6423173.605	171.943
12	600 SQ CONCRETE OR PVC CLASS D GRATE	301011.210	6423163.637	171.949

DETAIL 1 / - 1:100

LEGEND

- DESIGN MAJOR CONTOUR WITH LEVEL (2m INTERVAL)
- DESIGN MINOR CONTOUR WITH LEVEL (0.2m INTERVAL)
- EXISTING MAJOR CONTOUR WITH LEVEL (1m INTERVAL)
- EXISTING MINOR CONTOUR WITH LEVEL (0.5m INTERVAL)
- EXISTING STORMWATER LINE
- NEW STORMWATER LINE WITH PIT
- RETAINING WALL
- SMH EXISTING SEWER MANHOLE

STORMWATER PLAN

1:250

No.	REVISION	DATE	DWN
03	GENERAL AMENDMENTS	28/06/18	AW
02	GENERAL AMENDMENTS	07/06/18	AW
01	BUILDING PADS & RETAINING WALL AMENDED	08/02/18	AW

LEGEND

© COPYRIGHT 2017
The design and details shown on these drawings are applicable to this project only and may not be reproduced in whole or in part or be used for any other project or purpose without the written consent of McKENZIE BURRIDGE & ASSOCIATES PTY LTD with whom copyright resides.

DO NOT SCALE THE STRUCTURAL DRAWINGS. DIMENSIONAL ERRORS MAY OCCUR DURING COPYING OR REPRODUCTION OF THE DRAWINGS.

APPROVED

I CERTIFY THAT THE WORKS SHOWN ON THIS PLAN HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS.

M. BURRIDGE M.I.E Aust., C.P. Eng.
(FOR McKENZIE BURRIDGE & ASSOCIATES PTY. LTD.)

McKenzie Burridge & Associates Pty Ltd
CIVIL & STRUCTURAL CONSULTING ENGINEERS

PO BOX 503
17 WEBBERS ARCADE
133 PRINCE STREET
GRAFTON NSW 2460
(02) 6643 2116
www.mckenzieburridge.com.au
office@mckenzieburridge.com.au
ABN 18 092 914 595

DRAWN	AW	SCALE	AS SHOWN
DESIGNED	SB	LEVELS	METRES
CHECKED	MB	CONTOURS	0.2m
APPROVED	MB	DATUM	AHD
SURVEY BY		DIMENSIONS	mm
SHEET SIZE	A1 (NOTE: DRAWING MAY BE REDUCED - DO NOT SCALE!)	DATE	NOVEMBER 2017

JOB DESCRIPTION
THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

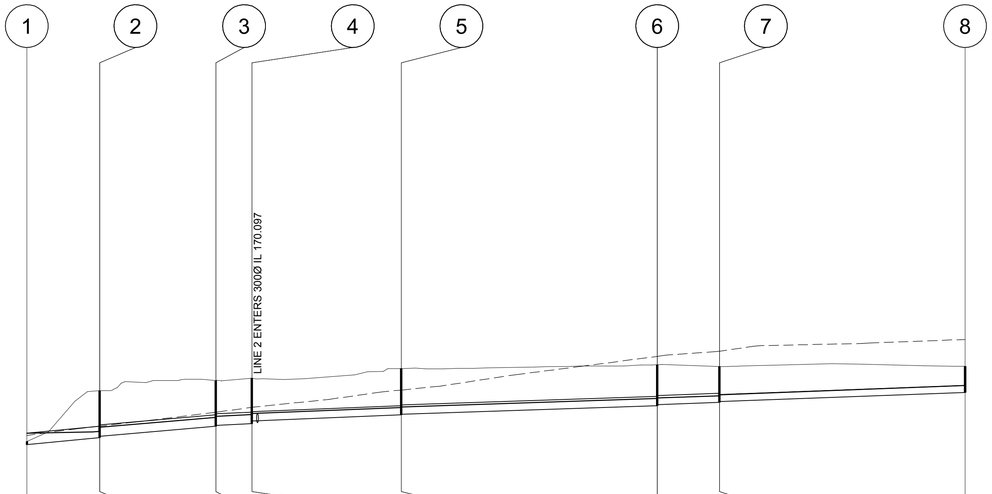
DRAWING TITLE
STORMWATER PLAN

JOB No. 16-149

SHEET No. 10 (of 12)

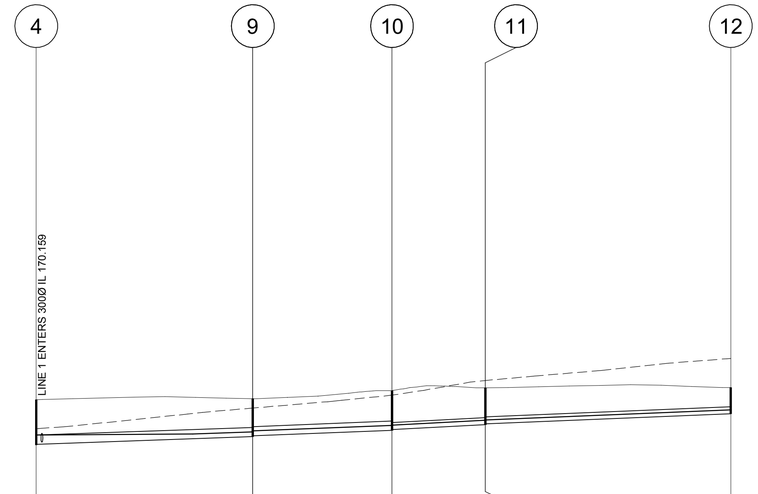
REVISION 03

CLIENT
ETHANOL TECHNOLOGIES LTD



ACTUAL VELOCITY (m/s)		1.30		0.78		0.79	0.53	0.55	0.56	0.52			
CAPACITY VELOCITY (m/s)		2.29		1.94		1.58	1.18	1.11	1.16	1.00			
PIPE FLOW (l/sec)		144		87		87	38	39	39	22			
CAPACITY (l/sec)		341		322		242	121	110	116	57			
PIPE DETAILS		375Ø Class 2 RRJ		375Ø Class 2 RRJ		375Ø Class 2 RRJ	300Ø Class 2 RRJ	300Ø Class 2 RRJ	300Ø Class 2 RRJ	225Ø Class 2 RRJ			
SLOPE/GRADE		1.9%		1.7%		1.0%	0.8%	0.7%	0.7%	0.8%			
DATUM RL 163.4													
HGL	169.759		169.820	169.948		170.275	170.306	170.384	170.402	170.597	170.611	170.800	170.906	170.981	171.013	171.451
DEPTH TO INVERT	0.103		1.530	1.485		1.489	1.459	1.479	1.392	1.510	1.485	1.333	1.303	1.167	1.142	0.854
INVERT LEVEL	169.384		169.612	169.657		169.984	170.014	170.072	170.159	170.354	170.379	170.658	170.688	170.763	170.788	171.089
FINISHED SURFACE	169.487		171.142		171.473		171.551		171.864		171.991		171.930		171.943	
EXISTING SURFACE	169.685		169.988		170.444		170.601		171.166		172.266		172.431		172.818	
CHAINAGE	0.000	11.885	11.885	18.973	30.858	5.872	36.730	24.385	61.114	41.798	102.913	10.155	113.068	40.113		153.180

DRAINAGE LONGITUDINAL SECTION FOR LINE 1
SCALES: HORIZONTAL 1:500 VERTICAL 1:100



	0.59	0.22	0.38	0.28	
	1.15	0.93	1.05	0.88	
	42	16	16	11	
	112	121	68	61	
	300Ø Class 2 RRJ	300Ø Class 2 RRJ	225Ø Class 2 RRJ	225Ø Class 2 RRJ	
	0.7%	0.8%	1.0%	0.8%	
RL 164.1					
HGL	170.402	170.498	170.714	170.877	171.276
DEPTH TO INVERT	1.454	1.241	1.294	1.201	0.854
INVERT LEVEL	170.097	170.344	170.551	170.735	171.095
FINISHED SURFACE	171.551	171.585	171.845	171.936	171.949
EXISTING SURFACE	170.601	171.278	171.698	172.180	172.897
CHAINAGE	0.000	35.348	58.083	73.326	113.395
		35.348	22.735	15.243	40.070

DRAINAGE LONGITUDINAL SECTION FOR LINE 2
SCALES: HORIZONTAL 1:500 VERTICAL 1:100

No.	REVISION	DATE	DWN
03	GENERAL AMENDMENTS	28/06/18	AW
02	GENERAL AMENDMENTS	07/06/18	AW
01	BUILDING PADS & RETAINING WALL AMENDED	08/02/18	AW

LEGEND

© COPYRIGHT 2017
The design and details shown on these drawings are applicable to this project only and may not be reproduced in whole or in part or be used for any other project or purpose without the written consent of McKENZIE BURRIDGE & ASSOCIATES PTY LTD with whom copyright resides.

DO NOT SCALE THE STRUCTURAL DRAWINGS. DIMENSIONAL ERRORS MAY OCCUR DURING COPYING OR REPRODUCTION OF THE DRAWINGS.

APPROVED
I CERTIFY THAT THE WORKS SHOWN ON THIS PLAN HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS.

M. BURRIDGE M.I.E Aust., C.P. Eng.
(FOR McKENZIE BURRIDGE & ASSOCIATES PTY. LTD.)

McKenzie Burridge & Associates Pty Ltd
CIVIL & STRUCTURAL CONSULTING ENGINEERS
PO BOX 503
17 WEBBERS ARCADE
133 PRINCE STREET
GRAFTON NSW 2460
(02) 6643 2116
www.mckenzieburridge.com.au
office@mckenzieburridge.com.au
ABN 18 092 914 595

DRAWN	AW	SCALE	AS SHOWN		
DESIGNED	SB	LEVELS	METRES		
CHECKED	MB	CONTOURS	0.2m		
APPROVED	MB	DATUM	AHD		
SURVEY BY		DIMENSIONS	mm		
SHEET SIZE	A1 (NOTE: DRAWING MAY BE REDUCED DO NOT SCALE)	DATE	NOVEMBER 2017		

JOB DESCRIPTION
THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

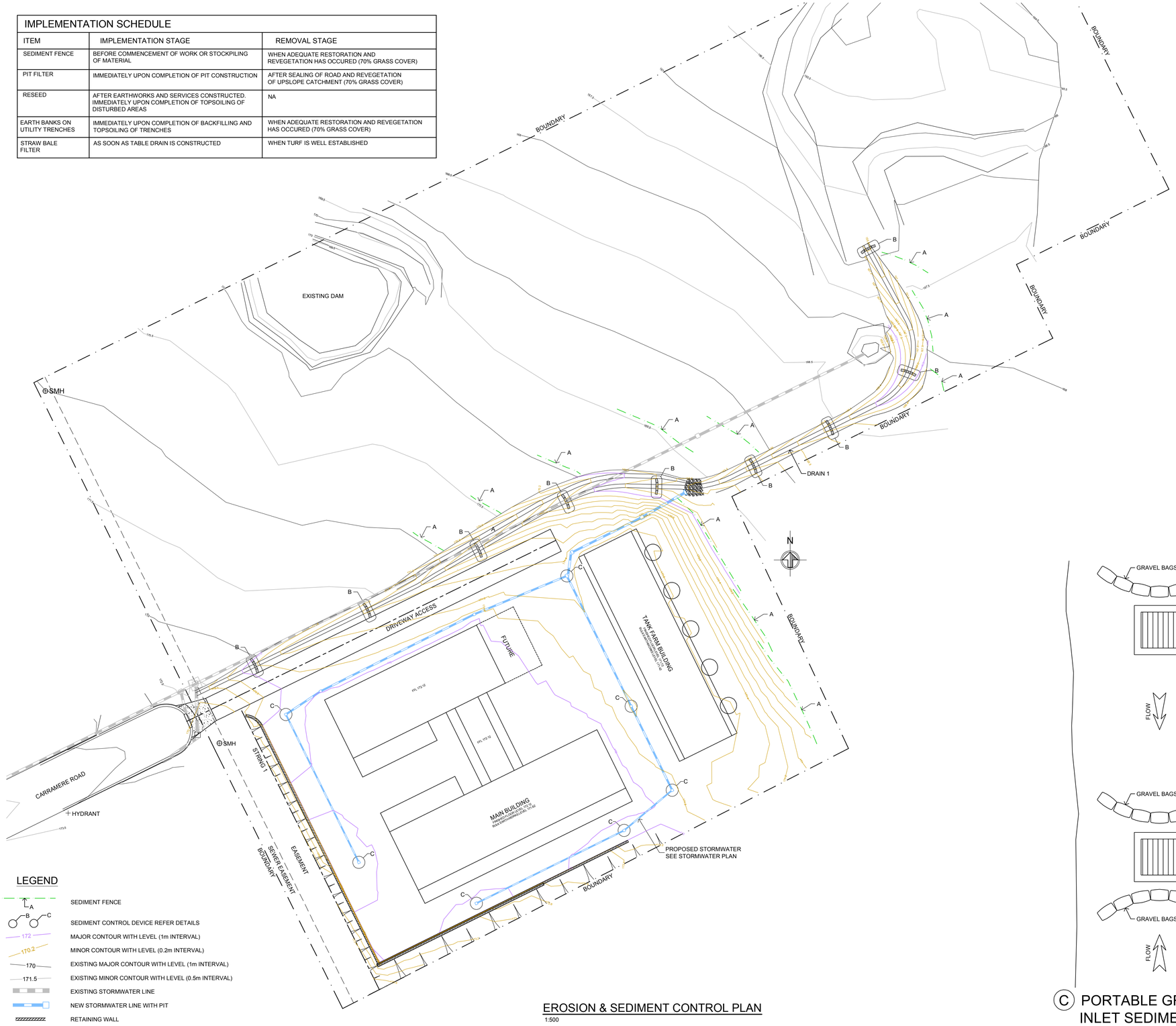
DRAWING TITLE
STORMWATER LONGITUDINAL SECTIONS LINE 1 & LINE 2

CLIENT
ETHANOL TECHNOLOGIES LTD

JOB No. 16-149
SHEET No. 11 (of 12)
REVISION 03

IMPLEMENTATION SCHEDULE

ITEM	IMPLEMENTATION STAGE	REMOVAL STAGE
SEDIMENT FENCE	BEFORE COMMENCEMENT OF WORK OR STOCKPILING OF MATERIAL	WHEN ADEQUATE RESTORATION AND REVEGETATION HAS OCCURED (70% GRASS COVER)
PIT FILTER	IMMEDIATELY UPON COMPLETION OF PIT CONSTRUCTION	AFTER SEALING OF ROAD AND REVEGETATION OF UPSLOPE CATCHMENT (70% GRASS COVER)
RESEED	AFTER EARTHWORKS AND SERVICES CONSTRUCTED. IMMEDIATELY UPON COMPLETION OF TOPSOILING OF DISTURBED AREAS	NA
EARTH BANKS ON UTILITY TRENCHES	IMMEDIATELY UPON COMPLETION OF BACKFILLING AND TOPSOILING OF TRENCHES	WHEN ADEQUATE RESTORATION AND REVEGETATION HAS OCCURED (70% GRASS COVER)
STRAW BALE FILTER	AS SOON AS TABLE DRAIN IS CONSTRUCTED	WHEN TURF IS WELL ESTABLISHED

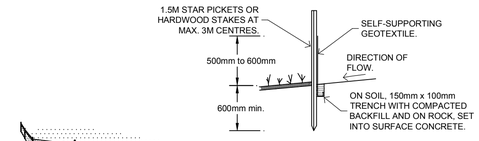


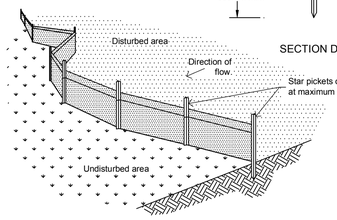
LEGEND

- SEDIMENT FENCE
- SEDIMENT CONTROL DEVICE REFER DETAILS
- MAJOR CONTOUR WITH LEVEL (1m INTERVAL)
- MINOR CONTOUR WITH LEVEL (0.2m INTERVAL)
- EXISTING MAJOR CONTOUR WITH LEVEL (1m INTERVAL)
- EXISTING MINOR CONTOUR WITH LEVEL (0.5m INTERVAL)
- EXISTING STORMWATER LINE
- NEW STORMWATER LINE WITH PIT
- RETAINING WALL
- EXISTING SEWER MANHOLE

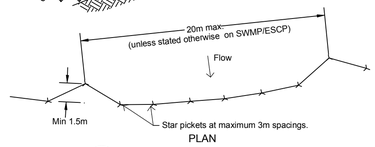
EROSION & SEDIMENT CONTROL PLAN

1:500





SECTION DETAIL



PLAN

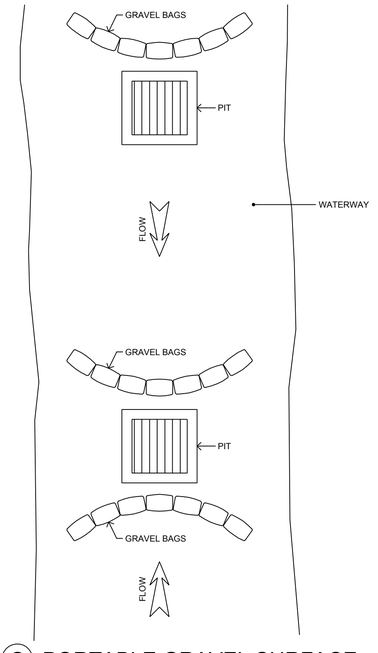
(A) SEDIMENT FENCE

CONSTRUCTION NOTES

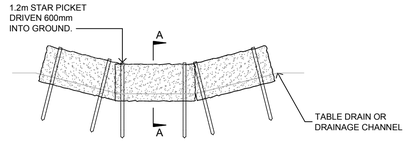
1. CONSTRUCT SEDIMENT FENCE AS CLOSE AS POSSIBLE TO PARALLEL TO THE CONTOURS OF THE SITE.
2. DRIVE 1.5 METRE LONG STAR PICKETS INTO GROUND, 3 METRES APART.
3. DIG A 150MM DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
4. BACKFILL TRENCH OVER BASE OF FABRIC.
5. FIX SELF-SUPPORTING GEOTEXTILE TO UPSLOPE SIDE OF OF POSTS WITH WIRE TIES OR AS RECOMMENDED BY GEOTEXTILE MANUFACTURER.
6. JOIN SECTIONS OF FABRIC AT SUPPORT POST WITH A 150MM OVERLAP.

MAINTENANCE NOTES

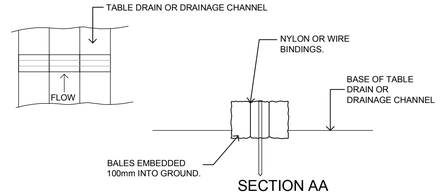
1. CHECK FENCE REGULARLY AND AFTER RAINFALL EVENTS. REINSTATE ANY DISLODGED GEOTEXTILE OR SUPPORT STAKES.
2. SEDIMENT IS TO BE REMOVED PERIODICALLY AS REQUIRED AFTER RAINFALL EVENTS.
3. THE SOURCE OF ANY EXCESSIVE SEDIMENT IS TO BE INVESTIGATED AND MEASURES UNDERTAKEN TO LIMIT EXCESSIVE BUILD UP.



(C) PORTABLE GRAVEL SURFACE INLET SEDIMENT TRAP



ELEVATION



SECTION AA

(B) STRAW/HAY BALE FILTER

CONSTRUCTION NOTES

1. CONSTRUCT STRAW BALE FILTER AT 30m cts IN BASE OF TABLE DRAINS AND DRAINAGE CHANNEL.
2. PLACE BALES LENGTHWISE IN A ROW WITH ENDS TIGHTLY ABUTTING. USE STRAW TO FILL ANY GAPS BETWEEN BALES.
3. MAXIMUM HEIGHT OF FILTER IS ONE BALE.
4. ON SOFT MATERIALS, EMBED EACH BALE IN THE GROUND 75mm TO 100mm AND ANCHOR WITH TWO 1.2m STAR PICKETS. DRIVE STAKES 600mm INTO THE GROUND AND FLUSH WITH THE TOP OF THE BALES.

MAINTENANCE NOTES

1. INSPECT AFTER RAINFALL EVENTS TO ENSURE FUNCTIONALITY. REINSTATE ANY DISLODGED HAY BALES OR SUPPORT STAKES.
2. SEDIMENT IS TO BE REMOVED PERIODICALLY AS REQUIRED AFTER RAINFALL EVENTS.
3. THE SOURCE OF ANY EXCESSIVE SEDIMENT IS TO BE INVESTIGATED AND MEASURES UNDERTAKEN TO LIMIT EXCESSIVE BUILD UP.

No.	REVISION	DATE	DWN
03	GENERAL AMENDMENTS	28/06/18	AW
02	GENERAL AMENDMENTS	07/06/18	AW
01	EROSION AND SEDIMENT CONTROL PLAN AMENDED	08/02/18	AW

LEGEND

© COPYRIGHT 2017
The design and details shown on these drawings are applicable to this project only and may not be reproduced in whole or in part or be used for any other project or purpose without the written consent of McKENZIE BURRIDGE & ASSOCIATES PTY LTD with whom copyright resides.

DO NOT SCALE THE STRUCTURAL DRAWINGS. DIMENSIONAL ERRORS MAY OCCUR DURING COPYING OR REPRODUCTION OF THE DRAWINGS.

APPROVED

I CERTIFY THAT THE WORKS SHOWN ON THIS PLAN HAVE BEEN DESIGNED IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS.

M. BURRIDGE M.I.E Aust., C.P. Eng.
(FOR McKENZIE BURRIDGE & ASSOCIATES PTY. LTD.)

McKenzie Burridge & Associates Pty Ltd
CIVIL & STRUCTURAL CONSULTING ENGINEERS

PO BOX 503
17 WEBBERS ARCADE
133 PRINCE STREET
GRAFTON NSW 2460
(02) 6643 2116
www.mckenzieburridge.com.au
office@mckenzieburridge.com.au
ABN 18 092 914 595

DRAWN	AW	SCALE	AS SHOWN
DESIGNED	SB	LEVELS	METRES
CHECKED	MB	CONTOURS	0.2m
APPROVED	MB	DATUM	AHD
SURVEY BY		DIMENSIONS	mm
SHEET SIZE	A1 (NOTE: DRAWING MAY BE REDUCED DO NOT SCALE)	DATE	NOVEMBER 2017

JOB DESCRIPTION
THE HUNTER PILOT BIOREFINERY PROJECT
LOT 22 CARRAMERE ROAD, MUSWELLBROOK

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN & DETAILS

JOB No. 16-149

SHEET No. 12 (of 12)

CLIENT
ETHANOL TECHNOLOGIES LTD

REVISION 03

Appendix I – Traffic flow path plan

Existing
Dam

ACTO Portable
Project Offices

Shipping Container
Equipment Compound

Camera

Construction
Vehicle
Carpark

ATCO Contractor Portable
Construction Offices

Enclosed Solid Waste Collection with signage
Recepticles during Construction
(paper/cardboard, recyclables, general waste)

Truck
Washdown
Area

Stock-
Piling
Area

Sediment
Fencing
as required

Carramere Rd

SMH

Construction
Amenities

Solid Waste
Collection Point
(paper/cardboard,
recyclables,
general waste)

Trade
Waste
System

Lignin
Solid
Waste

0 10 20 30 40 50 60 70 80 90 100m

Legend

Traffic	Areas
Visitor Vehicles	Visitor Parking
Heavy Vehicles	Forklift Operation
Combined Traffic	Skidsteer Operation
X Biased recycling Points	Combined Loading/ Unloading

Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 27/08/2018

North

Sitr Waste Minimisation Plan A

Drawing No:
BA030A2 DRAFT NFC

Appendix J – Water services and rainwater retention designs

Construction Vehicle Carparking

ATCO Contractor Portable Construction Offices

Security Fence

Carramere Rd

SMH

20.0m
45.0m
45.0m
25.0m
10.0m
Awning
20.0m
19.5m
35.4m
19.5m
20.0m
Awning
25.0m
20.0m
9.4m
55.0m
Awning
55.0m

55.0m

ROCK RIP RAP SCOUR PROTECTION 200-300Ø MINIMUM 4m IN LENGTH x 3m WIDE

450Ø Class 2 RRJ

Overflow to Pit 2

Flushing Port

0 10 20 30 40 50 60 70 80 90 100m

Note

Roof water run-off design criteria:

Rainfall Average Recurrence Interval (ARI) = 1:20 yrs
Rainfall Intensity = 170mm/hr
Storm duration = 5 mins (pipe sizing)

Underground RW drain size = 300mm dia (single pipe)
Pipe grade = 1:200

RW outfall to tanks manifolded for equal flow.

Entry to each tank to be via prefilter screen. Secondary and final filtration if applicable, provided prior to recycling.

Integrated retention system of 20,000L with 5 x 20,000L tanks.

Legend

Roof	Piping
Ridge	Overflow
Valley	150mm Line
200mm Eave Gutter	300mm Line

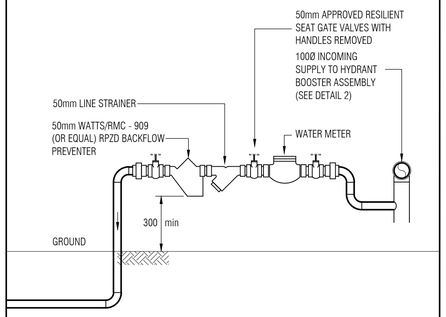
Hunter Pilot Biorefinery

Proposed Development in Muswellbrook.
Lot 22 / DP1131270 Date: 24/08/2018

Roof shape of main building for rainwater harvesting system.
Dimensions also indicated.

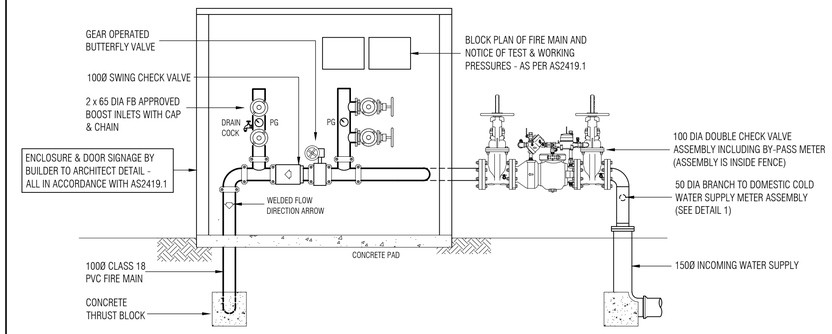
North

Drawing No:
BA001B6 DRAFT NFC

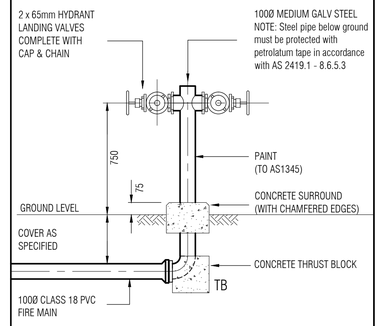


DETAIL 1
DOMESTIC WATER SUPPLY METER ASSEMBLY
1 : 20

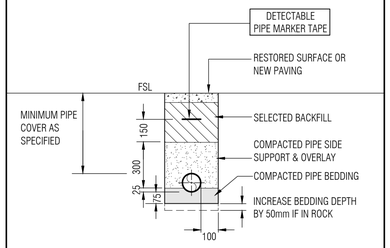
DOMESTIC WATER RETICULATION, INCLUDING METER ASSEMBLY, IS PART OF FUTURE HYDRAULIC SERVICES WORKS. REFER TO SEPARATE DOCUMENTATION.



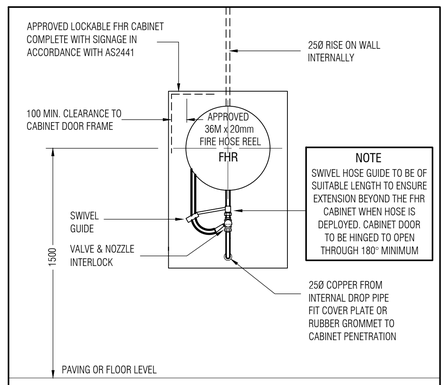
DETAIL 2
FIRE HYDRANT BOOSTER ASSEMBLY
1:25 0 0.25 0.5m



DETAIL 3
FIRE HYDRANT POINT
1 : 20



DETAIL 4
FIRE MAIN TRENCH DETAIL
1:20



DETAIL 5
FIRE HOSE REEL MOUNTING
1 : 20

WATER SUPPLY PERFORMANCE SCHEDULE FOR THE DEVELOPMENT SITE

FLOW RATE L/sec	RESIDUAL PRESSURE kPa TEST	RESIDUAL PRESSURE kPa MINIMUM REQUIRED	TEST METHOD	NOTE
0	800	NA	FLOW/PRESSURE RELATIONSHIPS, PROVIDED BY MUSWELLBROOK SHIRE COUNCIL, ARE DERIVED FROM TEST PERFORMED 18 MAY 2018 AT STREET HYDRANT IN CARRAMERE ROAD (SEE LOCATION PLAN)	1 - 150mm DIA EXTENSION OF WATER SUPPLY TO SITE PROVIDES COMBINED DOMESTIC & FIRE FIGHTING DEMAND. FOR ASSESSMENT PURPOSES, THE TOTAL FLOW RATE IS 20 L/sec FOR FIRE HYDRANT SUPPLY + AN ESTIMATED SIMULTANEOUS DOMESTIC WATER DEMAND OF 4 L/sec (including domestic supply to future buildings proposed on the north of site). 2 - THE MINIMUM REQUIRED RESIDUAL PRESSURE OF 350kPa, FOR A COMBINED DOMESTIC/FIRE FLOW RATE OF 24 L/sec, AT THE PROPOSED CONNECTION TO THE EXISTING 200mm DIA TOWN SUPPLY, IS DERIVED BY: i) ESTIMATION OF TOTAL STATIC & DYNAMIC LOSSES FROM POINT OF CONNECTION AT 200mm DIA TOWN MAIN, TO THE MOST HYDRAULICALLY DISADVANTAGED SITE HYDRANT. RESULT: Pr = 100kPa ii) AS 2419.1 REQUIRED MINIMUM RESIDUAL PRESSURE AT THE MOST HYDRAULICALLY DISADVANTAGED HYDRANT IS: Pmin = 250kPa (ATTACK HYDRANT) iii) RESULT: Pr + Pmin = 350kPa 3 - FIRE HYDRANT FLOW RATE OF 20L/sec IS DETERMINED BY BUILDING CLASSIFICATION - CLASS 8; AND FLOOR AREA - GREATER THAN 500m²
2.5	600			
10	500			
15	530			
24	500	350 (NOTE 2)		

SCHEDULE OF PIPEWORK MATERIALS

SERVICE	LOCATION	MINIMUM COVER	MATERIAL	JOINTING
COLD WATER	EXTERNAL	VEHICLE WAYS : 600mm PAVED AREAS : 100mm CONCRETE SLAB : 75mm	TYPE B COPPER	WELDED
COLD WATER	INTERNAL	NA	TYPE B COPPER	WELDED
NEW WATER SUPPLY	BELOW GROUND	VEHICLE WAYS : 600mm ELSEWHERE : 450mm	CLASS 12 PVC 'BLUE BRUTE' OR EQUAL	RUBBER RING
	ABOVE GROUND	NA	MEDIUM GALV STEEL OR TYPE B COPPER	VICTAULIC (OR WELDED COPPER)
FIRE MAIN	BELOW GROUND	VEHICLE WAYS : 600mm PAVED AREAS : 450mm TURFED AREAS : 600mm	CLASS 18 PVC 'BLUE BRUTE' OR EQUAL	RUBBER RING
FIRE MAIN	ABOVE GROUND	NA	MEDIUM GALV STEEL	VICTAULIC AND/OR FLANGED
100mm DIA FIRE MAIN FITTINGS	BELOW GROUND	AS PIPE	CAST IRON OR DUCTILE IRON IN ACCORDANCE WITH AS2544 AND AS2280	RUBBER RING

TENDER ISSUE
24.05.18
NOTE: THIS IS NOT A WORKING DRAWING

© Copyright
THIS DRAWING AND CONTENT SHALL REMAIN THE PROPERTY OF CRONSHAW & ASSOCIATES UNAUTHORISED USE OR ALTERATION IS PROHIBITED.

PROJECT NORTH

NOTES

ISSUE	DESCRIPTION	CHKD	DATE
C	TENDER ISSUE	RC	24.05.18
B	AMENDED REVIEW ISSUE	RC	13.04.18
A	REVIEW ISSUE	RC	23.03.18

CLIENT
ETHANOL TECHNOLOGIES LTD

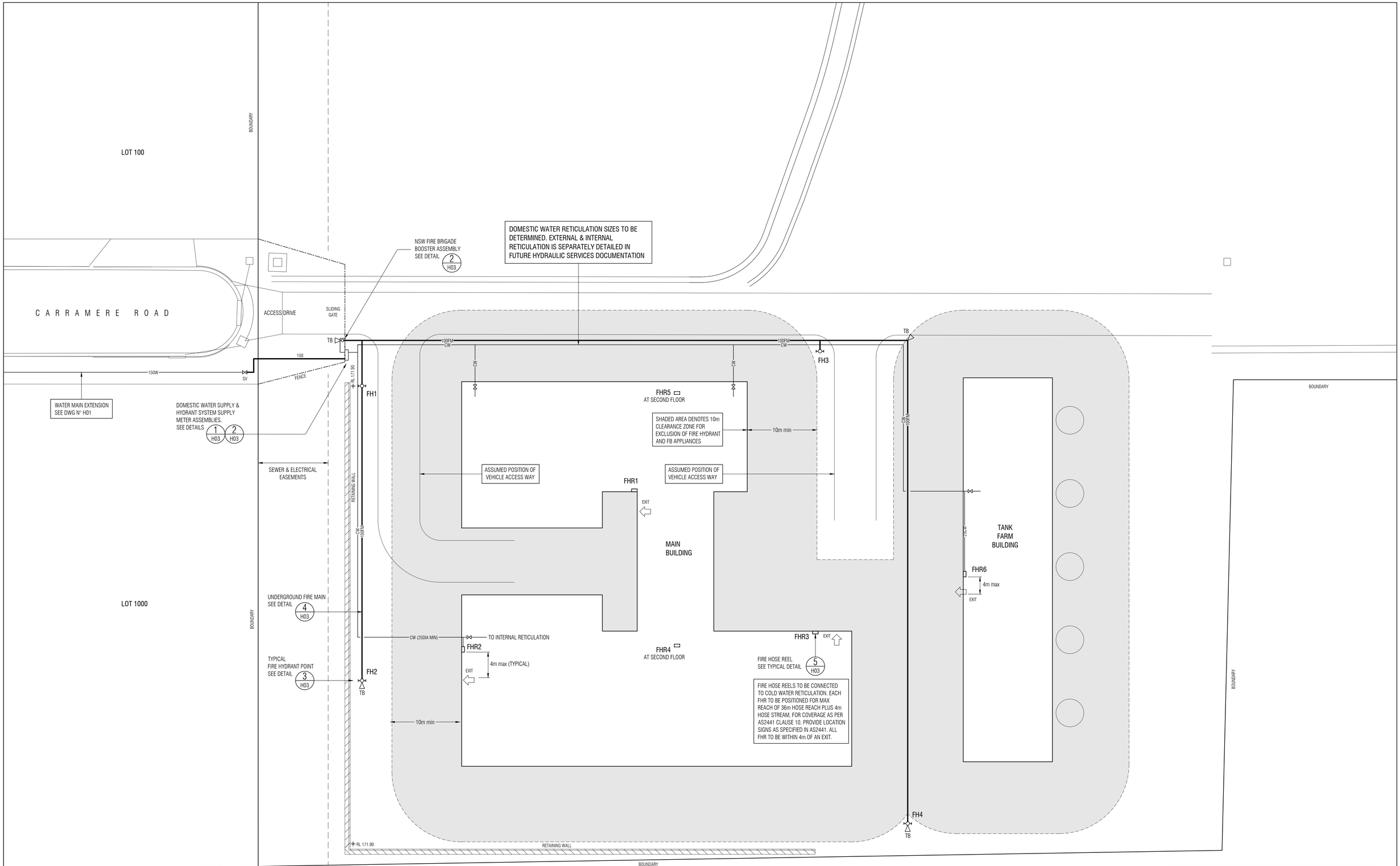
THIS DRAWING IS FOR TENDER PURPOSES ONLY BUT MAY BE USED FOR CONSTRUCTION PROVIDED ALL DIMENSIONS AND TOLERANCES, EITHER NOTED OR SCALED, ARE CHECKED FOR COORDINATION, CONFIGURATION AND FIT WITH THE PROJECT SPECIFICATION, ARCHITECTURAL DRAWINGS & OTHER CONTRACT DOCUMENTATION

CRONSHAW & ASSOCIATES
BUILDING SERVICES CONSULTING ENGINEERS
29 SANDPIPER CRESCENT
BOAMBEE EAST, COFFS HARBOUR NSW 2450
TEL 02 6658 2962 E cronshaw1@bigpond.com

PROPOSED DEVELOPMENT AT
LOT 22 CARRAMERE ROAD,
MUSWELLBROOK

HYDRAULIC SERVICES
FIRE FIGHTING PROVISION DETAILS

DA NUMBER
No IN SET 3
SHEET SIZE A1
SCALE AS NOTED
DESIGN RC
DRAWN MVD
DRAWING No 8681/H03
ISSUE No C
CHECKED R A Cronshaw AMIEAust Member No. - 1323119



PART SITE PLAN

TENDER ISSUE
24.05.18
NOTE: THIS IS NOT A WORKING DRAWING

© Copyright
THIS DRAWING AND CONTENT SHALL REMAIN THE PROPERTY OF CRONSHAW & ASSOCIATES. UNAUTHORISED USE OR ALTERATION IS PROHIBITED.

PROJECT NORTH

NOTES

1 - FIRE HYDRANT PROTECTION ILLUSTRATED IS COMPLIANT WITH THE BCA AND IN ACCORDANCE WITH THE REQUIREMENTS OF AS2419.1

2 - FIRE HOSE REEL PROTECTION SHOWN IS IN ACCORDANCE WITH BCA - E1.4

3 - AUTOMATIC FIRE SPRINKLER PROTECTION MAY BE REQUIRED - TO SATISFY BCA REQUIREMENTS ACCORDING TO HAZARDOUS PROCESSES OR STORAGE. (SUBJECT TO SEPARATE ASSESSMENT)

4 - PORTABLE FIRE EXTINGUISHERS MAY BE REQUIRED - TO SUPPLEMENT OTHER FIRE FIGHTING EQUIPMENT PROVISIONS.

ISSUE	DESCRIPTION	CHKD	DATE
C	TENDER ISSUE	RC	24.05.18
B	AMENDED REVIEW ISSUE	RC	13.04.18
A	REVIEW ISSUE	RC	23.03.18

CLIENT
ETHANOL TECHNOLOGIES LTD

THIS DRAWING IS FOR TENDER PURPOSES ONLY BUT MAY BE USED FOR CONSTRUCTION PROVIDED ALL DIMENSIONS AND TOLERANCES, EITHER NOTED OR SCALED, ARE CHECKED FOR COORDINATION, CONFIGURATION AND FIT WITH THE PROJECT SPECIFICATION, ARCHITECTURAL DRAWINGS & OTHER CONTRACT DOCUMENTATION

CRONSHAW & ASSOCIATES
BUILDING SERVICES CONSULTING ENGINEERS
29 SANDPIPER CRESCENT
BOAMBEE EAST, COFFS HARBOUR NSW 2450
TEL 02 6658 2962 E cronshaw1@bigpond.com

PROPOSED DEVELOPMENT AT
LOT 22 CARRAMERE ROAD,
MUSWELLBROOK

HYDRAULIC SERVICES

FIRE FIGHTING PROVISION

DA NUMBER		DRAWING No
No IN SET: 3	SHEET SIZE: A1	8681 /H02
SCALE: 1:250 (0 2 5m)		ISSUE No: B
DESIGN: RC	DRAWN: MVD	CHECKED: R A Cronshaw AMIEAust Member No. - 1323119

TOWN WATER SUPPLY EXTENSION - CONSTRUCTION NOTES

1 PIPEWORK SHALL BE UPVC CLASS 16 RRJ DICL COMPATIBLE (BLUE BRUTE OR EQUAL), ALL TO AS2032 .

2 PIPEWORK FITTINGS SHALL BE CLASS 16 DUCTILE IRON WITH CEMENT OR EPOXY LINING TO AS2544 AND AS2280.

3 ALIGNMENT OF WATER MAIN TO BE 0.5m FROM AND PARALLEL TO EXISTING 100mm DIA WATER MAIN.

4 LAY PIPING USING MAXIMUM LENGTHS (6m) WITH A MINIMUM COVER OF 450mm BELOW FINISHED SURFACE LEVEL (LOCATION NOT SUBJECT TO VEHICLE LOADS).

5 EXCAVATION, PIPE LAYING & BEDDING, AND BACKFILLING OF PIPE TRENCHES SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF MUSWELLBROOK SHIRE COUNCIL ENGINEERING GUIDELINES, AS3500 AND WATER SUPPLY CODE OF AUSTRALIA: WSA03.

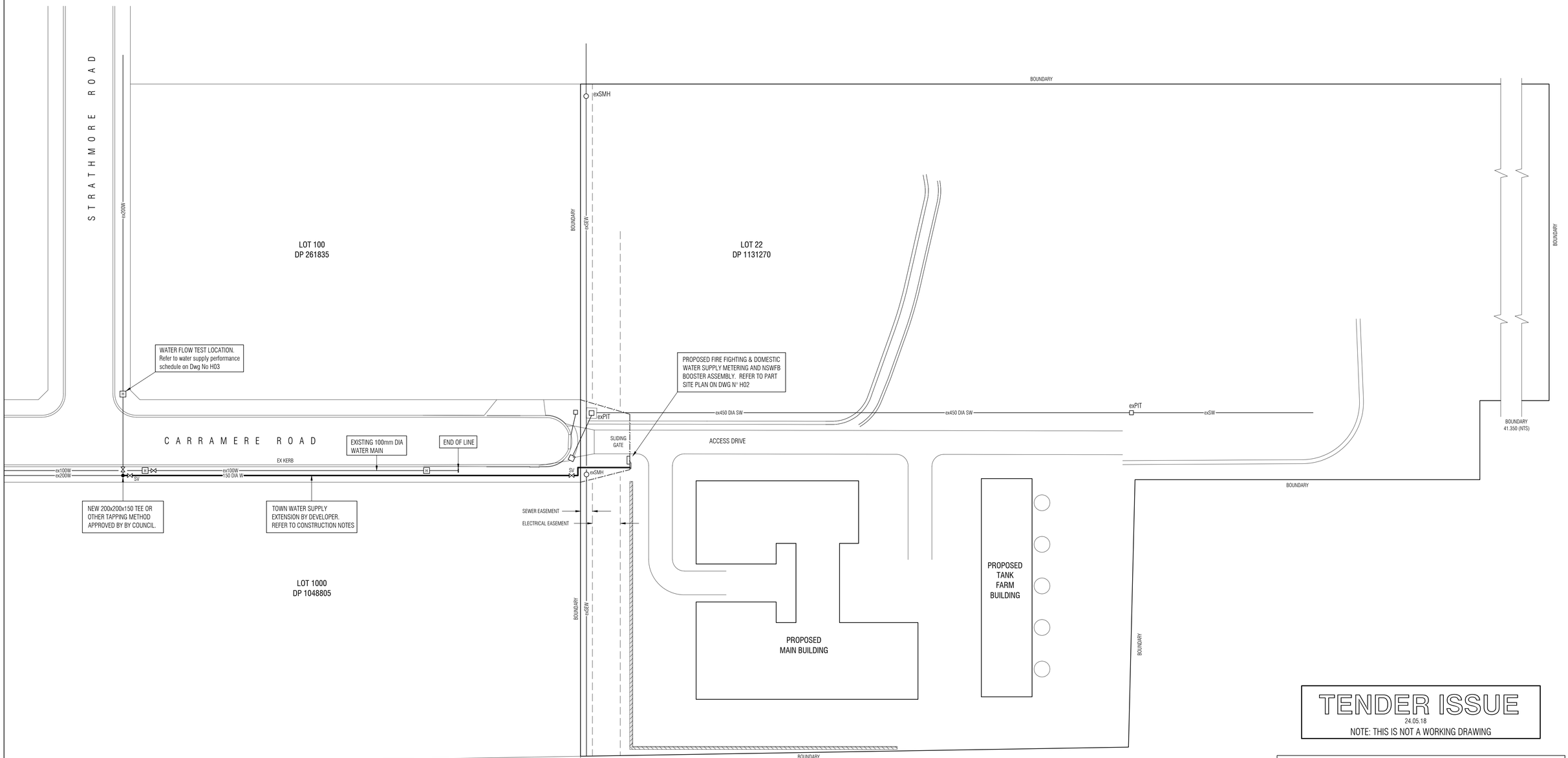
6 MASS CONCRETE THRUST BLOCKS SHALL BE PROVIDED AT PIPE FITTINGS, VALVES AND PIPE DEAD ENDS. THRUST BLOCKS SHALL BE CONSTRUCTED OF 20MPa CONCRETE WITH ONE SIDE BEARING AGAINST UNDISTURBED VERTICAL OR HORIZONTAL FACE OF THE PIPE TRENCH. BEARING SURFACE AREA SHALL BE PROPORTIONATE TO THE MAXIMUM BEARING PRESSURES OF THE SOIL AND PIPE MATERIAL.

7 DETECTOR TAPE COMPLYING WITH AS2648 SHALL BE LAID CONTINUOUSLY ABOVE THE FULL LENGTH OF THE WATER MAIN AND SHALL BE ELECTRICALLY BONDED TO METALLIC COMPONENTS (e.g. DICL FITTINGS).

8 STOP VALVES SHALL BE MINIMUM CLASS 16 CAST IRON WITH SOCKET JOINTS, RESILIENT SEATING, CLOCKWISE CLOSING SPINDLE AND INTERNAL & EXTERNAL COATING WITH AN APPROVED MATERIAL. VALVE SPINDLE ACCESS SHALL BE AN APPROVED CAST IRON COVER SET IN CONCRETE SURROUND. ACCESS LID SHALL BE STAMPED INDICATING STOP VALVE ACCESS.

9 CONNECTION TO COUNCIL EXISTING 200mm DIA WATER MAIN IF MADE BY MUSWELLBROOK SHIRE COUNCIL SHALL BE AT DEVELOPERS COST AND PART OF WORKS CONTRACT.

10 TESTING AND COMMISSIONING OF THE WORKS SHALL BE ALL IN ACCORDANCE WITH THE REQUIREMENTS OF MUSWELLBROOK SHIRE COUNCIL. PROVIDE WORK-AS-EXECUTED DRAWINGS AS SPECIFIED IN COUNCIL ENGINEERING GUIDELINES.



SITE PLAN

TENDER ISSUE
24.05.18
NOTE: THIS IS NOT A WORKING DRAWING

DRAWING SCHEDULE

DWG No	TITLE	ISSUE	DATE
H01	SITE WATER SUPPLY	C	24.05.18
H02	FIRE FIGHTING PROVISION	C	24.05.18
H03	FIRE FIGHTING PROVISION DETAILS	C	24.05.18

© Copyright
THIS DRAWING AND CONTENT SHALL REMAIN THE PROPERTY OF CRONSHAW & ASSOCIATES. UNAUTHORISED USE OR ALTERATION IS PROHIBITED.

PROJECT NORTH

NOTES

ISSUE	DESCRIPTION	CHKD	DATE
C	TENDER ISSUE	RC	24.05.18
B	AMENDED REVIEW ISSUE	RC	13.04.18
A	REVIEW ISSUE	RC	23.03.18

CLIENT
ETHANOL TECHNOLOGIES LTD

THIS DRAWING IS FOR TENDER PURPOSES ONLY BUT MAY BE USED FOR CONSTRUCTION PROVIDED ALL DIMENSIONS AND TOLERANCES, EITHER NOTED OR SCALED, ARE CHECKED FOR COORDINATION, CONFIGURATION AND FIT WITH THE PROJECT SPECIFICATION, ARCHITECTURAL DRAWINGS & OTHER CONTRACT DOCUMENTATION

CRONSHAW & ASSOCIATES
BUILDING SERVICES CONSULTING ENGINEERS
29 SANDPIPER CRESCENT
BOAMBEE EAST, COFFS HARBOUR NSW 2450
TEL 02 6658 2962 E cronshaw1@bigpond.com

PROPOSED DEVELOPMENT AT
LOT 22 CARRAMERE ROAD,
MUSWELLBROOK

HYDRAULIC SERVICES

SITE WATER SUPPLY

DA NUMBER
No IN SET: 3
SHEET SIZE: A1
SCALE: 1:500 (0 5 10m)
DESIGN: RC
DRAWN: MVD
DRAWING No: 8681 /H01
ISSUE No: C
CHECKED: R A Cronshaw AMIEAust Member No. - 1323119

GHD

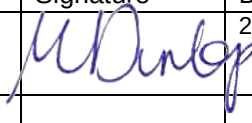
Level 3 GHD Tower 24 Honeysuckle Drive Newcastle NSW 2300
PO BOX 5403 Hunter Region Mail Centre NSW 2310
T: 61 2 4979 9999 F: 61 2 4979 9988 E: ntlmail@ghd.com

© GHD 2018

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

2219644-66648/https://projects.ghd.com/oc/Newcastle2/proposalforhunterpil/Delivery/Documents/2219644-REP-SEE.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	E Rindfleish B Wood	L King		M Dunlop		29/10/2018

www.ghd.com