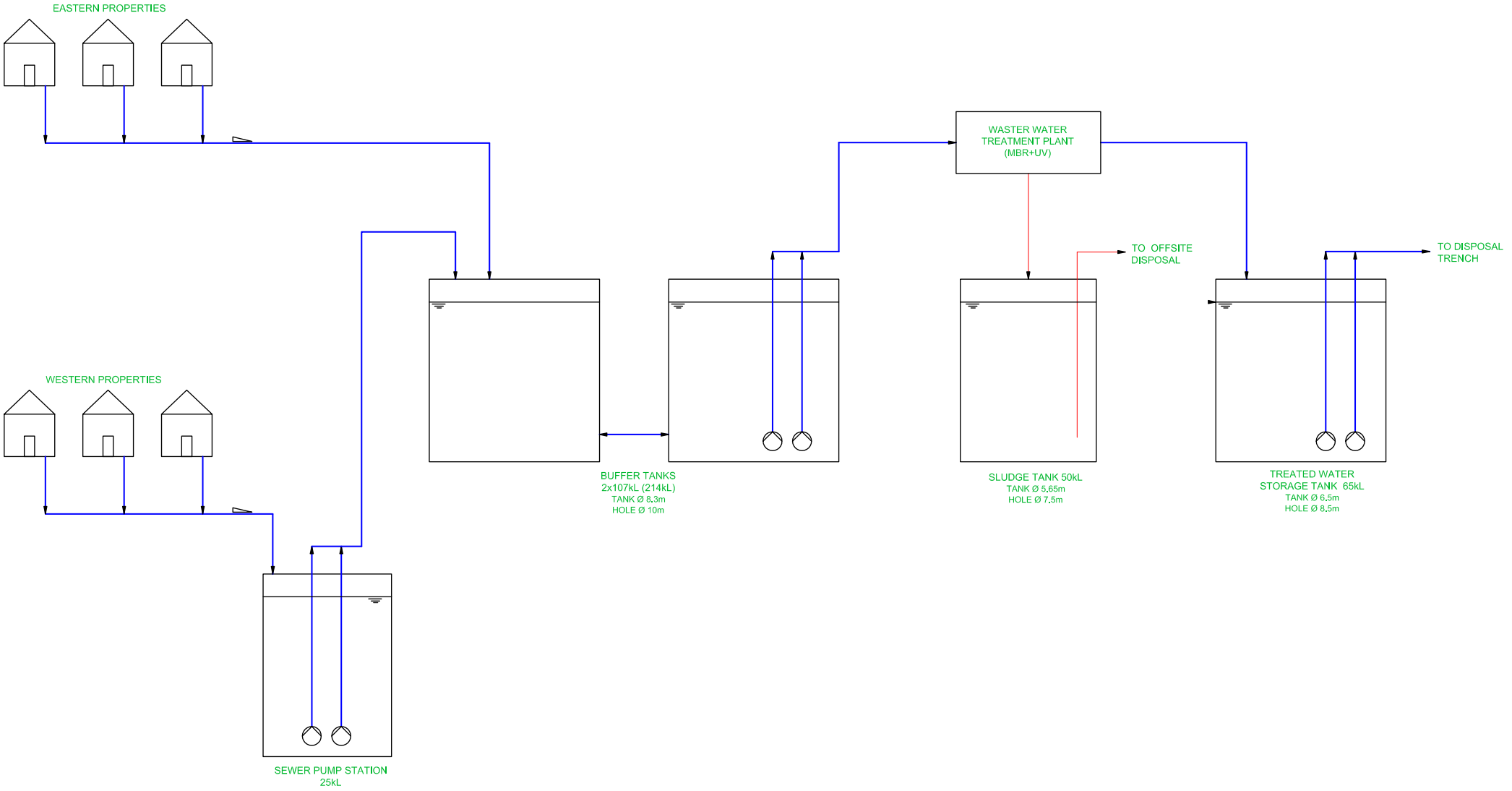
Appendix C1 A0111-001-A Process Flow Diagram



REVISION TABLE

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
A	25-Nov-2019	INTIAL ISSUE	S.BIABANI	W.JOHNSON	W.JOHNSON						

GENERAL TOLERANCES U.N.O
LINEAR : ± 1/16"
ANGULAR : ± 0.05 deg
ALL DIMENSIONS IN FEET-INCHES U.N.O

aquacell water recycling by PHOENIX
PHOENIX Process Equipment Co.
2402 Watterson Trail, Louisville, KY 40299
P: 502-499-6198
Email: info@aquacell.us

DRAWN	S.BIABANI	DATE	25-Nov-2019
CHECKED	W.JOHNSON	DATE	25-Nov-2019
APPROVED	W.JOHNSON	DATE	25-Nov-2019

TITLE: PROCESS FLOW DIAGRAM
BLACKWATER TREATMENT PLANT

JOB No: A0111
DRAWING No: A0111-001
PROJECT: 67 KURRAJONG ROAD

DRAWING STANDARD AS1100 | DO NOT SCALE | Rev: A | SHEET No: 01 OFF 01 | A1

KEY

- FINAL SURFACE CONTOURS
- EFFLUENT MANAGEMENT AREA
- STP AND EMA INTERNAL FENCING
- PROPOSED RISING MAIN
- INDICATIVE DWELLING FOOTPRINT
- LOT BOUNDARY
- PUMP STATION
- SITE BOUNDARY
- INTERALLOTMENT DRAINAGE EASEMENT

NOTES:

1. FINAL DESIGN TO BE IN ACCORDANCE WITH IPART APPROVAL REQUIREMENTS.
2. ABSORPTION TRENCHES:
   - ALLOCATED AREA: 1,880 SQUARE METERS.
   - MINIMUM AREA REQUIRED: 700 SQUARE METERS.
   - MAX TRENCH LENGTH = 20 M.
   - TRENCH WIDTH = 0.6 M.
   - TRENCH SPACING = 1.6 M CENTRES.
   - TRENCH BEDS TO BE LEVEL (TOLERANCE ± 0.1%)

STORMWATER DETENTION SYSTEM

RETICULATED SEWER PUMP STATION

KURRAJONG ROAD

FUTURE ROAD

LOT 64 DP.14735

LOT 2 DP.735719

LOT 7 DP.833801

LOT 6 DP.38583

LOT 5 DP.38583

LOT 4 DP.38583

LOT 3 DP.38583

LOT 2 DP.38583

LOT 3 DP.1154000

LOT 202 DP.1167523

LOT 201 DP.1167523

LOT 1 DP.1018851

LOT 1 DP.361464

No.83 LOT 3 DP.36452

No.81 LOT 2 DP.36452

No.79 LOT 1 DP.36452

No.65 LOT 1 DP.21874

EXISTING RESIDENCE

1.5m OFFSET FROM FENCE

145.1m

9.5m

148.7m

49.7m

52.1m

AQUACELL S20 TREATMENT PLANT

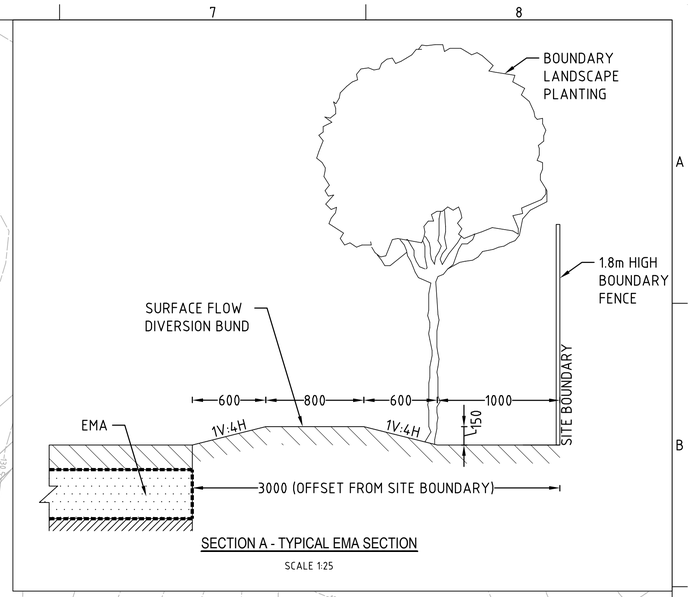
STORMWATER DETENTION SYSTEM

SURFACE FLOW DIVERSION BUND

LOT BOUNDARIES WITHIN EMA NOT FENCED

3.0m OFFSET FROM SITE BOUNDARY

SURFACE FLOW DIVERSION BUND



SECTION A - TYPICAL EMA SECTION

SCALE 1:25

IPART SUBMISSION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
C	**MINOR AMENDMENTS**	**8/9/2020**	**MD**	**MD**	**MS**	**MS**
B	MINOR AMENDMENTS	28/08/2020	CG	MS	MS	MS
A	INITIAL RELEASE	17/08/2020	GM	MD	MS	MS

SCALE

A1 (A3) 1:500 (1:1,000) METRES

A1 (A3) 1:25 (1:50) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	MS

CLIENT

PRJM Pty Ltd ATF Kurrajong Trust

PROJECT NAME/PLANSET TITLE

RESIDENTIAL SUBDIVISION

WASTEWATER MANAGEMENT

67 KURRAJONG ROAD
LOT 1 - DP 1185012

martens & Associates Pty Ltd

Consulting Engineers
Environment
Water
Geotechnical
Civil

Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE

WASTEWATER MANAGEMENT PLAN

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1706231	PS04	R03	PS04-F200	C

PRINTED: --- USER: MDAMS

A1 / A3 LANDSCAPE (A1LC_v02.0.01)

DRAWING ID: P1706231-PS04-R03-F200

Wastewater Management Plan: 67 Kurrajong Road, Kurrajong, NSW

PRJM Pty Ltd ATF Kurrajong Trust

Report No: 1706231JR04V02

8 September 2020

IPART SUBMISSION

Project Details

Project Item	Detail
Name	Wastewater Management Plan: 67 Kurrajong Road, Kurrajong, NSW
Client	PRJM Pty Ltd ATF Kurrajong Trust
Number	P1706231
Document	P1706231JR04V01
Manager	M. Shahrokhian
Principal Authors	M. Dumas, D. Martens

Document History

Issue	Issue Date	Status	Description / Comment	Author	Reviewer	Approved
1	08/09/2020	Final	IPART Submission	MD	MS, DM	DM

All enquiries regarding this project are to be directed to the Project Manager.

Suite 201, 20 George St, Hornsby, NSW 2077, Australia
ACN 070 240 890 ABN 85 070 240 890
P +61-2-9476-9999 | mail@martens.com.au | www.martens.com.au

Executive Summary

This study has been prepared to support a licence application to IPART, to install a sewage management system to service an approved 37 lot community title subdivision (DA 0830/15). The approval includes 2 community lots and 35 residential lots.

The wastewater infrastructure required to service the approved development is comprised of: an internal reticulated sewer; a sewage pump station (SPS); a sewage treatment plant (STP); and a combined effluent management area (EMA).

This report considers the proposed EMA, which modifies that considered under the consent, by amalgamating 35 separate irrigation areas to a single centralised EMA. Significant elements of the proposed EMA are as follows:

1. The EMA is 1,880 m^2, this being approximately 2.2 times the minimum required area of 842 m^2.
2. The EMA will be fenced to prevent public access.
3. The EMA will dispose of effluent by application to shallow absorption trenches, notwithstanding that the proposed effluent quality shall be suitable for low level human contact.
4. Tertiary grade effluent will be supplied to the trenches from the proposed MBR STP, thus ensuring no impacts on soil or ground conditions.
5. The EMA is positioned such that it is a significant distance away from any overland flow paths, intermittent drainage lines and watercourses.
6. The EMA will not impact on any groundwater or groundwater dependent ecosystem.
7. The EMA has been designed such that it will operate in perpetuity under a routine inspection and maintenance regime.
8. Ongoing environmental monitoring is included as part of the EMA operation to ensure that any unlikely future potential impacts on soil or groundwater are identified and remediated.

Contents

1 Introduction 8
1.1 Overview 8
1.2 IPART Request for Information 8
1.3 Scope of Report 8
1.4 Guidelines and Standards 9
1.5 WICA Licensing 10
2 Review of Environmental Setting 11
2.1 Rainfall 11
2.2 Topography 11
2.3 Local Drainage and Runoff 11
2.4 Geology 11
2.5 Soil Profiles 12
2.5.1 Soil Landscapes 12
2.5.2 Boreholes 12
2.5.3 Laboratory Testing 13
2.6 Groundwater 14
2.7 Land Capability Assessment 14
2.7.1 Soil Capability 14
2.7.2 EMA Landform Capability 15
2.7.3 Design Loading Rates 16
3 Wastewater Management 17
3.1 Wastewater Generation 17
3.2 Design Effluent Quality 17
3.3 EMA Sizing and Location 18
3.4 Nutrients 19
3.5 Buffers and Setbacks 19
3.6 Water Balance 20
3.7 Monitoring and Maintenance Requirements 20
3.8 EMA Reserve Area and Lifespan 21
3.9 EMA Design Review 21
3.9.1 Design Robustness 21
3.9.2 EMA Compliance 22
4 Attachment A – Figures 24
5 Attachment B – Maps 29
6 Attachment C – Plans 38
7 Attachment D – Borehole Logs 40
8 Attachment E – Soil Laboratory Results 59
9 Attachment F – Nutrient Balance 78
10 Attachment G – Water Balance 80

Tables

Table 1: Summary of IPART RFI issues. **8**
Table 2: Summary of relevant guidelines and standards. **9**
Table 3: Soil profiles. **13**
Table 4: Summary of soil samples sent for laboratory analyses. **13**
Table 5: Summary of laboratory test data for EMA. **14**
Table 6: EMA soil capability assessment. **15**
Table 7: Summary of EMA landform capability assessment. **16**
Table 8: Recommended effluent quality and monitoring requirements. **18**
Table 9: Minimum absorption trench area requirement. **18**
Table 10: EMA sizing requirements. **19**
Table 11: Design robustness assessment. **22**
Table 12: Scheme compliance assessment. **23**

Figures

Figure 1: Borehole 11 showing typical sandstone profile. **25**
Figure 2: Borehole 14 showing typical transitional profile..... **26**
Figure 3: Borehole 19 showing typical shale profile. **27**
Figure 4: Typical section through an absorption trench extracted from AS/NZS 1547 (2012). .. **28**

Maps

Map 1: Site topography. **30**
Map 2: Topographical Relief. **31**
Map 3: Site Slope Map. **32**
Map 4: Local Drainage. **33**
Map 5: Geology. **34**
Map 6: Site Soil Landscapes. **35**
Map 7: Site Borehole Locations. **36**
Map 8: Site Soil Mapping **37**

1 Introduction

1.1 Overview

This wastewater management plan has been prepared to support an application to the Independent Pricing and Regulatory Tribunal (**IPART**) to construct and operate a private sewage management scheme servicing an approved 37 lot residential subdivision (the **Consent**) located at 67 Kurrajong Road, Kurrajong, NSW (the **Site**).

The wastewater management scheme proposed includes a centralised tertiary treatment grade sewage treatment plant (the **STP**) followed by sub-surface application to a centralised treated effluent management area (the **EMA**). The proposed EMA system modifies that originally conceived under the Consent, which consisted of application of treated effluent to discrete disposal fields within each approved Lot. The modified scheme now proposed consolidates the effluent disposal area into a single centralised area, this assisting with access, maintenance and long-term management.

1.2 IPART Request for Information

This report has been prepared in response to a request from IPART for further information as described in a letter dated 1 June 2020 (IPART reference D20/12418) (the **RFI**). This report supersedes all previous reports prepared in respect of wastewater management at the Site. Issues raised by IPART are outlined in Table 1.

Table 1: Summary of IPART RFI issues.

IPART RFI Reference Number	RFI Issue	Relevant Report Section
4	**Relevance of AS/NZS 1547 (2012)**	1.4
4	**Soil profile description**	2.5
4	**Adopted buffer distances**	3.5
4	**Nutrient balancing**	3.4
4	**Hydraulic balancing**	3.6
4/6	**Monitoring of effluent disposal area**	3.8
4	**Reserve area and lifespan of system**	3.9
4/5	**Risk assessment, including unmitigated and residual risks**	See Aquacell RFI Response Table
3/4	**Operational controls to manage risks to receiving environments.**	See Aquacell RFI Response Table
4	**Inconsistencies on the use of UV disinfection in STP**	See Aquacell RFI Response Table

1.3 Scope of Report

This report comprises the following scope:

1. Provides a description of the local environment including site soils and drainage.

2. Undertakes a land capability assessment for treated effluent disposal.
3. Provides an assessment of sewage generation from the development.
4. Determine the EMA requirements.
5. Describe the wastewater management scheme components.

1.4 Guidelines and Standards

Table 2 provides a summary of the guidelines and standards referred to in this report.

Table 2: Summary of relevant guidelines and standards.

Guideline	Relevance
Natural Resource Management Ministerial Council et al (2006), *Australian Guidelines for Water Recycling: Managing Health and environmental Risks (Phase 1)*	Overarching applicability to design of sewerage management scheme.
Department of Water and Energy (2008), *Interim Guidelines for Management of Private Recycled Water Schemes*	Provides recommendations for effluent quality targets and operational monitoring requirements.
Water Services Association of Australia (WSA, 2002), *Sewerage Code of Australia*	Provides background information for wastewater generation.
Australian / New Zealand Standard 1547 (2012), *On-site Domestic Wastewater Management* (AS/NZS 1547)	A standard specifically designed for the design of wastewater disposal systems. Whilst the standard is designed for single households, it is particularly useful in that contains long-term sustainable effluent application rates to land used for sizing effluent disposal fields. It also contains unit wastewater generation rates based on National data. The 2012 edition contains design effluent loading rates based on more than 20 years of standards revisions and industry experience. Given the absence of a similar robust standard for systems greater than the domestic scale, most NSW Local Government Authorities in our experience rely heavily on the soil and site assessment aspects of the standard, as well as the effluent loading rates for designing disposal systems. This is particularly the case for developments where the waste stream produced is of a residential / domestic character.
NSW Department of Local Government *et al.* (1998) *On-site Sewage Management for Single Households* (DLG 1998)	A guideline designed for the assessment of wastewater disposal systems. Whilst the standard is designed for single households, it is useful in that it contains site soil and land capability matrices. It is our experience that most NSW Local Government Authorities still rely heavily on the soil and site assessment aspects of the guideline. This is particularly the case for developments where the waste stream produced is of a residential / domestic character
Hawkesbury City Council Development Control Plan 2002 Part C Chapter 7 Effluent Disposal (HDCP)	The DCP provides guidance for all types of on-site effluent disposal in the Hawkesbury LGA. It specifically refers to AS/NZS1547 and DLG 1998 and outlines the requirements for undertaking '*site and soil assessments*' for on-site wastewater disposal.

***Sydney Regional Environmental Plan 20 Hawkesbury-Nepean River* (No 2—1997) (SREP 20)**	SREP 20 provides a number of environmental performance objectives pursuant to Clauses 6(3) and 11(17) in respect of on-site sewage systems or works.

1.5 WICA Licensing

The STP and EMA require IPART licensing pursuant to the NSW *Water Industry Competition Act 2006* (**WICA**). A network operator's license (**NOL**) is required to construct and operate the wastewater management scheme, and a retail supplier's license (**RSL**) is required to provide sewerage services to the community.

2 Review of Environmental Setting

2.1 Rainfall

The nearest climate station with an appropriate length of Bureau of Meteorology (**BOM**) daily rainfall data is Kurrajong Heights (BOM station 063043). The nearest climate station with appropriate daily pan evaporation data is Richmond RAAF Base (BOM station 067033).

Based on these BOM sites, median rainfall at the site is estimated to be 1,170 mm/year, median pan evaporation is estimated to be 1,520 mm/year.

2.2 Topography

The site is located on a north / south running ridgeline to the north of Kurrajong township. The site slopes generally towards the northeast and northwest from the top of the ridge at grades of generally between 5 – 10%. Site slopes are generally concave. Map 1, Map 2 and Map 3 provide details of existing site contours, slopes and topography. In the proposed EMA:

1. Levels vary between 132 – 141 mAHD (Map 1 and Map 2).
2. Slopes are gentle at <10% (see Map 3) and suitable for effluent disposal.

2.3 Local Drainage and Runoff

The site generally drains towards Kurrajong Road as sheet flow to the north-east and north-west. There are no defined watercourses on the site or signs of any formal drainage. Map 4 depicts local drainage. The following is noted:

1. The proposed EMA is > 100 m from any permanent watercourse.
2. The proposed EMA is > 40 m from any intermittent drainage line.
3. No concentrated drainage occurs within the EMA.
4. No potential for surface runon to the EMA.

2.4 Geology

Review of the Penrith 1:100,000 Geological Series Sheet shows that the site is underlain by two geological units:

1. Hawkesbury Sandstone: Consisting of medium to very coarse grained quartz sandstone, minor laminated mudstone and siltstone lenses. This geological unit is predominantly in the northwestern part of the site.

2. Ashfield Shale: Consisting of claystone-siltstone and fine sandstone-siltstone laminite. This geological unit is in the southern and eastern parts of the site.

Site geology is provided in Map 5.[1]

2.5 Soil Profiles

2.5.1 Soil Landscapes

Local soil landscapes are documented in the Penrith 1:100,000 Soil Landscape Sheet[2] with an extract containing the site provided in Map 6. Two soil landscapes occur close to or on the site:

1. Luddenham: This is the predominant soil landscape of the site consisting of loams overlying clay loams grading to light to medium clay at depth.

2. Agnes Banks: This landscape is generally limited to areas adjacent to Little Wheeny Creek and consists of sands overlying loamy sands then bedrock. This soil profile is unlikely to occur on the site itself.

2.5.2 Boreholes

In order to examine site specific soil properties, borehole investigations were undertaken across the development areas, including 6 boreholes completed on 20/1/2017 (Boreholes 001 – 006) and 12 boreholes undertaken on 25/6/2020 (Boreholes 009 – 020). Borehole locations are provided in Map 7 with borehole logs provided at Attachment D.

Site investigations indicated that site soils can be categorised into three profiles, as shown in Map 8 and summarised as follows:

1. Sandstone profile: To the west and north of the site. Consisting of loam overlying clay loam grading to sandy light clay at depth then sandstone bedrock (refer to Figure 1).

2. Transitional profile: Between the sandstone and shale profiles in the middle of the site ridge. Consisting of sandy loams and loams overlying clay loams grading to light clays then shale / sandstone bedrock (refer to Figure 2).

3. Shale profile: Located in the eastern part of the site. Consisting of sandy loam topsoils overlying well drained clay loam subsoils grading to light to medium clays then shale bedrock. Total soil depth is greater than 1.5 m (refer to Figure 3).

Within the EMA, soils are wholly within the shale profile (BH016, BH017, BH018, BH019 and BH020). These are described generally as follows:

1. Layer 1 (A): 0 – 300/400 mm dark brown sandy loam, well structured and well drained topsoil.

---

1 Source: Clark, N.R. and Jones, D. C. (1991) *Penrith 1:100,000 Geological Series Sheet 9030.*

2 Hazelton, P.A. (1992) *Soil Landscapes of the Penrith 1:100,000 Sheet*, NSW Department of Conservation and Land Management.

2. Layer 2 (B_1): 300/400 – 600/900 mm brown / reddish brown sandy loam or loam, well structured, well drained subsoil.

3. Layer 3 (B_2): 600/900 – 1000/1500 mm reddish brown clay loam, moderately structured and well drained.

Soils in the EMA are well structured and well drained, with no evidence of intermittent elevated water table. We note that the base of the trenches will be at 450 – 500 mm below ground level. The relevant limiting soil horizon is therefore Layer 2, being sandy loam to loam in places. Indicative permeabilities are provided in Table 3.

Table 3: Soil profiles.

Layer	Soil Textural Classification	Indicative Permeability (K_{sat}) (m/day)
A1 – Topsoil	Sandy Loam	> 3.0
B1 – Subsoil	Sandy Loam / Loam	1.5 – 3.0
B2 – Subsoil	Clay Loam	0.5 – 1.5

2.5.3 Laboratory Testing

A number of soil samples have been collected from the boreholes and assessed by laboratory analyses for a range of analytes including: pH, electrical conductivity (EC), cations, cation exchange capacity, Emerson class number and phosphorus sorption. Sampling for laboratory analyses is summarised in Table 4.

Table 4: Summary of soil samples sent for laboratory analyses.

Date	27/2/2017	22/7/2020
Borehole/depth (m)	BH001/0/3	BH012/0.5
	BH001/0.6	BH014/0.5
	BH005/0.2	BH017/0.2
	BH005/0.5	BH017/0.5
	BH006/0.3	BH017/1.2
	BH006/0.6	BH019/0.5

Laboratory test data are provided at Attachment E. We note that only samples from BH017 and BH 019 reflect soil chemistry in the proposed EMA. Test data for the EMA are summarised in Table 6. The following is noted:

1. pH is acidic, which is expected given the parent rock material, but not considered to be a limitation given the proposed trenching system.

2. EC is low indicating non-saline soils and suitability for effluent disposal.

3. CEC is moderate indicating good growing conditions and suitability for effluent disposal.

4. Phosphorus sorption is high with a phosphorus retention index of 2077.5 mg/kg, indicating suitability for effluent disposal.

5. Emerson class number indicates non-dispersive soils.

6. Test data indicates soils are well suited to long-term effluent disposal.

Table 5: Summary of laboratory test data for EMA.

Parameter	Average EMA Value	Units
pH	5.4	-
Electrical Conductivity	0.06	dS/m
Cation Exchange Capacity	9.5	cmol(+)/kg)
Phosphorus Retention Index	2,077.5	mg/kg
Emerson Class Number	3.1	-

2.6 Groundwater

Groundwater was not encountered during excavation of subsurface boreholes. It is expected given that the EMA is located on a ridge, that permanent groundwater will be located at depths of greater than 5 m. We note that no elevated soil moisture was observed at the soil / bedrock interface at any borehole

A search of the Water NSW groundwater bore register showed that there are no bores within 250 m of the proposed EMA. Additionally, there are no groundwater dependent ecosystems (GDEs) within 100 m of the EMA.

2.7 Land Capability Assessment

2.7.1 Soil Capability

The capacity of soils to accept treated wastewater was assessed by applying the criteria provided in NSW DLG *et al.* (1998). Results of the assessment are provided in Table 6. The following is observed:

1. Soils are suitable for effluent disposal.

2. Low pH is acceptable given good vegetation cover indicating that this is not a limitation of plant growth.

3. Soil depth is considerable and will not limit potential for long-term sustainable effluent disposal.

Table 6: EMA soil capability assessment.

Parameter	Average/Typical Value	Limitation[3]
Depth to bedrock (m)	> 1.5	Minor
Depth to water table (m)	> 5.0	Minor
Permeability category	2a / 3a	Moderate / Minor
Coarse fragments	< 5%	Minor
Bulk density (g/cm³)	< 1.6 (estimated)	Minor
pH (1:5 in H_20)	5.4	Moderate
ECe (dS/m)	0.06	Minor
CEC (cmol(+)/kg)	9.5	Moderate
P-sorption (mg P/kg soil)	2,077.5	Minor
Emerson Aggregate Class	3.1	Minor

2.7.2 EMA Landform Capability

Suitability of EMA landform features was assessed in accordance with criteria provided in NSW DLG *et al.* (1998), with outcomes of the assessment summarised in Table 7. The following observations are made:

1. The EMA is well suited to on-site effluent disposal and there are no significant constraints to the disposal of suitably treated wastewater.

2. The site is sufficiently large to be able to achieve suitable buffers to permanent watercourses and adjoining land holder groundwater wells.

3. The EMA is located > 40 m to any intermittent watercourse and > 100 m to any permanent watercourse.

[3] Limitations ratings based on NSW Department of Local Government *et al* (1998).

Table 7: Summary of EMA landform capability assessment.

Feature	Commentary for EMAs	Limitation[4]
Flood potential	EMA is not flood affected.	Minor
Exposure	Site is well exposed to wind and sun	Minor
Slope (%)	< 10 %	Minor
Landform	Side slope / ridge line	Minor
Run-on / seepage	No signs present and unlikely	Minor
Erosion potential	No signs present and unlikely	Minor
Site drainage	No visible signs of surface dampness	Minor
Fill	Not present	Minor
Buffer distance	> 100 m to permanent watercourses, > 40 m to intermittent watercourses; > 250 m to groundwater wells	Minor
Land area	Adequate land area available	Minor
Rock outcrop	No extensive outcropping on site	Minor

2.7.3 Design Loading Rates

The base of the proposed absorption trenches will be located within well structured sandy loam or loam. On that basis, AS/NZS 1547 (2012) recommends a Design Loading Rates (DLR) of 50 mm/day. For the well structured clay loams, which occur at deeper depths, a DLR of 30 mm/day is recommended. In order that a conservative design approach is facilitated, we have adopted the more conservative DLR of 30 mm/day for design of the EMA, rather than the guideline value of 50 mm/day.

[4] Limitations ratings based on NSW Department of Local Government *et al* (1998).

3 Wastewater Management

3.1 Wastewater Generation

System hydraulic loads are calculated based on the anticipated wastewater generation rates in equivalent tenements (ET) for the subdivision and design generation rates for households with reticulated water supply given in AS/NZS 1547 (2012):

1. Equivalent Person (EP) design flow rate = 150 L/day
2. Mean persons/dwelling (ABS Census, 2011) = 3
3. Mean Daily flow rate/dwelling = 450 L/day
4. Equivalent Tenements (ET) = 35
5. Design Daily flow rate = 15.8 kL/day
6. Design with 33% increase as 'buffer' = 21.0 kL/day

The design rate is therefore equivalent to a mean residential occupation rate of 4 EP/dwelling (or 600 L/ET/day). This is well above the ABS Census dwelling occupation rate, and provides for a high level of confidence in the system.

3.2 Design Effluent Quality

The adopted design effluent quality is provided at Table 8 including recommended effluent monitoring. The nominated compliance criteria are taken from NSW DWE (2008) for 'low level contact', this being defined as end uses with a low level of human contact including: urban irrigation with enhanced restricted access and application irrigation.

We note the following:

1. Disposal trenches will preclude all passive human contact with treated effluent. The performance criteria are therefore conservative.
2. The adopted level of disinfection is < 10 CFU/100 mL, this being a further 2 log reduction over the nominated performance standard.

Table 8: Recommended effluent quality and monitoring requirements.

Parameter	Low-Level Contact Standard[1]	Adopted Value	Monitoring
E. coli	< 1000 cfu/100 mL	< 10 cfu/100 mL	Monthly[2]
BOD_5	< 20 mg/L	< 20 mg/L	n/a[3]
SS	< 30 mg/L	< 30 mg/L	n/a[3]
pH	6.5-8.5	6.5-8.5	Continuous on-line
Turbidity	Compliance <5 NTU, alert level >2 NTU	Compliance <5 NTU, alert level >2 NTU	Continuous on-line
Total Nitrogen [3]	-	< 15 mg/L	n/a[2]
Total Phosphorus [3]	-	< 9 mg/L	n/a[2]

Notes:

[1] NSW DWE (2008) Table 7.2, page 40, *Management of Private Recycled Water Schemes.*

[2] Reviewed after 6 months operation. Weekly during verification monitoring.

[3] Reviewed after 8 weeks operation. Weekly during verification monitoring.

3.3 EMA Sizing and Location

The EMA will consist of a series of absorption trenches constructed such that the trench bed will be level and enable treated effluent to be uniformly dispersed over the entire trench bed area. Assessment of the required trench bed area is presented in Table 9. This indicates that based on the allowable DLR of 50 mm/day and likely daily flow of approximately 15.8 kL/day, a minimum bed area of 316 m^2 is required. With the 33% factored up flow rate, together with the 40% factored down DLR, the adopted design area is 700 m^2, this being 2.2 times the minimum required area.

Table 9: Minimum absorption trench area requirement.

Scenario	Scheme flow rate (kL/day)	DLR (mm/day)	Absorption Trench Area (m^2)[5]
Minimum Required	15.8	50	316
Adopted Design	21.0	30	700

In accordance with AS/NZS 1547 (2012), trenches will be 0.6 m wide and constructed at 1.6 m centres, thus providing a 1.0 m space between each trench. Trenches will be constructed as outlined in AS1547 (2012) and as shown on Figure 4, this being:

1. Typical trench length of 9.5 m.
2. Minimum 400 mm depth and 600 mm width.
3. 230 mm high self-supporting arch covered with filter cloth.
4. Backfilled to natural ground surface level with suitable topsoil.

[5] Measured as base area of trench.

Based on these specifications, EMA sizing requirements are presented in Table 10. We note that the adopted design is some 1,000 m^2 larger than the minimum required as per AS/NZS 1547 (2012).

Table 10: EMA sizing requirements.

Scenario	Total Trench Length at 0.6 m Width (m)	Total number of trenches	Total EMA (m^2)
Minimum Required	527	55	842
Adopted Design	1167	122	1,880

3.4 Nutrients

The STP will produce residual nutrients, which will be transferred to the EMA. At the nominated effluent concentration and adopting the likely effluent flow rate of 15.8 kL/day, nitrogen and phosphorus levels will be of the order of 87 kg/year of nitrogen and 52 kg/year of phosphorus respectively.

Based on a nutrient balance (see Attachment F), the total area required to assimilate this load is 4,375 m^2 for nitrogen and 801 m^2 for phosphorus. The following is observed:

1. Given that allocated area for effluent disposal is 1,880 m^2, there will be some movement of nitrogen over time away from the direct disposal field. Based on the nitrogen balance, that travel distance will be approximately 5 – 10 m either side of the trenches before soil assimilates any excess nitrogen. We note that the excess nitrogen load leaving the direct disposal area is very low and will be largely assimilated within or close to the EMA. The analysis demonstrates that the effluent will not impact on the ecology of watercourse systems. We note also that given the significant depth to groundwater, limited availability of groundwater resources and significant distance to any potential groundwater users, no impacts to groundwater resources are expected.

2. In terms of phosphorus, the proposed EMA is more than 2 times the size required to assimilate phosphorus. No impacts associated with phosphorus are expected.

In summary, whilst some nutrients will be present in the treated effluent, the residual concentrations are low and will be assimilated within or very close to the direct effluent disposal area. No impact on receiving waters, including watercourses or groundwater systems is likely.

3.5 Buffers and Setbacks

On the basis of current best practices, the following environmental buffers and setbacks are recommended:

1. To buildings: 6 m if upgradient and 3 m if downgradient.

2. To intermittent watercourses: 40 m.

3. To permanent waters: 100 m.

The proposed EMA has been sited and designed to meet these buffers. We note that buffers to buildings and structures are determined from NSW DLG *et al.* (1998) on the basis of primary treated effluent. In this case, the effluent standard will be tertiary treated. The adopted buffers are therefore highly conservative given that the effluent is suitable for 'low level contact'.

3.6 Water Balance

A water balance assessment has been completed for the proposed treated wastewater disposal area to ensure that effluent does not resurface when applied to absorption trenches. The water balance assessment is provided as Attachment G. Results show:

1. No effluent will resurface. The DLR of 30 mm/day Is well below the assessed soil permeability.

2. No wet weather storage is required.

3. Extending ponding of effluent within trenches will not occur.

3.7 Monitoring and Maintenance Requirements

EMA is to have a dedicated monitoring program to ensure that its operation remains sustainable and does not impact on surrounding properties or the downslope receiving environment. This shall consist of the following elements:

1. Groundwater: A groundwater bore taken to 5 – 10 m depth shall be constructed on the community lot downslope of the absorption trenches. Ongoing sampling (three monthly) of groundwater is to be undertaken with samples analysed by a NATA accredited laboratory to determine the quality of the groundwater and determine if there have been any detrimental impacts to site groundwater from treated wastewater application. Groundwater levels shall also be monitored throughout the operation of the scheme. Prior to commencement of scheme operation, 2 baseline monitoring events shall be undertaken within a 3 month period.

2. Soil: 3 Soil samples shall be taken annually on an ongoing basis from the EMA and analysed by a NATA accredited laboratory to verify the long-term sustainability of the soil to accept treated wastewater. Prior to commencement of scheme operation, 1 baseline monitoring event shall be undertaken.

3. Effluent: Treated effluent from the STP shall be tested periodically in accordance with Table 8 and Aquacell's recommendations.

4. Visual: A visual inspection of disposal area and delivery system (valves, solenoids, mains, *etc*) should be undertaken on a quarterly basis. Should the visual inspection determine that there is an issue, the application of treated wastewater to the affected area should cease or be isolated until such time as the issue is rectified.

5. Reporting: A monthly performance and monitoring report shall be provided by the WICA Licensee. The report should include all monitoring and performance

data, details of any incidents and rectification measures undertaken. The WICA Licensee shall comply with all its reporting obligations under the WIC Act.

EMA shall be maintained on a regular basis which shall include the following:

1. Visual inspection of the EMA and delivery system.
2. Mowing of EMA to maintain a maximum grass blade length of 75 mm. All clippings are to be removed from the site.
3. Routine inspection of all pipework.
4. Routine inspection of all system pumps, control valves and control systems.
5. Routine inspection and maintenance of all system electrical components.
6. Repair / replacement any damaged components.

3.8 EMA Reserve Area and Lifespan

In terms of a reserve EMA, this is not required on account of the following:

1. All components of the EMA have been sized based on existing soil and environmental conditions. These will not change during the operation of the EMA.
2. The minimum required EMA is 847 m^2 (see Table 10), however, a total of 1,880 m^2 has been provided. This being more than 2.2 times the minimum area.
3. Effluent will be treated to a tertiary standard using an MBR process. This is highly reliable and robust treatment process that will produce a clear, low solids effluent that will not clog or detrimentally affect soil absorption properties.

On the above basis, the EMA has been designed for perpetual operation with an unlimited lifespan. We expect that during the operational period, there may be times when components wear out, such as pipes and fittings, and that these may need replacement. Such matters would fall within the remit of the routine inspection and maintenance regime. If any individual trench should fail, it would be cleaned and repaired so that it can be returned to full operation.

3.9 EMA Design Review

3.9.1 Design Robustness

The robustness of the EMA design is assessed in Table 11, which indicates that the proposal is sound and conservatively formulated. The following is noted:

1. Wastewater loads have been factored up by 33%.
2. Effluent disposal rates have been factored down by 40%.

3. Effluent quality is suitable for low level contact even though no contact will be allowed as all effluent will be disposed of below ground.

4. EMA is 2.2 times the required minimum size.

5. The EMA maintains adequate separation from any receiving waters, ensuring effluent disposal is safe and sustainable.

Table 11: Design robustness assessment.

Feature	Required Minimum Design	Adopted Design
Wastewater Generation	15.8 kL/day based on 3 persons/dwelling and 150 L/person/day.	21 kL/day based on 4 persons/dwelling and 150 L/person/day. This is 33% higher than the average for Kurrajong given in the Australian Bureau of Statistics (2016) census data.
EMA	316 m^2 minimum base trench area. 842 m^2 minimum EMA required.	700 m^2 base trench area provided. This is 2.2 times the minimum area and ignores sidewall percolation. 1,880 m^2 EMA is provided. This is 2.2 times the required minimum.
Effluent Quality	NSW DWE (2008) guidelines for 'low level human contact': *E.coli* - < 1000 cfu/100 mL BOD < 20 mg/L Suspended solids < 30 mg/L pH 6.5 – 8.5	Adopted wastewater quality as per Table 8 including: *E.coli* - <10 cfu / 100 mL BOD < 20 mg/L Suspended solids < 30 mg/L pH 6.5 – 8.5
Water balance	No resurfacing	Design ensures no resurfacing or ponding in trenches.
Receiving waters	No impact	All effluent disposal is > 40 m to intermittent watercourses and > 100 m to permanent waters.
Groundwater	No impact	No groundwater resources or users are impacted by the EMA.
Buildings and Structures	Achieves required setbacks.	The EMA addresses all necessary required setbacks.

3.9.2 EMA Compliance

The EMA has been designed to comply with relevant standards.

Table 12: Scheme compliance assessment.

Guideline	Required Minimum Design	Assessment
AS/NZS 1547	EMA minimum area 842 m^2.	Complies: 1,880 m^2 provided.
DWE 2008 **'Low Level Human Contact'**	*E.coli* - < 1000 cfu/100 mL BOD < 20 mg/L Suspended solids < 30 mg/L pH 6.5 – 8.5	Complies: *E.coli* - <10 cfu / 100 mL BOD < 20 mg/L Suspended solids < 30 mg/L pH 6.5 – 8.5
HDCP	Recommended onsite systems comply with AS/NZS 1547 (2000) (sic) and NSW DLG *et al.* (1998) guidelines. New development proposing onsite wastewater management to include a site and soil assessment, details of operation and maintenance of the system and treated wastewater quality specifications.	Complies: This assessment includes site landscape, soil and environmental setting assessment (Section 2). Details of operation and maintenance of the scheme by Aquacell and details of system monitoring of the disposal area is provided in Section 3.8. Wastewater quality is given in Section 3.2.
SREP 20	Cl 8(17)(b) The suitability of the site for on-site disposal of effluent or sludge and the ability of the sewerage systems or works to operate over the long-term without causing significant adverse effects on adjoining property.	Complies: See Section 2.7 and Section 3.8
	Cl 8(17)(c) The likely effect of any on-site disposal area required by the proposed development on: • any water bodies in the vicinity (including dams, streams and rivers), or • any mapped wetlands, or • any groundwater, or • the floodplain.	Complies: See Sections 3.4, 3.5 and 3.6.
	Cl 8(17)(d) The scope for recycling and reusing effluent or sludge on the site.	Complies: Treated wastewater is being applied to the site in a sustainable manner. It is not proposed to reuse treated wastewater for any non-potable purpose.
	Cl 8(17) (e) The adequacy of wet weather storage and the wet weather treatment capacity (if relevant) of the proposed sewerage system or works.	Complies: A dedicated wet weather tank is not required due to absorption trench design.
	Cl 8(17)(f) Downstream effects of direct discharge of effluent to watercourses.	Complies: Treated wastewater is being applied to subsurface absorption trenches. There shall be no direct discharge to the downstream environment.
	Cl 8(17)(g) The need for ongoing monitoring of the system or work.	Complies: See Section 3.7.

4 Attachment A – Figures

Figure 1: Borehole 11 showing typical sandstone profile.

Figure 2: Borehole 14 showing typical transitional profile.

Figure 3: Borehole 19 showing typical shale profile.

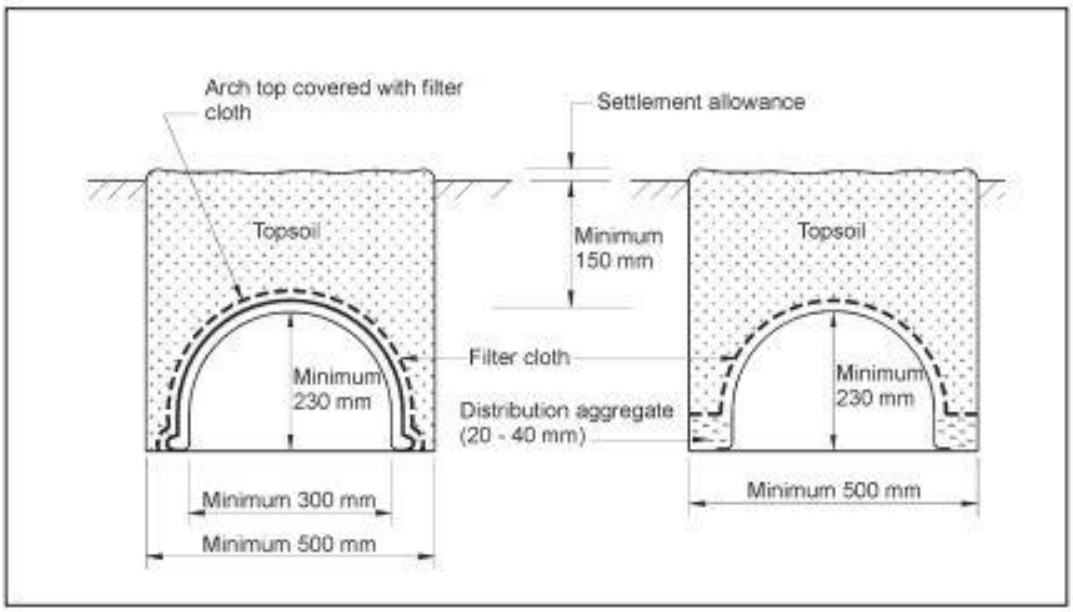


FIGURE L2 SELF-SUPPORTING ARCH TRENCH

Figure 4: Typical section through an absorption trench extracted from AS/NZS 1547 (2012).

5 Attachment B – Maps

0 20 40 60 80 100 m

1:2000 @ A4

Viewport A4

Source: NSW Land and Property Information

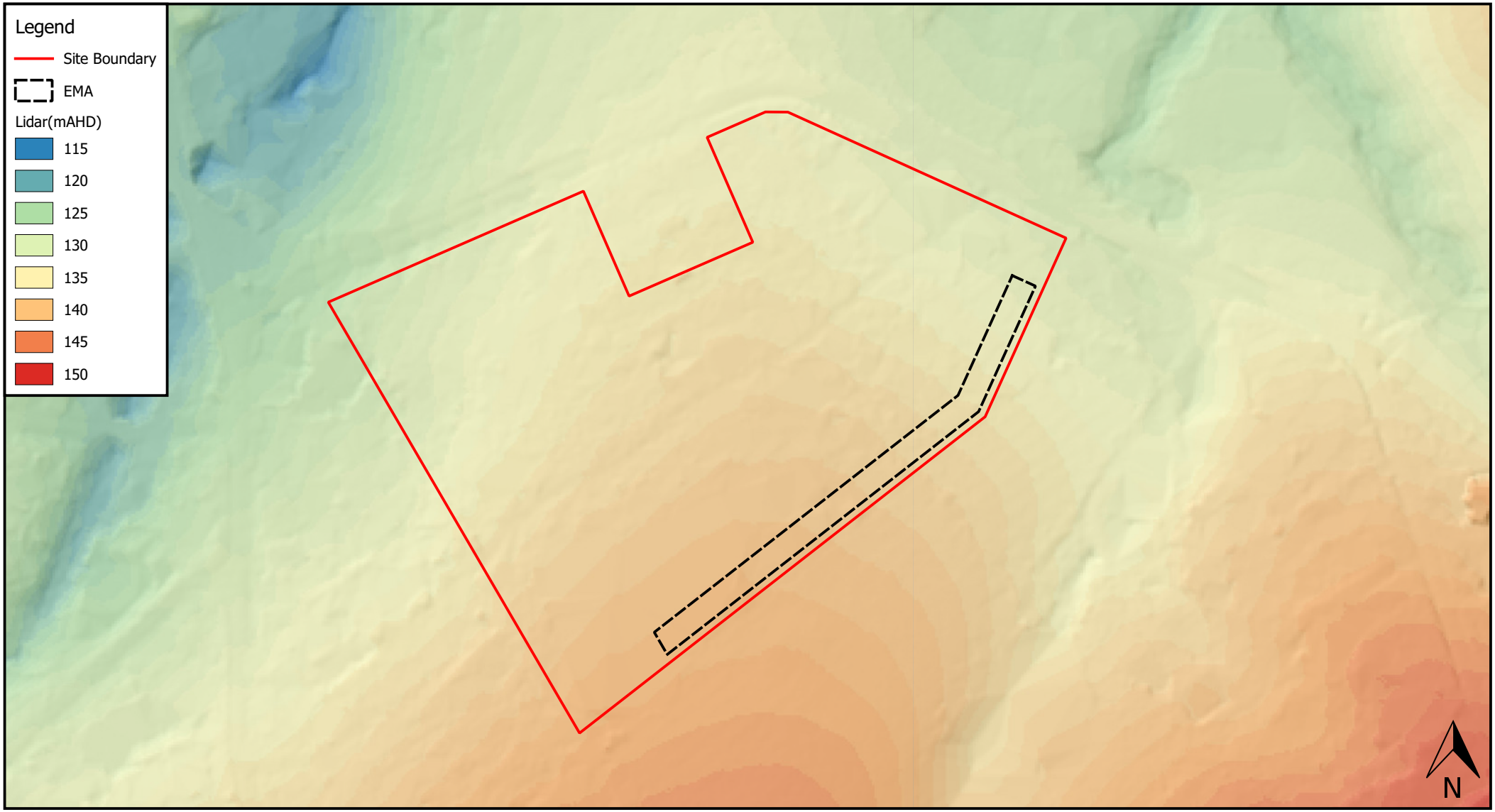
Project No: P1706231 Map Set: MS02-R01 EPSG:

Map Title / Figure:

Contours (mAHD)

Map 01	Map
67 Kurrajong Road, Kurrajong, NSW	Site
Approved Subdivision	Project
Wastewater Management	Sub-Project
PRJM Pty Ltd ATF Kurrajong Trust	Client
04/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects



0 20 40 60 80 100 m

1:2000 @ A4

Viewport A4

Source: NSW Land and Property Information

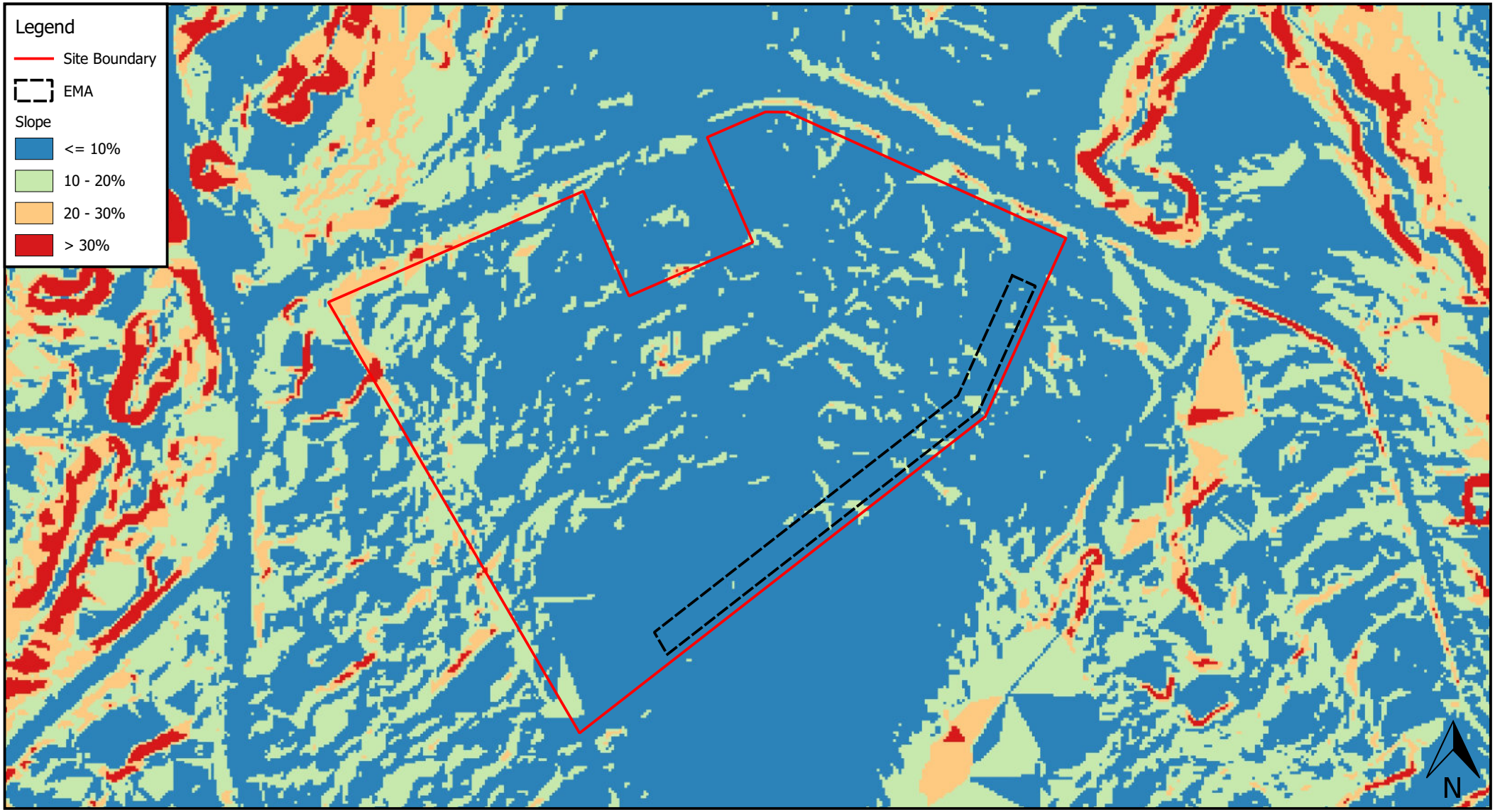
Project No: P1706231 Map Set: MS02-R01 EPSG:

Map Title / Figure:

Topographical Relief

Map 02	Map
67 Kurrajong Road, Kurrajong, NSW	Site
Approved Subdivision	Project
Wastewater Management	Sub-Project
PRJM Pty Ltd ATF Kurrajong Trust	Client
04/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects



0 20 40 60 80 100 m

1:2000 @ A4

Viewport A4

Source: NSW Land and Property Information

Project No: P1706231 Map Set: MS02-R01 EPSG:

Map Title / Figure:

Site Slope

Map 03	Map
67 Kurrajong Road, Kurrajong, NSW	Site
Approved Subdivision	Project
Wastewater Management	Sub-Project
PRJM Pty Ltd ATF Kurrajong Trust	Client
04/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects

0 20 40 60 80 100 m

1:2000 @ A4
Viewport A4
Source: NSW Land and Property Information

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1706231 Map Set: MS02-R01 EPSG:

Map Title / Figure:
Local Drainage

Map 04	Map
67 Kurrajong Road, Kurrajong, NSW	Site
Approved Subdivision	Project
Wastewater Management	Sub-Project
PRJM Pty Ltd ATF Kurrajong Trust	Client
04/09/2020	Date

0 20 40 60 80 100 m

1:2000 @ A4

Viewport A4

Source: Clark, N.R. and Jones, D. C. (1991) Penrith 1:100,000 Geological Series Sheet 9030

Project No: P1706231 Map Set: MS02-R01 EPSG:

Map Title / Figure:

Geology

Map 05	Map
67 Kurrajong Road, Kurrajong, NSW	Site
Approved Subdivision	Project
Wastewater Management	Sub-Project
PRJM Pty Ltd ATF Kurrajong Trust	Client
04/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects

0 20 40 60 80 100 m

1:2000 @ A4

Viewport A4

Source: Bannerman, S.M. and Hazelton, P.A. (1990) Soil Landscapes of the Penrith 1:100,000 Sheet.

Project No: P1706231 Map Set: MS02-R01 EPSG:

Map Title / Figure:

Soil Landscapes

Map 06	Map
67 Kurrajong Road, Kurrajong, NSW	Site
Approved Subdivision	Project
Wastewater Management	Sub-Project
PRJM Pty Ltd ATF Kurrajong Trust	Client
04/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects

0 20 40 60 80 100 m

1:2000 @ A4
Viewport A4

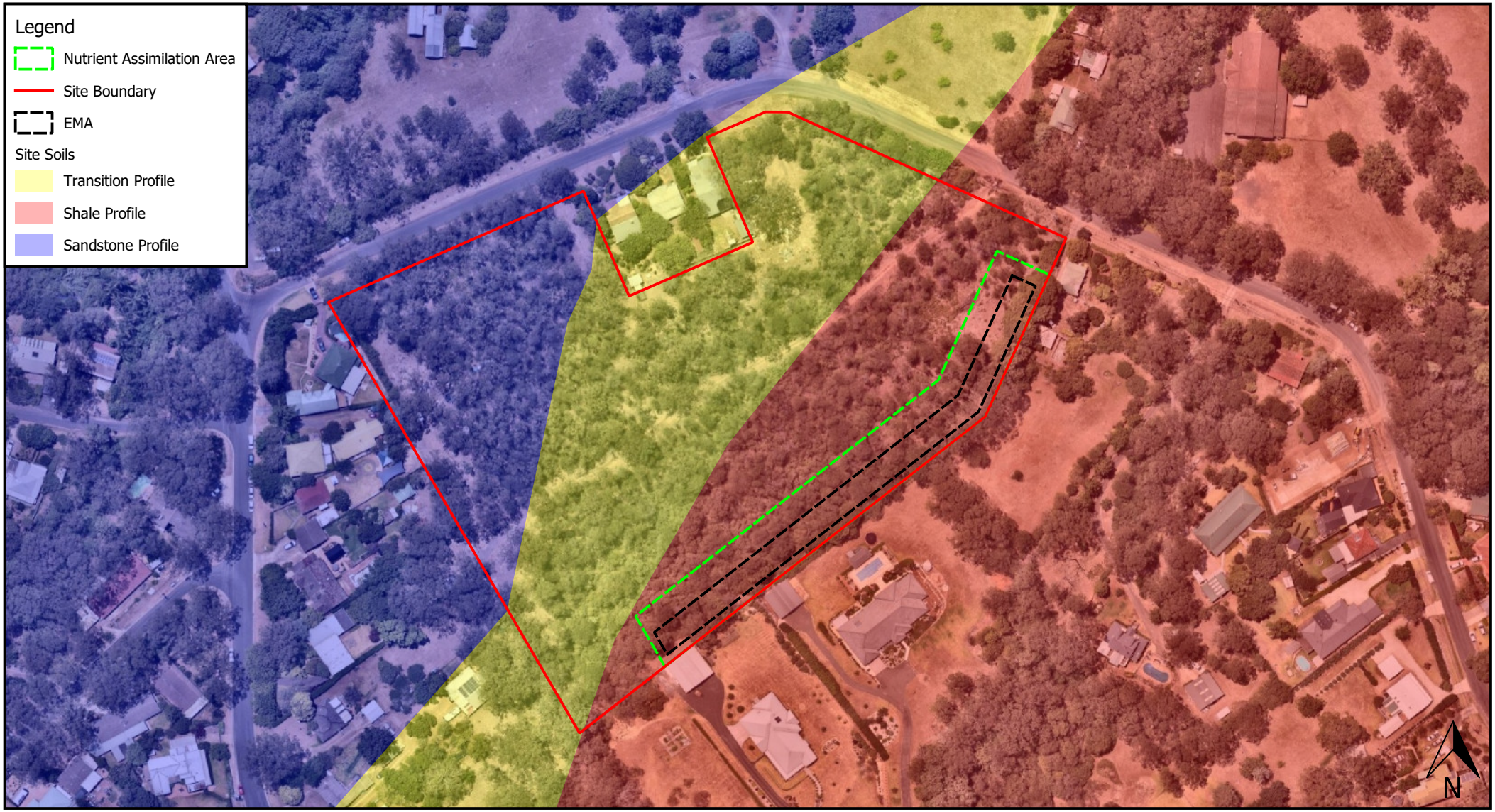
Project No: P1706231 Map Set: MS02-R01 EPSG:

Map Title / Figure:

Borehole Locations

Map 07	Map
67 Kurrajong Road, Kurrajong, NSW	Site
Approved Subdivision	Project
Wastewater Management	Sub-Project
PRJM Pty Ltd ATF Kurrajong Trust	Client
04/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects



0 20 40 60 80 100 m

1:2000 @ A4
Viewport A4

Project No: P1706231 Map Set: MS02-R01 EPSG:

Map Title / Figure:

Soil Zonation

Map 08	Map
67 Kurrajong Road, Kurrajong, NSW	Site
Approved Subdivision	Project
Wastewater Management	Sub-Project
PRJM Pty Ltd ATF Kurrajong Trust	Client
04/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects

6 Attachment C – Plans

KEY

- FINAL SURFACE CONTOURS
- EFFLUENT MANAGEMENT AREA
- STP AND EMA INTERNAL FENCING
- PROPOSED RISING MAIN
- INDICATIVE DWELLING FOOTPRINT
- LOT BOUNDARY
- PUMP STATION
- SITE BOUNDARY
- INTERALLOTMENT DRAINAGE EASEMENT

NOTES:

1. FINAL DESIGN TO BE IN ACCORDANCE WITH IPART APPROVAL REQUIREMENTS.
2. ABSORPTION TRENCHES:
   - ALLOCATED AREA: 1,880 SQUARE METERS.
   - MINIMUM AREA REQUIRED: 700 SQUARE METERS.
   - MAX TRENCH LENGTH = 20 M.
   - TRENCH WIDTH = 0.6 M.
   - TRENCH SPACING = 1.6 M CENTRES.
   - TRENCH BEDS TO BE LEVEL (TOLERANCE ± 0.1%)

STORMWATER DETENTION SYSTEM

RETICULATED SEWER PUMP STATION

KURRAJONG ROAD

FUTURE ROAD

LOT 64 DP.14735

LOT 2 DP.735719

LOT 7 DP.833801

LOT 6 DP.38583

LOT 5 DP.38583

LOT 4 DP.38583

LOT 3 DP.38583

LOT 2 DP.38583

LOT 3 DP.1154000

LOT 202 DP.1167523

LOT 201 DP.1167523

LOT 1 DP.1018851

LOT 1 DP.361464

No.83 LOT 3 DP.36452

No.81 LOT 2 DP.36452

No.79 LOT 1 DP.36452

No.65 LOT 1 DP.21874

EXISTING RESIDENCE

1.5m OFFSET FROM FENCE

145.1m

9.5m

148.7m

49.7m

52.1m

AQUACELL S20 TREATMENT PLANT

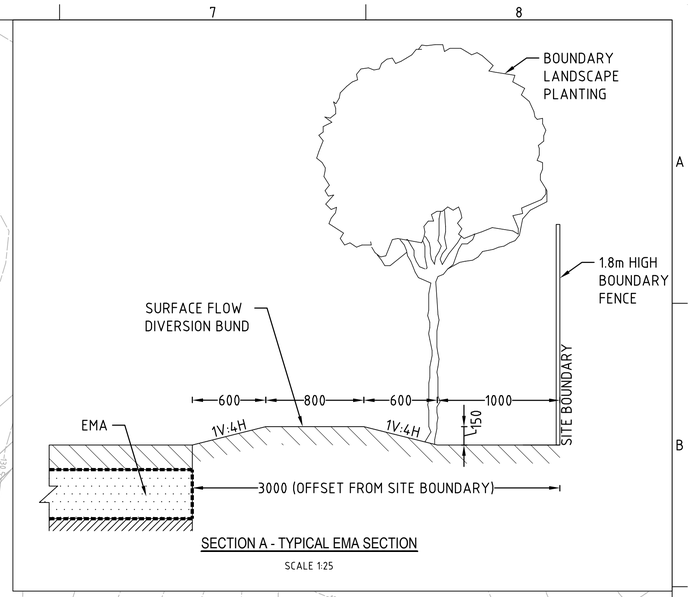
STORMWATER DETENTION SYSTEM

SURFACE FLOW DIVERSION BUND

LOT BOUNDARIES WITHIN EMA NOT FENCED

3.0m OFFSET FROM SITE BOUNDARY

SURFACE FLOW DIVERSION BUND



SECTION A - TYPICAL EMA SECTION

SCALE 1:25

IPART SUBMISSION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
C	**MINOR AMENDMENTS**	**8/9/2020**	**MD**	**MD**	**MS**	**MS**
B	MINOR AMENDMENTS	28/08/2020	CG	MS	MS	MS
A	INITIAL RELEASE	17/08/2020	GM	MD	MS	MS

SCALE

A1 (A3) 1:500 (1:1,000) METRES

A1 (A3) 1:25 (1:50) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	MS

CLIENT

PRJM Pty Ltd ATF Kurrajong Trust

PROJECT NAME/PLANSET TITLE

RESIDENTIAL SUBDIVISION

WASTEWATER MANAGEMENT

67 KURRAJONG ROAD
LOT 1 - DP 1185012

martens & Associates Pty Ltd

Consulting Engineers
Environment
Water
Geotechnical
Civil

Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE

WASTEWATER MANAGEMENT PLAN

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1706231	PS04	R03	PS04-F200	C

PRINTED: --- USER: MDAMS

A1 / A3 LANDSCAPE (A1LC_v02.0.01)

DRAWING ID: P1706231-PS04-R03-F200

7 Attachment D – Borehole Logs

CLIENT	MMLM Trust PRJM Pty Ltd		COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH009**
PROJECT	Supplementary Land Capability Assessment		LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW		GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT		4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	Not Encountered	0.2	*0.20*				SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained; trace fine to medium gravel.			TOPSOIL
	M		0.4	*0.50*				CL	Clay LOAM; pale brown and dark red; moderately structured; well drained.	M (<PL)	F - St	RESIDUAL SOIL
	M-H		0.6 0.8 1.0 1.2 1.4	*1.47*				LC	Light CLAY; pale brown and dark red; moderately structured; well drained.	M (<<PL)	St - VSt	
			1.6 1.8						Hole Terminated at 1.47 m (Target depth reached)			

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd	COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH010**
PROJECT	Supplementary Land Capability Assessment	LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW	GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT	4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS	Ø50 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	Not Encountered	0.2	0.20				SL	TOPSOIL: Sandy LOAM; brown; moderately structured; well drained.		F	TOPSOIL
	M		0.4	0.50				SL	Sandy LOAM; pale brown and dark red; moderately structured; well drained.	M (<PL)	St	RESIDUAL SOIL
	M-H		0.6					LC	Light CLAY; pale brown and pale grey; moderately structured; well drained.	M (<<PL)	St - VSt	
			1.0									
			1.2									
			1.4	1.47					Hole Terminated at 1.47 m (Target depth reached)			
			1.6									
			1.8									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd		COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH011**
PROJECT	Supplementary Land Capability Assessment		LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW		GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT		4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	Not Encountered	0.2	0.30				SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained; trace fine to medium gravel.	M (<PL)	F	TOPSOIL
	M		0.4	0.50				CL	Clay LOAM; pale brown; moderately structured; well drained.		F - St	RESIDUAL SOIL
	M-H		0.6 0.8 1.0 1.2 1.4	1.47				LC	Light CLAY; pale grey and dark red; moderately structured; well drained.	M (<<PL)	St - VSt	
			1.6 1.8						Hole Terminated at 1.47 m (Target depth reached)			

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd	COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH012**
PROJECT	Supplementary Land Capability Assessment	LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW	GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT	4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS	ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	Not Encountered	0.2	0.25				CL	FILL: Clay LOAM; orange and brown; moderately structured; well drained.		St - F	FILL
			0.4					SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained.	M (<PL)		TOPSOIL
			0.6	0.60							St	
	M-H		0.8					CL	Clay LOAM; brown and orange; moderately structured; well drained.			RESIDUAL SOIL
			1.0	0.90				LC	Light CLAY; brown and orange; moderately structured; well drained.	M (<<PL)	St - VSt	
			1.2									
			1.4	1.47					Hole Terminated at 1.47 m (Target depth reached)			
			1.6									
			1.8									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd	COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH013**
PROJECT	Supplementary Land Capability Assessment	LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW	GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT	4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS	Ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	Not Encountered	0.2	0.30				SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained.		F - St	TOPSOIL
	M-H		0.4 0.6 0.8	0.90				CL	Clay LOAM; pale brown to orange; moderately structured; well drained.	M (<PL)	St - VSt	RESIDUAL SOIL
			1.0 1.2 1.4	1.47				LC	Light CLAY; pale grey and dark red; moderately structured; well drained.	M (<<PL)		
			1.6 1.8						Hole Terminated at 1.47 m (Target depth reached)			

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd	COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH014**
PROJECT	Supplementary Land Capability Assessment	LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW	GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT	4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS	ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M	Not Encountered	0.2	0.25				SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained.	M (<PL)	F - St	TOPSOIL
	M-H		0.4	0.60				L	LOAM; reddish brown and brown; moderately structured; well drained.		St	RESIDUAL SOIL
			0.6					CL	Clay LOAM; brown and reddish brown; moderately structured; well drained.			
			0.8	0.90						M (<<PL)		
	H		1.0					LC	Light CLAY; brown and reddish brown; moderately structured; well drained.		St - VSt	
			1.2									
			1.4	1.47								
			1.6						Hole Terminated at 1.47 m (Target depth reached)			
			1.8									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd	COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH015**
PROJECT	Supplementary Land Capability Assessment	LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW	GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT	4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS	ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT		Not Encountered	0.2	0.30				SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained.			TOPSOIL
			0.4					L	LOAM; orange to brown; moderately structured; well drained.			RESIDUAL SOIL
			0.6	0.60				CL	Clay LOAM; orange to brown; moderately structured; well drained.			
			0.8									
			1.0	1.00				LC	Light CLAY; orange to brown; moderately structured; well drained.			
			1.2									
			1.4	1.47								
			1.6						Hole Terminated at 1.47 m (Target depth reached)			
			1.8									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

martens

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd	COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH016**
PROJECT	Supplementary Land Capability Assessment	LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW	GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT	4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS	ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	Not Encountered	0.2	0.30				SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained.			TOPSOIL
	M		0.4					SL	Sandy LOAM; reddish brown; moderately structured; well drained.			RESIDUAL SOIL
			0.6	0.70				CL	Clay LOAM; reddish brown; moderately structured; well drained.	M		
			0.8									
			1.0									
			1.2									
			1.4	1.47					Hole Terminated at 1.47 m (Target depth reached)			
			1.6									
			1.8									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd	COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH017**
PROJECT	Supplementary Land Capability Assessment	LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW	GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT	4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS	ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	Not Encountered	0.2	0.30				SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained.			TOPSOIL
	M		0.4	0.60				SL	Sandy LOAM; dark red; moderately structured; well drained.	M (<PL)	St	RESIDUAL SOIL
	M-H		0.6					CL	Clay LOAM; dark red; moderately structured; well drained.	M (<<PL)	VSt - H	
			1.0									
			1.2									
			1.4	1.47					Hole Terminated at 1.47 m (Target depth reached)			
			1.6									
			1.8									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd	COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH018**
PROJECT	Supplementary Land Capability Assessment	LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW	GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT	4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS	ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT		Not Encountered	0.2	0.30				SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained.	M		TOPSOIL
			0.4					SL	Sandy LOAM; dark red; moderately structured; well drained.			RESIDUAL SOIL
			0.6									
			0.8	0.90				CL	Clay LOAM; dark red to reddish brown; moderately structured; well drained.			
			1.0									
			1.2									
			1.4	1.47					Hole Terminated at 1.47 m (Target depth reached)			
			1.6									
			1.8									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd	COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH019**
PROJECT	Supplementary Land Capability Assessment	LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW	GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT	4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS	Ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L	Not Encountered	0.2					SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained.	M (<PL)	St	TOPSOIL
			0.4	0.40				L	LOAM; pale brown and dark red; moderately structured; well drained.			RESIDUAL SOIL
			0.6									
			0.8	0.70				CL	Clay LOAM; pale brown and dark red; moderately structured; well drained.			
	M-H		1.0	1.00				LC	Light CLAY; pale brown; moderately structured; well drained.	M (<<PL)	VSt - H	
			1.2									
			1.4	1.47								
			1.6						Hole Terminated at 1.47 m (Target depth reached)			
			1.8									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	MMLM Trust PRJM Pty Ltd	COMMENCED	25/06/2020	COMPLETED	25/06/2020	**REF BH020**
PROJECT	Supplementary Land Capability Assessment	LOGGED	SVK	CHECKED		Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW	GEOLOGY	Ashfield Shale	VEGETATION	Grass & bushes	PROJECT NO. P1706231
EQUIPMENT	4WD truck-mounted hydraulic drill rig/Push tube	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS	Ø75 mm x 1.47 m depth	NORTHING		ASPECT		SLOPE

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT		Not Encountered	0.2					SL	TOPSOIL: Sandy LOAM; dark brown; moderately structured; well drained.	M		TOPSOIL
			0.4	0.40				SL	Sandy LOAM; brown; moderately structured; well drained; with gravel.			RESIDUAL SOIL
			0.6									
			0.8	0.80				LC	CLAY; pale brown and reddish brown; moderately structured; well drained.			
			1.0									
			1.2									
			1.4	1.47					Hole Terminated at 1.47 m (Target depth reached)			
			1.6									
			1.8									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	PRJM Pty Ltd		COMMENCED	20/01/2017	COMPLETED	20/01/2017	**REF BH001**
PROJECT	Proposed Residential Subdivision		LOGGED	DM	CHECKED	DM	Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW		GEOLOGY		VEGETATION	Grass/Shrubs	PROJECT NO. P1504885
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 2.00 m depth	NORTHING		ASPECT	NA	SLOPE Gentle

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5	*0.40*	4885/BH001/0.3/S1 D 0.30 m			SL	Sandy loam, dark grey/brown, well drained, moderately structured.	M		TOPSOIL
			1.0	*1.20*	4885/BH001/0.6/S1 D 0.60 m			CL	Sandy loam, grading to clay loam/light clay, yellowish brown, well drained, moderately structured.	D		RESIDUAL SOIL
			1.5					LC	Light clay, reddish brown, well drained, moderately structured, weathered ironstone fragments.	D		1.20: Comparative push tube depth.
			2.0	*2.00*					Hole Terminated at 2.00 m >2.00m: Light Clay/extremely weathered siltstone or shale with soil properties.			
			2.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	PRJM Pty Ltd		COMMENCED	20/01/2017	COMPLETED	20/01/2017	**REF BH002**
PROJECT	Proposed Residential Subdivision		LOGGED	DM	CHECKED	DM	Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW		GEOLOGY		VEGETATION	Grass/Shrubs	PROJECT NO. P1504885
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.60 m depth	NORTHING		ASPECT	NA	SLOPE Gentle

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5	0.45				SL	Sandy loam, dark grey/brown, well drained, moderately structured.	M		TOPSOIL
			1.0	1.10				CL	Sandy loam, grading to clay loam/light clay, light brown, well drained, moderately structured.	D		RESIDUAL SOIL
			1.5	1.60				LC	Light clay, reddish brown, well drained, moderately structured.			
			2.0						Hole Terminated at 1.60 m >1.60m: Light Clay/extremely weathered siltstone or shale with soil properties.			
			2.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	PRJM Pty Ltd		COMMENCED	20/01/2017	COMPLETED	20/01/2017	**REF BH003**
PROJECT	Proposed Residential Subdivision		LOGGED	DM	CHECKED	DM	Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW		GEOLOGY		VEGETATION	Grass/Shrubs	PROJECT NO. P1504885
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.70 m depth	NORTHING		ASPECT	NA	SLOPE Gentle

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5					SL	Sandy loam, dark grey/brown, well drained, moderately structured.	M		TOPSOIL
				0.35				CL	Sandy , grading to clay loam/light clay, light brown, well drained, moderately structured.			RESIDUAL SOIL
			1.0							D		
				1.10				LC	Light clay, reddish brown, well drained, moderately structured.			
			1.5									
				1.70					Hole Terminated at 1.70 m >1.70m: Light Clay/extremely weathered siltstone or shale with soil properties.			
			2.0									
			2.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	PRJM Pty Ltd		COMMENCED	20/01/2017	COMPLETED	20/01/2017	**REF BH004**
PROJECT	Proposed Residential Subdivision		LOGGED	DM	CHECKED	DM	Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW		GEOLOGY		VEGETATION	Grass/Shrubs	PROJECT NO. P1504885
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø75 mm x 1.10 m depth	NORTHING		ASPECT	NA	SLOPE Gentle

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT		Not Encountered	0.5	*0.40*				SL	Sandy loam, dark grey/brown, well drained, moderately structured.	M		TOPSOIL
			1.0	*1.10*				CL	Sandy loam, grading to clay loam/light clay, yellowish brown, well drained, moderately structured.	D		RESIDUAL SOIL
			1.5						Hole Terminated at 1.10 m >1.10m: Light Clay, reddish brown, well drained, moderately structured.			
			2.0									
			2.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	PRJM Pty Ltd		COMMENCED	20/01/2017	COMPLETED	20/01/2017	**REF BH005**
PROJECT	Proposed Residential Subdivision		LOGGED	DM	CHECKED	DM	Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW		GEOLOGY		VEGETATION	Grass/Shrubs	PROJECT NO. P1504885
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.30 m depth	NORTHING		ASPECT	NA	SLOPE Gentle

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5		4885/BH005/0.2/S1 D 0.20 m			SL	Sandy loam, dark grey/brown, well drained, moderately structured.	M		TOPSOIL
				0.35				CL	Sandy loam, grading to clay loam/light clay, light grey brown, well drained, moderately structured.			RESIDUAL SOIL
			1.0		4885/BH005/0.5/S1 D 0.50 m					D		
				1.00				LC	Light clay, reddish brown, well drained, moderately structured, weathered ironstone fragments.			
				1.30					Hole Terminated at 1.30 m >1.30m: Light Clay/extremely weathered siltstone or sandstone with soil properties.			
			1.5									
			2.0									
			2.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

martens

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	PRJM Pty Ltd		COMMENCED	20/01/2017	COMPLETED	20/01/2017	**REF BH006**
PROJECT	Proposed Residential Subdivision		LOGGED	DM	CHECKED	DM	Sheet 1 OF 1
SITE	67 Kurrajong Rd, Kurrajong, NSW		GEOLOGY		VEGETATION	Grass/Shrubs	PROJECT NO. P1504885
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.20 m depth	NORTHING		ASPECT	NA	SLOPE Gentle

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0.5	0.25				SL	Gravelly sandy loam with small gravels, medium brown, well drained, moderately structured.	M		TOPSOIL
				0.40	4885/BH006/0.3/S1 D 0.30 m			CL	Sandy loam, with small gravels, light brown, well drained, moderately structured.			
			1.0		4885/BH006/0.5/S1 D 0.50 m			LC	Clay loam, grading to light clay, brown, well drained, moderately structured, weathered ironstone fragments.	D		RESIDUAL SOIL
				1.20					Hole Terminated at 1.20 m >1.20m: Light Clay/extremely weathered siltstone or sandstone with soil properties.			
			1.5									
			2.0									
			2.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

martens
(C) Copyright Martens & Associates Pty. Ltd.

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

8 Attachment E – Soil Laboratory Results

SESL AUSTRALIA
Environment & Soil Sciences

General Soil Chemistry Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409 **Sample N°: 1** **Date Instructions Received: 22/7/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH012/0.5M**
Description: **Soil**
Test Type: **pHEC_S, ECEC_NH4Cl, EAT, PS**

SUMMARY AND RECOMMENDATIONS

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

EAT = 3.2
Phosphorous Sorption = 633.7

pH & ELECTRICAL CONDUCTIVITY

TEST	RESULT	COMMENTS
pH in water 1:5	5.6	Medium acidity
pH in $CaCl_2$ 1:5	4.3	Extreme acidity
EC dS/m 1:5	0.03	Very low
Chlorides (mg/kg)	-	
AE Buffer pH	7.2	

CATION ANALYSIS

TEST	SOLUBLE	EXCHANGEABLE		
Unit	cmol(+)/kg	cmol(+)/kg	% of ECEC	COMMENTS
Sodium	0.07	0.05	0.7	
Potassium	<0.05	0.04	0.6	
Calcium	<0.005	0.222	3.1	
Magnesium	0.08	1.65	23.1	
Aluminium	N/A	1.21	16.9	
Hydrogen	N/A	5.18	72.5	

Cation Exchange Capacity (cmol(+)/kg)	7.14	
Ca:Mg Ratio	.1	
Sodium Absorbtion Ratio (SAR)	0.5	Low

AVAILABLE NUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Ammonium as N	-	
Nitrate as N	-	
Phosphate as P	-	
Potassium	25	
Sulphate as S	-	
Calcium	45	
Magnesium	211	

AVAILABLE MICRONUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Boron	N.D.	
Copper	N.D.	
Iron	N.D.	
Manganese	N.D.	
Zinc	N.D.	

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). **Aluminium:** Method 3500 APHA (1992). **Phosphate:** Method 9E1 Rayment & Higginson (1992).
Ammonium, Sulphate, Iron, Copper, Manganese + Zinc: Method 83-1 to 83-5 Black (1983). **Boron:** Method 12C2 Rayment & Higginson (1992).

NOTE:
* Chloride only determined if EC(1:5) is >0.25 dS/m
** Al only determined if pH in $CaCl_2$ is <= 5.2

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated
3/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

General Soil Chemistry Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409 **Sample N°: 2** **Date Instructions Received: 22/7/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH014/0.5M**
Description: **Soil**
Test Type: **pHEC_S, ECEC_NH4Cl, EAT, PS**

SUMMARY AND RECOMMENDATIONS

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

EAT = 3.2
Phosphorous Sorption = 670.4

pH & ELECTRICAL CONDUCTIVITY

TEST	RESULT	COMMENTS
pH in water 1:5	5.6	Medium acidity
pH in $CaCl_2$ 1:5	4.3	Extreme acidity
EC dS/m 1:5	0.03	Very low
Chlorides (mg/kg)	-	
AE Buffer pH	7.3	

CATION ANALYSIS

TEST	SOLUBLE	EXCHANGEABLE		
Unit	cmol(+)/kg	cmol(+)/kg	% of ECEC	COMMENTS
Sodium	0.07	0.11	1.2	
Potassium	<0.05	0.048	0.5	
Calcium	<0.005	0.074	0.8	
Magnesium	0.01	4.17	46.9	
Aluminium	N/A	1.75	19.7	
Hydrogen	N/A	4.49	50.5	

Cation Exchange Capacity (cmol(+)/kg)	8.89	
Ca:Mg Ratio	<0.05	
Sodium Absorbtion Ratio (SAR)	1.4	Low

AVAILABLE NUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Ammonium as N	-	
Nitrate as N	-	
Phosphate as P	-	
Potassium	18.7	
Sulphate as S	-	
Calcium	15	
Magnesium	508	

AVAILABLE MICRONUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Boron	N.D.	
Copper	N.D.	
Iron	N.D.	
Manganese	N.D.	
Zinc	N.D.	

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). **Aluminium:** Method 3500 APHA (1992). **Phosphate:** Method 9E1 Rayment & Higginson (1992).
Ammonium, Sulphate, Iron, Copper, Manganese + Zinc: Method 83-1 to 83-5 Black (1983). **Boron:** Method 12C2 Rayment & Higginson (1992).

NOTE:
* Chloride only determined if EC(1:5) is >0.25 dS/m
** Al only determined if pH in $CaCl_2$ is <= 5.2

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated
3/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

General Soil Chemistry Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409 **Sample N°: 3** **Date Instructions Received: 22/7/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH017/0.2M**
Description: **Soil**
Test Type: **pHEC_S, ECEC_NH4Cl, EAT, PS**

SUMMARY AND RECOMMENDATIONS

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

EAT = 5
Phosphorous Sorption = 753.2

pH & ELECTRICAL CONDUCTIVITY

TEST	RESULT	COMMENTS
pH in water 1:5	5.4	Strong acidity
pH in $CaCl_2$ 1:5	4.3	Extreme acidity
EC dS/m 1:5	0.07	Very low
Chlorides (mg/kg)	-	
AE Buffer pH	6.6	

CATION ANALYSIS

TEST	SOLUBLE	EXCHANGEABLE		
Unit	cmol(+)/kg	cmol(+)/kg	% of ECEC	COMMENTS
Sodium	0.11	0.092	0.9	
Potassium	<0.05	0.249	2.3	
Calcium	0.01	0.593	5.6	
Magnesium	0.06	1.07	10.1	
Aluminium	N/A	2.2	20.8	
Hydrogen	N/A	8.55	80.7	

Cation Exchange Capacity (cmol(+)/kg)	10.6	
Ca:Mg Ratio	.5	
Sodium Absorbtion Ratio (SAR)	0.8	Low

AVAILABLE NUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Ammonium as N	-	
Nitrate as N	-	
Phosphate as P	-	
Potassium	111	
Sulphate as S	-	
Calcium	121	
Magnesium	136	

AVAILABLE MICRONUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Boron	N.D.	
Copper	N.D.	
Iron	N.D.	
Manganese	N.D.	
Zinc	N.D.	

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). **Aluminium:** Method 3500 APHA (1992). **Phosphate:** Method 9E1 Rayment & Higginson (1992).
Ammonium, Sulphate, Iron, Copper, Manganese + Zinc: Method 83-1 to 83-5 Black (1983). **Boron:** Method 12C2 Rayment & Higginson (1992).

NOTE:
* Chloride only determined if EC(1:5) is >0.25 dS/m
** Al only determined if pH in $CaCl_2$ is <= 5.2

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated
3/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

General Soil Chemistry Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409 **Sample N°: 4** **Date Instructions Received: 22/7/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH017/0.5M**
Description: **Soil**
Test Type: **pHEC_S, ECEC_NH4Cl, EAT, PS**

SUMMARY AND RECOMMENDATIONS

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

EAT = 3.1
Phosphorous Sorption = 729.6

pH & ELECTRICAL CONDUCTIVITY

TEST	RESULT	COMMENTS
pH in water 1:5	5.5	Strong acidity
pH in $CaCl_2$ 1:5	4.2	Extreme acidity
EC dS/m 1:5	0.05	Very low
Chlorides (mg/kg)	-	
AE Buffer pH	7	

CATION ANALYSIS

TEST	SOLUBLE	EXCHANGEABLE		
Unit	cmol(+)/kg	cmol(+)/kg	% of ECEC	COMMENTS
Sodium	0.12	0.123	1.3	
Potassium	<0.05	0.173	1.8	
Calcium	<0.005	0.24	2.5	
Magnesium	0.07	2.71	28.4	
Aluminium	N/A	1.51	15.8	
Hydrogen	N/A	6.3	66	

Cation Exchange Capacity (cmol(+)/kg)	9.55	
Ca:Mg Ratio	.1	
Sodium Absorbtion Ratio (SAR)	0.9	Low

AVAILABLE NUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Ammonium as N	-	
Nitrate as N	-	
Phosphate as P	-	
Potassium	75.6	
Sulphate as S	-	
Calcium	48	
Magnesium	338	

AVAILABLE MICRONUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Boron	N.D.	
Copper	N.D.	
Iron	N.D.	
Manganese	N.D.	
Zinc	N.D.	

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). **Aluminium:** Method 3500 APHA (1992). **Phosphate:** Method 9E1 Rayment & Higginson (1992).
Ammonium, Sulphate, Iron, Copper, Manganese + Zinc: Method 83-1 to 83-5 Black (1983). **Boron:** Method 12C2 Rayment & Higginson (1992).

NOTE:
* Chloride only determined if EC(1:5) is >0.25 dS/m
** Al only determined if pH in $CaCl_2$ is <= 5.2

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated
3/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

General Soil Chemistry Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409 **Sample N°: 5** **Date Instructions Received: 22/7/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH017/1.2M**
Description: **Soil**
Test Type: **pHEC_S, ECEC_NH4Cl, EAT, PS**

SUMMARY AND RECOMMENDATIONS

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

EAT = 3.1
Phosphorous Sorption = 757.4

pH & ELECTRICAL CONDUCTIVITY

TEST	RESULT	COMMENTS
pH in water 1:5	5.1	Strong acidity
pH in $CaCl_2$ 1:5	4.3	Extreme acidity
EC dS/m 1:5	0.07	Very low
Chlorides (mg/kg)	-	
AE Buffer pH	7.1	

CATION ANALYSIS

TEST	SOLUBLE	EXCHANGEABLE		
Unit	cmol(+)/kg	cmol(+)/kg	% of ECEC	COMMENTS
Sodium	0.17	0.111	1.2	
Potassium	<0.05	0.077	0.8	
Calcium	<0.005	0.124	1.4	
Magnesium	0.07	3.13	34.3	
Aluminium	N/A	1.52	16.7	
Hydrogen	N/A	5.68	62.3	

Cation Exchange Capacity (cmol(+)/kg)	9.12	
Ca:Mg Ratio	<0.05	
Sodium Absorbtion Ratio (SAR)	1.3	Low

AVAILABLE NUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Ammonium as N	-	
Nitrate as N	-	
Phosphate as P	-	
Potassium	30.3	
Sulphate as S	-	
Calcium	25	
Magnesium	389	

AVAILABLE MICRONUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Boron	N.D.	
Copper	N.D.	
Iron	N.D.	
Manganese	N.D.	
Zinc	N.D.	

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). **Aluminium:** Method 3500 APHA (1992). **Phosphate:** Method 9E1 Rayment & Higginson (1992).
Ammonium, Sulphate, Iron, Copper, Manganese + Zinc: Method 83-1 to 83-5 Black (1983). **Boron:** Method 12C2 Rayment & Higginson (1992).

NOTE:
* Chloride only determined if EC(1:5) is >0.25 dS/m
** Al only determined if pH in $CaCl_2$ is <= 5.2

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated
3/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

General Soil Chemistry Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409 **Sample N°: 6** **Date Instructions Received: 22/7/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH019/0.5M**
Description: **Soil**
Test Type: **pHEC_S, ECEC_NH4Cl, EAT, PS**

SUMMARY AND RECOMMENDATIONS

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

EAT = 4
Phosphorous Sorption = 694.6

pH & ELECTRICAL CONDUCTIVITY

TEST	RESULT	COMMENTS
pH in water 1:5	5.5	Strong acidity
pH in $CaCl_2$ 1:5	4.3	Extreme acidity
EC dS/m 1:5	0.04	Very low
Chlorides (mg/kg)	-	
AE Buffer pH	7.2	

CATION ANALYSIS

TEST	SOLUBLE	EXCHANGEABLE		
Unit	cmol(+)/kg	cmol(+)/kg	% of ECEC	COMMENTS
Sodium	0.1	0.111	1.3	
Potassium	<0.05	0.062	0.7	
Calcium	<0.005	0.262	3	
Magnesium	0.02	3.55	40.7	
Aluminium	N/A	1.54	17.7	
Hydrogen	N/A	4.74	54.3	

Cation Exchange Capacity (cmol(+)/kg)	8.73	
Ca:Mg Ratio	.1	
Sodium Absorbtion Ratio (SAR)	1.6	Low

AVAILABLE NUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Ammonium as N	-	
Nitrate as N	-	
Phosphate as P	-	
Potassium	20.5	
Sulphate as S	-	
Calcium	53	
Magnesium	433	

AVAILABLE MICRONUTRIENT PROFILE

TEST	mg/kg	COMMENTS
Boron	N.D.	
Copper	N.D.	
Iron	N.D.	
Manganese	N.D.	
Zinc	N.D.	

Explanation of the Methods:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). **Exchangeable Cations, ECEC:** Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). **Aluminium:** Method 3500 APHA (1992). **Phosphate:** Method 9E1 Rayment & Higginson (1992).
Ammonium, Sulphate, Iron, Copper, Manganese + Zinc: Method 83-1 to 83-5 Black (1983). **Boron:** Method 12C2 Rayment & Higginson (1992).

NOTE:
* Chloride only determined if EC(1:5) is >0.25 dS/m
** Al only determined if pH in $CaCl_2$ is <= 5.2

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated
3/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

Multiple Analysis Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409A **Sample N°: 1** **Date Instructions Received: 4/8/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH012/0.5M**
Description: **Soil**
Test Type: **PRI**

Analysis	Unit	Result
Phosphate Retention Index (PRI)	mg/kg	1640

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated
7/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

Multiple Analysis Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409A **Sample N°: 2** **Date Instructions Received: 4/8/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH014/0.5M**
Description: **Soil**
Test Type: **PRI**

Analysis	Unit	Result
Phosphate Retention Index (PRI)	mg/kg	1470

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated 7/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

Multiple Analysis Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409A **Sample N°: 3** **Date Instructions Received: 4/8/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH017/0.2M**
Description: **Soil**
Test Type: **PRI**

Analysis	Unit	Result
Phosphate Retention Index (PRI)	mg/kg	2510

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated 7/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

Multiple Analysis Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409A **Sample N°: 4** **Date Instructions Received: 4/8/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH017/0.5M**
Description: **Soil**
Test Type: **PRI**

Analysis	Unit	Result
Phosphate Retention Index (PRI)	mg/kg	2130

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated
7/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

Multiple Analysis Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409A **Sample N°: 5** **Date Instructions Received: 4/8/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH017/1.2M**
Description: **Soil**
Test Type: **PRI**

Analysis	Unit	Result
Phosphate Retention Index (PRI)	mg/kg	2170

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated 7/08/2020

SESL AUSTRALIA
Environment & Soil Sciences

Multiple Analysis Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 57409A **Sample N°: 6** **Date Instructions Received: 4/8/20** **Report Status: Final**

Client Name: **Martens & Associates Pty Ltd**
Client Contact: **Michael Dumas**
Client Order N°: **P1706231**
Address: **Suite 201, 20 George St**
Hornsby NSW 2077

Project Name: **P1706231- Kurrajong**
SESL Quote N°:
Sample Name: **6231/BH019/0.5M**
Description: **Soil**
Test Type: **PRI**

Analysis	Unit	Result
Phosphate Retention Index (PRI)	mg/kg	1500

Recommendations not requested.

Analysed by SESL Australia Pty Ltd (NATA #15633).

Consultant: Owen Guy

Authorised Signatory: Chantal Milner

Date Report Generated
7/08/2020

Effluent Subdivison Profile

SESL AUSTRALIA
Environment & Soil Sciences

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Mailing Address: PO Box 357
Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 42071 **Sample N°: 1** **Date Received: 27/1/17** **Report Status:** ○ Draft ◉ Final

Client Name: **Martens & Associates**
Client Contact: **Michael Huan**
Client Job N°: **P1605670COC01V01**
Client Order N°:
Address: **Suite 201, 20 George St HORNSBY NSW 2077**

Project Name: **P1504885: Geotechnical/Wastewater Assessment**
SESL Quote N°:
Sample Name: **4885/BH001/0.3/S1**
Description: **Soil**
Test Type: **pH_Sol, ECEC_NH4Cl, PRI, BD_4419, EAT**

TEST	RESULT	COMMENTS
pH in water 1:5	5.0	
pH in $CaCl_2$ 1:5	4.7	
EC dS/m 1:5	0.08	Very low

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
	meq%	Comment	meq%	% of ECEC	Comment
Sodium	0.03		0	0	
Potassium	<0.05		0.147	1.5	
Calcium	0.02		0.743	7.6	
Magnesium	0.05		0.778	8	
Aluminium			1.38	14.1	
		ECEC	9.78		
		Ca/Mg	1.5		

Phosphate Retention Index (%): 60.20 Medium **PRI (mgP/kg):** 3080.0 **PRI (kg/ha):** 6006 to 150 mm

PHYSICAL CHARACTERISTICS **Comment**

Texture: -
Colour: -
Size: -
Aggregate strength: -
Structural unit: Did not test
Approx. Clay Content (%): Did not test
Potential infiltration rate: Did not test
Gravel Content: Soil is
Additional comments:

Field Density (g/mL): 1.15 mg/L
Emerson Stability Class: H20 CLASS 6
High SAR/Low Iconic Strength:
Med SAR/High Iconic Strength:

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

Method references:

Bulk density: AS4419:2003

No commentary requested from SESL Australia

Method References:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). Exchangeable Cations, ECEC: Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). Aluminium: Method 3500 APHA (1992). Phosphate: 9H1 of Rayment & Lyons. Wax Block Density: Method 30-4 Black (1983), Emerson's Aggregate Test: Charman & Murphy (1991), Particle Size Analysis: Modified Black (1983) Method 43-1 to 43-6. Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

Consultant: Kelly Lee

Authorised Signatory: Ryan Jacka

Date Report Generated
1/02/2017

Effluent Subdivison Profile

SESL AUSTRALIA
Environment & Soil Sciences

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Mailing Address: PO Box 357
Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 42071 **Sample N°: 2** **Date Received: 27/1/17** **Report Status:** ○ Draft ◉ Final

Client Name: **Martens & Associates**
Client Contact: **Michael Huan**
Client Job N°: **P1605670COC01V01**
Client Order N°:
Address: **Suite 201, 20 George St HORNSBY NSW 2077**

Project Name: **P1504885: Geotechnical/Wastewater Assessment**
SESL Quote N°:
Sample Name: **4885/BH001/0.6/S1**
Description: **Soil**
Test Type: **pH_Sol, ECEC_NH4Cl, PRI, BD_4419, EAT**

TEST	RESULT	COMMENTS
pH in water 1:5	5.1	
pH in $CaCl_2$ 1:5	4.8	
EC dS/m 1:5	0.07	Very low

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
	meq%	Comment	meq%	% of ECEC	Comment
Sodium	0.05		0.002	0	
Potassium	<0.05		0.088	1	
Calcium	0.01		0.591	6.5	
Magnesium	0.07		2.14	23.6	
Aluminium			0.345	3.8	
		ECEC	9.06		
		Ca/Mg	.4		

Phosphate Retention Index (%): 47.20 Medium **PRI (mgP/kg):** 2540.0 **PRI (kg/ha):** 4953 to 150 mm

PHYSICAL CHARACTERISTICS **Comment**

Texture: -
Colour: -
Size: -
Aggregate strength: -
Structural unit: Did not test
Approx. Clay Content (%): Did not test
Potential infiltration rate: Did not test
Gravel Content: Soil is
Additional comments:

Field Density (g/mL): 1.20 mg/L
Emerson Stability Class: H20 CLASS 6
High SAR/Low Iconic Strength:
Med SAR/High Iconic Strength:

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

Method references:

Bulk density: AS4419:2003

No commentary requested from SESL Australia

Method References:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). Exchangeable Cations, ECEC: Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). Aluminium: Method 3500 APHA (1992). Phosphate: 9H1 of Rayment & Lyons. Wax Block Density: Method 30-4 Black (1983), Emerson's Aggregate Test: Charman & Murphy (1991), Particle Size Analysis: Modified Black (1983) Method 43-1 to 43-6. Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

Consultant: Kelly Lee

Authorised Signatory: Ryan Jacka

Date Report Generated
1/02/2017

Effluent Subdivison Profile

SESL AUSTRALIA
Environment & Soil Sciences

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 42071 **Sample N°: 3** **Date Received: 27/1/17** **Report Status:** ○ Draft ◉ Final

Client Name:	**Martens & Associates**	Project Name:	**P1504885: Geotechnical/Wastewater Assessment**
Client Contact:	**Michael Huan**	SESL Quote N°:	
Client Job N°:	**P1605670COC01V01**	Sample Name:	**4885/BH005/0.2/S1**
Client Order N°:		Description:	**Soil**
Address:	**Suite 201, 20 George St HORNSBY NSW 2077**	Test Type:	**pH_Sol, ECEC_NH4Cl, PRI, BD_4419, EAT**

TEST	RESULT	COMMENTS
pH in water 1:5	5.1	
pH in $CaCl_2$ 1:5	4.7	
EC dS/m 1:5	0.07	Very low

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
	meq%	Comment	meq%	% of ECEC	Comment
Sodium	0.04		0.019	0.2	
Potassium	<0.05		0.208	2	
Calcium	0.02		0.749	7.1	
Magnesium	0.06		0.843	8	
Aluminium			1.3	12.3	
		ECEC	10.6		
		Ca/Mg	1.4		

Phosphate Retention Index (%): 63.40 High **PRI (mgP/kg):** 3210.0 **PRI (kg/ha):** 6259.5 to 150 mm

PHYSICAL CHARACTERISTICS **Comment**

Texture:	-	**Field Density (g/mL):**	1.06 mg/L
Colour:	-	**Emerson Stability Class:**	H20 CLASS 7
Size:	-	**High SAR/Low Iconic Strength:**	
Aggregate strength:	-	**Med SAR/High Iconic Strength:**	
Structural unit:	Did not test	**Particle Size Analysis (PSA)**	
Approx. Clay Content (%):	Did not test	> 2mm	Gravel
Potential infiltration rate:	Did not test	2 - 0.2 mm	Coarse Sand
Gravel Content:	Soil is	0.2 - 0.02 mm	Fine Sand
Additional comments:		0.02 - 0.002 mm	Silt
		< 0.002 mm	Clay

Recommendations

Method references:

Bulk density: AS4419:2003

No commentary requested from SESL Australia

Method References:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). Exchangeable Cations, ECEC: Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). Aluminium: Method 3500 APHA (1992). Phosphate: 9H1 of Rayment & Lyons. Wax Block Density: Method 30-4 Black (1983), Emerson's Aggregate Test: Charman & Murphy (1991), Particle Size Analysis: Modified Black (1983) Method 43-1 to 43-6. Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

Consultant: Kelly Lee

Authorised Signatory: Ryan Jacka

Date Report Generated
1/02/2017

Effluent Subdivison Profile

SESL AUSTRALIA
Environment & Soil Sciences

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 42071 **Sample N°: 4** **Date Received: 27/1/17** **Report Status:** ○ Draft ◉ Final

Client Name:	**Martens & Associates**	Project Name:	**P1504885: Geotechnical/Wastewater Assessment**
Client Contact:	**Michael Huan**	SESL Quote N°:	
Client Job N°:	**P1605670COC01V01**	Sample Name:	**4885/BH005/0.5/S1**
Client Order N°:		Description:	**Soil**
Address:	**Suite 201, 20 George St HORNSBY NSW 2077**	Test Type:	**pH_Sol, ECEC_NH4Cl, PRI, BD_4419, EAT**

TEST	RESULT	COMMENTS
pH in water 1:5	5.1	
pH in $CaCl_2$ 1:5	4.6	
EC dS/m 1:5	0.07	Very low

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
	meq%	Comment	meq%	% of ECEC	Comment
Sodium	0.07		0.03	0.3	
Potassium	<0.05		0.132	1.4	
Calcium	0.01		0.348	3.6	
Magnesium	0.07		1.55	16.2	
Aluminium			1.18	12.4	
		ECEC	9.55		
		Ca/Mg	.4		

Phosphate Retention Index (%): 64.80 High **PRI (mgP/kg):** 2930.0 **PRI (kg/ha):** 5713.5 to 150 mm

PHYSICAL CHARACTERISTICS			Comment
Texture:	-	**Field Density (g/mL):**	1.23 mg/L
Colour:	-	**Emerson Stability Class:** H20 CLASS 6	
Size:	-	**High SAR/Low Iconic Strength:**	
Aggregate strength:	-	**Med SAR/High Iconic Strength:**	
Structural unit:	Did not test	**Particle Size Analysis (PSA)**	
Approx. Clay Content (%):	Did not test	> 2mm Gravel	
Potential infiltration rate:	Did not test	2 - 0.2 mm Coarse Sand	
Gravel Content:	Soil is	0.2 - 0.02 mm Fine Sand	
Additional comments:		0.02 - 0.002 mm Silt	
		< 0.002 mm Clay	

Recommendations

Method references:

Bulk density: AS4419:2003

No commentary requested from SESL Australia

Method References:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). Exchangeable Cations, ECEC: Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). Aluminium: Method 3500 APHA (1992). Phosphate: 9H1 of Rayment & Lyons. Wax Block Density: Method 30-4 Black (1983), Emerson's Aggregate Test: Charman & Murphy (1991), Particle Size Analysis: Modified Black (1983) Method 43-1 to 43-6. Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

Consultant: Kelly Lee

Authorised Signatory: Ryan Jacka

Date Report Generated
1/02/2017

Effluent Subdivison Profile

SESL AUSTRALIA
Environment & Soil Sciences

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 42071 **Sample N°: 5** **Date Received: 27/1/17** **Report Status:** ○ Draft ◉ Final

Client Name: **Martens & Associates**
Client Contact: **Michael Huan**
Client Job N°: **P1605670COC01V01**
Client Order N°:
Address: **Suite 201, 20 George St HORNSBY NSW 2077**

Project Name: **P1504885: Geotechnical/Wastewater Assessment**
SESL Quote N°:
Sample Name: **4885/BH006/0.3/S1**
Description: **Soil**
Test Type: **pH_Sol, ECEC_NH4Cl, PRI, BD_4419, EAT**

TEST	RESULT	COMMENTS
pH in water 1:5	5.0	
pH in $CaCl_2$ 1:5	4.6	
EC dS/m 1:5	0.07	Very low

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
	meq%	Comment	meq%	% of ECEC	Comment
Sodium	0.03		0.001	0	
Potassium	<0.05		0.108	1.2	
Calcium	0.01		0.6	6.4	
Magnesium	0.04		0.533	5.7	
Aluminium			1.94	20.8	
		ECEC	9.35		
		Ca/Mg	1.8		

Phosphate Retention Index (%): 49.90 Medium **PRI (mgP/kg):** 2580.0 **PRI (kg/ha):** 5031 to 150 mm

PHYSICAL CHARACTERISTICS **Comment**

Texture: -
Colour: -
Size: -
Aggregate strength: -
Structural unit: Did not test
Approx. Clay Content (%): Did not test
Potential infiltration rate: Did not test
Gravel Content: Soil is
Additional comments:

Field Density (g/mL): 1.15 mg/L
Emerson Stability Class: H20 CLASS 7
High SAR/Low Iconic Strength:
Med SAR/High Iconic Strength:

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

Method references:

Bulk density: AS4419:2003

No commentary requested from SESL Australia

Method References:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). Exchangeable Cations, ECEC: Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). Aluminium: Method 3500 APHA (1992). Phosphate: 9H1 of Rayment & Lyons. Wax Block Density: Method 30-4 Black (1983), Emerson's Aggregate Test: Charman & Murphy (1991), Particle Size Analysis: Modified Black (1983) Method 43-1 to 43-6. Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

Consultant: Kelly Lee

Authorised Signatory: Ryan Jacka

Date Report Generated
1/02/2017

Effluent Subdivison Profile

SESL AUSTRALIA
Environment & Soil Sciences

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 42071 **Sample N°: 6** **Date Received: 27/1/17** **Report Status:** ○ Draft ◉ Final

Client Name: **Martens & Associates**
Client Contact: **Michael Huan**
Client Job N°: **P1605670COC01V01**
Client Order N°:
Address: **Suite 201, 20 George St HORNSBY NSW 2077**

Project Name: **P1504885: Geotechnical/Wastewater Assessment**
SESL Quote N°:
Sample Name: **4885/BH006/0.5/S1**
Description: **Soil**
Test Type: **pH_Sol, ECEC_NH4Cl, PRI, BD_4419, EAT**

TEST	RESULT	COMMENTS
pH in water 1:5	5.3	
pH in $CaCl_2$ 1:5	4.7	
EC dS/m 1:5	0.05	Very low

CATION ANALYSIS

TEST	SOLUBLE		EXCHANGEABLE		
	meq%	Comment	meq%	% of ECEC	Comment
Sodium	0.03		0	0	
Potassium	<0.05		0.018	0.3	
Calcium	<0.005		0.224	3.2	
Magnesium	0.09		1.15	16.4	
Aluminium			0.44	6.3	
		ECEC	7.01		
		Ca/Mg	.3		

Phosphate Retention Index (%): 37.60 Medium **PRI (mgP/kg):** 1800.0 **PRI (kg/ha):** 3510 to 150 mm

PHYSICAL CHARACTERISTICS **Comment**

Texture: -
Colour: -
Size: -
Aggregate strength: -
Structural unit: Did not test
Approx. Clay Content (%): Did not test
Potential infiltration rate: Did not test
Gravel Content: Soil is
Additional comments:

Field Density (g/mL): 1.51 mg/L
Emerson Stability Class: H20 CLASS 6
High SAR/Low Iconic Strength:
Med SAR/High Iconic Strength:

Particle Size Analysis (PSA)

> 2mm	Gravel
2 - 0.2 mm	Coarse Sand
0.2 - 0.02 mm	Fine Sand
0.02 - 0.002 mm	Silt
< 0.002 mm	Clay

Recommendations

Method references:

Bulk density: AS4419:2003

No commentary requested from SESL Australia

Method References:
pH, EC, Soluble Cations, Nitrate: Bradley et al (1983). Exchangeable Cations, ECEC: Method 15A1 Rayment & Higginson (1992)
Chloride: Vogel (1961). Aluminium: Method 3500 APHA (1992). Phosphate: 9H1 of Rayment & Lyons. Wax Block Density: Method 30-4 Black (1983), Emerson's Aggregate Test: Charman & Murphy (1991), Particle Size Analysis: Modified Black (1983) Method 43-1 to 43-6. Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

Consultant: Kelly Lee

Authorised Signatory: Ryan Jacka

Date Report Generated
1/02/2017

9 Attachment F – Nutrient Balance

Effluent Disposal Field - Annual Nutrient Balance Assessment

Method ST-14 Revised 20.3.2007

6/37 Leighton Place, Hornsby, NSW 2077, Ph: (02) 9476 999 Fax: (02) 9476 8767, mail@martens.com.au, www.martens.com.au

PROJECT DETAILS

Project	Subdivision of 67 Kurrajong Road, Kurrajong, NSW			Ref. No.	P1706231JS06V03
Author	MGD/DMM	Reviewed	DMM	Date Created	7/09/2019

STEP 1 : ENTER SITE AND FIELD CHARACTERISTICS

FACTOR	Enter Data	Unit
Treatment System	Aquacell MBR	-
Effluent flow rate	15800	L/day
Effluent N	15.0	mg/L
Effluent P	9.0	mg/L
Design soil depth	1.00	m
Soil P-sorption	1903.0	mg/kg
Plant N uptake	200.0	kg/ha/year
Plant P uptake	20.0	kg/ha/year

STEP 2 : ASSESSMENT

NITROGEN BUDGET FOR DISPOSAL FIELD

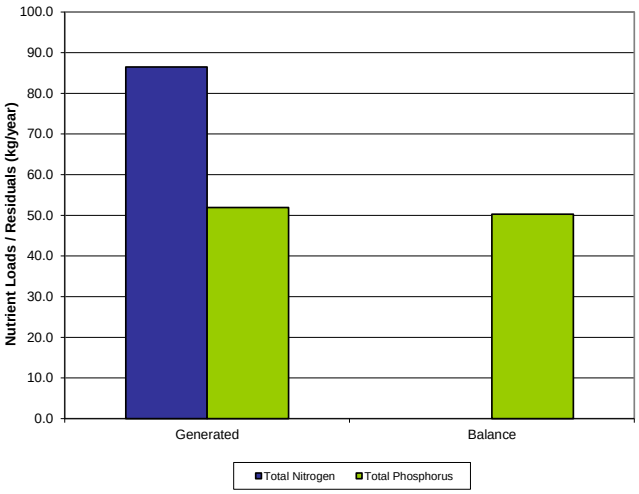
N generated	86.51	kg/year
N consumed	86.51	kg/year
N balance	0.00	kg/year
Passive Uptake	4325	m^2

PHOSPHORUS BUDGET FOR DISPOSAL FIELD

P generated	51.90	kg/year
P consumed	1.60	kg/year
P balance	50.30	kg/year
P sorption	2515.1	kg P/design soil depth
Field life (for P)	50.0	Years
Passove Uptake	801	m^2

SUMMARY

Passive uptake area	4325	m^2



10 Attachment G – Water Balance

Effluent Disposal Field - Water Balance Assessment

Method:ST-XX Revised 11.8.2010

martens

Suite 201, 20 George St, Hornsby, NSW 2077, Ph: (02) 9476 9999 Fax: (02) 9476 8767, mail@martens.com.au, www.martens.com.au

PROJECT DETAILS **Subdivision of 67 Kurrajong Road, Kurrajong**

Project	Wastewater Assessment: 67 Kurrajong Road, Kurrajong			Ref. No.	P1706231JS09V01
Author	MGD	Reviewed	DMM	Date Created	28/08/2020

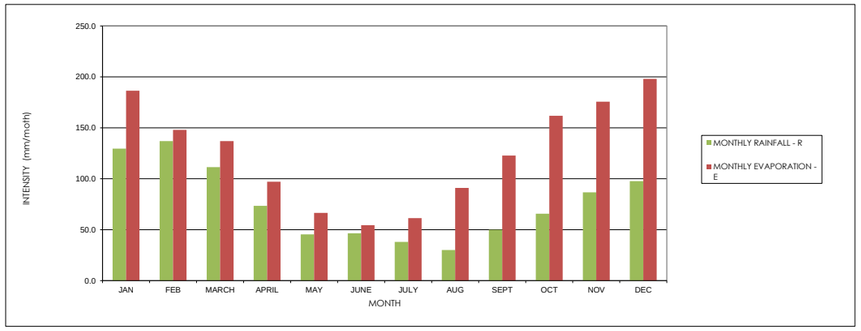
STEP 1 : ENTER SITE AND FIELD CHARACTERISTICS

FACTOR	Enter Data	Unit			
Runoff Factor - RF	0.40	%	Design Irrigation Rate - DLR	30.0	mm/day
Daily Effluent Load - DEL	21000.0	L	Wet-Weather Storage (KL)	0.0	KL
Effluent Disposal Area - A	700.0	m^2			
Design Percolation Rate (DPR)	30.0	mm/day			

STEP 2 : ENTER CLIMATE DATA

Source(s): **Kurrajong Heights, Richmond** Badgerys Creek

MONTH	MONTHLY RAINFALL - R Enter Data	MONTHLY EVAPORATION - E Enter Data
JAN	129.60	186.40
FEB	137.00	148.00
MARCH	111.40	137.00
APRIL	73.40	97.10
MAY	45.40	66.50
JUNE	46.50	54.40
JULY	38.00	61.40
AUG	30.00	91.00
SEPT	50.00	122.80
OCT	65.70	161.80
NOV	86.70	175.70
DEC	97.70	198.10



STEP 3 : ASSESSMENT

MONTH	NUMBER OF DAYS	MONTHLY RAINFALL (mm)	RETAINED RAINFALL	MONTHLY EVAPORATION	CROP FACTOR	EVAPO-TRANSPIRATION RATE	DESIGN PERCOLATION	AVAILABE IRRIGATION CAPACITY	EFFLUENT APPLIED	APPLICATION RATE	INCREASE IN PONDING DEPTH OF EFFLUENT	CUMULATIVE PONDING DEPTH OF EFFLUENT FROM PREVIOUS MONTH	DEPTH OF EFFLUENT	PONDING DEPTH OF EFFLUENT	WET-WEATHER STORAGE REQUIRED
-	(days)	(mm/month)	(mm/month)	(mm/month)	-	(mm/month)	(mm/day)	(mm/month)	(L/month)	(mm/month)	(mm)	(mm)	(mm/month)	(mm)	(KL)
-	DAY	R	RR = R x (1- RF)	E	CF	ETR = E x CF	DP = DPR x DAYS	AIC = ETR - RR +DP	EA = DEL x DAY	AR = EA / A	D = (AIC - AR)	CPD = PD from previous month	DE = D + CPD	PD	WWS
JAN	31	129.60	77.8	186.40	0.85	158.4	930.0	1010.7	651000	930.0	-80.7	0.0	-80.7	**0.0**	**0.0**
FEB	28	137.00	82.2	148.00	0.85	125.8	840.0	883.6	588000	840.0	-43.6	0.0	-43.6	**0.0**	**0.0**
MARCH	31	111.40	66.8	137.00	0.85	116.5	930.0	979.6	651000	930.0	-49.6	0.0	-49.6	**0.0**	**0.0**
APRIL	30	73.40	44.0	97.10	0.70	68.0	900.0	923.9	630000	900.0	-23.9	0.0	-23.9	**0.0**	**0.0**
MAY	31	45.40	27.2	66.50	0.70	46.6	930.0	949.3	651000	930.0	-19.3	0.0	-19.3	**0.0**	**0.0**
JUNE	30	46.50	27.9	54.40	0.70	38.1	900.0	910.2	630000	900.0	-10.2	0.0	-10.2	**0.0**	**0.0**
JULY	31	38.00	22.8	61.40	0.70	43.0	930.0	950.2	651000	930.0	-20.2	0.0	-20.2	**0.0**	**0.0**
AUG	31	30.00	18.0	91.00	0.70	63.7	930.0	975.7	651000	930.0	-45.7	0.0	-45.7	**0.0**	**0.0**
SEPT	30	50.00	30.0	122.80	0.70	86.0	900.0	956.0	630000	900.0	-56.0	0.0	-56.0	**0.0**	**0.0**
OCT	31	65.70	39.4	161.80	0.85	137.5	930.0	1028.1	651000	930.0	-98.1	0.0	-98.1	**0.0**	**0.0**
NOV	30	86.70	52.0	175.70	0.85	149.3	900.0	997.3	630000	900.0	-97.3	0.0	-97.3	**0.0**	**0.0**
DEC	31	97.70	58.6	198.10	0.85	168.4	930.0	1039.8	651000	930.0	-109.8	0.0	-109.8	**0.0**	**0.0**

praktik

a PO Box 876, North Sydney NSW 2059, Australia abn 72 633 727 527
m +61 404 384 389 w www.praktik.com.au e hello@praktik.com.au

Workshop Summary Paper

Document Issue Record

Issue Date	Version	Author	Distributed to	Notes
17/03/2020	A	Sarah Loder	N/A	Preliminary draft for Aquacell internal executive review meeting
25/03/2020	B	Sarah Loder	Colin Fisher, Warren Johnson, Justin Taylor	Draft for client review Results of risk review incorporated
30/03/2020	C	Sarah Loder	Aquacell: Colin Fisher, Warren Johnson, Justin Taylor, Adriana Maras Martens: Grant Harlow NSW Health: James Plant, Stephanie Ferrer	Draft for comment by workshop participants
24/04/2020	D	Sarah Loder	Aquacell	Updated water quality targets (no change to ratings) No comments received from workshop participants
07/ 09/2020	E	Sarah Loder	Aquacell	Edited in response to RFI. Risk register updated to distinguish between preventative, detective and responsive controls. Word 'irrigation' replaced with 'disposal' throughout to better reflect system as designed.

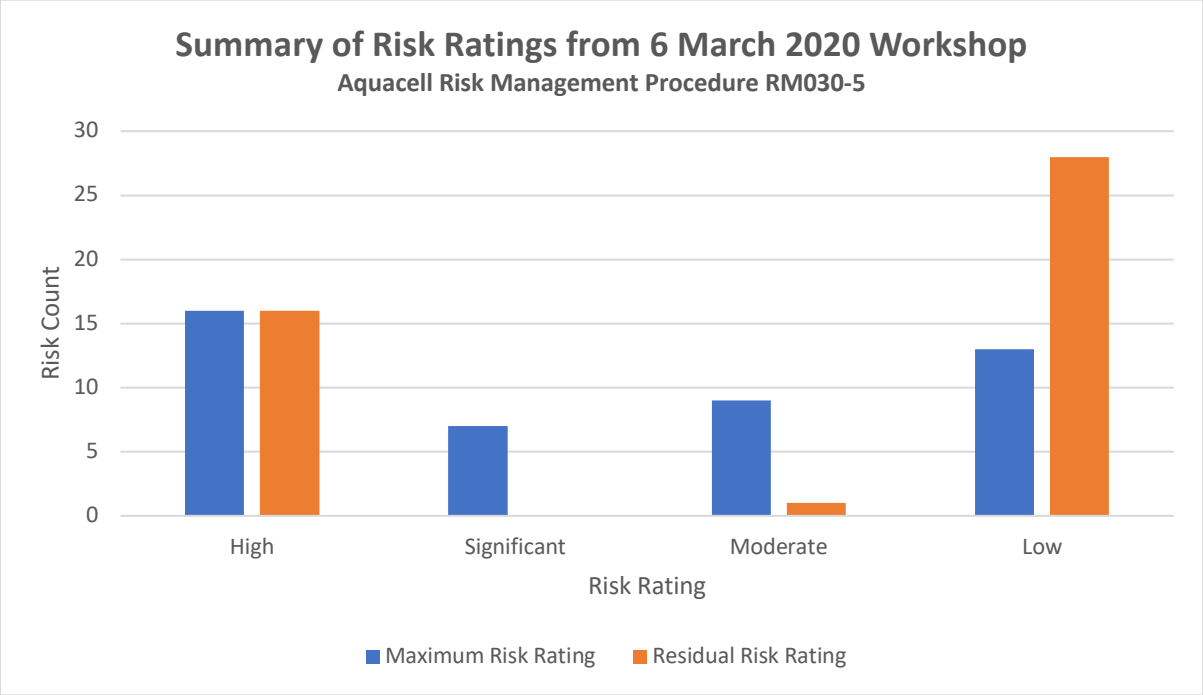
Executive Summary

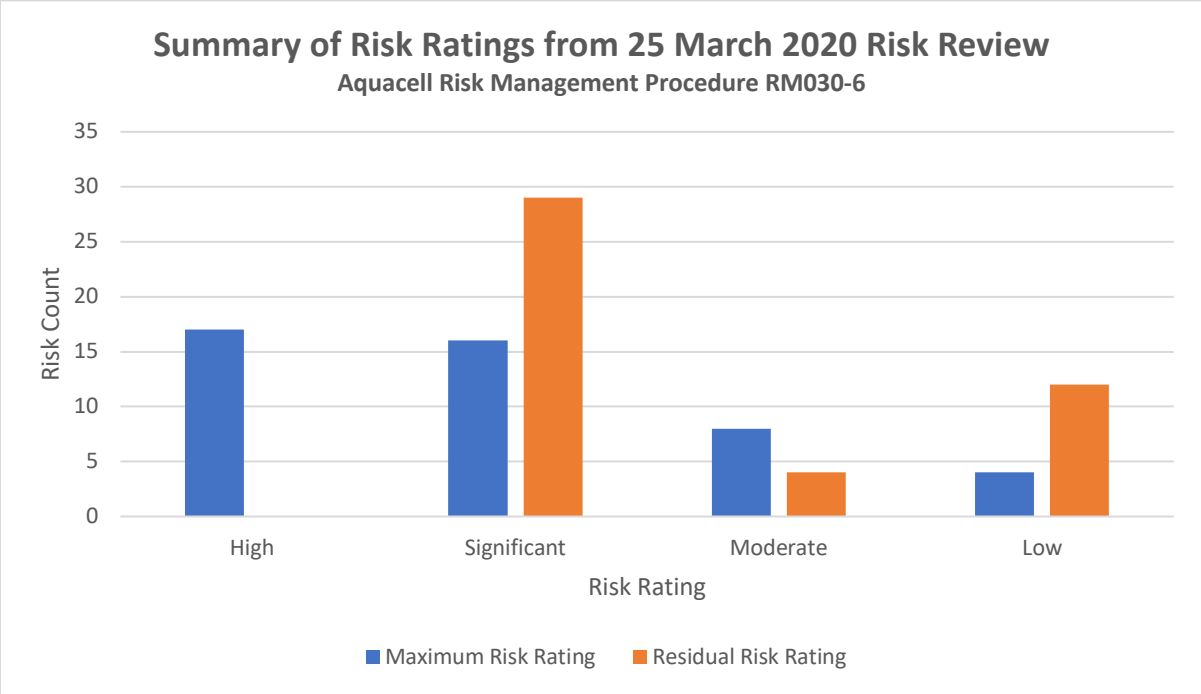
A risk assessment workshop was held on 6 March 2020 with representatives from Aquacell, NSW Health Nepean Blue Mountains Local Health District Public Health Unit and land capability specialist Martens in attendance. Representatives were also invited from NSW Health Water Unit and Hawkesbury City Council but were unable to attend.

The proposed scheme design was presented at the beginning of the workshop, with an update on the revised treated wastewater disposal system. Associated log reduction credits and water quality targets were also presented and discussed. A key outcome of the risk assessment workshop was that no changes to the design or proposed controls were identified as being required to reduce the risks to a tolerable level.

The risk assessment was conducted using Aquacell's current Risk Management Procedure (RM030 version 5). During the workshop it was noted that more events were rated High risk (after preventative measures were applied) than expected given the strength of the controls proposed. The Aquacell methodology was compared with the methodology presented in the Australian Guidelines for Water Recycling (AGWR) and found to be more conservative when High consequence was applied and that the descriptors did not take into account size of population affected therefore all risks with a potential consequence of pathogen exposure were automatically rated High residual risk.

As per Aquacell's Risk Management Procedure, any risks rated High require executive review. At that review it was agreed that the risk ratings could not be further reduced by applying additional controls. It was further determined that the spread of risk ratings, concentrated at the High and Low ends (with no Significant and only one Moderate rated residual risk), did not allow management to adequately prioritise risk management for this scheme. It was therefore decided to review the Aquacell Risk Management Procedure against that presented in the AGWR and review the risks for the 67 Kurrajong Road project accordingly.





1 Workshop Details

The details of the workshop, a list of participants and the agenda for the workshop are presented in Appendix A.

In order to best utilise the available time of participants and focus on the area of the design which had changed, risks associated with treated wastewater disposal were addressed first.

2 Background

2.1 Project Overview

The 67 Kurrajong Road residential community development is a 37 lot (35 home) residential estate, being developed by PRJM Pty Ltd. It is located on the southern side of Kurrajong Road, off Old Bells Line of Road, in the local government area of the City of Hawkesbury.

The Development Application was approved subject to a Network Operator Licence and a Retail Supplier Licence being granted by IPART for a wastewater treatment system with onsite disposal. Potable water is being supplied by Sydney Water's existing potable water reticulation system. There is no effluent reuse or recycling proposed for this site, only treated wastewater disposal. The treated effluent is to be discharged to the environment via subsurface absorption trenches in a dedicated disposal area, in compliance with the Water Industry Competition Act 2006 (WICA).

While it was originally proposed to dispose of the treated wastewater via sub-surface irrigation on a dedicated area of each residential lot, the concept design has since been amended with subsurface disposal to absorption trenches in a segregated wastewater disposal area.

2.2 System Description

The following table outlines the intended users, uses and potential misuses of the wastewater generated by the scheme.

Table 2-1: Intended uses and potential misuses

Item	Category	Description
Users	Network operator	Human contact with the treated wastewater is limited to wastewater infrastructure operators (risk to be managed through work health safety measures).
Intended Use	Disposal of treated wastewater	Subsurface disposal to absorption trenches. Although the water quality may exceed the requirements for this end use, it is not intended for reuse or disposal by any other means.
Potential Misuse	Health Impact – Acute Exposure Risks	Failure of sewerage infrastructure and discharge of treated / untreated wastewater.
	Health Impact – Chronic Exposure Risks	Potential chemical and microbiological impacts.
	Environmental Risks	Nutrient release. Salinity. Overapplication (water table impacts etc).

A summary description of the system is provided in Table 2-2 and the following drawings (as current at the time of the workshop).

Table 2-2: Product and process description

Element	Description
Product:	Treated wastewater
Source:	Raw sewage will be received from the sewer catchment made up of domestic inputs. Sewage collected from the homes on the site will flow by gravity through the sewage network to 2 x 107 kL Buffer Tanks (equivalent to more than 13 days' storage when the residential community is fully populated).
Treatment:	Raw sewage will be treated at an on-site Sewage Treatment Plant consisting of the following proposed treatment steps: • Pre-screen (2mm spiral sieve screen) • Biological treatment (aerobic digestion) • Membrane filtration (ultrafiltration) • UV disinfection
Storage/ Transfer:	The final treated water will be sent to a 65 kL Treated Wastewater Storage Tank. There will be no dual pipe system nor any above ground taps that are fed with treated effluent anywhere in the development. Reuse is not permitted, and the disposal network will be largely inaccessible, underground and sign posted.
Disposal:	Subsurface disposal to absorption trenches in a segregated area on-site with buffer zones as follows: • 1.5 m to buildings and site boundaries if upslope of the disposal area. • 6 m to buildings and site boundaries if downslope of the disposal area.

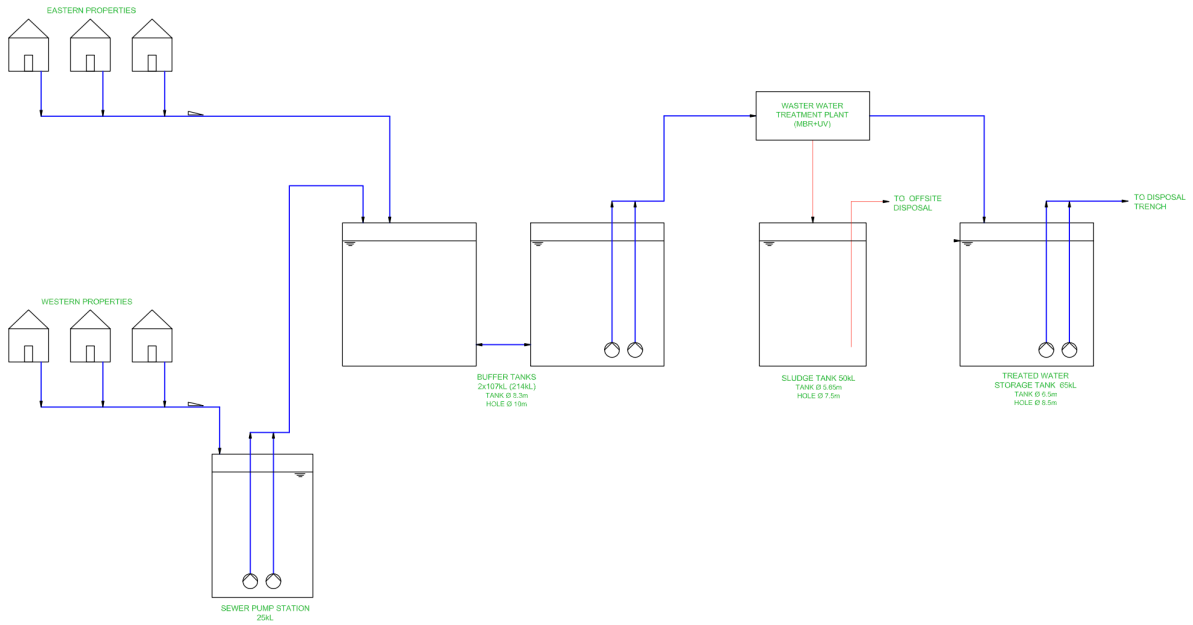


Figure 2-1: Process flow diagram for the proposed scheme at 67 Kurrajong Road (Source: Aquacell)

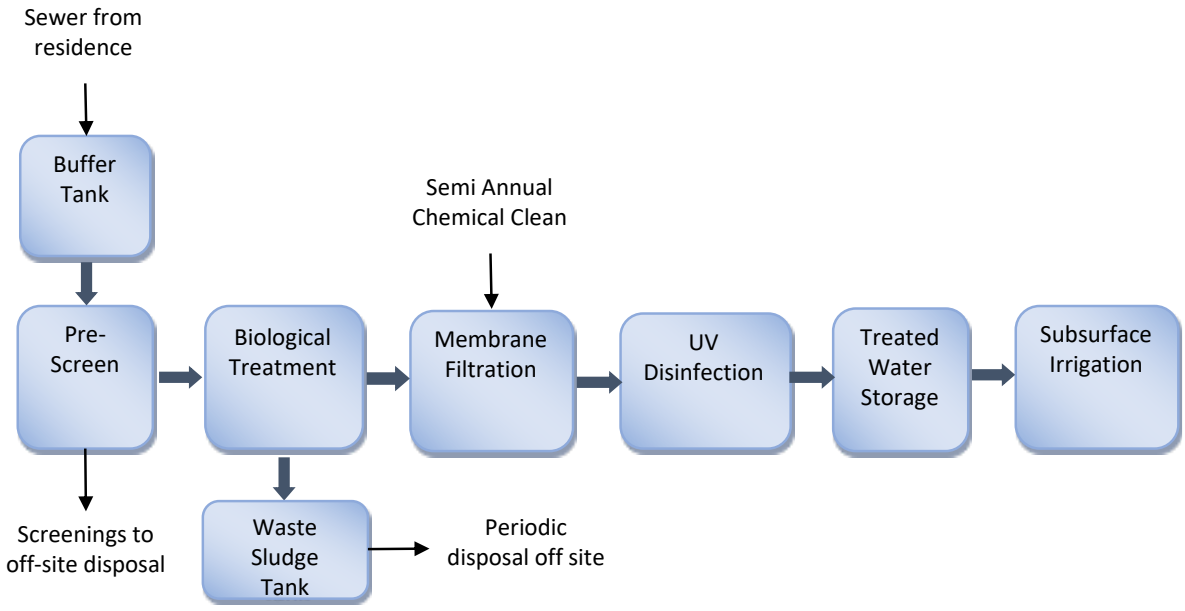


Figure 2-2: Proposed treatment process to achieve treated effluent fit for subsurface disposal via absorption trenches (Source: Aquacell)

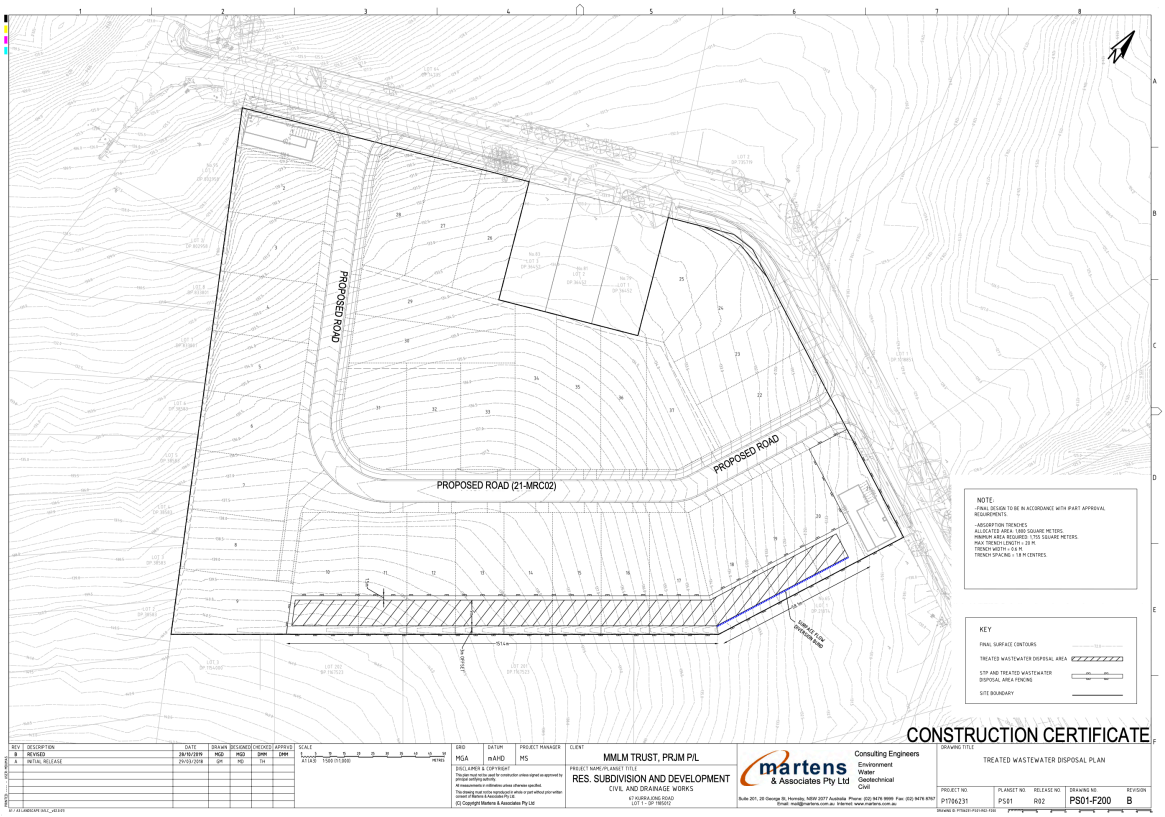


Figure 2-3: Treated Wastewater Disposal Plan (Martens 2019) showing segregated area (shaded)[1]

2.3 Treated Wastewater Quality Targets

In order to ensure the installed system is performing as intended, a series of 8 samples will be collected over 8 weeks and analysed as per Table 2-3. A validation report will be prepared summarising these results.

The target water quality is based on the low risk of subsurface disposal in an area with controlled and restricted access.

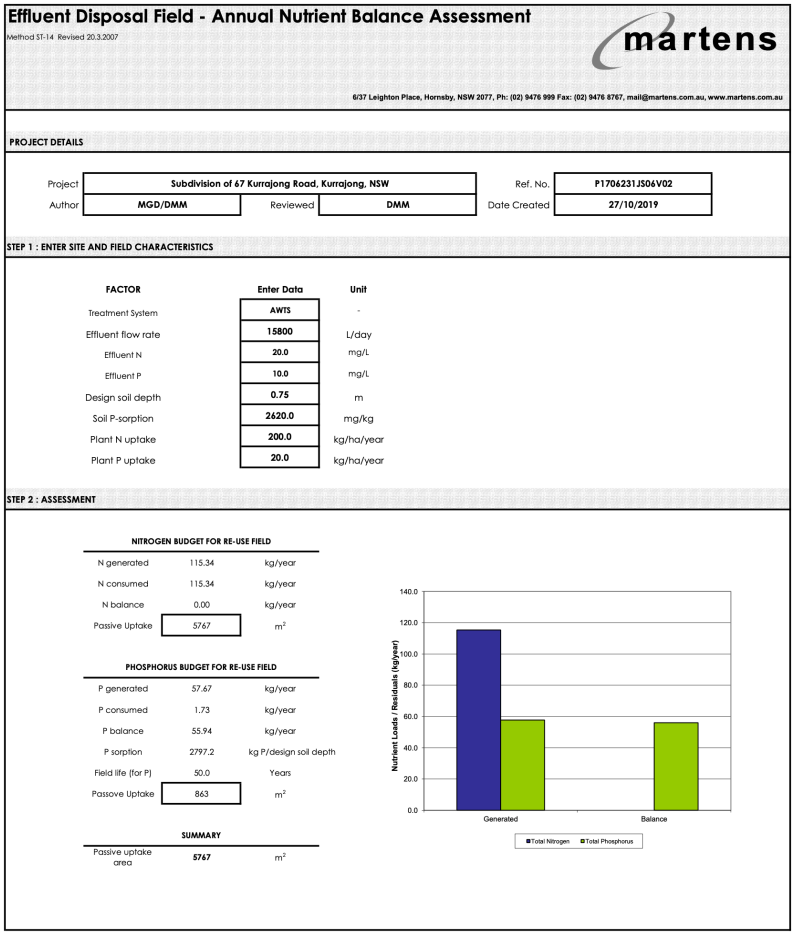
Table 2-3: Target treated wastewater quality and frequency of monitoring

Parameter	Monitoring	Target quality
E. coli	Monthly[2]	< 10 cfu/100mL[3]
BOD	n/a[4]	< 20 mg/L
Suspended Solids	n/a[5]	< 30 mg/L
Turbidity	Continuous on-line	< 5 NTU
pH	Continuous on-line	6.5-8.5

[1] 07/09/2020 update: Note that wastewater disposal design has since revised based on modelling of peak effluent flowrate of 21 kL/day. Refer latest revision of the Martens report *Wastewater Management Plan: 67 Kurrajong Road, Kurrajong, NSW* for updated drawings.
[2] To be monitored weekly during validation period; monitoring to be reviewed after 6 months operation.
[3] 24/04/2020 update: Previous target of <1,000 cfu/100 mL revised to <10 cfu/100 mL – performance at nearby Tallowood facility shows that this is generally achieved even without UV disinfection
[4] To be monitored weekly during validation period; monitoring to be reviewed after 8 weeks operation.
[5] To be monitored weekly during validation period; monitoring to be reviewed after 8 weeks operation.

2.4 Nutrient Balance

The following inputs, assumptions and results of nutrient balance modelling were presented in the workshop (refer Figure 2-4).



Effluent Disposal Field - Annual Nutrient Balance Assessment

Method ST-14 Revised 20.3.2007

martens

6/37 Leighton Place, Hornsby, NSW 2077, Ph: (02) 9476 999 Fax: (02) 9476 8767, mail@martens.com.au, www.martens.com.au

PROJECT DETAILS

Project	Subdivision of 67 Kurrajong Road, Kurrajong, NSW			Ref. No.	P1706231JS06V02
Author	MGD/DMM	Reviewed	DMM	Date Created	27/10/2019

STEP 1 : ENTER SITE AND FIELD CHARACTERISTICS

FACTOR	Enter Data	Unit
Treatment System	AWTS	-
Effluent flow rate	15800	L/day
Effluent N	20.0	mg/L
Effluent P	10.0	mg/L
Design soil depth	0.75	m
Soil P-sorption	2620.0	mg/kg
Plant N uptake	200.0	kg/ha/year
Plant P uptake	20.0	kg/ha/year

STEP 2 : ASSESSMENT

NITROGEN BUDGET FOR RE-USE FIELD

N generated	115.34	kg/year
N consumed	115.34	kg/year
N balance	0.00	kg/year
Passive Uptake	5767	m^2

PHOSPHORUS BUDGET FOR RE-USE FIELD

P generated	57.67	kg/year
P consumed	1.73	kg/year
P balance	55.94	kg/year
P sorption	2797.2	kg P/design soil depth
Field life (for P)	50.0	Years
Passove Uptake	863	m^2

SUMMARY

Passive uptake area	5767	m^2

Figure 2-4: Nutrient Balance Modelling (Martens 2019)[6]

2.5 Pathogen Removal

Although not a recycled water system, the log reduction targets for typical exposures as per DPI 2015 Table 4 have been used to demonstrate theoretical pathogen removal capability of the proposed treatment train.

The intended end use for the treated wastewater (subsurface disposal) is not described within DPI 2015 but to be conservative, the values for municipal use and non-food crops have been used for reference.

Table 2-4: Log removal requirements for different end uses (adapted from DPI 2015 Table 4)

End Use	Log Reduction Targets		
	Protozoa	Viruses	Bacteria
Municipal use — open spaces, sports grounds, golf courses, trees, shrubs, public gardens, dust suppression or unrestricted access and application	3.7	5.2	4.0

[6] 24/02/2020 update: Note that wastewater disposal design has since revised based on modelling of peak effluent flowrate of 21 kL/day. Refer latest revision of the Martens report *Wastewater Management Plan: 67 Kurrajong Road, Kurrajong, NSW* for updated modelling.

Non-food crops — trees, turf, woodlots, flowers, pasture etc.	3.7	5.2	4.0

The theoretical log reduction capabilities of the proposed 67 Kurrajong Road scheme are shown in the following table. This information has been compiled based on information from DPI 2015 Table 8 and Table 9 on likely log reduction capabilities of various treatment barriers and operational controls, with the following assumptions:

- Where a range of achievable log reductions has been presented for a particular barrier, the minimum achievable value has been assumed.
- To be conservative, the log reduction targets have been based on Adenovirus, as this virus is the most resistant to disinfection.
- The total log reduction for non-treatment barriers has been capped at 3 logs in accordance with DPI 2015.

Theoretical log reductions assumed for the proposed 67 Kurrajong Rd scheme are set out in Table 2-5.

Table 2-5: Theoretical log reduction for the proposed 67 Kurrajong Road scheme

Proposed Barrier[7]	**Log_{10} Reduction (minimum)**		
	Protozoa	**Viruses**	**Bacteria**
Pre-screen (*Primary treatment*)	0.0	0.0	0.0
Biological treatment (*Secondary treatment*)	0.5	0.5	1.0
Membrane Bioreactor (*Membrane filtration*)	4.0	2.5	3.5
UV disinfection (*UV light*)[8]	3.0	0.5	2.0
Subtotal – treatment barriers	**7.5**	**3.5**	**6.5**
Subsurface disposal (*Subsurface irrigation of plants/shrubs or grassed areas*)	5.0	5.0	5.0
Segregated disposal area (*No public access during irrigation*)	2.0	2.0	2.0
Subtotal – non-treatment barriers	**Capped at 3.0**	**Capped at 3.0**	**Capped at 3.0**
Total – treatment and non-treatment barriers	**10.5**	**6.5**	**9.5**

The results in Table 2-5 show that, using the approach outlined above, the proposed scheme exceeds requirements for 'municipal use'.

3 Risk Assessment Process

3.1 Risk Approach

The risk assessment was conducted in accordance with Aquacell's Risk Management Procedure RM030 (Aquacell 2011), which sets out the risk approach.

[7] Non-italicised text references the relevant element of the proposed system design and italicised text is associated wording from DPI 2015 Table 8 and Table 9

[8] LRV for viruses based on USEPA guidance with a UV dose of 39 mJ/cm^2

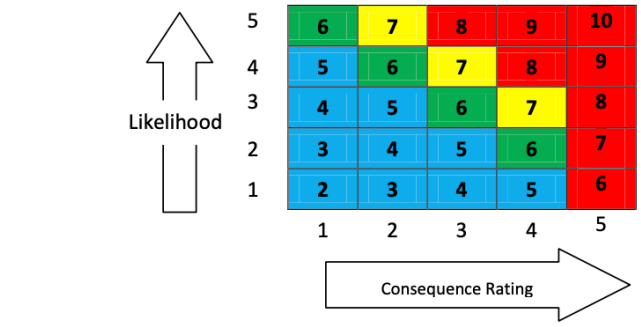
Table 3-1: Summary of Aquacell's risk approach and how each component was addressed in the workshop

Component	Actions	Workshop activity?	
Outline the context	Construct a general flow diagram showing all steps in the scheme from source to end use.	Yes	Conceptual flow diagrams were presented at the workshop as part of the system description (refer Figure 2-1 and Figure 2-2).
Set the criteria	Define tolerable risk levels according to the type of risk.	Yes	The proposed methodology (refer section 3.2) was presented at the workshop.
Identify hazardous contaminants	Identify biological, chemical and physical hazards with the potential to cause an adverse effect when present at a certain level.	Yes	Hazards were identified during the workshop and recorded in the HACCP risk register for the project.
Identify and analyse the hazardous events	Work through each step in the process and consider the scenarios by which hazards can enter or arise in the system. Also consider influencing factors such as: • accidental or deliberate contamination • pollution source control practices • wastewater treatment processes including raw materials • receiving and storage practices • sanitation and hygiene • equipment and infrastructure maintenance and protection practices • design deficiencies (known and unknown) • quality control reports, customer complaints, inspection reports (not hazards per se but can be indicative of where hazards may exist) • intended consumer use • unintended or unauthorised use.	Yes	Hazardous events were identified during the workshop and recorded in the HACCP risk register for the project.
Evaluate the risks	Assign a risk score for each hazardous event, without controls in place (i.e. maximum risk, before mitigation).	Yes	Risk scores for each event were assigned during the workshop and recorded in the HACCP risk register for the project.
Treat the risks	Identify treatment and non-treatment barriers (preventive measures) to reduce the risks. Identify critical control points.	Yes	Preventive measures were identified for each hazardous event and a new risk score assigned (i.e. residual risk, after mitigation) and recorded in the HACCP risk register for the project.

3.2 Risk Assessment Methodology

3.2.1 Original Procedure (RM030-5)

The risk assessment on 6 March 2020 was conducted using the risk rating matrix and associated likelihood and consequence descriptors as per Aquacell's Risk Management Procedure RM030 (Aquacell 2011; version 5).



High Risk – Must complete control evaluation. Executive review.

Significant Risk – Must complete control evaluation. Management review

Moderate risk – Management responsibility must be defined. Control evaluation where appropriate.

Low risk – Monitor. Examination of controls is not specifically required

Figure 3-1: Risk rating matrix (Aquacell 2011)

Table 3-2: Likelihood descriptors (Aquacell 2011)

Rating		**Likelihood of occurrence**
Almost certain	5	The event ***will occur*** within the planning period (Chance of ***daily*** occurrence)
Likely	4	The event is ***likely to occur*** once a week within the planning period (Chance of ***weekly*** occurrence)
Possible	3	The event ***may occur*** within the planning period (Chance of ***monthly*** occurrence)
Unlikely	2	The event is ***not likely to occur*** in the planning period (Chance of ***annual*** occurrence)
Rare	1	The event will only ***occur in exceptional*** circumstances

Table 3-3: Consequence descriptors (Aquacell 2011)

Rating		Area of impact						
		Financial (A)	**Customer Service / Business Continuity (B)**	**Regulatory / Legal (C)**	**Reputation & Image (D)**	**Environmental (E)**	**Human Resources (F)**	**Public Health (G)**
Extreme	5	Financial loss in excess of $200,000.	Loss of customer service for more than 4 weeks. Virtually all customers are affected.	Significant legal, regulatory or internal policy failure. Loss of licence(s).	Results in adverse media coverage.	Significant widespread harm outside local area.	Unexpected / unplanned loss of several key managers. Death.	Potentially lethal on contact population, death.
Major	4	Financial loss between $50,000 and $200,000.	Loss of customer service between 1 week and 4 weeks. Significant portion of customers affected.	Major legal, regulatory or internal policy failure. Imposition of licence conditions.	Adverse stakeholder comments or complaints.	Significant harm to the local environment.	Unexpected / unplanned loss of a key senior manager. Extensive injuries.	Major impact on contact population, extensive injuries.
Moderate	3	Financial loss between $10,000 and $50,000.	Loss of customer service between 2 days and 1 week. Customer of community segment affected.	Limited legal, regulatory or internal policy failure.	Media coverage preventable through good public relations / strength of public image.	Significant harm to the local environment for a short period.	Unexpected / unplanned loss of a senior staff member considered to be a key dependency. Medical treatment required. Dangerous near miss.	Moderate impact on contact population, medical treatment required.
Minor	2	Financial loss between $1,000 and $10,000.	Loss of customer service between 1 and 2 days. Separate group(s) of customers affected.	Minor legal, regulatory or internal policy failure.	Has minimal impact on the company reputation.	Minimal and short term harm to the environment	Unexplained / unplanned loss of a senior staff member. First aid treatment.	Minor impact on contact population, first aid treatment required.
Insignificant	1	Financial loss up to $1,000.	Loss of customer service for up to 1 day. Individual customer affected.	Insignificant legal, regulatory or internal policy failure.	No impact.	Negligible harm to the environment.	Unexpected / unplanned loss of a single staff member.	Insignificant impact or not detectable.

Outcomes were captured in Aquacell's HACCP register for the project. Prior to the workshop, the HACCP register was pre-populated with hazardous events identified for a similar project, Aquacell's Tallowood Residential Community, also in Kurrajong. These were treated as 'workshop starters' to be amended and added to by workshop participants, as appropriate.

Note that HAZOP analysis did not form part of this workshop – this will be conducted as part of the detailed design phase of the project.

3.2.2 Revised Procedure (RM030-6)

The risk review on 25 March 2020 was conducted using the risk rating matrix and associated likelihood and consequence descriptors as per Aquacell's Risk Management Procedure RM030 (Aquacell 2020; version 6) which is based on the methodology presented in the AGWR.

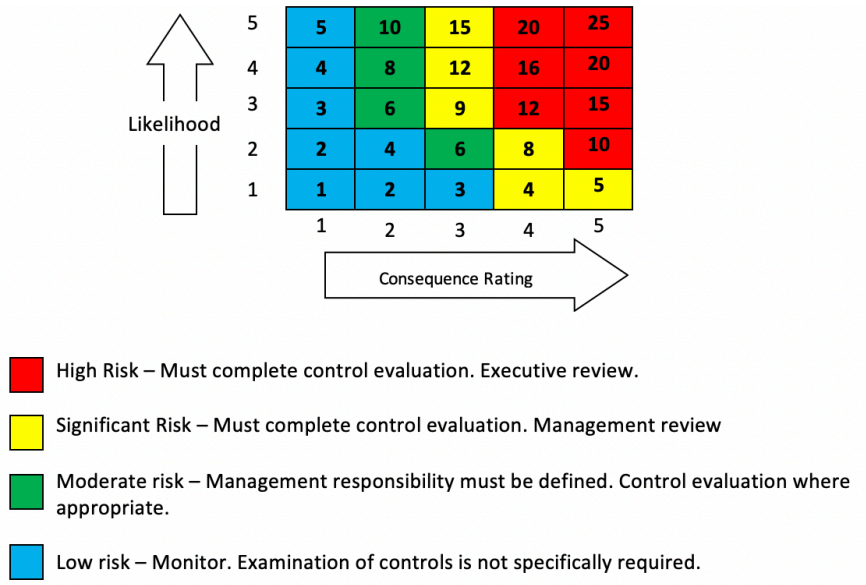


Figure 3-2: Risk rating matrix – RM030-6 (Aquacell 2020)

Table 3-4: Likelihood descriptors – RM030-6 (Aquacell 2020)

Rating		**Likelihood of occurrence**
Almost certain	5	The event ***will occur*** within the planning period
Likely	4	The event is ***likely to occur*** once a week within the planning period
Possible	3	The event ***may occur*** within the planning period
Unlikely	2	The event is ***not likely to occur*** in the planning period
Rare	1	The event will only ***occur in exceptional*** circumstances

Table 3-5: Consequence descriptors – RM030-6 (Aquacell 2020)

Rating		Area of impact						
		Financial (A)	**Customer Service / Business Continuity (B)**	**Regulatory / Legal (C)**	**Reputation & Image (D)**	**Environmental (E)**	**Human Resources (F)**	**Public Health (G)**
Extreme	5	Financial loss in excess of $200,000.	Loss of customer service for more than 4 weeks. Virtually all customers are affected.	Significant legal, regulatory or internal policy failure. Loss of licence(s).	Results in adverse media coverage.	Significant widespread harm outside local area.	Unexpected / unplanned loss of several key managers. Death.	Major impact for a large segment of the community served.
Major	4	Financial loss between $50,000 and $200,000.	Loss of customer service between 1 week and 4 weeks. Significant portion of customers affected.	Major legal, regulatory or internal policy failure. Imposition of licence conditions.	Adverse stakeholder comments or complaints.	Significant harm to the local environment.	Unexpected / unplanned loss of a key senior manager. Extensive injuries.	Major impact on contact population, extensive injuries.
Moderate	3	Financial loss between $10,000 and $50,000.	Loss of customer service between 2 days and 1 week. Customer of community segment affected.	Limited legal, regulatory or internal policy failure.	Media coverage preventable through good public relations / strength of public image.	Significant harm to the local environment for a short period.	Unexpected / unplanned loss of a senior staff member considered to be a key dependency. Medical treatment required. Dangerous near miss.	Major impact for a small segment of the community served.
Minor	2	Financial loss between $1,000 and $10,000.	Loss of customer service between 1 and 2 days. Separate group(s) of customers affected.	Minor legal, regulatory or internal policy failure.	Has minimal impact on the company reputation.	Minimal and short term harm to the environment	Unexplained / unplanned loss of a senior staff member. First aid treatment.	Minor impact on contact population, first aid treatment required.
Insignificant	1	Financial loss up to $1,000.	Loss of customer service for up to 1 day. Individual customer affected.	Insignificant legal, regulatory or internal policy failure.	No impact.	Negligible harm to the environment.	Unexpected / unplanned loss of a single staff member.	Minor impact for a large segment of the community served.

Outcomes of the risk review were also captured in Aquacell's HACCP register for the project.

3.3 CCP Identification Process

Critical control points (CCPs) were identified using the decision tree in Aquacell's Risk Management Procedure RM030 (Aquacell 2011). The CCP identification process was unchanged with the latest revision of the Risk Management Procedure (RM030-6).

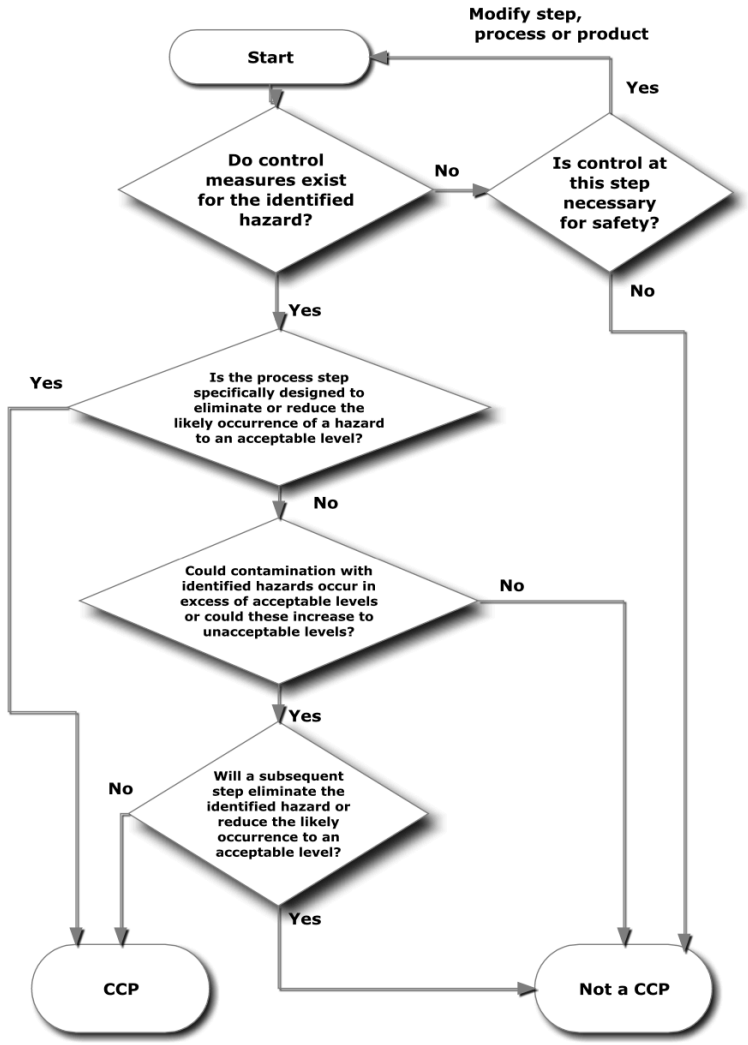


Figure 3-3: CCP identification decision tree (Aquacell 2011)

4 Summary of Risks Identified

The risk assessment was conducted using Aquacell's current Risk Management Procedure (RM030 version 5). During the workshop it was noted that more events were rated High risk (after preventative measures were applied) than expected. The Aquacell methodology was compared with the methodology presented in the Australian Guidelines for Water Recycling (AGWR) and found to be more conservative when High consequence was applied and that the descriptors did not take into account size of population affected therefore all risks with a potential consequence of pathogen exposure were automatically rated High residual risk.

As per Aquacell's Risk Management Procedure, any risks rated High require executive review. At that review it was agreed that the risk ratings could not be further reduced by applying additional controls. It was further determined that the spread of risk ratings, concentrated at the High and Low ends (with no Significant and only one Moderate residual risk rating), did not allow management to adequately prioritise risk management for this scheme. It was therefore decided to review the

Aquacell Risk Management Procedure against that presented in the AGWR and review the risks for the 67 Kurrajong Road project accordingly.

A summary of the risk ratings using each of the methods is provided in Figure 4-1 and Figure 4-2.

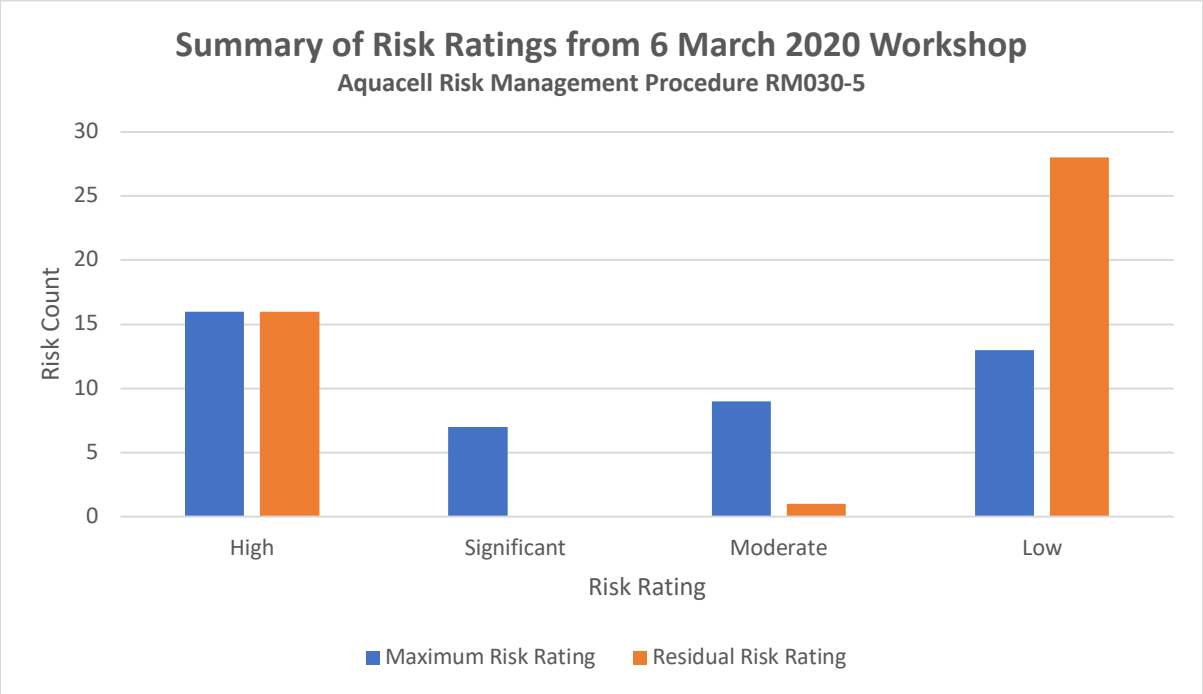


Figure 4-1: Summary of Risks Ratings – 6 March 2020 Risk Workshop (Aquacell Risk Management Procedure RM030-5)

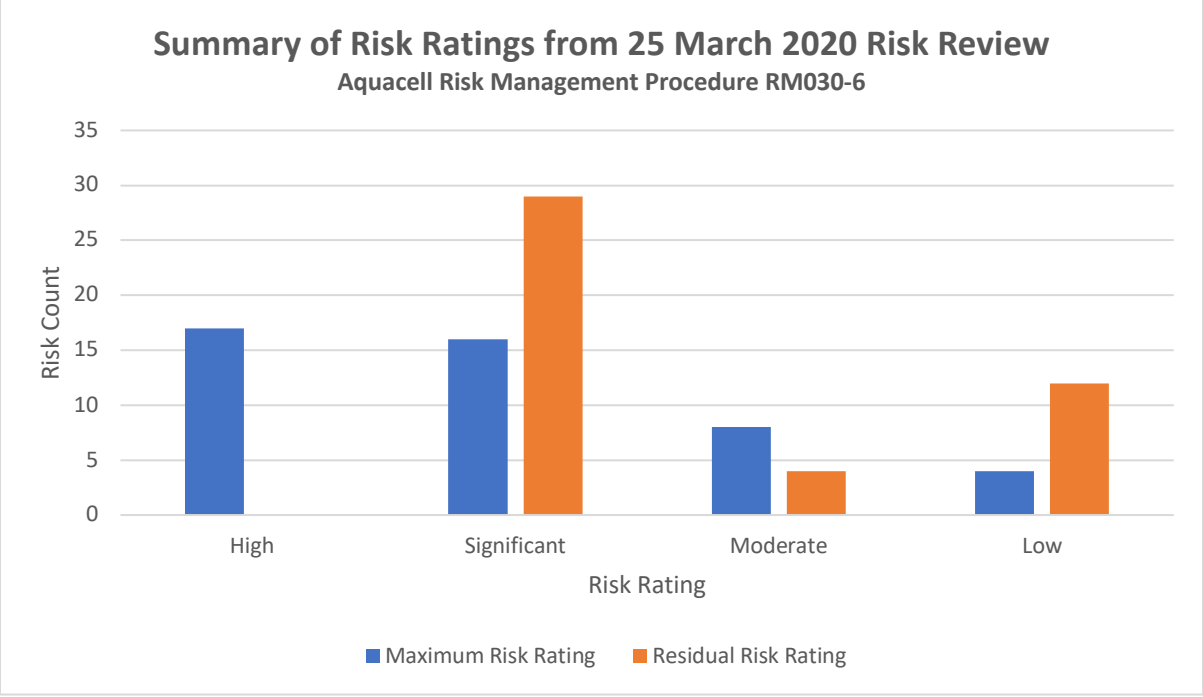


Figure 4-2: Summary of Risks Identified – 25 March 2020 Risk Review (Aquacell Risk Management Procedure RM030-6)

A summary of the risk ratings by process step using each of the methods is provided in Table 4-1 and Table 4-2. The source water step was generally rated higher risk due to the presence of untreated sewage. The disposal step was also rated relatively high due to the presence of treated wastewater which is expected to be of high quality but could be more attractive to misuse. The general category was rated higher due to inclusion of rare but catastrophic events such as fire, flood and sabotage.

Table 4-1: Summary of Risks Ratings by Process Step – 6 March 2020 Risk Workshop (Aquacell Risk Management Procedure RM030-5)

	Maximum Risk Rating				Residual Risk Rating			
	High	Significant	Moderate	Low	High	Significant	Moderate	Low
1. Source water	6	0	1	3	6	0	0	4
2. Screen	1	0	0	1	1	0	0	1
3. MBR	2	2	5	5	2	0	0	12
4. UV	0	0	0	1	0	0	0	1
5. Disposal	0	4	3	2	0	0	1	8
6. General	7	1	0	1	7	0	0	2
TOTAL	**16**	**7**	**9**	**13**	**16**	**0**	**1**	**28**

Table 4-2: Summary of Risks Ratings by Process Step – 25 March 2020 Risk Review (Aquacell Risk Management Procedure RM030-6)

	Maximum Risk Rating				Residual Risk Rating			
	High	Significant	Moderate	Low	High	Significant	Moderate	Low
1. Source water	5	2	2	1	0	6	1	3
2. Screen	1	0	1	0	0	1	0	1
3. MBR	3	6	4	1	0	7	3	4
4. UV	0	0	0	1	0	0	0	1
5. Disposal	4	4	0	1	0	8	0	1
6. General	4	4	1	0	0	7	0	2
TOTAL	**17**	**16**	**8**	**4**	**0**	**29**	**4**	**12**

5 Critical Control Points Identified

Using this decision tree presented in section 0 above, the workshop identified **membrane filtration** as a CCP, as outlined in Table 5-1.

Table 5-1: Critical Control Point identified

Critical Control Point	Targets/ Limits		Monitoring	Corrective Actions		Records
	Target	*Action*		*What*	*How*	
CCP 1 Membrane filtration	<2 NTU	Alert >2 NTU Critical >5 NTU	Online turbidity	Stop delivering treated water to storage	Stop filtration process, placing plant in standby automatically	Online datalogging

In addition, three Quality Control Points (QCPs) were identified, as outlined in Table 5-2.

Table 5-2: Quality Control Points identified

Control Point	Targets/ Limits		Monitoring
	Target	*Action*	
QCP 1 Raw wastewater pH	4 < pH < 9	Alert pH < 4 or > 9	Online pH monitoring
QCP 2 Treated wastewater pH	5 < pH < 9	Alert pH < 5 or > 9	Online pH monitoring
QCP 3 UV disinfection	>40 mJ/cm^2 No instrument or controller faults		

6 References

Aquacell (2019) Sewage Management Plan, draft, 24 April 2019.

Aquacell (2011) Risk Management Procedure, RM030, Revision 5.

Martens (2009) Concept Wastewater Management Strategy: 67 Kurrajong Road, Kurrajong, NSW, P1706231JR02V01, revised October 2019.

NSW Department of Primary Industries – Office of Water (2015) NSW Guidelines for Recycled Water Management Systems, web copy: ISBN 978-1-74256-764-8.

NSW Department of Water and Energy (2007) Interim NSW Guidelines for Management of Private Recycled Water Schemes, web copy: ISBN 978 0 7347 5940 5.

Appendix A – Workshop Details

Workshop details

Item	Description
Project:	Aquacell WICA Licence Application for proposed development at 67 Kurrajong Road, Kurrajong
Purpose:	To understand the public health and environmental risks associated with the proposed wastewater treatment and disposal system at 67 Kurrajong Road, Kurrajong
Date / Time:	Friday 6 March 2020 / 8:45am for 9:00am start to 5:00pm
Venue:	Launch Pad –Werrington Park Corporate Centre 14 Great Western Highway, Werrington, NSW 2747
Contacts:	Colin Fisher, 0409 393 389, colinf@aquacell.com.au (Aquacell representative) Sarah Loder, 0404 384 389, sarah@praktik.com.au (consultant representative)

Workshop invitees and attendees

Name	Position	Organisation	Role in workshop	Attended?
James Plant	Manager Environmental Health	Public Health Unit, Nepean Blue Mountains Local Health District, NSW Health	NSW Health perspective	Yes (until 2:30pm)
Stephanie Ferrer	Environmental Health Officer	Public Health Unit, Nepean Blue Mountains Local Health District, NSW Health	NSW Health perspective	Yes (until 2:30pm)
TBA	TBA	Water Unit, NSW Health	NSW Health perspective	No
TBA	TBA	Hawkesbury City Council	Local council perspective	No
Grant Harlow	Senior Engineer	Martens	Land capability specialist	Yes (until 1:00pm)
Warren Johnson	Technical Manager	Aquacell	Project manager	Yes
Joan Roura Garcia	Process Engineer	Aquacell	Wastewater treatment expertise	No
Justin Taylor	Production Manager	Aquacell	Plant design, manufacturing and operations	Yes
Adriana Maras	Graduate Engineer	Aquacell	Recorder	Yes
Sarah Loder	Principal Analyst	Praktik	Facilitator	Yes

Workshop agenda

Time	Item	Description	Person
8:45 – 9:00	Arrival	Arrival and tea/coffee	All
9:00 – 9:10	Welcome	Introduction roundtable	Sarah Loder
9:10 – 9:20	Introduction	Project overview	Warren Johnson
9:20 – 9:35	Scheme description	Overview of the scheme and design of the proposed treatment system	Warren Johnson
9:35 – 9:40	Workshop overview	Outline workshop methodology	Sarah Loder
9:40 - 10:30	Risk assessment	Commence risk assessment Identify hazardous events, hazards, risk scores and proposed controls	All, facilitated by Sarah Loder
10:30 – 10:45	Break	Morning tea	All
10:45 – 12:30	Risk assessment	Risk assessment continued Identify hazardous events, hazards, risk scores and proposed controls	All, facilitated by Sarah Loder
12:30 – 13:00	Break	Lunch	All
13:00 – 14:45	Risk assessment	Risk assessment continued Identify hazardous events, hazards, risk scores and proposed controls	All, facilitated by Sarah Loder
14:45 – 15:00	Break	Afternoon tea	All
15:00 – 16:50	Risk assessment	Risk assessment continued Identify hazardous events, hazards, risk scores and proposed controls	All, facilitated by Sarah Loder
16:50 – 17:00	Close	Workshop close and next steps	Sarah Loder

Appendix B – HACCP Register[9]

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
1. Source water (sewage influent, collection lines, pump stations)	Physical contact with untreated wastewater - operators *	Health impact from exposure to pathogens	Biological	Health	<u>Preventative</u> • Training of services personnel. • Use correct PPE. • SWMS.	5	5	High (10)	2	5	High (7)	Confident (+/- 1)	5	4	High (20)	2	4	Significant (8)	Likelihood unchanged. Consequence updated based on small subset of population impacted.
	Physical contact with untreated wastewater - community/public *	Health impact from exposure to pathogens	Biological	Health	<u>Preventative</u> • Exclude the public from the plant and disposal area. • Covers on tanks, locks where appropriate, signage, difficult to access.	3	5	High (8)	1	5	High (6)	Confident (+/- 1)	3	4	High (12)	1	4	Significant (4)	Likelihood unchanged. Consequence updated based on small subset of population impacted.
	Influent water quality exceeds design specifications *	Additional contaminant load to treatment plant resulting in out of spec treated water	Biological	Health/ Enviro.	<u>Preventative</u> • Contingency in design calculations to allow for exceedances. <u>Detective</u> • Verification testing.	2	2	Low (4)	1	2	Low (3)	Confident (+/- 1)	2	2	Low (4)	1	2	Low (2)	No change.
	Blockage or break in sewerage network.*	Overflow of untreated wastewater	Physical, biological	Health/ Enviro.	<u>Preventative</u> • Properly designed and installed sewer (adherence to plumbing codes). • Resident education on appropriate sewer inputs. <u>Detective</u> • Installation testing. • Visual inspection.	2	5	High (7)	1	5	High (6)	Confident (+/- 1)	2	4	Significant (8)	1	4	Significant (4)	Likelihood unchanged. Consequence updated based on small subset of population impacted.

[9] 07/09/2020 update: Column heading 'Preventative Measures' changed to 'Control Measures' to better reflect the bredth of the measures identified in the workshop. Measures previously identified have been sorted under the following sub-headings: Preventative, Detective, Responsive.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Pump station failure *	Overflow of untreated wastewater - potential public contact and/or flow to waterway	Biological	Health/ Enviro.	Preventative • Duty/assist pump. • 25 kL pump station (approx. 3 days of storage). Detective • Tank level remote monitoring with alarms. • Local audible and visible alarm. Responsive • Can pump out if required.	4	5	High (9)	1	5	High (6)	Confident (+/- 1)	4	5	High (20)	1	5	Significant (5)	No change. Rating based on off-site environmental impacts (waterways).
	Prolonged / extreme wet weather event leading to excessive inflows	Overflow of untreated wastewater - potential public contact and/or flow to waterway	Biological	Health/ Enviro.	Preventative • High capacity in storage and buffer tanks. • Sealed and properly designed. • Commissioning to ensure no cross-connections/ingress. • Buffer tank run at low level. • Pump station sufficient capacity and duty/assist pumps. Detective • High level alarms. Responsive • Pump out of buffer tanks.	3	5	High (8)	1	5	High (6)	Confident (+/- 1)	3	5	High (15)	1	5	Significant (5)	No change. Rating based on off-site environmental impacts (waterways).
	Inappropriate connections to sewer network (e.g. stormwater)	Compromised inflow (no overflow)	Physical		Detective • Monitor inflow quality and flow for changes. • Visual inspections during monthly services. • Consider periodic review of DAs in community.	3	2	Low (5)	2	2	Low (4)	Confident (+/- 1)	3	2	Moderate (6)	2	2	Low (4)	No change.
	Residents disposing of foreign objects down the drain	Pipework blockages - sewage backs up (potential contact)	Physical	Health	Preventative • Resident education.	3	5	High (8)	2	5	High (7)	Confident (+/- 1)	3	4	High (12)	2	4	Significant (8)	Likelihood unchanged. Consequence updated based on small subset of population impacted.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Residents disposing of foreign objects down the drain	Pump blockages - process downtime	Physical		<u>Preventative</u> • Resident education. • Duty/standby pumps. • 2 buffer tanks, with pumps in second tank. <u>Detective</u> • Pump failure alarm.	3	2	Low (5)	2	2	Low (4)	Confident (+/- 1)	3	2	Moderate (6)	2	2	Low (4)	No change.
	Residents disposing of chemicals down the drain	Disrupt biological processes, damage membranes, foam over	Chemical		<u>Preventative</u> • Resident education. <u>Detective</u> • pH monitoring of the influent, any out of range feed not accepted. <u>Responsive</u> • Dilution of feed by other residents.	3	3	Moderate (6)	2	3	Low (5)	Confident (+/- 1)	3	3	Significant (9)	2	3	Moderate (6)	No change.
2. Screen	Screen may block or fail. *	Process downtime.	Physical		<u>Preventative</u> • Regular maintenance. • Potable water flushing. <u>Detective</u> • Routine maintenance inspections. • Level alarms. • Drive failure alarm. <u>Responsive</u> • Screen overflows to buffer tank.	3	2	Low (5)	1	2	Low (3)	Confident (+/- 1)	3	2	Moderate (6)	1	2	Low (2)	No change.
	Screenings and grit need to be removed from site and accidental discharge to environment may result with potential public contact to pathogens. Contractor may contact the contaminants via the skin or inhalation *	Exposure to pathogens.	Biological	Health	<u>Preventative</u> • Ensure appropriately experienced plant operators are used for maintenance of systems. • Operators use adequate PPE to mitigate against ingestion, skin contact and inhalation. • Screenings collected in sealed bag and disposed of appropriately. • Public excluded from plant.	3	5	High (8)	1	5	High (6)	Confident (+/- 1)	3	4	High (12)	1	4	Significant (4)	Likelihood unchanged. Consequence updated based on small subset of population impacted.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	Hazardous Event	Impact	Hazard	Category	Control Measures	L	C	Rating	L	C	Rating	Uncertainty	L	C	Rating	L	C	Rating	Basis for re-rating
3. MBR (Aerators, Mixed Liquor, Membranes)	Chemical hazard - pH neutral *	Process disruption. Damage to membranes.	Chemical		Detective • DO indicator of biomass health. Responsive • High MLSS - shock resistance.	2	3	Low (5)	2	3	Low (5)	Confident (+/- 1)	2	3	Moderate (6)	2	3	Moderate (6)	No change.
	Operator error - chemical cleaning process destroys biomass *	Process disruption.	Chemical		Preventative • Appropriate procedures. • Operator training. Responsive • Slow down production to allow biomass to rebuild. • Last resort, shutdown and re-seed.	2	3	Low (5)	1	3	Low (4)	Confident (+/- 1)	2	3	Moderate (6)	1	3	Low (3)	No change.
	Chemical cleaning damages membranes. *	Damage to membranes - low throughput or poor integrity.	Chemical		Preventative • Appropriate procedures. • Operator training. • Membranes selected for broad compatibility range. Detective • In the event membranes are damaged, breach would be detected by turbidity probe.	2	4	Moderate (6)	1	4	Low (5)	Confident (+/- 1)	2	4	Significant (8)	1	4	Significant (4)	No change.
	Over aeration - nitrification reduces pH in tank *	Inhibits biology leading to poor treatment and low pH treated water	Biological		Preventative • Operator training. Detective • DO monitoring. • pH probe in filtrate pit is indicator of bioreactor pH. Responsive • Remote monitoring allows operator to make changes.	3	2	Low (5)	2	2	Low (4)	Confident (+/- 1)	3	2	Moderate (6)	2	2	Low (4)	No change.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Under aeration biology tanks: 1) electrical blower failure 2) diffuser blockage/failure *	Poor treated water quality leading to membrane fouling and reduced throughput.	Biological		Preventative • Duty/standby blowers. • Routine maintenance program. Detective • Blowers are alarmed for electrical failure. • Pressure transducers on aeration system detect diffuser blockages. • DO probe alarmed for aeration failure.	3	2	Low (5)	1	2	Low (3)	Confident (+/- 1)	3	2	Moderate (6)	1	2	Low (2)	No change.
	Aeration failure. *	Shutdown of the filtration process.	Physical		Preventative • Routine maintenance program. Detective • Blowers are alarmed for electrical failure. • Pressure transducers on aeration system detect diffuser blockages.	3	3	Moderate (6)	2	3	Low (5)	Confident (+/- 1)	3	3	Significant (9)	2	3	Moderate (6)	No change.
	Loss of biomass due to lack of feed. *	Process interruption.	Biological		Preventative • Residential estate is likely populated at all times. • Experience shows biomass can sustain health over several days.	2	2	Low (4)	2	2	Low (4)	Confident (+/- 1)	2	2	Low (4)	2	2	Low (4)	No change.
	Membrane failure allowing pathogens through, either by gross rupturing or pinholing *	Poor treated water quality	Physical	Health/ Enviro.	Preventative • Upstream screen to protect membranes from foreign matter. • Membrane selection with a broad compatibility range. Detective • Level and overflow alarms (membranes dry out). • Online turbidity measurement of filtrate. • Monthly testing for *E.coli*. Responsive • Turbidity shutdown alarm.	3	4	Significant (7)	1	4	Low (5)	Confident (+/- 1)	3	4	High (12)	1	4	Significant (4)	No change.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	Hazardous Event	Impact	Hazard	Category	Control Measures	L	C	Rating	L	C	Rating	Uncertainty	L	C	Rating	L	C	Rating	Basis for re-rating
	Leave drain valve to sludge tank open, emptying membrane tank *	Damage to membranes by drying out	Physical		Preventative • Operator training. • Remove valve handles. Detective • Low level alarm on membrane tank.	2	4	Moderate (6)	1	4	Low (5)	Confident (+/- 1)	2	4	Significant (8)	1	4	Significant (4)	No change.
	Faulty connections to/from membrane filter. *	Loss of integrity due to faulty connections that are submerged.	Physical	Health	Preventative • Good pipework design and flexible connections used. • Use stainless steel clamps and screws. • Use hold down clamps to prevent membranes from moving and putting pressure on pipework. Detective • Online turbidity to maintain spec.	3	4	Significant (7)	1	4	Low (5)	Confident (+/- 1)	3	4	High (12)	1	4	Significant (4)	No change.
	Loss of air scour due to large bubble size (broken diffuser). *	Reduce throughput, cleaning and recovery difficult	Physical	Health	Preventative • Appropriate design. Detective • Inspection. • Pressure transducers with low pressure alarm	3	3	Moderate (6)	2	3	Low (5)	Confident (+/- 1)	3	3	Significant (9)	2	3	Moderate (6)	No change.
	Faulty membrane installed *	Poor quality treated water or low throughput.	Physical	Health	Preventative • Reputable supplier. • Quality checks at manufacturing, construction, commissioning. • Manufacturers approval. Detective • Verification during commissioning. • Water Quality Testing. • Turbidity monitoring.	2	4	Moderate (6)	1	4	Low (5)	Confident (+/- 1)	2	4	Significant (8)	1	4	Significant (4)	No change.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Routine sludge removal from process tanks. *	Contact with sludge when loading the truck. Inappropriate disposal of waste.	Biological	Health/ Enviro.	Preventative • Use reputable contractor. Ensure contractors are adequately trained and licensed. • Use appropriate PPE to avoid inhalation and skin contact. • Supervision by Aquacell staff.	3	5	High (8)	1	5	High (6)	Confident (+/- 1)	3	4	High (12)	1	4	Significant (4)	Likelihood unchanged. Consequence updated based on small subset of population impacted and no potential for environmental impact but not widespread.
	Accidental discharge of sludge to environment during sludge removal *	Potential human contact and damage to environment	Biological	Health/ Enviro.	Preventative • Ensure contractors are adequately trained and licensed. • Exclude public access and immediately rectify spills. • Use appropriate PPE to avoid inhalation and skin contact. • Supervision by Aquacell staff.	2	5	High (7)	1	5	High (6)	Confident (+/- 1)	2	4	Significant (8)	1	4	Significant (4)	Likelihood unchanged. Consequence updated based on small subset of population impacted and no off-site environmental impact.
4. UV disinfection	UV failure *	Loss of additional disinfection barrier	Biological	Health	Preventative • Routine maintenance. Detective • Continuous monitoring of UV operation, including UV intensity, lamp condition, lamp hours, instrument fault.	3	1	Low (4)	2	1	Low (3)	Confident (+/- 1)	3	1	Low (3)	2	1	Low (2)	No change.
5. Disposal System and Storage Tanks	Exposure hazard, improper use of treated water. (E.g. from tanks, sample points)	Potential ingestion	Biological	Health	Preventative • Resident education. • Lilac coloured pipes and fittings. • Signage indicating recycled water usage. • No taps on disposal network. • Restricted access to tanks, plant and disposal area. • Sample points are not hose cocks. • Treatment plant operating correctly – high quality effluent.	3	4	Significant (7)	2	4	Moderate (6)	Confident (+/- 1)	3	4	High (12)	2	4	Significant (8)	No change.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Degradation in water quality and delivery due to biofilm growth (no chlorination)	Delivery to disposal system compromised (worst case - tank overflow)	Physical	Health/ Enviro.	Preventative • Correct sizing of disposal field and storage tanks. • Correct pipe sizing and velocity. • Limited length of distribution pipe than can be blocked. • Monthly servicing. Detective • Tank level alarms if disposal system blocks (interlock on high level). • Remote monitoring by trained operators. Responsive • Flushing point on disposal system installed. • Pump out tanks if required.	3	4	Significant (7)	1	4	Low (5)	Confident (+/- 1)	3	4	High (12)	1	4	Significant (4)	No change.
	Disposal pump may fail	Delivery to disposal system compromised (worst case - tank overflow)	Physical	Health/ Enviro.	Preventative • Duty/standby pump with automatic changeover (spares readily available). • Adequate storage volume in buffer and disposal tank to allow time for pump to be replaced. • Monthly servicing. Detective • Tank level alarms if disposal system blocks (interlock on high level). • Remote monitoring by trained operators. Responsive • Disposal tank and buffer tank can be pumped out if necessary.	2	4	Moderate (6)	1	4	Low (5)	Confident (+/- 1)	2	4	Significant (8)	1	4	Significant (4)	No change.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Disposal pipes or fittings may fail	Delivery to disposal system compromised (worst case - tank overflow)	Physical	Health/ Enviro.	Preventative • Adequate storage volume in buffer and disposal tank to allow time for pump to be replaced. • Poly pipes flexible + favourable soil type decreases chance of failure. • Pipework in segregated area and buffer. • Pipework tested by experienced commissioning team prior to use. Detective • Routine checks to look for pooling or leaking. Responsive • Disposal tank and buffer tank can be pumped out if necessary.	2	4	Moderate (6)	1	4	Low (5)	Confident (+/- 1)	2	4	Significant (8)	1	4	Significant (4)	No change.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Tank integrity failure (rupture)	Tank rupture leading to spill	Physical	Health/ Enviro.	<u>Preventative</u> • Above ground poly storage tank used, closed tank in secure fenced area from reputable supplier. • Protection from moving plant and traffic. • Storage tank usually at low level. • Dedicated disposal area has been designed with a factor of safety included with regards to hydraulic capacity of the soils. • Routine maintenance of the disposal field including: vegetation management and weed control; and, topsoil replacement and improvement on an as needs basis. • Considerable distance exists between the site and downslope receiving environments which decreases the likelihood of impacts on downslope areas. <u>Detective</u> • Routine inspections and maintenance including regular checks of the storage tanks, mains and disposal area. • Regular validation testing. <u>Responsive</u> • Replacement of tanks on an as needs basis	1	4	Low (5)	1	4	Low (5)	Confident (+/- 1)	1	4	Significant (4)	1	4	Significant (4)	No change.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Tank integrity compromised by user error *	External materials (e.g. rodents, pests) enter tank leading to degraded treated wastewater quality	Physical		Preventative • Above ground poly storage tank used, closed tank in secure fenced area from reputable supplier. • Storage tank usually at low level. • Dedicated disposal area has been designed with a factor of safety included with regards to hydraulic capacity of the soils. • Routine maintenance of the disposal field including: vegetation management and weed control; and, topsoil replacement and improvement on an as needs basis. • Considerable distance exists between the site and downslope receiving environments which decreases the likelihood of impacts on downslope areas. Detective • Routine inspections and maintenance including regular checks of the storage tanks, mains and disposal area. • Regular validation testing. Responsive • Replacement of tanks on an as needs basis.	2	2	Low (4)	1	2	Low (3)	Confident (+/- 1)	2	2	Low (4)	1	2	Low (2)	No change.

	Structural damage to disposal area.	Public health issues arising from exposure to pathogens in treated effluent.	Physical		<u>Preventative</u> • Disposal area not accessible (removed from construction area). • Subsurface system. • Recognised, fit for purpose product. • Regularly observed and maintained. • Separated trenches. • Buffer tank is designed with a capacity of 2 x 107kL (approx. 13 days of storage). • Treated wastewater storage tank is designed with a capacity of 65 kL (approx. 3 days of storage). • Pump station is designed with a capacity of 25kL (approx. 3 days of storage). • System designed to prevent groundwater ingress therefore overloading unlikely. • All transfer mains are to be buried at appropriate depths below finished ground surface (areas with vehicular loading) in accordance with WSA02 (2002) to protect them from mechanical damage. • All treatment plant components will have backup components onsite and automatic standby operation. • Routine maintenance of disposal area including vegetation management and weed control and topsoil replacement and improvement on an as needs basis. • Prevention of heavy machinery driving over the disposal area. <u>Detective</u> • Regular checks and maintenance of the pumps, tanks, alarms and control	2	4	Moderate (6)	1	4	Low (5)	Confident (+/- 1)	2	4	Significant (8)	1	4	Significant (4)	No change.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
					infrastructure of the treatment plant, pump station and reticulated treated wastewater mains and storage tank. • Regular checks of disposal area.														
	Resurfacing of irrigated effluent	Public health issues arising from exposure to pathogens in treated effluent.	Biological	Health/ Enviro.	Preventative • Appropriate design based on soil analysis. • Supplied at depth. • Self-supporting trench arch provides effluent storage. • Proven technology; fit for purpose and reputable products used. • Mound on downslope to stop run in to residential properties. • Effluent treated to high quality (ensures soil integrity and reduces impact on public).	3	4	Significant (7)	1	4	Low (5)	Confident (+/- 1)	3	4	High (12)	1	4	Significant (4)	No change.
	Long-term/extreme wet weather overloading storage and disposal	Public health issues arising from exposure to pathogens in treated effluent.	Biological	Health/ Enviro.	Preventative • Control of stormwater run on/ run off using diversion bunds. • Favourable positioning against stormwater catchment. Away from water sources. • Storage capacity in underground self-supporting trenches and storage tank (3 days). • Disposal at depth and suitable soil. • Vegetation maintenance (prevent soil erosion). Responsive • Pump out if required.	3	4	Significant (7)	1	4	Low (5)	Confident (+/- 1)	3	4	High (12)	1	4	Significant (4)	No change.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
6. General	Prolonged power outages *	Influent wastewater can't be treated, leading to overflow at both buffer tank and pump stations.	Biological	Health/ Enviro.	Preventative • Buffer tank can hold up to 13 days storage, pump station can hold up to 3 days storage. Responsive • Buffer tank and pump station can be pumped out.	2	5	High (7)	1	5	High (6)	Confident (+/- 1)	2	5	High (10)	1	5	Significant (5)	No change.
	Extreme weather (flooding)	Failure of treatment processes from inundation leading to human contact with raw sewage	Physical	Health/ Enviro.	Preventative • Critical equipment under cover. • Plant is above flood level on the side of a hill. Responsive • Pump out can be used if plant is disabled.	1	5	High (6)	1	5	High (6)	Confident (+/- 1)	1	5	Significant (5)	1	5	Significant (5)	No change.
	Extreme weather (heat)	Control system failure - process downtime.	Physical	Health	Preventative • Control system and equipment are out of direct sunlight. • Ventilation in plant room (whirly birds). • Pumps fail off. Responsive • Critical spares are readily available/easily substitutable. • Can pump out if required.	3	2	Low (5)	2	2	Low (4)	Confident (+/- 1)	3	2	Moderate (6)	2	2	Low (4)	No change.
	Extreme weather (heat)	Expansion of pipework - breaking (public exposure).	Physical	Health/ Enviro.	Preventative • Pipework underground or out of direct sunlight. • Short pipe runs above ground. • Suitable and UV stabilised material. • Flexible joints. • Bracket pipes to allow for expansion.	2	5	High (7)	1	5	High (6)	Confident (+/- 1)	2	4	Significant (8)	1	4	Significant (4)	Likelihood unchanged. Consequence updated based on small subset of population impacted and no potential for environmental impact but not widespread.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Extreme weather (heat)	UV degradation of components - process downtime/public exposure.	Physical	Health/ Enviro.	Preventative • UV stabilised materials. • Pumps fail off. Responsive • Pump out. • Critical spares are readily available/easily substitutable.	2	5	High (7)	1	5	High (6)	Confident (+/- 1)	2	5	High (10)	1	5	Significant (5)	No change.
	Earthquake *	Damage of critical infrastructure, subsequent exposure to waste due to overflows or pipe breakage	Biological	Health/ Enviro.	Responsive • Pump out can be used if plant is disabled.	1	5	High (6)	1	5	High (6)	Confident (+/- 1)	1	5	Significant (5)	1	5	Significant (5)	No change. As low as reasonably practicable (ALARP).
	Fire (bushfire or electrical) *	Damage of critical infrastructure, subsequent exposure to waste	Biological	Health/ Enviro.	Preventative • Vegetation is maintained around plant. • Plant designed to Australian standards and local planning regulations regarding bushfire zones. Responsive • Pump out can be used if plant is disabled.	2	5	High (7)	1	5	High (6)	Confident (+/- 1)	2	5	High (10)	1	5	Significant (5)	No change. As low as reasonably practicable (ALARP).
	Human actions (sabotage, vandalism or terrorism) *	Damage of critical infrastructure, subsequent exposure to waste	Biological	Health/ Enviro.	Preventative • Plant is in gated estate to prevent any access from general public. Responsive • Pump out can be used if plant is disabled.	2	5	High (7)	1	5	High (6)	Confident (+/- 1)	2	5	High (10)	1	5	Significant (5)	No change. As low as reasonably practicable (ALARP).

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Poor maintenance of treatment infrastructure. *	Reduced throughput or process downtime	Physical		Preventative • Adequate financial provisions to perform maintenance. • Routine maintenance of the disposal field including: vegetation management and weed control; and, topsoil replacement and improvement on an as needs basis. Detective • Regular water quality testing. • Visual inspection of infrastructure and disposal fields.	4	3	Significant (7)	1	3	Low (4)	Confident (+/- 1)	4	3	Significant (12)	1	3	Low (3)	No change.
	Odour emitted from sewerage infrastructure including buffer tanks *	Customer complaints	Other		Preventative • Expert assessment has been performed by GHD to confirm that expected impact on residents and neighbours is negligible. • Buffer tanks kept at low level to minimise retention time. • Carbon filters to be installed on buffer tank vents. • Membrane and biology blowers can be configured to aerate bio tanks even if a blower fails. • Treatment plant equipment contained within shed. Detective • Customer complaints program.	5	2	Significant (7)	2	2	Low (4)	Confident (+/- 1)	5	2	Moderate (10)	2	2	Low (4)	No change.

Original Risk Assessment Workshop based on Methodology in Aquacell Risk Management Procedure RM030-5 (06/03/2020)													Post-Workshop Risk Review based on updated Risk Management Procedure RM030-6 (25/03/2020)						
DESIGN / CONCEPT STAGE HACCP						Maximum Risk			Residual Risk				Maximum Risk			Residual Risk			
Step	**Hazardous Event**	**Impact**	**Hazard**	**Category**	**Control Measures**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Uncertainty**	**L**	**C**	**Rating**	**L**	**C**	**Rating**	**Basis for re-rating**
	Offensive levels of noise from plant *	Customer complaints	Other		Preventative • All external equipment likely to generate noise reviewed at design stage and acoustic enclosure provided where appropriate. Detective • Customer complaints program.	5	2	Significant (7)	2	2	Low (4)	Confident (+/- 1)	5	2	Moderate (10)	2	2	Low (4)	No change.

* Items marked with an asterisk indicate that these risks were assessed without input from a NSW Health representative

Appendix A9(b). Other Information - Response to Previous Hawkesbury Council Submission to Public Consultation Process 01/02/2019 & 01/07/2019

RFI	Date	Party	Category	Comment/ concern	Solution/ response
3	1/02/2019	Hawkesbury City Council	General	Council did not support the proposed subdivision application	None - the application was approved by Land and Environment Court (with conditions).
3	1/02/2019	Hawkesbury City Council	General	How the sewerage scheme would operate and whether or not the proposed lots were large enough to allow for: - the retention of significant trees on the site - the construction of a dwelling on each lot - the establishment of suitable irrigation areas (including buffers). and - location of private open space areas separate from the effluent irrigation areas	The disposal area being separate from individual lots should alleviate this concern.
3	1/02/2019	Hawkesbury City Council	General	How system would be approved, licensed, inspected and managed on an ongoing basis (in relation to irrigation areas on individual properties)	The disposal area being separate from individual lots should alleviate this concern.
3	1/02/2019	Hawkesbury City Council	General	Insufficient documentation provided in application to construct a new wastewater treatment plant. Further information required as follows: **1. Application to install an on-site sewerage management facility** The application is required to be supported by the information specified on page 3 of Council's 'application to install an on-site sewerage management facility' form. This information is required to be prepared in accordance with Clause 26 of the Local Government (General) Regulation 2005. It should be noted that the submission of previous reports prepared for the development application are considered to be conceptual and do not address all the above requirements. **2. Conditions of Development Consent Notice No. DA0830/15** Full specifications and details of the subdivision be provided in order to consider the sewerage management facility application, and should take into consideration: • Location and size of on-site detention basins, • Gross pollutant traps, • Location of building envelopes, • Irrigation areas, • Fencing, and • Retaining walls. Full construction details for the subdivision works and potential future building envelopes must be shown as part of this application. In this regard it is required that all construction certificate details of the application be submitted along with the operational details as outlined under Development Consent No. DA0830/15, and should include but not be limited to the following: a) Complete design and engineering plans of the sewerage treatment plant, including the gravity mains, rising mains and the pump station.	Many of these items are not relevant to the sewerage management facility and therefore have not been addressed in the WICA application. A S68 approval is no longer required as a WICA license applies to the scheme as a whole. Furthermore, as the project no longer includes wastewater disposal on individual lots, individual S68 approvals are no longer required.
3	1/02/2019	Hawkesbury City Council	General	The application does not provide any specific detail in relation to the following: - costs of maintaining the system, - potential for compaction of soils around irrigated areas, - location of parking/manoeuvring areas for pump out/service vehicles, - what limitations will apply to effluent irrigation areas, - what will happen with excess treated water, - odour impacts associated with the facility, - noise control measures, and - the overall appearance of the facility and how it will present to adjacent development.	Refer section B2 of the application form for costs. Refer Martens Concept Wastewater Management (appendix C6(a)) for design assumptions/limitations of the irrigation areas. Refer appendix IOP (appendix C10(a)), SMP (appendix C10(b)) and risk assessment (appendix C8) for contingency arrangements for excess treated water. Refer to risk assessment (appendix C8) for assessment of odour and noise. Refer to Odour Assessment Report in appendix C14(c). Refer to Traffic Report in appendix C14(d).
3	1/02/2019	Hawkesbury City Council	Plant buildings	It is unclear as to whether or not the application relies on the construction of the sewerage buildings based on the concept plans accepted by the Court or if the buildings have been modified since the determination of the application.	The sewerage buildings on the concept drawings accepted by court have not been modified. The components ***inside*** the building, which form the sewage treatment plant, have changed.

Aquacell Pty Ltd

Head office: Suite 602/6A Milsons Point NSW 2061, Australia
P: +61 2 4721 0545
www.aquacell.com.au

ABN 79 072 487 015

3	1/02/2019	Hawkesbury City Council	Disposal areas	It is considered that one of the main health and environmental risks posed by the development is in relation to the restrictive use of irrigation areas on small residential lots and the potential for future property owners to modify or interfere with the irrigation areas. In order to resolve any potential issues in this regard it would be preferred that water be treated to a higher level than what is proposed with the subsurface irrigation areas. This would allow recycled wastewater to be used for tap use as indicated under Section 3.8.13 of the Martens report, dated October 2018, reference P1504885JR03VO4, submitted with the licence application. Another environmental risk associated with the proposal would be the monitoring of all irrigation areas for each of the individual lots and frequency of inspections. Council is of the understanding that irrigation areas form part of the entire sewerage system as a whole and irrigation areas would need to be covered by a WICA licence which would be issued and managed by IPART and not as part of a separate Section 68 approval. This is similar to what occurs in Pitt Town (Retail Supplier's Licence Number 13_001R). It is unclear as to how such a regime would be managed and controlled during the process of construction and during future inspections.	The disposal area being separate from individual lots should alleviate this concern.
3	1/02/2019	Hawkesbury City Council	General	Specific conditions with the application should at a minimum be consistent with the conditions issued as part of the consent including conditions No. 28, 64, 77, 79, 80.	Condition 28 refers to an owner's operating manual for the sub-surface irrigation systems describing the responsibilities of individual lot owners. The disposal area being separate from individual lots should alleviate this concern. However, an owner's operating manual will still be prepared. Condition 64 refers to a public positive covenant to be lodged with Council. Several sub-items relate to disposal and should be negated by the disposal area being separate from individual lots. The remaining items will be part of a covenant application to Council once the WICA licence is approved by IPART. Condition 77 states minimum requirements of a Plan of Management for the scheme, to be submitted to Council. The relevant management plans are the IOP (appendix C10(a)) and SMP (appendix C10(b)). Condition 79 states minimum water quality requirements and disposal area requirements. Typical and target water quality is set out in Tables 6.2 and 11.1 of the SMP (appendix C10(b)). Change to disposal area design will change design criteria accordingly. The new design is described in Martens Concept Wastewater Management (appendix C6(a)). Condition 80 states that the Plan of Management must be implemented and adhered to.
3	1/02/2019	Hawkesbury City Council	Disposal areas	Planning measures that could be put in place to protect subsurface irrigation areas would be restrictions on title to prevent building structures on/or interfering with the irrigation areas identified on the land. Consequently, the management of any risks associated with complying development would be reliant upon the relevant certifier obtaining a satisfactory service arrangement with the service provider.	The disposal area being separate from individual lots should alleviate this concern.
3	15/02/2019	NSW Health	Inconsistencies	NSW Health has concerns regarding the applicant's application and understanding of the relevant guidelines. Although, the Draft Sewage Management Plan (appendix 4.3.10.1) states that the Australian Guidelines for Water Recycling was used to set the appropriate water quality, the preventive risk management framework which includes setting target log reduction values of pathogens based on the intended end uses of recycled water was not followed. There is also inconsistency in the terminology used in the application with reference to both water recycling and effluent disposal.	Target log reduction values were documented and presented in the risk assessment (refer appendix C8). Inconsistencies in terminology have been corrected throughout.
3	15/02/2019	NSW Health	Inconsistencies	It is also unclear if the treatment process includes chlorine disinfection which is mentioned in the Martens Concept Recycled Water Management Scheme (appendix 4.3.8.1), but not the application form or Draft Sewage Management Plan (appendix 4.3.10.1).	Inconsistency in Martens report now corrected.
3	15/02/2019	NSW Health	Risk management	NSW Health requests that IPART require a risk assessment with relevant stakeholders to ensure that the public health risks are adequately managed. The risk assessment should include the potential impact to residents (including odour) if the irrigation system became clogged and potential for effluent to resurface or run-off during wet-weather periods. I request, as noted previously, that NSW Health is consulted during risk assessments, development of management plans and development of incident notification protocols.	Risk assessment conducted on 06/03/2020 with NSW Health PHU representatives in attendance. Refer draft summary paper (appendix C8).
3	15/02/2019	NSW Dept Planning & Environment	General	No specific concerns or conditions	Nil

3	24/01/2019	EPA	General	No specific concerns or conditions	Nil
3	18/02/2019	Minister for Regional Water	General	No specific concerns or conditions	Nil
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	Inadequate size of area for effluent disposal	The disposal area has been re-designed to be separated from individual lots. The new design is described in Martens Concept Wastewater Management (appendix C6(a)). Design meets requirements of AS/NZS 1547 (2012).
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	Effluent disposal areas on individual lots are not within the control of the proposed retail licensee or network operator	The disposal area being separate from individual lots should alleviate this concern.
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	The need for site by site compliance has not been addressed	The disposal area being separate from individual lots should alleviate this concern.
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Treatment process	**A reduced level of disinfection is proposed in the application (contrary to the scheme considered by the Land and Environment Court)** Appendix 4.3.5.1 outlines the Sewage Treatment Plant Specification, which Aquacell would need to comply with. The table titled "STP Control" outlines that double barrier disinfection is required. Double barrier disinfection is a reasonable approach for a community scale treatment system that is sending treated effluent back to individual residences for disposal. The treatment process proposed by Aquacell does not provide double barrier disinfection, instead it provides single barrier disinfection by use of membrane filtration. In the response to Section 4.3.1 of the WICA application it states: *Aquacell can achieve the recommended operational compliance values as stipulated in Table 2 of the re-issued Martens report (Appendix 4.3.8.1) by utilizing an MBR (membrane bioreactor) without UV Treatment.* *The MBR system without UV is the same process as used in the current Tallowood Treatment System. The MBR System chosen since the issuing of the original Martens report in December 2016 treats wastewater to a far higher standard than SBP or idea alone.* *Note the Martens specification report at Appendix 4.3.5.1 highlights all three treatment systems as acceptable options.*	UV disinfection will be provided downstream of the MBR. This is shown in the process flow diagram at appendix C1.

3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Construction	**Effluent management during the staging of the development has not been addressed** It is proposed that each lot provide an irrigation area of 203 m2 including buffers (150 m2 actual irrigation area). This area is based on an average sewage generation rate of 600 L/dwelling/day. The actual sewage generation rate will depend on the development that is approved, the actual occupancy rate, water use within the dwelling, and other features such as if a pool or spa is proposed. The total sewage flow will also be impacted by any inflow and infiltration into the reticulated sewer, both during wet weather and dry weather. It is understood that the proposed sewage management system (except for the subsurface irrigation) will be constructed before any residential lots can be developed. The residential lots will then be developed by individual landowners over time. This will include providing subsurface irrigation system as part of the development of each lot. This means that the sewerage system, including reticulated sewer, pump station and treatment plant will need to be constructed, and presumably commissioned, before any homes have been developed and before any subsurface irrigation area for disposal of effluent has been constructed. As the subsurface irrigation area for disposal of effluent is only constructed at the time of home development, the following needs to be addressed: . During commissioning of the system including the treatment plant, all effluent generated will need to be removed by tanker The amount of inflow and infiltration to the sewer system relates to the size, design, construction and condition of the sewer system. There will be inflow and infiltration during wet weather even if there are no homes connected to the system. Hence early in the development the volume of wet weather inflow and	The disposal area being separate from individual lots should alleviate this concern.
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Nutrient balance	**The need to control phosphorus concentration in effluent has not been addressed** The Annual Nutrient Balance Assessment provided in Appendix 4.3.8.1 is based on the soil having a phosphorous absorption capacity of 410 mg/kg, which relates to the maximum amount of phosphorous that the soil can adsorb. The nutrient assessment shows that with an average discharge of 8 mg/L of phosphorous it would take 50 years to utilise the phosphorous absorption capacity of the soil for an irrigation area of 150 m2 per lot. The first issue is that these calculations are based on a reduced flow of 450 L/dwelling/day rather than the flow outlined in the legal judgment of 600 L/dwelling/day (Clause 34 of Appendix 3.5.1.1). A higher flow of 600 L/dwelling/day would require either a larger irrigation area, or would mean that the phosphorous absorption capacity of the soil is reached in less than 50 years. The second issue is that phosphorous adsorption from a soil will start to occur before the phosphorous absorption capacity of the soil is reached. This means that leaching of phosphorous will occur considerably earlier than 50 years. The following is obtained from Use of Effluent by Irrigation (NSW Department of Environment and Conservation, 2004): The phosphorus saturation point of most soils is probably reached between 0.25 and 0.5 of total sorption capacity (Kruger et al. 1995). If application of P exceeds this threshold, both runoff and leaching of phosphorus to surface and groundwater may occur. When calculating the amount of P that can be sustainably applied to land, the percentage of total sorption capacity at which phosphorus leaching occurs (sorption saturation point) should be calculated and used. It is possible to design the treatment plant to produce effluent with a lower average phosphorous concentration than 8 mg/L, which will reduce issues associated with phosphorous leaching to surface and groundwater. Finally there is a slight discrepancy between the target phosphorous concentration shown in the On- site Sewage Treatment Plant Specification (Appendix 4.3.5.1) of	Calculations updated to be based on 600 L/dwelling/day and 90th percentile Nitrogen and Phosphorous values, which is considered highly conservative. The total available area for passive nutrient uptake is 2 ha, which is well above the 6,900m2 required for passive nitrogen assimilation at maximum daily design load (see Attachment B of Martens Concept Wastewater Management Strategy (appendix C6(a))).
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Treatment capacity	**The need to allow for design flux rate of membrane filters has not been addressed** The response provided to Section 4.3.5 in the WICA application provides details on the proposed treatment plant capacity, including design flow of 21 kL/day and wet weather flow capacity of 150 kL/day. The design flow of 21 kL/day is based on 600 L/dwelling/day (as per Clause 34 of Appendix 3.5.1.1) and 35 lots. The basis for the adopted wet weather flow capacity of 150 kL/day is not known, however for a membrane filtration plant (as proposed by Aquacell) the peak capacity is likely to be limited by the peak flux of the membrane filters. Membrane filters can typically operate with high peak fluxes for limited time periods. As no information is provided on the peak flux rate or duration at which the membranes can operate at that peak flux it is difficult to make an assessment. As a reference Sydney Water typically use an excel spreadsheet tool (Sewerage Flow Schedule) to estimate the expected daily average, peak day and peak wet weather flows from a sewer system. Using that tool for 35 residential lots over 3.232 ha (with 4 EP per lot and 150 L/EP/day) and a 'leak tight sewer' provides a peak instantaneous sewage flow of 3.85 L/s. If this flow is maintained over the entire day it would equate to 333 kL/day. It is acknowledged that the Sydney Water tool is typically used for much larger systems than 35 lots, and hence is not necessarily accurate for the proposed development of 67 Kurrajong Rd. In reality, the actual peak wet weather flow will be impacted by the design, construction and condition of the sewer system, including the state of individual lot connections to the reticulated sewer main. The amount of wet weather can change over time due to deterioration in the condition of the sewer. It is acknowledged that the treatment plant is equipped with a sewage buffer tank with considerable volume (100 kL) which will allow it to even out the daily flow and absorb a significant portion of the wet weather flow for short duration events.	Buffer Tank capacity is greater than originally proposed, being 214 kL (2 x 107 kL), therefore greater flow balancing capacity is provided. Aquacell has not stated a wet weather flow capacity of 150 kL/day in any documentation. The peak flow flux of the membrane modules is 20 LMH (manufacturer specified). The design will include 3 membrane modules = 3 x 37.6 m2 = 112.8 m2 area. Expected average flow = 15,800 L/day = 5.8 LMH required flux. Design flow = 21,00 L/day = 7.8 LMH required flux. These fluxes are both considerably lower than the manufacturer advised peak flow flux. If an extreme wet weather event were to fill the buffer tank, operating the plant at 20 LMH flux would restore the buffer tank to normal operating level in 5-6 days (assuming the maximum design flow of 21 kL/day continues to enter the plant). In the unlikely event that wet weather flows exceed this capacity, contingency measures including emergency pump out are described in the IOP (refer appendix C10(a).

3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Inconsistencies	The material in the applications contains numerous discrepancies including in relation to the size of irrigation areas, the storage volumes and the description of the proposal as being for a recycled water system 2.2 General Discrepancies A number of discrepancies were noticed in the WICA application and the various appendixes. The discrepancies should be clarified between all parties. The following discrepancies were identified, though doubtless there are others. 2.2.1 Irrigation area Various references are made to irrigation area of 200 m2 per lot including in Appendix 4.3.8.2 and in response to Sections 4.3.3 and 4.3.8 in the WICA application. In some references it is not clear if the area of 200 m2 is intended to refer to the irrigation area only, or the irrigation area plus setbacks. However Appendix 4.3.8.2 specifically refers to a total dispersal area of 7,000 m, which is equivalent to 35 x 200 m , and includes water balance calculations based on an effluent disposal area of 22 7,000m. This would indicate that the irrigation are proposed is 200m per lot, with buffer area additional to this. 2.2.2 Storage Volumes	A single disposal area is now proposed and the required disposal area has been calculated in Martens Concept Wastewater Management Strategy (appendix C6(a)). Buffer requirements additional to the disposal area are also set out in that document. The Treated Water Storage Tank volume has been changed to 65 kL throughout. Additional storage has been provided in the Buffer Tanks which have been increased to 214kL (from 100kL). Terminology has been corrected throughout with the system being referred to as a wastewater management system rather than a recycled water system.
3	1/07/2019	Dr Robert Patterson of Lanfax Laboratories (soil scientist and environmental engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	**The design effluent loading rate of 4mm/day is too high given the soil profile which includes light clay** The Court accepted the evidence of Dr Martens that an irrigation rate of 4 mm/day, including a safety factor, was applicable. Yet the latest version of the Concept Recycled Management Scheme (Martens & Associates, 2018), sets out in its Table 3, that only the topsoil (loamy sand) of 350-500 mm deep had a design loading rate (DLR) of 5 mm/day and that the subsoil was a 'light clay' with a DIR of 2.5 mm/day. It is unclear why Martens & Associates would claim that the recycled water irrigation rate is 5 mm/day (page 13), when the Court accepted 4 mm/day and the Table 3 suggests that the limitation to deep drainage is the light clay at 2.5 mm/day. Surely, to comply with the Standard, the effluent loading rate is decided by the permeability of the 'restricting layer', in this case the light clay. It is clear from Dr Hazelton's report, that the surface soil was variously a sandy loam, a silty clay loam or a sandy clay loam. These surface textures are definitely not 'loamy sand' as reported by Martens & Associates (2016, 2018) but a texture requiring a lesser irrigation rate than proposed. The Standard (p.54) states that "The Design Loading Rate (DLR) should be determined from the soil category based on the soil texture and structure assessment for the most restrictive soil layer within the clearance depth set by the regulatory agency and not the shallower soils within which the land application system is installed (see 5.2.3). Care is required to determine if the shallower soil or the deeper soils are the more restrictive soil horizon and the SLR is based upon the most restrictive soil horizons." Each of the profiles reported by Martens & Associates (BH001-006) has the 'restrictive layer' in the light clay commencing variably around 350 mm deep, but has not persuaded them to alter the effluent application rate accordingly. The Standard s.5.2.3, referenced in the paragraph above refers to Table 5.1 Determination of Soil Category. Those categories are then used in Table E1, as set out in	The wastewater disposal system design has been changed to absorption trenches rather than subsurface irrigation and therefore the Court accepted irrigation rate of 4mm/day no longer applies. Soil profiles and design loading rates (DLRs) according to AS/NZS 1547 (2012) are set out in Martens Concept Wastewater Management Strategy (appendix C6(a)). Although the design treated wastewater loading rate would be 50 mm/day based on a design trench depth of 400mm, a more conservative rate of 30mm/day based on the upper portions of the sub-soil profile has been used in the design.
3	1/07/2019	Dr Robert Patterson of Lanfax Laboratories (soil scientist and environmental engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Construction	**The need to retain the existing soil profile for irrigation areas during site disturbance and construction has not been addressed** It is important that the design of the effluent irrigation area can be based upon the soil profile as purported to be present before any vegetation removal or other earthworks are conducted. That the soil profile is protected, during development of the site, is critical to nutrient assimilation and percolation of effluent to avoid overloading the allocated area. Reconstituting a soil profile after construction machinery has run backwards and forwards over the area is a difficult process that will require considerable expertise if the effluent irrigation areas are to be established within the design criteria of the management plan.	The disposal area would be built prior to development of lots to minimise disruption to future owners of lots and ensure all treated wastewater can be immediately disposed of. Given the relatively gentle slopes within the development, no significant earthworks within the disposal area are expected. Where required, treated wastewater disposal areas shall be top dressed to ensure a minimum sandy loam / loamy sand depth of 0.5 m. Refer Martens Concept Wastewater Management Strategy (appendix C6(a)).

3	1/07/2019	Dr Robert Patterson of Lanfax Laboratories (soil scientist and environmental engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	**The net effluent application rate has been wrongly calculated over the entire site rather than only on the irrigation areas** Concept Recycled Management Scheme (Martens & Associates, 2018), states (S 3.8.9) that 'the net site recycled water application rates will be in the order of 0.5 mm/day.' It appears that the 0.5 mm/day was calculated for the 15.8 kL/day effluent over the total area of the subdivision (3.232 ha) giving 0.49 mm/day. This calculation takes in all the irrigation areas, the area of buffers, under the houses, paths and roadways: a nonsense!	The revised wastewater disposal system design includes a total disposal area of 1,755m2 based absorption trenches with loading rates as per AS/NZS 1547 (2012). However, the total available area for passive nutrient uptake has been estimated at 2 ha as nutrients will be absorbed by surrounding soils. Refer to Martens Concept Wastewater Management Strategy (appendix C6(a)).
3	1/07/2019	Dr Robert Patterson of Lanfax Laboratories (soil scientist and environmental engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	**The small lot sizes are insufficient to accommodate the irrigation areas plus setbacks, plus reserve area, plus retaining significant trees plus new development** One factor not accounted for in the overall layout of the lot is the impact that a retained large tree will have on the denial of an area around the tree for effluent irrigation. Depending upon the species, many trees do not tolerate high levels of soil moisture on a permanent basis within their drip zone. It is unclear as to how each lot will be affected by the loss of available irrigation area because of existing large trees.	The disposal area being separate from individual lots should substantially alleviate this concern. The disposal area is also conservatively sized. Irrigation is subsurface, and will be set up to have several zones that operate at different times of the day. Refer to Martens Concept Wastewater Management Strategy (appendix C6(a)).
3	1/07/2019	Dr Robert Patterson of Lanfax Laboratories (soil scientist and environmental engineer) via	Disposal areas	**The use of median rainfall records will under-estimate the impacts of weather conditions which are unfavourable to evaoptranspirtion and deep drainage** The applicant has not addressed the cumulative effect of disposing of 21 kL of effluent on 27%, or 49% as the case may be, of the development when weather conditions are unfavourable to evapotranspiration and/or deep drainage. The water balance, provide by Martens & Associates (October 2018) uses the median rainfall records, that under-estimate the impact of rainfall on soil moisture profile, to be discussed later.	The revised wastewater disposal system design includes a total disposal area of 1,755m2 based absorption trenches with loading rates as per AS/NZS 1547 (2012). This represents 5.4% of the total site area of 32,536m2. Treated wastewater distribution lines will be placed below the surface to ensure that there is no contact with incident rainfall, which will be otherwise managed through the site's stormwater management system. The impact of wet weather and flooding was considered in the risk assessment (refer appendix C8).
3	1/07/2019	Dr Robert Patterson of Lanfax Laboratories (soil scientist and environmental engineer) via Pikes & Verekers Lawyers (for	Disposal areas	**There is no provision for a reserve area to allow "resting" of irrigation areas** AS/NZS 1547:2012 defines "Reserve area" as "an area set aside for future use as a land application area to replace or extend the original land application area." Section 5.5.3.4 (p. 51) states that "A reserve area of 100% of the design area or other equivalent mitigation measure should be considered as part of the risk management process to be available on a site for expansion, or for resting the land application system, or for duplication of the land application system if other circumstances require this at some further time. The reserve area shall be protected from any development that would prevent is being used in the future." The "Environment and Health Protection Guidelines" state (p. 141) that "The minimum effluent application area should include a sufficient reserve to allow rotation of the dosing area to help recovery of soils and vegetation and to provide an alternative application area in case of system failure." The loss of setbacks for road frontage, exclusion for the home and ancillary activities around the home, make the allocation of a reserve area on each lot difficult to secure. Council wishes that a further 150 m2 be identified as 'reserve area' set aside for future use as land application area to replace the original land application system, if required. This requirement of a 'reserve area' is consistent with AS1547:2012 (2.4.1 (g); 5.5.3.4). Table 1 in the Environment & Health Protection Guidelines (DLG et	The conservative design has been developed to enable long- term continuous application. In addition to this, the irrigation system will be set up in zones, which would allow for the resting of irrigation areas/ isolation for maintenance. Refer Martens Concept Wastewater Management Strategy (appendix C6(a)).

3	1/07/2019	Dr Robert Patterson of Lanfax Laboratories (soil scientist and environmental engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	There is a lack of detail about the delivery of effluent to irrigation areas regarding: - timing of delivery period(s) - exceedance of daily estimated volumes - the distribution of effluent amongst lots ignores effluent generation and is inequitable - there is insufficient information for purchasers of lots about the design of irrigation areas on individual lots - insufficient disinfection treatment (no UV treatment now proposed, contrary to the scheme proposed in the Land and Environment Court) - inadequate water balance modelling to support design irrigation areas due to: reliance on median monthly rainfall rather than 70th percentile monthly rainfall overestimation of irrigation areas (i.e. 150sqm not the 200 sqm assumed)	Concerns regarding inequitable distribution amongst lots and information for purchases on irrigation areas on individual lots should be alleviated by revised wastewater disposal system design of absorption trenches in a segregated disposal area. There are multiple layers of conservatism built into the wastewater disposal system design, as described in Concept Wastewater Management Strategy (appendix C6). Contingency measures including emergency pump out are described in the IOP (refer appendix C10(a). The treatment process includes UV disinfection. Water balance and wastewater disposal system design are provided in Martens Concept Wastewater Management Strategy (appendix C6). The revised wastewater disposal system design includes a total disposal area of 1,755m2 based absorption trenches with loading rates as per AS/NZS 1547 (2012). The disposal area may be irrigated in zones. Refer to Appendix C6(a).
3	1/07/2019	Dr Robert Patterson of Lanfax Laboratories (soil scientist and environmental engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Monitoring and compliance	The proposal fails to provide sufficient detail of the monitoring regime, the body or person who bears responsibility for ensuring compliance with that regime or the cost of that regime to the end user	The monitoring regime is described in the SMP (refer appendix C10(b)), as are the roles and responsibilities for the various aspects of the operation and maintenance of the infrastructure.
3	1/07/2019	Scott Lee of Lee Environmental Planning (town planner) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	General	Kurrajong and surrounding areas are under considerable development pressure but are unsewered	The proposed system provides a solution to this.
3	1/07/2019	Scott Lee of Lee Environmental Planning (town planner) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	Unlike other approved on-site sewerage treatment systems there will not be a single, isolated area available for effluent disposal	Disposal areas being separate from individual lots should alleviate this concern.

3	1/07/2019	Scott Lee of Lee Environmental Planning (town planner) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	General	The grant of development consent to subdivision does not presuppose a WICA license but defers to the Minister administering the WICA responsibility to ensure that any license will protect public health, the environment, public safety and consumers generally	Noted.
3	1/07/2019	Scott Lee of Lee Environmental Planning (town planner) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	There is an inherent conflict between expected development rights on small residential lots where a large proportion of the lot must be quarantined for effluent disposal	Disposal areas being separate from individual lots should alleviate this concern.
3	1/07/2019	Scott Lee of Lee Environmental Planning (town planner) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	Future development on individual lots is not under the control of the applicant, IPART or Council and may be carried out as exempt or complying development	Disposal areas being separate from individual lots should alleviate this concern.
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Overflow	The two main risks for pollution that do not appear to have been addressed include overflow of the recycled water reservoir and overloading of the irrigation area. These two risks are related to each other and are affected by the size of the irrigation area and how the effluent management system will be controlled. Overflow of the sewage pump station has been addressed through provision of more than one day of storage volume in the pump station.	These aspects were addressed in the risk assessment workshop (refer appendix C8).
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	It is noted that Table 3 in Appendix 4.3.8.1 shows that the topsoil has a design irrigation rate of 5 mm/day, the subsoil (which is the soil below 350 mm deep) has a design irrigation rate of only 2.5 mm/day. This restricted design irrigation rate of the subsoil is due to the nature of the subsoil (shown as light clay) and its substantially lower permeability than the topsoil (shown as loamy sand). Hence there is a risk that when irrigating at the design rate of 4 mm/day not all effluent applied by the subsurface irrigation will be able to percolate through the subsoil. This means that the excess effluent will accumulate in the topsoil, leading to saturated topsoil and/or resulting in horizontal flow of effluent through the topsoil to adjacent areas. This could lead to effluent flowing through the soil to unwanted locations and/or being discharged to local watercourses. The former could cause damage to foundations of structures, including structures on adjacent properties and/or community owned infrastructure. The latter could result in pollution of land and waterways, particularly considering the relatively high nutrient concentrations in the treated effluent.	The wastewater disposal system design has been changed to absorption trenches rather than subsurface irrigation and therefore the Court accepted irrigation rate of 4mm/day no longer applies. Soil profiles and design loading rates (DLRs) according to AS/NZS 1547 (2012) are set out in Martens Concept Wastewater Management Strategy (appendix C6(a)). Although the design treated wastewater loading rate would be 50 mm/day based on a design trench depth of 400mm, a more conservative rate of 30mm/day based on the upper portions of the sub-soil profile has been used in the design. Where required, treated wastewater disposal areas shall be top dressed to ensure a minimum sandy loam / loamy sand depth of 0.5 m. Refer Martens Concept Wastewater Management Strategy (appendix C6).

3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury	Disposal areas	**Is there any control over the supply of treated effluent or only measurement?** The concern is that if there is only monitoring and no control, then some irrigation areas may become overloaded. As all irrigation areas will be fed from a single reticulated main, the irrigation areas closest to the treatment plant will receive higher pressure and hence would receive more treated effluent than those that are further away from the treatment plant. This may overload some of the irrigation areas, meaning that they would receive more than the design irrigation rate. This will adversely affect certain properties and could overload the sub-soil irrigation system for those lots.	A dedicated disposal area being separate from individual lots should largely alleviate this concern. The design loading rates have been developed to enable long- term continuous application. Treated wastewater will be transferred to the dedicated absorption disposal area via a pressurised, metered reticulated main. The main will likely consist of an 80 mm diameter pressure main. Connection to individual absorption trenches within the dedicated disposal area would be provided through a pressurised delivery main. Control over supply of treated effluent will be by level in the Treated Water Storage Tank. Refer Martens Concept Wastewater Management Strategy (appendix C6(a)).
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	**How will the system operate in order to dispose of additional treated effluent that is generated during wet weather?** If the soil in the irrigation area is saturated, e.g. due to rainfall, and additional effluent is applied by the irrigation system, the applied effluent may enter surface or groundwater leading to pollution. For example treated effluent may travel horizontally between the topsoil and subsoil and emerge to the surface at a downhill location. The water balance modelling provided indicates that during the winter months the amount of treated effluent generated exceeds the irrigation demand and hence the excess effluent is A design irrigation rate of 4 mm/d with an irrigation area of 150 m2 per lot gives a daily effluent flow of 600 L/d per lot. The proponent needs to clearly explain if the intention is to exceed this irrigation rate at specific times, such as when the recycled water reservoir reaches a high level. Exceeding the design irrigation rate exacerbates risks associated with treated effluent, and hence nutrients, making their way into surface water or groundwater. Clarity needs to be provided on how these risks wills be managed. Appendix 4.3.8.1 explains that the design irrigation rate was obtained from AS/NZS 1547 (2012). This standard relates to "On-site domestic wastewater management". Typically on- site systems do not include a reticulated sewer system and hence have much lower propensity for wet weather inflow and infiltration into the sewer system than a reticulated sewer. The proposed system for 67 Kurrajong Rd includes a reticulated sewer with larger propensity for inflow and infiltration during wet weather. Clarity needs to be provided on how the additional treated effluent that is produced by the plant during wet weather will be managed. If the treated effluent generated by the treatment plant exceeds what can be returned to the irrigation area the excess effluent will accumulate in the recycled water	The treated wastewater storage tank will provide some 3-4 days of temporary storage, which will be more than adequate to enable day- to-day flow rate equilibration. In terms of the disposal field, this was sized in accordance with the DLRs in AS/NZS 1547 (2012). These rates have been developed to enable long- term continuous application, and do not rely on water balance calculations or temporary storage of treated wastewater. The DLRs are of such a low level that normal evaporation, transpiration and percolation processes will remove any treated wastewater applied to the soil via sub-surface application. Treated wastewater distribution lines will be placed below the surface to ensure that there is no contact with incident rainfall, which will be otherwise managed through the site's stormwater management system. The disposal field will not lead to downslope seepage issues due to there being adequate soil depths and the treated wastewater soil loading rates being selected in accordance with AS/NZS 1547 (2012). Mound on downslope will stop run off to residential properties. Refer Martens Concept Wastewater Management Strategy (appendix C6(a)). This risk was also addressed in the risk assessment workshop (refer appendix C8).
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	**What is the contingency plan for when high level is reached in the recycled water reservoir?** If the treated effluent generated by the treatment plant exceeds what can be returned to the irrigation area the excess effluent will accumulate in the recycled water reservoir. The recycled water reservoir could become full after two consecutive days of wet weather. Overflow of the recycled water reservoir would constitute as uncontrolled discharge of treated effluent to the environment and hence cannot be allowed to occur without an appropriate licence from NSW EPA. Hence the excess effluent will need to be otherwise managed, such as removal offsite by tanker. A contingency plan needs to be set up to ensure that the appropriate actions are undertaken in a timely manner.	There area multiple layers of conservatism built into the wastewater disposal system design, as described in Concept Wastewater Management Strategy (appendix C6(a)). Contingency measures including emergency pump out are described in the IOP (refer appendix C10(a). The Treated Wastewater Storage Tank will be fitted with level sensors and will alarm if irrigation system blocks (interlock on high level).
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	**How will the effluent management system be controlled to ensure that the design irrigation rate of 4 mm/d is not exceeded on any irrigation area?** A design irrigation rate of 4 mm/d with an irrigation area of 150 m2 per lot gives a daily effluent flow of 600 L/d per lot. The proponent needs to clearly explain if the intention is to exceed this irrigation rate at specific times, such as when the recycled water reservoir reaches a high level. Exceeding the design irrigation rate exacerbates risks associated with treated effluent, and hence nutrients, making their way into surface water or groundwater. Clarity needs to be provided on how these risks wills be managed. Appendix 4.3.8.1 explains that the design irrigation rate was obtained from AS/NZS 1547 (2012). This standard relates to "On-site domestic wastewater management". Typically on- site systems do not include a reticulated sewer system and hence have much lower propensity for wet weather inflow and infiltration into the sewer system than a reticulated sewer. The proposed system for 67 Kurrajong Rd includes a reticulated sewer with larger propensity for inflow and infiltration during wet weather. Clarity needs to be provided on how the additional treated effluent that is produced by the plant during wet weather will be managed.	A dedicated disposal area being separate from individual lots should largely alleviate this concern. The design loading rates have been developed to enable long- term continuous application. Treated wastewater will be transferred to the dedicated absorption disposal area via a pressurised, metered reticulated main. Control over supply of treated effluent will be by level in the Treated Water Storage Tank. Refer Martens Concept Wastewater Management Strategy (appendix C6(a)).

3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	**Will the effluent management system operate independent of rainfall and/or soil moisture level? If so, what precautions will be provided to prevent treated effluent reaching surface or ground water?** If the soil in the irrigation area is saturated, e.g. due to rainfall, and additional effluent is applied by the irrigation system, the applied effluent may enter surface or groundwater leading to pollution. For example treated effluent may travel horizontally between the topsoil and subsoil and emerge to the surface at a downhill location. The water balance modelling provided indicates that during the winter months the amount of treated effluent generated exceeds the irrigation demand and hence the excess effluent is stored. How will the irrigation system be controlled to ensure that the irrigation demand is not exceeded?	The treated wastewater storage tank will provide some 3-4 days of temporary storage, which will be more than adequate to enable day- to-day flow rate equilibration. In terms of the disposal field, this was sized in accordance with the DLRs in AS/NZS 1547 (2012). These rates have been developed to enable long- term continuous application, and do not rely on water balance calculations or temporary storage of treated wastewater. The DLRs are of such a low level that normal evaporation, transpiration and percolation processes will remove any treated wastewater applied to the soil via sub-surface application. Treated wastewater distribution lines will be placed below the surface to ensure that there is no contact with incident rainfall, which will be otherwise managed through the site's stormwater management system. The disposal field will not lead to downslope seepage issues due to there being adequate soil depths and the treated wastewater soil loading rates being selected in accordance with AS/NZS 1547 (2012). Mound on downslope will stop run off to residential properties. Refer Martens Concept Wastewater Management Strategy (appendix C6(a)). This risk was also addressed in the risk assessment workshop (refer appendix C8).
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	**What is the contingency plan if the capacity of the irrigation area is less than what is required?** This could happen by specific action, such as if an individual homeowner blocks or restricts their effluent irrigation area (e.g. physically block or damage the incoming pipe supplying treated effluent to the subsoil irrigation system, or to block, damage or remove all or a portion of the subsoil irrigation system). This could also happen over time such as if the soils in the irrigation area become clogged over time or otherwise have lower capacity to accommodate the hydraulic flow and/or nutrients than design (for household effluent disposal systems it is common practise to provide a reserve irrigation area that can be used to allow the other irrigation area to 'rest', though the proposed system for 67 Kurrajong Rd does not include reserve area). Either of these would reduce the amount of effluent that can be irrigated at a site, possibly to the detriment of the total community. Appendix 4.3.10.1 indicates that the irrigated disposal scheme will be owned by the 67 Kurrajong Rd Community Association (KCA). However there may be a situation which could take considerable time to resolve (e.g. if there was legal action taken) and hence a contingency plan needs to be in place to manage how the system will operate and how any treated effluent in excess of the capacity of the sub-soil irrigation system will be managed (e.g. tanker offsite) and at whose cost.	There area multiple layers of conservatism built into the wastewater disposal system design, as described in Concept Wastewater Management Strategy (appendix C6(a)). Contingency measures including emergency pump out are described in the IOP (refer appendix C10(a). Blockages and overflows were addressed at the risk assessment workshop (refer appendix C8).
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Risk management	A risk management plan should be prepared for the facility to outline the actions to be undertaken to ensure no pollution from overflow of the sewage pump station, sewage buffer tank, recycled water reservoir, and irrigation system. This shall ensure that appropriate actions are taken at the right time (e.g. it takes time for a tanker to arrive on site to remove excess treated effluent, and hence the tanker needs to be ordered well in advanced of the tank level reaching 100% full).	These risks were addressed in the risk assessment workshop (refer appendix C8). The risk assessment will be incorporated into the SMP (refer appendix C10(b)). Contingency measures including emergency pump out are described in the IOP (refer appendix C10(a).
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Disposal areas	Also it is not clear what crop has been assumed to estimate the crop factor. It is proposed that the subsoil irrigation areas are to be vegetated with grass and hence the crop factor used in the water balance should be representative of household grassed areas.	The water balance assumed crop factors ranging between 0.4 (June) to 0.8 (January) (refer to Concept Wastewater Management Strategy (appendix C6(a)).
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes &	Risk management	A management plan needs to address the risk that the irrigation area provided is insufficient. Typically household effluent disposal systems include a reserve area, defined in AS/NZS 1547 (2012) as "An area set aside for future use as a land application area to replace or extend the original land application system." The reserve area is identified as a risk reduction measure in AS/NZS 1547 (2012). Section 5.5.3.4 of AS/NZS 1547 (2012) states: A reserve area of 100% of the design area or other equivalent mitigation measure should be considered as part of the risk management process to be available on a site for expansion, or for resting of the land application system, or for duplication of the land application system if other circumstances require this at some future	The design loading rates have been developed to enable long- term continuous application. Refer Martens Concept Wastewater Management Strategy (appendix C6(a)). The disposal area was assessed in the risk assessment workshop (refer appendix C8). The risk assessment will be incorporated into the SMP (refer appendix C10(b)).

3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes &	General	Serious consideration should be given to modify the scheme to supply recycled water to homes for non-potable uses including toilet flushing and outdoor usage. This would recycle a portion of the effluent and hence reduce the amount of effluent that needs to be disposed of via the subsoil irrigation system. This would mean that treated effluent is actually recycled and hence make it a proper recycled water scheme, rather than a household effluent disposal scheme. It would allow homeowners to meet BASIX requirements without the need for homes to install a rainwater tank.	This option has been thoroughly considered and not selected for this scheme.
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Risk management	The management plan needs to detail the plan for monitoring and maintaining the sub-surface irrigation system. Whilst the proponent's risk assessment rated blockage as a low risk, there seems to be no provision made for monitoring this. This is quite critical as these assets are within private property and malfunctions can potentially cause third party damage.	The risk of blockage in the disposal system was assessed in the risk assessment workshop (refer appendix C8). The risk assessment will be incorporated into the SMP (refer appendix C10(b)). A dedicated disposal area being separate from individual lots should further alleviate this concern.
3	1/07/2019	Philip von Huben of Jacobs (waste water engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Odour	**Treatment - Odour Impact** An odour impact assessment was undertaken by GHD (Appendix 4.3.3.6). In section 4.2 of this assessment it states: *STP tanks were designed to allow airflow at a rate of 0.005 cubic meter per second through the 50 millimetre vent at a height of 2.1 meters. These design specifications were used as stack parameters in the model.* A ventilation rate of 0.005 m3/s was applied each to the sewage buffer tank and the biological treatment. For a buffer tank of 100 m3 volume (as is being proposed) a ventilation rate of 0.005 m3/s is too low. Such a ventilation rate would provide only 0.2 air changes per hour, which is significantly less than the typical air changes per hour for sewage buffer tanks of 5 – 20. Such a low rate of air changes per hour will encourage corrosive environment being formed in the buffer tank and may lead to more concentrated odours being released than were modelled. No justification is provided for the adopted ventilation rate of 0.005 m3/s. Justification should be provided and the rate increased if required. Provision should be made to enable forced ventilation with odour treatment to be provided in the future if required.	The standard of 5-20 changes per hour referred to applies to ventilation in a plantroom. As the buffer tanks will be outdoors, we accept GHD modelling in this situation. As an additional measure, Aquacell will install carbon filter on any vent lines in outlets. It is currently not proposed to contain the buffer tanks within a shed, but if this were adopted at a later date, Aquacell would provide at least 6-10 changes per hour (which is based on the standard for grease traps) which is consistent with Aquacell's standard practice in CBD high rise buildings.
3	1/07/2019	Dr Robert Patterson of Lanfax Laboratories (soil scientist and environmental engineer) via Pikes & Verekers Lawyers (for Hawkesbury City Council)	Infrastructure capacity	**Daily Wastewater Generation** In the approval, the Court accepted that for a dwelling the daily wastewater load was 600 L that relates to four persons at 150 litres per person per day (Lpd). It was presumed that the occupancy of four persons related to a three-bedroom home, although this was never clarified. That rate (600 L/day) is consistent with AS/NZS 1547:2012, Table H3 for a reticulated supply in households with full water-reduction facilities of 145 Lpd. Whether the same ratio is to be applied to two-bedroom homes (3 person = 450 L) or four-bedrooms (5 persons = 750 L) is unclear, presumably Council could impose those daily volumes to be consistent with the Court's approval. It is my view that 150 Lpd is a reasonable planning value. In neighbouring councils, to the south, where sewage management needs to comply with the Sydney Catchment Authority's, Designing and Installing On-site Wastewater Systems: A Sydney Catchment Authority Current Recommended Practice (2012), Table 2.1 sets the design wastewater loading calculations at 600 L per bedroom. While these loading rates may be excessive, the concern is that, on small lots, the cumulative effects may be significant.	Mean persons per dwelling Census data has been used as outlined in section 3.2 of Martens Concept Wastewater Management Strategy document (appendix C6(a)). A 33% buffer has also been applied.

3	1/07/2019	Dr Robert Patterson of Lanfax Laboratories (soil scientist and environmental engineer) via Pikes & Verekers Lawyers (for	Effluent quality	The recent document by Martens & Associates (2018) set out in its Table 2, that E.coli only needs to meet the <1000 cfu/100 mL requirement, contrary to the level committed to in the Joint Statement (issue 11 – 3 February 2019) that was <10 cfu/100 mL. It was also agreed that the nitrogen limit at <18 mg N/L and phosphorus limit of <9 mg P/L were acceptable for the soil's chemical attributes. These levels were maxima, not 90th percentiles. The Martens & Associates (2018) state that "we note that the expected E.coli levels will be <10cfu/100 mL, and that the WRF could readily be designed to achieve this target should this be required by Council." (p.13). It is unclear as to why the compliance limit of <1000 cfu/100 mL is the goal set by them when clearly the agreement, and compliance with the Standard is <10 cfu/100 mL.	Table 2 values have been changed to reflect the Joint Statement (refer to Concept Wastewater Management Strategy (appendix C6(a)).

Appendix A9(c). Other Information - Response to NSW Health Comments 29/05/2019

Date	Party	Category	Comment/ concern	Solution/ response
29/05/2019	NSW Health	Regulatory/technical	The proposal as presented by Aquacell for the 67 Kurrajong Road application, creates a potential for residents to be exposed to inadequately treated sewage, and therefore biologically active contaminants, due to the disposal area being in close proximity to people (specifically an unfenced and unsigned area of residents' backyard).	The dedicated disposal area is now separated and fenced off from individual lots. Residential access of the disposal area will not be permitted. The risks of residential exposure to this new deisgn is addressed in the Risk Assessment (Appendix C8).
29/05/2019	NSW Health	Regulatory/technical	The proposal defines all infrastructure applied for within the area of operations as sewage infrastructure within this proposal. No application has been made for recycled water infrastructure, meaning that the automatic protections which require water quality management plans for recycled water infrastructure within the WIC regulations, will not automatically apply to mitigate the risks above.	The scheme will provide sewage disposal, not recycled water. Aquacell have produced an Infrastructure Operating Plan (Appendix C10(a)) and Sewage Management Plan (Appendix C10(b)) to manage the infrastructure and treated wastewater quality,
29/05/2019	NSW Health	Regulatory/technical	Aquacell should conduct a risk assessment for the scheme as a whole. NSW Health reviewed Aquacell's response to item 27 of the RFI 3 and did not consider that the response addressed the concerns or provided a preliminary risk assessment addressing public health risks.	A Risk Workshop was conducted, with attendance by Aquacell, NSW Health, and Martens Associates addressing public health risks. The outcomes from the Risk Assessment is attached in Appendix C8.

29/05/2019	NSW Health	Regulatory/technical	Mitigations for this type of scheme should include routine water testing and incident plans	Validation and routine water testing, in addition to an incident response plan, are outlined in the SMP (Appendix C10(b)).
29/05/2019	NSW Health	Regulatory/technical	Concerns were raised that as a minimum UV and chlorine would be required for this type of scheme	The scheme will include UV treatment. As the new disposal area is subsurface and removed from individual lots, chlorine will not be required.
29/05/2019	NSW Health	Regulatory/technical	Information about initial notification, changes of ownership and leasing and subletting is not sufficiently covered by the application.	Resident notification is covered in the SMP (Appendix Cb(10)). An Owner's Manual will be distrubuted to new residents and will also be accessible through the Community Association.
29/05/2019	NSW Health	Regulatory/technical	Water logging of backyards was raised as an issue and resident's level of awareness may hinder the reporting of incidents.	Individual lots will not be used to dispose treated wastewater.
29/05/2019	NSW Health	Regulatory/technical	Other issues where the actions of some residents may impact on the service of other residents	This is adressed in the Risk Assessment (Appendix C8). Primarily, there is sufficent buffer storage capacity within the system to allow time for the WICA Licensee to respond to any issues caused by detrimental actions of a resident, without services to the remaining residents being impacted.

Appendix C12(a) PRJM Pty Ltd v Hawkesbury City Council - NSW Caselaw

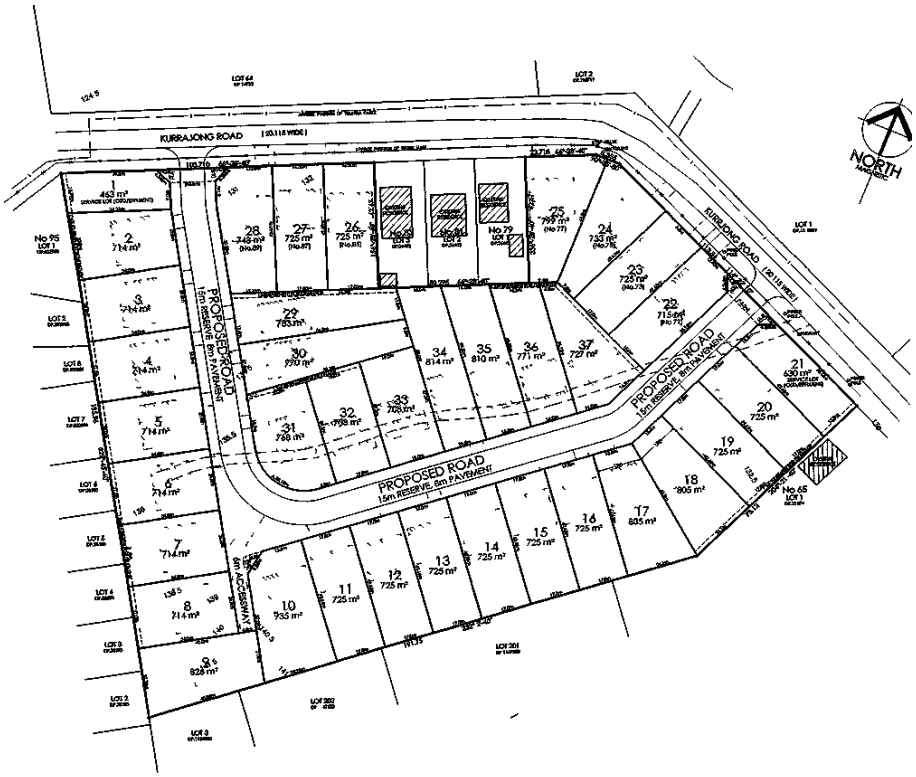
Land and Environment Court
New South Wales

Medium Neutral Citation:	**PRJM Pty Ltd v Hawkesbury City Council [2017] NSWLEC 1339**
Hearing dates:	8,9,10 February 2017, 1 May 2017
Date of orders:	30 June 2017
Decision date:	30 June 2017
Jurisdiction:	Class 1
Before:	Brown C
Decision:	See orders at [88]
Catchwords:	DEVELOPMENT APPLICATION: subdivision - inconsistent with some aims of the local environmental plan - inconsistent with some objectives of the zone - impact on existing vegetation - inappropriate method of disposal of sewage - inadequate arrangements for water supply, stormwater disposal, waste collection and road access – appropriate conditions of consent
Legislation Cited:	Environmental Planning and Assessment Act 1979 Hawkesbury Local Environmental Plan 2012 Sydney Regional Environmental Plan No 20-Hawkesbury-Nepean River (No 2-1997)
Category:	Principal judgment
Parties:	PRJM Pty Ltd (Applicant) Hawkesbury City Council.(Respondent)
Representation:	Counsel: Mr P Tomasetti SC (Applicant) Ms R McCullough (Respondent) Solicitors: Brock Partners (Applicant) Pikes & Verekers Lawyers (Respondent)
File Number(s):	2016/162961

Publication restriction: No

JUDGMENT

1 **COMMISSIONER**: This is an appeal against the refusal of Development Application DA0830/15 that proposes a 37 lot community title subdivision, including the construction of a new private road, drainage system and installation of a water recycling facility to treat sewage. Two lots (Lots 1 and 21) would be used for these services and the remaining 35 lots would be used for residential development and range in size from 708 sqm to 1355 sqm.



2 The council maintains that the application should be refused because the proposal will:

- be inappropriate for the site,
- have an adverse impact on existing vegetation,
- have an inappropriate method of disposal of sewage, and
- have inadequate arrangements for water supply, stormwater disposal, waste collection and road access.

The site

3 The site is 67 Kurrajong Road, Kurrajong and is Lot 1 in DP 1185012. It is irregular in shape with an area of 3.23 ha and is vacant. The site is intersected by an access track, covered in vegetation, consisting of canopy trees and lower level weeds and does not

have access to reticulated sewer.

4 The site has direct access to Kurrajong Road, surrounds three residential lots along Kurrajong Road and shares property boundaries with 13 other residential lots. The majority of land uses surrounding the site are used for residential purposes. The residential properties surrounding the site range from medium sized residential lots to larger residential lots with a land area of approximately 2ha.

5 Prior to July 2015, the site was Crown Land owned and managed, known as Lot 63 in DP 14736 and was created for future public requirements.

Relevant planning controls

6 The site is within Zone R2 Low Density Residential under *Hawkesbury Local Environmental Plan 2012* (LEP 2012). The subdivision of land is permissible, with consent. Clause 2.3(2) provides that the Court must "have regard to the objectives for development in a zone when determining a development application in respect of land within the zone".

7 Clause 4.1 permits subdivision of the land provided that the new lots created are not less than the minimum subdivision lot size shown on the Lot Size Map. The Lot Size Map identifies that a minimum lot size of 450 sqm applies to the land and that the land is located within "Area A". "Area A" refers to cl 4.1D (1) of LEP 2012.

8 Clause 4.1D(1) provides an exception to the minimum lot size for certain land and the relevant section of this clause is:

> (1) Despite clauses 4.1, 4.1AA and 4.1A, development consent must not be granted for the subdivision of land that is identified as "Area A" and edged heavy blue on the Lot Size Map if:
>
> > (a) arrangements satisfactory to the consent authority have not been made before the application is determined to ensure that each lot created by the subdivision will be serviced by a reticulated sewerage system from the date it is created, and

9 Clause 6.4(4) states:

> (4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:
>
> > (a) the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or
> >
> > (b) if that impact cannot be reasonably avoided by adopting feasible alternatives —the development is designed, sited and will be managed to minimise that impact, or
> >
> > (c) if that impact cannot be minimised—the development will be managed to mitigate that impact.

10 Clause 6.7 states:

> 6.7 Development consent must not be granted to development unless the consent authority is satisfied that any of the following services that are essential for the proposed development are available or that adequate arrangements have been made

to make them available when required:

(a) the supply of water,

(b) the supply of electricity,

(c) the disposal and management of sewage,

(d) stormwater drainage or on-site conservation,

(e) suitable road access.

11 Clauses 4.1D(1), 6.4(4) and 6.7 contain requirements that require a positive response to allow the further consideration of the application. A negative response to any of the clauses must see the application refused.

12 *Hawkesbury Development Control Plan 2002* (DCP 2002) applies, particularly Part C Chapter 7 - Effluent disposal and Part D Chapter 3 - Subdivision

13 *Sydney Regional Environmental Plan No 20-Hawkesbury-Nepean River (No 2-1997)* (SREP 20) applies to the site. Clause 4 relevantly states:

> **4. Application of general planning considerations, specific planning policies and recommended strategies**
>
> (1) The general planning considerations set out in clause 5, and the specific planning policies and related recommended strategies set out in clause 6 which are applicable to the proposed development, must be taken into consideration:
>
> (a) by a consent authority determining an application for consent to the carrying out of development on land to which this plan applies, and
>
> (b) by a person, company, public authority or a company State owned corporation proposing to carry out development which does not require development consent.

Inappropriate development

14 The Council contends that the development is inappropriate on planning grounds as the proposal is contrary to the overall aims and objectives of LEP 2012, the objectives of the R2 Low Density Residential zone, the subdivision layout has not been planned having regard to site constraints and insufficient information has been submitted in support of the application to approve the proposed subdivision.

The evidence

15 Expert evidence was provided by town planners Mr William Pillon, for the council and Mr Neil Kennan for the applicant.

16 Mr Pillon states that the proposed development is inappropriate for the following reasons:

- contrary to the aims and objectives of LEP 2012 and the objectives of the R2 zone,
- based on expert advice provided by Dr Patterson, the council's expert engineer on sewage disposal, the application is unable to demonstrate that arrangements satisfactory to the consent authority can be made as required by cl 4.1D(1) of

LEP 2012,

- it would set an undesirable precedent in supporting a subdivision that would have an unacceptable impact on the future design, development and management of the proposed lots,
- the subdivision relies on the development of the land to be confined to specific areas on lots that are limited in area and are too restrictive to allow for the orderly and economic development of land,
- the subdivision does not provide for an appropriate level of flexibility for future development of the land and achieve both the objectives of the zone and merits envisaged at subdivision stage,
- larger residential lots would ensure that the land could be developed in a manner that provides for suitable services and land area to protect the traditional character of the surrounding residential area, and
- the subdivision relies on a sewerage system and water supply service to be approved by external agencies.

17 Mr Kennan states that the proposed service arrangements are suitable for a community title subdivision and would permit the orderly and economic development of land. The proposed development takes reasonable account of all the natural and other constraints of the site and will conserve the land so that it can be used for its intended purpose. Any development of the site will have an impact on the native vegetation of the site, however the relevant issue is whether that impact is acceptable. In his opinion, the subdivision design takes into account the native vegetation on the site which includes dense harmful weeds, regrowth and some older trees. The proposal provides for a subdivision pattern, character and appearance which is consistent with surrounding development.

18 Based on the information prepared by the applicant in this matter, Mr Kennan states that there is sufficient information available to enable the Court to determine that the subdivision has been designed to maximise the retention of significant vegetation while at the same time allowing for the orderly and economic development of the site. A suitable method of sewage reticulation is provided to the proposed development in accordance with the design prepared by Dr Martens, the applicant's expert engineer on sewage disposal.

19 The proposed number of lots, the proposed lots sizes, the resultant density and the associated works are perfectly consistent with the surrounding residential development of Kurrajong, its varied cadastral pattern, and will be compatible with the character of the locality.

Findings

20

"Inappropriate development" is not a term that should be used to describe a contention. A development may be inappropriate if it does not satisfy certain criteria but it is the criteria that are the contentions – different criteria should not be grouped into one collective contention. I have attempted to extract what appears to be concerns of the council however some are repeated in other contentions.

Plan objectives

21 The council contentions state that the proposed subdivision is contrary to the following plan objectives in cl 1.2(2):

> (a) to provide the mechanism for the management, orderly and economic development and conservation of land in Hawkesbury,
>
> .
>
> (c) to protect attractive landscapes and preserve places of natural beauty, including wetlands and waterways,
>
> (d) to protect and enhance the natural environment in Hawkesbury and to encourage ecologically sustainable development,

22 Even though cl 1.2 provides Aims of the Plan and cl 1.2(2) provides specific aims of the plan; there is no operative clause that requires consideration be given to these aims in the assessment of the application, in the same way that cl 2.3(2) requires that "regard" has to be given to the zone objectives when considering a development application in that zone. In any event, I am satisfied that any matter raised in the plan objectives is raised, in generally more detail, through the other contentions raised by the council.

Zone objectives

23 The zone objectives are:

> • To provide for the housing needs of the community within a low density residential environment.
>
> • To enable other land uses that provide facilities or services to meet the day to day needs of residents.
>
> • To protect the character of traditional residential development and streetscapes.
>
> • To ensure that new development retains and enhances that character.
>
> • To ensure that development is sympathetic to the natural environment and ecological processes of the area.
>
> • To enable development for purposes other than residential only if it is compatible with the character of the living area and has a domestic scale.
>
> • To ensure that water supply and sewage disposal on each resultant lot of a subdivision is provided to the satisfaction of the Council.
>
> • To ensure that development does not create unreasonable demands for the provision or extension of public amenities or services.

24 The council contentions do not identify any specific objectives but broadly state that the proposed subdivision is unacceptable because:

- the sewerage system is unacceptable,
- the number of lots is excessive and out of character with the Kurrajong area, and
- the subdivision does not properly address site constraints of topography, proximity to adjacent dwellings and loss of trees.

25 The matters relating to the sewerage system and loss of trees are addressed later in the judgment by Dr Martens and Dr Patterson and I am not aware of any meaningful evidence on the site constraint of topography and proximity to adjacent dwellings. With the benefit of the site inspection and an understanding of the subdivision layout, it would be difficult to accept that these matters would warrant the refusal or modification of the application.

26 On the matter of character, Mr Pillon and Mr Kennan disagreed on the impact that the proposed subdivision will have on Kurrajong. The site is located opposite land within Zone RU1 Primary Production and Mr Pillon and Mr Kennan agree that this land is different to the existing and desired future character of the R2 zone.

27 Mr Pillon describes the R2 zoned area as having a number of distinct areas with some areas greater than 1000 sqm in size with other areas below this size. Mr Kennan describes the area, in terms of lot size, as varied but similar to the areas of the proposed development. Mr Kennan states that any test of character should be based on the desired future character anticipated by the R2 zone requirements for lot size. LEP 2012 anticipates a minimum lot size of 450 sqm and also the opportunity to have on site disposal of sewage, subject to it being disposed on site in a satisfactory manner.

28 In relation to the question of whether the proposed subdivision is “compatible with the character of the living area and has a domestic scale”, I agree with the comments of Mr Kennan that the desired future character is that anticipated by the R2 zone rather than a selective assessment against parts of the R2 zoned land. With the proposed lot sizes ranging in size from 708 sqm to 1355 sqm, I can comfortably conclude that the proposed development is compatible with the R2 zoned area of Kurrajong.

29 If regard is had to the zone objectives in the context of those matters raised by the council in their contentions, then I am satisfied that adequate regard has been given to the R2 zone objectives in the proceeding paragraphs, in accordance with cl 2.2(3) and the objectives present no barrier to the approval of the application.

Sewage disposal

30 The proposal provides for the collection of domestic sewage via a reticulated sewer system from the 35 proposed dwellings, with recycled water returned to dedicated sub-surface irrigation areas on each lot. The reticulated sewer flows either directly to the packaged Water Recycling Facility (WRF) on Lot 21, or to a pump station on Lot 1 for

conveyance to the WRF. Reclaimed water will be pumped to each of the 35 lots for sub-surface irrigation onto a dedicated sub-surface irrigation area for dispersal. The WRF and the effluent recycling are proposed to be operated and managed under community title.

31 Expert evidence on this contention was provided by Dr Martens, for the applicant and Dr Patterson, for the council. They produced a joint report that addressed the contentions raised by the council. The specific relevant matters in dispute related to:

- estimated daily water use,
- extent of soil investigation,
- seepage from irrigation areas,
- area of proposed irrigation fields,
- timing of construction of proposed irrigation fields, and
- water balance.

Estimated daily water use

32 Dr Martens states that If an average of 3 persons (EP) per house is assumed, which is the expected average occupancy rate across the sub-division irrespective of dwelling bedroom numbers, then the design flow rate would be 450 L/dwelling/day. A rate of 600 L/dwelling/day has however been adopted, which is 4EP/house, and is a conservative design allowing for an increase of 33% over design. Dr Martens also states that the Australian Bureau of Statistics (ABS) identifies an occupancy rate of 2.7 persons/dwelling for Kurrajong and that this figure was used in estimating the estimated daily water use by the council in a recent approval for on-site disposal in a development in Vincents Road at Kurrajong.

33 Dr Patterson states that an average of 4 EP/house is assumed, for a 3-bedroom dwelling, for which the design daily flow rate would be 600 L/dwelling/day.

34 I accept that a rate of 600 L/dwelling/day is appropriate.

Extent of soil investigation/ seepage from irrigation areas

35 Dr Martens states that sufficient information has been provided in terms of soil properties to establish that the soils on the site soils will not constrain the application of recycled effluent. In addition to the previous testing, 6 boreholes and 2 hydraulic push tubes (for comparative purposes) were undertaken by Dr Martens on 20 January 2017. These reveal similar findings to previous boreholes, although clay content is somewhat lower at shallow depths than previous reports. Soil laboratory testing was undertaken by SESL Australia, at the suggestion of Dr Patterson, and this testing indicates that the soils are non-saline, non-sodic, non-dispersive, with a high capacity for phosphorus

sorption. Field texture investigations by Dr Martens reveal that soils are well structured, well drained with no material impeding layer, and well suited to recycled water application. Dr Martens is of the view that there is no need for further soil testing based on his investigations to date.

36 Dr Martens accepts that while the words “Light clay” are used in the description of the “Soil/rock material test description” in the test bores (REF BH 001-006) to interpret the design irrigation rate in Table M1 of "*Australian and New Zealand Standard: On-site domestic wastewater management"* AS/NZS 1547:2012 (AS 1547) (p 160), his opinion, from the physical inspection of the soil profile is that the soil texture is best described as “Loams”, ” Sandy loams” or even “Gravels and sand” where the design irrigation rate is 4mm/day or 5 mm/day for the latter soil texture. Adopting a conservative approach, Dr Martens adopts a design irrigation rate of 4mm/day.

37 The applicant also provided evidence from Dr Pam Hazelton, although somewhat reluctantly because her involvement with the soil on the site involved 6 test pits in 2016. These were not dug for the purposes of establishing whether it could accommodate the sub-surface irrigation but rather whether the soil characteristics were consistent with a certain endangered ecological community. In any event, her evidence was helpful in that she stated that the soil profile would not impede the flow of treated effluent from the sub-surface irrigation. She described the soil as “graduational, with no significant colour changes, no obvious layers and no perched water table”.

38 Dr Patterson states that it is usual to report soil structure, soil dispersibility, and salinity/sodicity and other chemical properties in determining site/soil constraints. "*Environment and Health Protection Guidelines: On-site sewage management for single households."* Department of Local Government (1998), *Environmental Guidelines: Use of Effluent by Irrigation.* Department of Environment and Conservation, Sydney (2004) and AS 1547 all rely upon site and soil descriptions. While Dr Patterson had visited the site prior to the hearing, his soil investigations were limited to holes dug with a spade to a depth of around 250mm. Dr Patterson relies on the words “Light clay” in the description of the “Soil/rock material test description” in the test bores of Mr Martens (REF BH 001-006) to interpret the design irrigation rate in Table M1 of AS 1547 of 3 mm/day.

39 I accept the evidence of Dr Martens that a design irrigation rate of 4 mm/day is appropriate for a number of reasons. First, the concerns of Dr Patterson stem solely from the words “Light clay” in the description of the “Soil/rock material test description” in the test bores of Mr Martens. Given the physical investigations undertaken by Dr Martens and Dr Hazelton and their evidence on the ability of the soil to accept the sub-surface irrigation, the sole reliance on the descriptions in Table M1 should not be preferred above actual physical investigations of the soil. Second, the independent

evidence of Dr Hazelton supports the conclusions of Dr Martens. Third, both Dr Martens and Dr Hazelton are experienced soil engineers and importantly, have conducted physical soil testing on the site compared to the limited testing undertaken by Dr Patterson. Fourth, the comprehensive testing through test pits, core sampling, laboratory testing and field texture testing supports the conclusions of Dr Martens.

40 I accept a design irrigation rate of 4mm/day based on the evidence of Dr Martens and Dr Hazelton.

Area of proposed irrigation fields

41 Dr Martens states that the soil investigations show that there is ample depth to install a shallow sub-surface drip irrigation system using a design irrigation rate of 5 mm/day however a rate of 4 mm/day as a factor of safety is adopted.

42 Dr Martens concludes that the irrigation area is therefore 150 sqm and when the agreed setbacks are applied, an area of 203 sqm is required for the sub-surface irrigation area.

43 Dr Patterson maintains that 3mm/day is appropriate thus, a minimum area of 200 sqm for dedicated irrigation area is required however when the agreed setbacks of are applied to the design area, an area of 270 sqm is required.

44 Based on a design irrigation rate of 4 mm/day, I accept the irrigation field for each lot (including setbacks) is 203 sqm.

Timing of construction of proposed irrigation fields

45 Dr Martens states that at the development application stage for a dwelling, applicants will be required to prepare a landscape plan that shows the final location and set-out of the recycled water irrigation areas. This will need to comply with the conditions of approval in terms of area and setbacks. Ultimately the entirety of the recycled water management scheme will be overseen and managed by the community association, thus ensuring long-term operation. Dr Martens sees no reason why council would require a separate approval under s68 of the *Local Government Act 1993*. However, if council does require this, then a separate and additional mechanism can be put in place for the long-term operation of the scheme to be overseen. Dr Martens notes also that it is expected that the IPART license operating conditions will cover operation of the irrigation areas and usually negates the need for any further s68 approval.

46 Dr Patterson states that it appears that the proposal requires each lot owner to be responsible for a s 68 application to council for the location and set out of the irrigation area, its maintenance and continued operation without any input from the developer.

Such actions may limit the functioning and long term viability of the irrigation area, particularly if the soil profile in the effluent irrigation area no longer resembles the soil profile used for the current development application for subdivision.

47 As a general approach, I agree with Dr Martens that applicants should be required to prepare a landscape plan at the dwelling application stage that shows the final location and set-out of the recycled water irrigation areas. It would seem impractical to set aside areas for irrigation that may conflict with a future dwelling on each lot. The only caveat is that prospective purchasers need to be fully aware of their obligations in terms of the sewage disposal for each new residential lot.

Water balance

48 Dr Martens states that no water balance for the dedicated effluent re-use fields is required. The fields have been sized in accordance with AS 1547 which does not rely on water balances. Dr Patterson states that it is usual that local conditions of rainfall, and evaporation are taken into account.

49 I accept Dr Martens evidence that water balances are not required.

50 For the reasons in the preceding paragraphs, I am satisfied that pursuant to :

- clause 4.1D(1) of LEP 2012, “arrangements satisfactory to the consent authority have been made before the application is determined to ensure that each lot created by the subdivision will be serviced by a reticulated sewerage system from the date it is created”,
- clause 6.4(4)(a) of LEP 2012, “the development is designed, sited and will be managed to avoid any significant adverse environmental impact”, in this case disposal of sewage,
- clause 6.7(c) of LEP 2012, adequate arrangements have been made for the “the disposal and management of sewage” available when required,
- clause 3.8.4, Part D of DCP 2002 Effluent Disposal, the Aims and Objectives are satisfied,
- clause 5 of SREP 20 in relation to General planning considerations, particularly sub sec (d) “the relationship between the different impacts of the development or other proposal and the environment, and how those impacts will be addressed and monitored” have been taken into consideration, and
- clause 6(3), (4) and (17) of SREP 20 in relation to the specific planning policies and related recommended strategies for Water quality, Water quantity and Sewerage systems and works, have been taken into consideration.

Impact on existing vegetation

The evidence

51

The contention raised by the council is that the proposed development application should be refused as it would have an adverse impact on the trees located on the land and on the surrounding locality and consequently the loss will have an unacceptable impact on the scenic quality of the area.

52 Expert evidence was provided by Mr Guy Paroissien, an arborist for the council and for the applicant by Ms Narelle Sonter, a landscape designer and Dr Anne Marie Clements, an ecologist.

53 Mr Paroissien states that the retention of larger canopy trees is less likely on smaller lots due to higher potential for conflict with infrastructure and perceived threats from large trees in the vicinity of dwellings (branch/tree failure, bush fire risk etc). The proposed lot layout will result in the short and long term removal/loss of a significant number of trees in the north-west area of the site and the loss of these trees will impact the landscape character of the site.

54 Mr Paroissien notes that the proposed subdivision layout is uniform throughout the site and makes no particular design allowance for tree retention in the north-west part of the site, indicating that the proposed tree retention is incidental to, rather than a result of the proposed lot layout. He acknowledges that the most significant tree on the site (Tree 42), is now proposed to be retained rather initially removed.

55 In terms of replacement plantings, Mr Paroissien states that the proposed plantings on the Landscape plan prepared by Botanica include *Brachychiton populnens* (Kurrajong) and *Hymenosporum flavum* (Native Frangipani) as proposed street tree plantings however these are not considered to be locally native species. The Landscape Plan also nominates tree locations in the rear gardens of the proposed lots but does not specify whether these are to be locally native, native or exotic species. Mr Paroissien notes that the evidence from the applicant's ecological expert, Dr Clements, recommends native trees with local provenance, which he supports.

56 Mr Paroissien notes that tree survey (the Travers plan) identifies 171 trees on the site and that numerous trees are missing. The Landscape Plan identifies that 107 trees are proposed to be retained however in the absence of detailed arboricultural assessment from the applicant, Mr Paroissien states that 6 trees indicated in the schedule on the Landscape Plan to be retained are not actually shown on the Landscape Plan but are shown to be within either the proposed road or nominated dwelling footprints and therefore cannot be retained as nominated. The remaining 89 trees are considered likely to be impacted by the development, many of them significantly so.

57 Ms Sonter states that in the orderly development of a residential subdivision with a number of trees, there will inevitably be a loss of some existing trees. However, the proposal incorporates the retention of more than 60 canopy trees on site and

notwithstanding that some of these trees may later be removed to accommodate wastewater irrigation areas on individual lots, this does represent a significant retention of existing canopy on the site.

58 The natural beauty of the locality is also enhanced by the plantings within the gardens of existing residential development in the locality. The size and shape of each of the proposed lots is generous and provides ample opportunity to establish gardens with the diversity of species over several canopy levels that typifies the existing residential landscapes within the locality.

59 Ms Sonter states that the applicant acknowledges the significance of the trees on site and the contribution that they make to the landscape character of the locality. Accordingly it is proposed to retain as many of the existing trees on site as can possibly be retained with the orderly and reasonable development of the site as a residential subdivision. The trees that are shown as being retained are those which are located to allow for:

- a road through the site,
- adequate driveway access from that road to each lot,
- a reasonably sized building footprint with appropriate setbacks,
- adequate room for wastewater irrigation requirements, and
- maintenance as an Inner Protect Area (IPA).

60 Ms Sonter states that in response to Mr Paroissien that attractive, small to medium size trees which should perform well in the locality have been included in the list of indicative trees for street tree planting. The Street Tree species list can be amended to include alternative species, as preferred by council.

61 In response to the concerns expressed by Mr Paroissien; Ms Sonter states that the amended landscape plan will remove reference to the proposed irrigation areas as these areas will not be constructed until the time of construction of the future residence for each lot. Whilst it is acknowledged that in some instances the construction the irrigation area may require the removal of a tree, it is not necessarily the case. Also, the landscape plan shows indicative footprints only and the actual future building footprint on any lot and its proximity to and impact on any existing tree to be retained will be the subject of a future development application for the lot. Similarly, for each lot, the development application will generally be required to incorporate a landscape plan which identifies all species to be planted.

62 Dr Clements and Mr Paroissien agree that the site contains a moderate to high levels of *Eucalyptus amplifolia* (Cabbage Gum) in the north-west of the site, with limited occurrences elsewhere on the site. Dr Clements is of the opinion that the canopy species *E. amplifolia* is not likely to be the original species of the site, as *E. amplifolia* is

a species usually associated with watercourses and low-lying sites, not on well-drained slopes typical of the site. From recent observations Dr Clements notes that not all of the individuals of *E. amplifolia* in the north-west corner of the site were recorded on Travers plan and there is significantly more saplings of *E. amplifolia* in the north-west than indicated. There are also minor occurrences of saplings of *E. amplifolia* (up to approximately 20 m) near the southern boundary from seed showers from former paddock fence line trees offsite to the south.

63 Dr Clements states that the pattern of *E.amplifolia* occurrence onsite may be indicative in soil moisture, as well as the source of the seed showers being from trees visible on the 1961 aerial photograph. From the quadrat data and confirmed by inspections, the most frequently recorded (and with the highest percent projected foliage cover in the unslashed areas) was the noxious weed *Ligustrum* spp.

64 In Dr Clements' opinion , the site does not represent a natural environment in the Hawkesbury area, as it is:

- former cleared grazing land colonised by *E. amplifolia* and *Acacia parramattensis* from a small number of native trees visible on the 1961 aerial photograph, and
- the understorey vegetation on the site is dominated by exotic species, mainly *Ligustrum* spp. and *Lantana camara,* with vegetation recorded in Quadrats 3, 6, 7, 8, 9 close to or over the 75% weed cover threshold for non-recovery of native vegetation.

Findings

65 The comments of Ms Sonter and Dr Clements must be largely accepted in relation to the impact on existing vegetation and the scenic quality of the area. The site has a considerable tree cover but also has a high proportion of weeds that adds to the perception of dense vegetation. There was no dispute that the existing trees are regrowth based on the site being used previously for grazing – a fact clearly established by aerial photographs. Of considerable importance to this contention is that the site is also zoned for low density residential development. The consequence of the zoning is that there is a reasonable and justified expectation that some form of residential form of development, consistent with the zoning of the site, will occur and this will necessitate the removal of some of the existing vegetation.

66 I accept that the Travers report was only accurate to about 1m or 2m by satellite positioning, as well as the difficulty in accessing some trees because of the weed infestation. Given the zoning of the site and the minimum lot size, it would seem that the focus should be to maximise the retention of trees on the site while allowing development to occur , consistent with the R2 zone.

67

While the council adopts the approach the trees need to be accurately defined in relation to the hypothetical building platforms and irrigation areas; I am not satisfied that this is the optimal solution. It would seem that in order to maximise tree retention, the applicant should be required to remove the weed infestation and accurately plot and assess the trees on the site with a BDH>300mm. Until a development application is submitted, the retained trees on each of the residential lots should remain. On lodgment of a development application for a dwelling and any ancillary buildings, an assessment can be made on the retention of any trees, taking into account the design of the dwelling, the irrigation area and the value of the tree. Of the trees on the site, it was agreed that Tree 42, which was considered to be tree of some importance, would now be retained.

68 The contentions specifically identify that the proposal is contrary to s 3.7.5 of the subdivision chapter of DCP 2002 which specifies that vegetation which adds to the visual amenity of a locality and/or which is environmentally significant should be conserved in the design of the subdivision proposal. Also, the contentions states that the proposal does not comply with s 3.2 of the subdivision chapter of DCP 2002 which specifies that vegetation should be retained where it forms a link between other bushland areas and that all subdivision proposals should be designed to minimise fragmentation of bushland.

69 While these are requirements should be considered, they are not an absolute requirement and any application for subdivision must take into account the other circumstances that relate to the site, particularly in this case, the R2 zoning of the site, the minimum lot size of 450 sqm and the quality of the vegetation on the site.

70 For the reasons in the preceding paragraphs, I am satisfied that pursuant to :

- clause 6.4(4)(a) of LEP 2012, “the development is designed, sited and will be managed to avoid any significant adverse environmental impact”,
- clause 3.2 and cl 3.7.5 of DCP 2002 have been appropriately considered,
- clause 5 of SREP 20 in relation to General planning considerations, particularly sub sec (d) “the relationship between the different impacts of the development or other proposal and the environment, and how those impacts will be addressed and monitored” have been taken into consideration, and
- clause 6(6) of SREP 20 in relation to the specific planning policies and related recommended strategies for Flora and fauna, have been taken into consideration.

Conditions

71 There are a number of conditions in dispute and also a number of conditions that will require amendment based on the finding in the judgment. The condition numbers relate to the original condition numbers of the council.

72 **Condition 9 and 10** – these conditions make reference to a Rehabilitation Plan when no plan is required however the council maintains that it is necessary to ensure that weed management will occur as part of the proposal. I agree with applicant that the reference to the Rehabilitation Plan should be deleted as management of weeds can be done without the need for a Rehabilitation Plan. A separate condition addresses the removal of the weeds.

73 **Condition 12 -** these conditions relate to earthworks and the applicant and makes reference to “effluent disposal areas”. The applicant states that these areas should not be designated at this time but rather at the DA stage for a dwelling. The council states that the subdivision time is the appropriate time for designating the areas and if the areas need to be changed then this can be done as part of the DA stage. I agree with the applicant that the most efficient approach is to define the area when the design of the proposed dwelling is known although greater information needs to be available to any prospective purchaser through the s 88E Instrument.

74 **Condition 16** - this condition requires an arboriculture report to, in part, identify the trees to be retained. The applicant states that this report is not required because of the zoning of the land, the trees have been previously identified and the work required by the current Weed Order will likely require tree removal. The council states that the condition should remain as there is no objective analysis as to whether the trees proposed for retention can be sustainably retained.

75 The Travers report was generally accepted as being inaccurate and not containing all trees that were greater than a Diameter Breast Height (DBH)>300mm. The identification of all trees on the site with a DBH>300mm should be provided (the Tree Location Plan) with sufficient accuracy so that potential house footprints can be located and the impacts on any tree with a DBH>300mm clearly identified. The significance of each tree should also be identified although trees in the road reserve need not be identified. Clearly, this must be done after the removal of the existing extensive weed infestation on the site.

76 **Condition 23, 53 -** this condition requires certain infrastructure to be provided and approved prior to a Construction Certificate: kerb and gutter (condition 23(a)), sealed road shoulder (condition 23(b)), stormwater drainage (condition 23(c)), and footpaving (condition 23(d)). The applicant argues that all conditions should be deleted whereas the council maintains that the conditions are warranted based on the additional traffic generated by the development.

77 On this condition, expert evidence was provided by Mr Brodie, for the applicant and Mr Vaby, for the council. The conditions sought by the council are not unreasonable for the subdivision of land within a R2 zone. The applicant has sought to develop the land to a level anticipated by the zone and there is consequential infrastructure that should be

provided as part of that redevelopment that includes kerb and gutter, construction of a road shoulder, stormwater drainage and footpaving, as would be expected in a R2 zone. However, I do not accept the council's position that the applicant should be expected to carry out those works for the existing properties in Kurrajong Road although there may be benefits if the engineering work for the existing dwellings is conducted concurrently with the proposed development, at the cost of the council.

78 **Condition 25, 41** - this condition requires an approval under s68 of the *Local Government Act 1993* and a license under the *Water Industry Competition Act 2006.* It is not clear from the evidence whether both are required or only one so the condition can remain.

79 **Condition 28** - this condition requires the preparation and notification of an owners operating manual for the proposed sewerage system, including a schematic cross-section of the irrigation field. The council seeks the inclusion of the conditions to alert potential buyers and the applicant seeks the deletion of the condition as this matter will be addressed at the DA stage.

80 I accept the condition can be retained so that prospective owners are aware of the operation of the sewage disposal system.

81 **Condition 40-** this condition requires compliance with the Environmental Management and Rehabilitation Plan, the arboricultural impact assessment and the Tree Protection Plan. I accept that this condition be amended to refer only to the Environmental Management Plan as the Rehabilitation Plan, and the Tree Protection Plan are no longer required and the arboricultural assessment of the trees with BDH>300mm is addressed elsewhere.

82 **Condition 64 –** this condition requires that certain matters are to be included in a public positive covenant under s88E of the *Conveyancing Act 1919.* These include the responsibilities of the Community Association, including the fencing of the OSD and basin areas. These are not opposed by the applicant.

83 Having found that the location and configuration of the irrigation areas is best left to the submission of a DA for a dwelling on each lot, it is appropriate that additional requirement should also be included in the s88E public positive covenant so that prospective purchasers are fully aware of their obligations if they purchase a lot in the subdivision. These are:

- the irrigation area, including setbacks,
- activities not appropriate for the irrigation areas,
- consideration of the Tree Location Plan when submitting a DA for a dwelling and ancillary buildings, and
- bushfire protection areas.

84

Conditions 72, 73, – these conditions require the final plan and a survey plan to identify all water and sewerage system infrastructure as well as other matters. Water and sewerage system infrastructure are still relevant and the conditions should remain however other matters identified in the conditions can be deleted.

85 **Conditions 75, 77** - condition 75 requires a Community Management Statement to identify certain matters on the land. There is agreement on certain matters and disagreement on other matters however only part of sub sec (a) is in conflict with the judgment. The words "…including details of the size and desired location of effluent disposal and buffer areas within each lot" can be deleted. Sub sec (b), (c) and (f) can be deleted because of the reference to the tree retention plan. The second dot point in condition 77 can be deleted for the same reason as sub sec (a).

86 **Condition 81** – this condition requires a more onerous noise standard than provided under the Noise Control Act and can be deleted.

Orders

87 I am satisfied that approval should be granted to the proposed subdivision but on terms different to that suggested by the applicant or the council. I have attempted to amend the conditions of consent to reflect the findings in the judgment however these amendments may require further amendment. I propose to stay the orders for a period of 14 days for the parties to review the conditions to ensure that they are consistent and properly reflect the findings in the judgment. The stay and the invitation to review the conditions is not an invitation to re-argue any of the contentions or make further submissions on matters already addressed.

88 The orders of the Court are:

Part A;

(1) The appeal is upheld.

(2) Development Application DA0830/15 for a 37 lot community title subdivision, including the construction of a new private road, drainage system and installation of a water recycling facility to treat sewage with two lots would be used for services and the remaining 35 lots would be used for residential development at. 67 Kurrajong Road, Kurrajong is approved subject to the conditions in Annexure A.

(3) The exhibits are returned with the exception of exhibits 1, B, C and D.

Part B;

(1) The orders in Part A are stayed for a period of 14 days from 30 June 2017 for the parties to make any written submissions on the conditions in Annexure A to ensure consistency and to ensure that they fully reflect the findings in the judgment. Final orders will be made in chambers.

G Brown

Commissioner of the Court

162961.16 (C) gtb (54.1 KB, pdf)

Decision last updated: 30 June 2017

Appendix C12(b) PRJM Pty Ltd v Hawkesbury City Council Final Judgement on s68 Approval

Land and Environment Court
New South Wales

Medium Neutral Citation:	**PRJM Pty Ltd v Hawkesbury City Council (No.2) [2017] NSWLEC 1434**
Hearing dates:	8,9,10 February 2017, 1 May 2017, final orders stayed for amended conditions 30 June 2017
Date of orders:	15 August 2017
Decision date:	15 August 2017
Jurisdiction:	Class 1
Before:	Brown C
Decision:	1. The appeal is upheld. 2. Development Application DA0830/15 that proposes a 37 lot community title subdivision, including the construction of a new private road, drainage system and installation of a water recycling facility to treat sewage at 67 Kurrajong Road, Kurrajong is approved subject to the conditions in Annexure A. 3. The exhibits are re4turned with the exception of exhibits 1, B,C and D.
Catchwords:	DEVELOPMENT APPLICATION: subdivision - inconsistent with some aims of the local environmental plan - inconsistent with some objectives of the zone - impact on existing vegetation - inappropriate method of disposal of sewage - inadequate arrangements for water supply, stormwater disposal, waste collection and road access – appropriate conditions of consent
Legislation Cited:	Environmental Planning and Assessment Act 1979 Hawkesbury Local Environmental Plan 2012 Sydney Regional Environmental Plan No 20-Hawkesbury-Nepean River (No 2-1997)
Category:	Principal judgment
Parties:	PRJM Pty Ltd (Applicant) Hawkesbury City Council.(Respondent)
Representation:	Counsel: Mr P Tomasetti SC (Applicant) Ms R McCullough (Respondent)

Solicitors:
Brock Partners (Applicant)
Pikes & Verekers Lawyers (Respondent)

File Number(s): 2016/162961

Publication restriction: No

JUDGMENT

1 **COMMISSIONER**: This is an appeal against the refusal of Development Application DA0830/15 that proposes a 37 lot community title subdivision at 67 Kurrajong Road, Kurrajong. The subdivision included the construction of a new private road, drainage system and installation of a water recycling facility to treat sewage. Two lots (Lots 1 and 21) would be used for these services and the remaining 35 lots would be used for residential development and range in size from 708 sqm to 1355 sqm.

Background

2 Following the hearing of the appeal on 8,9,10 February 2017 and 1 May 2017, final orders (*PRJM Pty Ltd v Hawkesbury City Council* [2017] NSWLEC 1339) were stayed to allow any submissions from the parties on conditions, given that the findings of the Court differed from that advocated by both parties. The relevant comments were:

> 89. I am satisfied that approval should be granted to the proposed subdivision but on terms different to that suggested by the applicant or the council. I have attempted to amend the conditions of consent to reflect the findings in the judgment however these amendments may require further amendment. I propose to stay the orders for a period of 14 days for the parties to review the conditions to ensure that they are consistent and properly reflect the findings in the judgment. The stay and the invitation to review the conditions is not an invitation to re-argue any of the contentions or make further submissions on matters already addressed.
>
> 90. The orders of the Court are:
>
> Part A;
>
> 1. The appeal is upheld.
>
> 2. Development Application DA0830/15 for a 37 lot community title subdivision, including the construction of a new private road, drainage system and installation of a water recycling facility to treat sewage with two lots would be used for services and the remaining 35 lots would be used for residential development at. 67 Kurrajong Road, Kurrajong is approved subject to the conditions in Annexure A.
>
> 3.The exhibits are returned with the exception of exhibits 1, B, C and D.
>
> Part B;
>
> The orders in Part A are stayed for a period of 14 days from 30 June 2017 for the parties to make any written submissions on the conditions in Annexure A to ensure consistency and to ensure that they fully reflect the findings in the judgment. Final orders will be made in chambers.

The submissions

3 Condition 27 was in dispute between the parties. This applicants condition 27 states:

> 27. An approval under s.68 Local Government Act 1993 must be obtained from Council for the carrying out of sewerage work and the operation of a sewage management system.

4 The council condition 27 states:

> 27. Prior to issuing a Construction Certificate a licence under the Water Industry Competition Act 2006 must be obtained from IPART and an approval under s.68 Local Government Act 1993 must be obtained from Council for the carrying out of sewerage work and the operation of a sewage management system.

5 The council maintains that the IPART approval ought to be obtained before the issue of any construction certificate related to the subdivision for which consent has been granted. If the applicants condition was accepted it would permit of the possibility that a Construction Certificate could be obtained for the civil works associated with the subdivision and those works carried out, even though an IPART licence might never be granted for the sewerage system. Such a scenario would be contrary to cl 4.1D(1) *Hawkesbury Local Environmental Plan 2012* which requires the consent authority to be satisfied about arrangements for a reticulated sewerage system from the date each lot is created and would not be consistent with the orderly and economic development of land.

6 I agree with the conclusions of the council on condition 27.

Orders

7 The orders of the Court are:

(1) The appeal is upheld.

(2) Development Application DA0830/15 for a 37 lot community title subdivision, including the construction of a new private road, drainage system and installation of a water recycling facility to treat sewage with two lots would be used for services and the remaining 35 lots would be used for residential development at. 67 Kurrajong Road, Kurrajong is approved subject to the conditions in Annexure A.

(3) The exhibits are returned with the exception of exhibits 1, B,C and D.

_____

G Brown

Commissioner of the Court

162961.16 (C) gtb (225 KB, pdf)

Decision last updated: 15 August 2017

Annexure 'A'

Conditions of Consent

DA0830/15 – 37 Lots
Subdivision of 67 Kurrajong Road Kurrajong

Integrated Development

1. The general terms of approval from the following Authorities, as referenced below form part of the consent conditions:

   NSW Rural Fire Service – The General Terms of Approval and dated 29 January 2016 (Reference D16/0001 DA16010600163 MA) and 2 November 2016 (Reference D16/0125 DA16010600163 MA).

General Conditions

2. The development shall take place generally in accordance with the following plans, specifications and documentation submitted with the application except as modified by these further conditions.

Drawing Nos.	**Date of drawing**	**Prepared by**
Plan of Subdivision 2002.DA.16 rev B	16 July 2016	Andrew P Grieve
Proposed Control Shed 2003.DA.16	7 August 2016	Andrew P Grieve
Development Overview and Viewport Reference Plan PS02-A050 rev D	14 December 2016	Martens & Associates Pty Ltd
Town Planning Layout (Viewport 01) PS02-A400 rev D	14 December 2016	Martens & Associates Pty Ltd
Soil & Water Management Plan PS02-B300 rev B	14 December 2016	Martens & Associates Pty Ltd
Soil & Water Management Plan Details Sheet 1 PS02-B310 rev B	14 December 2016	Martens & Associates Pty Ltd
Soil & Water Management Plan Details Sheet PS02-B311 rev B	14 December 2016	Martens & Associates Pty Ltd
Drainage Plan (Viewport 01) PS02-E100 rev E	14 December 2016	Martens & Associates Pty Ltd
On-Site Detention Catchment Plan Pre-development PS02-E600 rev C	14 December 2016	Martens & Associates Pty Ltd
On-Site Detention Catchment Plan Post-development PS02-E610 rev C	14 December 2016	Martens & Associates Pty Ltd
Concept On-Site Detention Typical Section PS02-E620 rev E	14 December 2016	Martens & Associates Pty Ltd

Pre-development MUSIC Catchment & Results PS02-E700 rev C	14 December 2016	Martens & Associates Pty Ltd
Pre-development MUSIC Catchment & Results PS02-E710 rev C	14 December 2016	Martens & Associates Pty Ltd
Concept Bio-retention Typical Section PS02-E720 rev C	14 December 2016	Martens & Associates Pty Ltd
Services Lot 'A' Layout Plan (Viewport 03) PS02-H101 rev D	14 December 2016	Martens & Associates Pty Ltd
Services Lot 'B' Layout Plan (Viewport 04) PS02-H102 rev D	14 December 2016	Martens & Associates Pty Ltd
Reticulated Wastewater Management Scheme (Layout 01) PS02-H200 rev C	14 December 2016	Martens & Associates Pty Ltd
Reticulated Sewer Pump Details PS02-H220 rev B	14 December 2016	Martens & Associates Pty Ltd
Concept Water Reticulation Plan (Viewport 01) PS02-H300 rev D	14 December 2016	Martens & Associates Pty Ltd
Landscape Plan LP.01/E Sheet 1 of 1	2 February 2017	Botanica
Estate Signage Details SP.01/A	15 August 2016	Botanica
Estate Signage Details SP.02/A	15 August 2016	Botanica

Reference Documentation	**Date of document**	**Prepared by**
Statement of Environmental Effects	26 July 2016	Nexus Environmental Planning Pty Ltd
Phase 1 Environmental Site Assessment	September 2015	C.M. Jewell & Associates Pty Ltd
Concept Stormwater Management Assessment	December 2016	Martens & Associates Pty Ltd
Traffic and Access Assessment Reports	17 December 2015 25 July 2016	Positive Traffic Pty Ltd
Bushfire Risk Assessments	27 July 2015 15 August 2016	Bushfire Planning Services Pty Ltd
Statement of Evidence	18 January 2016	Narelle Sonter, Botanica
Heritage Impact Statement	7 July 2016	Robert Staas, NBRS+P
Statement of Evidence	11 January 2017	Anne Clements & Associates Pty Ltd

3. The Landscape Plan LP.01/E Sheet 1 of 1 by Botanica is to be amended to provide for the retention of all trees prescribed for the purposes of clause 5.9 Hawkesbury Local Environmental Plan 2012 which are within 5m of the southern boundary and to substitute *Alphitonia excels* (Red Ash) and *Glochidion fernandii* (Cheese Tree) for *Brachychiton populneus* (Kurrajong) and *Hymenosporum flavum* (Native Frangipani). That plan as amended shall hereafter be referred to as the approved tree retention plan.

4. The plan of subdivision shall be amended to provide for all community land (currently lots 1 and 21 and proposed road) to be in a single lot.

Prior to Issue of Construction Certificate

5. No work including excavation, site work, demolition, landscaping, removal of trees (with the exception of permitted weed removal) or building work shall be commenced prior to the issue of an appropriate Construction Certificate.

6. Weed removal is to be carried out in accordance with the Property Weed Management Plan of Hawkesbury County Council dated 20 July 2016 under the supervision of an AQF Level 5 Arborist.

7. Trees required to be removed for the construction of services and roads shall be nominated on the Construction Certificate plans. All vegetative debris (including felled trees) is to be chipped or mulched. Tree trunks are to be recovered for posts, firewood or other appropriate use. No vegetative material is to be disposed of by burning.

8. Pursuant to section 80A(1) of the Environmental Planning and Assessment Act 1979 and Hawkesbury City Council's Section 94A Development Contributions Plan 2015 (as amended from time to time), a contribution fee must be paid prior to the issue of the Construction Certificate.

   The contributions levy is based on the cost of works associated with the proposed development. A cost estimate report prepared by a registered quantity surveyor must be submitted to Hawkesbury City Council for the calculation of applicable fees.

   The amount to be paid is to be adjusted at the time of the actual payment, in accordance with the provisions of Hawkesbury City Council's Section 94A Development Contributions Plan 2015 (as amended from time to time).

   Copies of receipt(s) confirming that the contribution has been fully paid are to be provided to the Certifying Authority prior to the issue of a Construction Certificate.

9. An Environmental Management Plan (EMP) for the development site shall be prepared by an appropriately qualified person. The EMP shall address (without being limited to) the clearing of vegetation, pruning and removal of trees, earthworks, erosion control, site rehabilitation and landscaping. The EMP is to be submitted to Council for approval prior to any works commencing on site.

10. All site works shall be carried out in accordance with the EMP. Implementation of the EMP shall be supervised by an appropriately qualified person.

11. Construction of the road, access, drainage, on-site detention (OSD) are not to commence until one full printed set and electronic copy of the plans and specifications of the proposed works are submitted to and approved by the Director City Planning or an Accredited Certifier.

12. All earthworks on site must comply with the following:

    a) Earthworks areas shall be minimised and the areas likely to be used for effluent disposal areas shall not be used for vehicle access or storage of materials. In the event that earthworks are carried out within effluent disposal areas the pre-development soil profile of those areas shall be reinstated using soil reclaimed from that area.

    b) Topsoil shall only be stripped from approved areas and shall be stockpiled for re-use during site rehabilitation and landscaping.

    c) All disturbed areas are to be stabilised/revegetated, using a minimum 300mm surface layer of topsoil, as soon as practicable after the completion of filling works.

d) All fill within the site shall be placed in layers not exceeding 300mm thickness and compacted to achieve a minimum dry density ratio of 95% when tested in accordance with *Australian Standard AS 1289: Methods of testing soils for engineering purposes* unless otherwise specified.

e) Filling shall be comprised of only uncontaminated virgin excavated natural material or excavated natural material. Contamination certificates for all source material shall be provided to the Principal Certifying Authority prior to placing any fill on site.

Details satisfying the above requirements are to be included on plans submitted to the Certifying Authority prior to issue of a Construction Certificate.

13. A Construction Management Plan shall be submitted and reviewed by Hawkesbury City Council prior to issue of a Construction Certificate. The Construction Management Plan shall include the following:

a) Details of the proposed works including the extent, staging and proposed timing of the works

b) A detailed Traffic Management Plan

c) A detailed Soil and Water Management Plan (SWMP)

d) Site specific Ecological Impact Mitigation Measures

e) Site specific tree protection measures for all trees to be retained in accordance with the approved tree retention plan.

14. The Traffic Management Plan must include the following:

a) The proposed method of loading and unloading excavation and construction machinery, excavation and building materials, formwork and the erection of any part of the structure within the site.

b) Control of traffic within the road reserve.

c) The proposed method of access to and egress from the site for vehicles.

d) Traffic Control Plans are to be prepared in accordance with the RMS publication *Traffic Control at Worksites* by an appropriately qualified person.

e) Construction traffic route.

15. The SWMP must take into account the requirements of Landcom's publication *Managing Urban Stormwater - Soils and Construction (2004)* and shall contain but not be limited to:

a) Clear identification of site features, constraints and soil types,

b) Erosion and sediment control plans,

c) A strategy for progressive revegetation and rehabilitation of disturbed areas of earth as rapidly as practicable after completion of earthworks.

16. A detailed survey of all vegetation with a BDR>300mm is to be prepared after the removal of weeds from the site pursuant to condition 6 of this consent (Tree Retention Plan (TRP)) An arboricultural impact assessment report relating to these trees is to be prepared in accordance with *AS4970-2009 Protection of Trees on Development Sites* and approved by the council.

17. OSD shall be provided to maintain all stormwater discharges from the 1:1 year storm up to the 1:100 year storm at pre-development levels. Calculations and detailed plans are to be

submitted with the application for the Construction Certificate. Discharge from the OSD structure must be by gravity.

18. A gross pollutant trap is required to be provided before stormwater is directed into the proposed OSD systems. Details must be shown on the plans prior to the issue of a construction certificate.

19. The OSD is to be designed in accordance with Hawkesbury Development Control Plan (Appendix E, Civil Works Specification, Part 1 – Design Specifications and Part 2 – Construction Specifications and the approved plans

20. The Bio-basin or stormwater quality treatment system contained within the OSD system is to be designed to meet the targets similar to those detailed in the Managing Urban Stormwater; Environmental Targets (DECC 2007) and the approved plans.. The water quality of stormwater discharged into the Hawkesbury-Nepean River System must comply with the standards set out below:

Standard Pollutant	**Treatment Standard**
Suspended solids	80% retention of the average annual load
Total Phosphorous	45% retention of the average annual load
Total nitrogen	45% retention of the average annual load
Litter	Retention of litter greater than 50mm for flows up to 25% of the 1 year ARI peak flows
Coarse sediment	Retention of sediment coarser than 0.125mm for flows up to 25% of the 1 year ARI peak flows
Oil and grease	In area with concentrated hydrocarbons deposition, no visible oils for flows up to 25% of the 1 year ARI peak flow

21. Should the development necessitate the installation or upgrading of utility services or any other works on Council land beyond the immediate road frontage of the development site and these works are not covered by a Construction Certificate issued by Council under this consent then a separate road opening permit must be applied for and the works inspected by Council's Construction and Maintenance Services team. The contractor is responsible for instructing sub-contractors or service authority providers of this requirement.

22. Details of any fill material to be removed from or imported to the site shall be submitted with the engineering plans. Details to include quantities, borrow sites and/or disposal sites.

23. An infrastructure upgrade plan is required to be prepared and submitted to Council for approval prior to the issue of a Construction Certificate. This plan is required to achieve the following:

    a) Construct kerb and gutter on the development side of Kurrajong Road for the proposed lots. The kerb alignment must provide for a 4.5m wide nature strip;

    b) Construct a sealed road shoulder with a minimum width of 2.5m for the kerb and gutter of the proposed lots. The constructed shoulder must retain a two way traffic flow on Kurrajong Road;

    c) Construct an underground stormwater drainage system to adequately drain the catchment including amplification of any down steam drainage system, if warranted.

    d) Construct a 1.2m wide concrete footpath along the frontage of Kurrajong Road for the proposed lots;

    e) Detailed engineering drawings to be submitted for approval prior to the commencement of any work.

24. Retaining walls over 600 mm in height are to be designed by a suitably qualified and experienced Structural Engineer. Where retaining walls are located along boundaries they must be of a material and colour that will reduce the visual impact of the walls from the adjoining lots.

25. A dilapidation survey and report (including photographic record) must be prepared by a suitably experienced person detailing the pre-developed condition of public road in the vicinity of the development. Particular attention must be paid to accurately recording any pre-developed damaged areas so that Council is fully informed when assessing any damage to public infrastructure caused as a result of the development.

    The developer may be held liable for all damage to public infrastructure in the vicinity of the site, where such damage is not accurately recorded and demonstrated as pre-existing under the requirements of this condition.

    The developer shall bear the cost of carrying out works to restore all public infrastructure damaged as a result of the carrying out of the development, and no occupation of the development shall occur until damage caused as a result of the carrying out of the development is rectified.

    A copy of the dilapidation survey and report must be lodged with Council by the Principal Certifying Authority prior to the issue of any Construction Certificate.

26. A compliance certificate under s.73 Sydney Water Act 1994 must be obtained from Sydney Water Corporation.

    Water and sewer infrastructure required to be built must be shown on the plans prior of the issue of a Construction Certificate.

27. Prior to issuing a Construction Certificate a licence under the Water Industry Competition Act 2006 must be obtained from IPART and an approval under s.68 Local Government Act 1993 must be obtained from Council for the carrying out of sewerage work and the operation of a sewage management system.

28. An owners' operating manual shall be prepared for the sub-surface irrigation systems explaining the irrigation system layout, buffers and landscaping. This manual shall be made available to potential purchasers to alert them to their responsibilities and irrigation area management. The manual shall include a schematic cross-section of the irrigation field showing natural soil or re-constituted soil profiles (where development has altered the existing profile) and how the irrigation field is to be installed within the profile.

Prior to Commencement of Works

29. The applicant shall advise Council of the name, address and contact number of the certifying authority appointed pursuant to s.81A 2(b) of the Environmental Planning and Assessment Act, 1979.

30. At least two days prior to commencement of work, written notice is to be given to Hawkesbury City Council of the proposed commencement of work.

31. A site meeting with Council's Engineer and the contractor must be held prior to the commencement of work on site.

32. All traffic management devices shall be installed and maintained in accordance with the approved Traffic Management Plan.

33. Erosion and sediment control devices are to be installed and maintained at all times during site works and construction. An appropriate warning sign shall be affixed to the sediment fence/erosion control devices.

34. Measures shall be implemented to prevent vehicles tracking sediment, debris, soil and other pollutants onto any road.

35. Toilet facilities (to the satisfaction of Council) shall be provided for workmen throughout the course of building operations. Such facility shall be located wholly within the property boundary.

36. A sign displaying the following information is to be erected adjacent to each access point and to be easily seen from the public road. The sign is to be maintained for the duration of works:

    a) Unauthorised access to the site is prohibited.

    b) The name of the owner of the site.

    c) The person/company carrying out the site works and telephone number (including 24 hour 7 days emergency numbers).

    d) The name and contact number of the Principal Certifying Authority.

During Construction

37. Clearing of land, running of machinery, excavation, and/or earthworks, building works and the delivery of building materials shall be carried out between the following hours:

    a) between 7:00 am and 6:00 pm, Mondays to Fridays inclusive;

    b) between 8:00 am and 4:00 pm, Saturdays;

    c) no work on Sundays and public holidays.

    d) works may be undertaken outside these hours where:

        (i) the delivery of vehicles, plant or materials is required outside these hours by the Police or other authorities;

        (ii) it is required in an emergency to avoid the loss of life, damage to property and/or to prevent environmental harm;

        (iii) a variation is approved in advance in writing by Council.

38. All traffic management devices shall be installed and maintained in accordance with the approved traffic management plan.

39. All civil construction works required by this consent shall be in accordance with Hawkesbury Development Control Plan appendix E Civil Works Specification.

40. All works are to be carried out in accordance with the EMP.

41. The protection of trees to be retained on site, as shown in the Tree Retention Plan, shall be undertaken under the supervision of an AQF Level 5 Arborist

42. The Construction Management Plan (including all sub-plans) must be implemented for the duration of the proposed works in compliance with the Construction Management Plan.

43. The sewer pumping station, water treatment plant, sewerage and recycled water reticulation infrastructure, including junctions to each residential lot in the subdivision, shall be constructed in accordance with approved plans.

44. Inspections shall be carried out and compliance certificates issued by Council or an accredited certifier for the components of construction detailed in Hawkesbury Development Control Plan Appendix B Civil Works Specification, Part II, Table 1.1.

45. Inspections and Compliance Certificates for sewer works can only be conducted and issued by a public authority or any person licensed under the Water Industry Competition Act 2006.

46. Street lighting in accordance with the current relevant Australian Standard is to be installed in the new road. Street lighting must be designed to be under the control of the community title subdivision.

47. Landscaping shall be completed in accordance with the approved landscape plans.

48. All constructed batters are to be topsoiled and turfed and where batters exceed a ratio of 3 (three) horizontal to 1 (one) vertical, retaining walls, stone flagging or terracing not exceeding 600mm in height shall be constructed. Retaining walls greater than 600mm in height must be indicated on approved construction plans.

49. All necessary works shall be carried out to ensure that any natural water flow from adjoining properties is not impeded or diverted.

50. Inter-allotment drainage shall be provided for all lots which do not drain directly to a public road. Easements are to be created at the applicant's cost.

51. Erosion and sediment control devices are to be installed and maintained until the site is fully stabilised in accordance with the approved plan and Hawkesbury Development Control Plan chapter on Soil Erosion and Sedimentation.

52. Dust control measures, e.g. vegetative cover, mulches, irrigation, barriers and stone shall be applied to reduce surface and airborne movement of sediment blown from exposed areas.

53. The grading, trimming, topsoiling and turning of the footpath verge fronting the development site is required to ensure a gradient between 2% and 4% falling from the boundary to the top of kerb is provided. This work must include the construction of any retaining walls necessary to ensure complying grades within the footpath verge area. All retaining walls and associated footings must be contained wholly within the subject site. Any necessary adjustment or relocation of services is also required, to the requirements of the relevant service authority. All service pits and lids must match the finished surface level.

Prior to Issue of Subdivision Certificate

54. Street name signs shall be provided at the junction of the new road/s.

55. All necessary street signage and pavement markings shall be installed.

56. Any damage to existing public assets as a result of development work must be repaired by the developer at no cost to Council.

57. All approved road, sewerage and drainage works including works in the approved infrastructure upgrade plan, shall be constructed.

58. All street trees to be planted in Kurrajong Road as required by this consent shall be planted.

59. All landscaping proposed within the development site shall be planted in accordance with the approved landscape plans.

60. A works as executed plan shall be submitted to Council showing all constructed infrastructure (road, sewerage and drainage works).

61. A works as executed plan for the OSD and Bio-basin showing construction details and levels of weir, top of surcharge pit, embankment levels shall be submitted to and approved by Council.

62. A report by the Design Engineer verifying that the OSD and Bio-basin systems conform to the approved design shall be submitted to and approved by Council.

63. A Plan of Management for the OSD and Bio-basin facilities shall be submitted to and approved by Council. The Plan of Management shall set out all design and operational parameters for the detention facilities including design levels, hydrology and hydraulics, inspection and maintenance requirements and time intervals for such inspection and maintenance.

64. A public positive covenant pursuant to the s.88E Conveyancing Act shall be submitted to Council for approval and registered on the title which provides the following:

    a) The Community Association will at all times maintain, repair and keep the OSD and Bio-basin facilities in a good and safe condition and state of repair, in accordance with the approved design to the reasonable satisfaction of Council, having due regard to the Plan of Management for the operation and maintenance of the OSD and Bio-basin facilities

    b) The OSD and Bio-basin areas must be fenced off with minimum 1.8 m high fences and sign posted for public safety

    c) A prohibition on any further subdivision or strata subdivision of any of the proposed lots.

    d) Prohibiting the use of the utility lots for residential purposes.

    e) Each residential lot is to have a minimum area of 203 sqm for on site effluent disposal and setbacks.

    f) A development application or Complying Development Certificatefor a dwelling and any ancillary buildings must consider the existing trees shown on the approved Tree Retention Plan.

    g)

    The proposed areas for effluent disposal area within each lot is to be

    i. appropriately signposted
    ii. landscaped with grasses or ornamental vegetation only;
    iii. if landscaped with grass the grass shall be mown regularly and clippings removed;
    iv. not unduly shaded by adjacent vegetation or structures;
    v. prohibiting structures from being built or any other items which may damage the reticulated irrigation system (including vehicles) from being placed over or under the dedicated disposal area within each lot; and

    All costs associated with the Covenant, including any legal costs payable by Council, are to be paid by the owner or applicant.

65. A Certificate from a telecommunications carrier confirming that provision has been made for services to the development shall be submitted to the Principal Certifying Authority.

66. Written clearance from Integral Energy shall be submitted to the Principal Certifying Authority.

67. A Section 73 Compliance Certificate under the Sydney Water Act 1994 must be obtained from Sydney Water Corporation.

68. The new road shall be named. Please contact Council's Infrastructure Services.

69. A Surveyor's Certificate stating that all pipelines (interallotment drainage) are contained within the proposed/existing easements shall be submitted.

70. A plan of community title subdivision and associated documents (together with four copies), prepared in accordance with the requirements of the Community Land Development Act, shall be submitted to Council for approval.

71. The proposed community lot shall be developed in accordance with the approved Development Contract.

72. The final plan of subdivision shall show the location of all infrastructure for the Recycled Water Management Scheme and bushfire asset protection zones.

73. A survey plan showing all existing services on the lots including sewerage infrastructure and, water connections shall be submitted. The plan shall demonstrate that there are no encroachments over remaining or proposed boundaries.

74. A Plan of Management for the Recycled Water Management Scheme shall be submitted to and approved by Council. The Plan of Management shall set out all design and operational parameters for the Scheme including design levels, hydrology and hydraulics, inspection and maintenance requirements and time intervals for such inspection and maintenance.

75. A Community Management Statement pursuant to the Community Land Development Act 1989 shall be submitted to Council for approval and registered. The Community Management Statement shall include but not be limited to:

    a) A full description of the waste management and water reticulation system

    b) Deleted.

    c) Deleted .

    d) Preventing the development or construction of structures on the effluent disposal or buffer areas identified on the development sites.

    e) Requiring a private waste collection service to remove household and "clean up" waste from the lots serviced by the community title road. All waste shall be collected from within the site.

    f) Deleted.

    g) Requiring landscaping within the community lot and the proposed trees along Kurrajong Road to be maintained in perpetuity, and requiring any vegetation which dies to be replaced with a species of a similar height and form as that approved.

    h) Limiting all vehicles associated with the maintenance, repair or monitoring of the sewerage system or the removal of sludge/solids from the sewage treatment plant to park wholly within the site.

    i) Requiring compliance by the lot owner with the approved Plan of Management for the Recycled Water Management Scheme.

    j) Requiring land proposed for effluent disposal area within each lot to be
        i) appropriately signposted
        ii) landscaped with grasses or ornamental vegetation only;
        Iii) if landscaped with grass the grass shall be mown regularly and clippings removed;
        Iv) not unduly shaded by adjacent vegetation or structures, and
        v) prohibiting structures from being built or any other items which may damage the reticulated irrigation system (including vehicles) from being placed over or under the dedicated disposal area within each lot; and

    k) A prohibition on any further subdivision or strata subdivision of any of the lots.

    All costs associated with the Community Management Statement, including any legal costs payable by Council, are to be paid by the owner or applicant.

76. A defects maintenance bond calculated in accordance with appendix E of the DCP (Chapter 15.4.4) shall be lodged with Hawkesbury City Council prior to issue of the Subdivision Certificate. The bond can be in the form of an unconditional bank guarantee or cash security. The bond is refundable on application, six months after the release of the Subdivision Certificate, upon satisfactory final inspection.

77. A Plan of Management for the Recycled Water Management Scheme shall be prepared and submitted to Council for approval. The Plan of Management including but not limited to:

- a comprehensive description of the requirements of the system
- deleted
- drippers with automatic shut off valves and herbicide dispersal facilities to avoid blockages
- appropriate flushing valves and air-release valves
- a comprehensive maintenance program for all aspects of the Recycled Water Management Scheme delineating the respective responsibilities of the Community Association and individual lot owners
- a monitoring system for all elements of the Recycled Water Management Scheme (including effluent disposal areas) to ensure compliance with performance criteria and to avoid over-watering
- health and safety advice to home occupants regarding recycled effluent
- a comprehensive description of emergency and contingency plans in the event of a system failure or a failure to achieve performance criteria.

Ongoing Conditions

78. Road and drainage works, must be maintained for a minimum period of 6 months commencing from the date of the issue of the Subdivision Certificate, unless otherwise agreed to in writing by Council. The developer must ensure that any defective works shall be rectified and/or replaced during the maintenance period in accordance with the approved construction certificate plans. All costs arising during the maintenance period must be borne by the developer. Road and drainage must be maintained in its original construction condition for this liability period. The developer must notify Council for a re-inspection at the end of the maintenance period.

79. The Recycled Water Management Scheme shall operate at all times so that the following is achieved:

a) *E. coli* of less than 10cfu/100ml

b) BOD5 of less than 20mg/L

c) suspended solids of at least 30mg/L

d) total nitrogen of less than 18mg/L (90^{th} percentile)

e) total phosphorus of less than 9mg/L (90^{th} percentile)

f) a design irrigation rate of not more than 4mm/day

g) the effluent disposal area has setbacks of 1m to site boundaries, 3m to swimming pools and 1m to dwellings unless those dwellings are downslope of the effluent disposal area in which case the setback shall be 3m

h) the effluent disposal area has a minimum area of 203sqm, including setbacks

80. The approved Plan of Mangement for the Recycled Water Mangement Scheme shall be implemented and adhered to at all times.

81. Deleted.

_____
G Brown
Commissioner of the Court

STATEMENT OF ENVIRONMENTAL EFFECTS

SUBDIVISION OF ONE (1) LOT INTO FIFTY TWO (52)

No.67 KURRAJONG ROAD

KURRAJONG

NEXUS
Environmental Planning Pty Ltd

STATEMENT OF ENVIRONMENTAL EFFECTS

SUBDIVISION OF ONE (1) LOT INTO FIFTY TWO (52)

No.67 KURRAJONG ROAD

KURRAJONG

22 December 2015

Prepared by:
Nexus Environmental Planning Pty Ltd
Suite 29, 103 Majors Bay Road
PO Box 212
CONCORD NSW 2137
Tel: (02) 9736 1313
Fax: (02) 9736 1306
Email: kennan@ozemail.com.au

B3163

Table of Contents

1. Introduction. 1

2. The Site. 1

3. Proposed Development. 3

4. Environmental Impact of Proposed Development. 4

   4.1 State Environmental Planning Policy No.55 - Remediation of Land. 4

   4.2 State Environmental Planning Policy No.44 - Koala Habitat Protection. 7

   4.3 Sydney Regional Environmental Plan No.20 Hawkesbury Nepean River (No.2 - 1997). 8

   4.4 Hawkesbury Local Environmental Plan 2012. 10

   4.5 Hawkesbury Development Control Plan 2002. 19

5. Conclusion. 26

Attachment 1: Land and Property Information Notice
Attachment 2: DP 1185012
Attachment 3: Plan of Proposed Subdivision
Attachment 4: DCP 2002 Compliance Table

1. INTRODUCTION

Nexus Environmental Planning Pty Ltd has been requested by PRJM Pty Ltd (**the Applicant**) to prepare a Statement of Environmental Effects (**SEE**) to accompany a Development Application to Hawkesbury City Council (**the Council**) for subdivision of the existing lot into fifty two (52) lots at No.67 Kurrajong Road, Kurrajong **(the Site**). The location of the Site is shown on **Figure 1**.

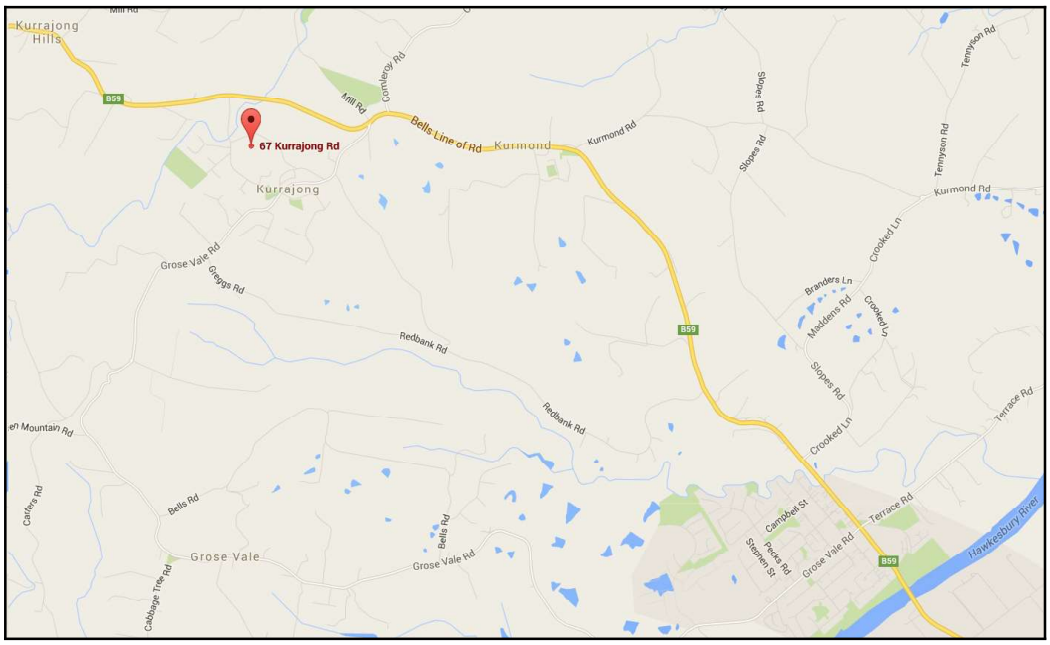


Figure 1: Site Location Map. © GOOGLE Maps

2. THE SITE

The Site has an area of 3.25 hectares and is legally defined as:

Lot 1, DP 1185012
No.67 Kurrajong Road
KURRAJONG

The Site is owned by PRJM Pty Ltd. A copy of a NSW Land and Property Information Title Search is at **Attachment 1** with a copy of DP 1185012 at **Attachment 2**.

The Site is located on the southern side of Kurrajong Road to the east of the intersection of Kurrajong Road with the Old Bells Line of Road.

An extract from an aerial photograph of the Site is at **Figure 2**.

Figure 2: Extract from an aerial photograph of the Site. © SIX Maps

A cadastral map is at **Figure 3**.

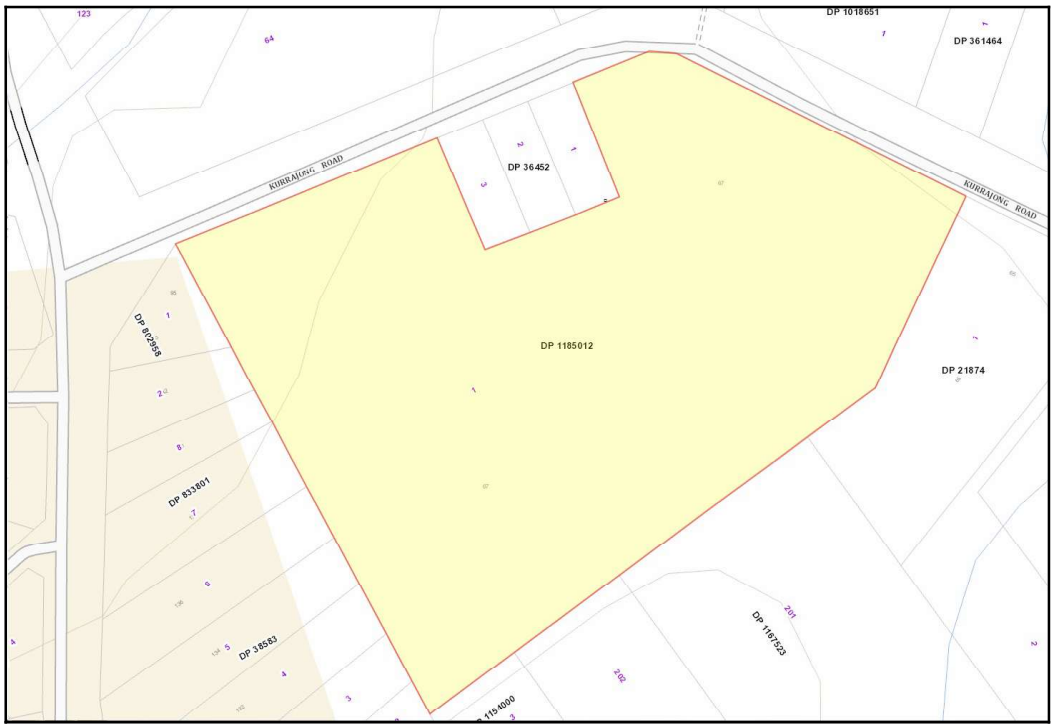


Figure 3: Cadastral Map of the Site with the Site highlighted in yellow. © SIX Maps

The Site is currently vacant land.

A ridge runs through the centre of the Site and slopes away from that ridge towards Kurrajong Road. An extract from the Council contour plan of the Site is at **Figure 4**.

Development in the vicinity of the Site comprises low density residential development.

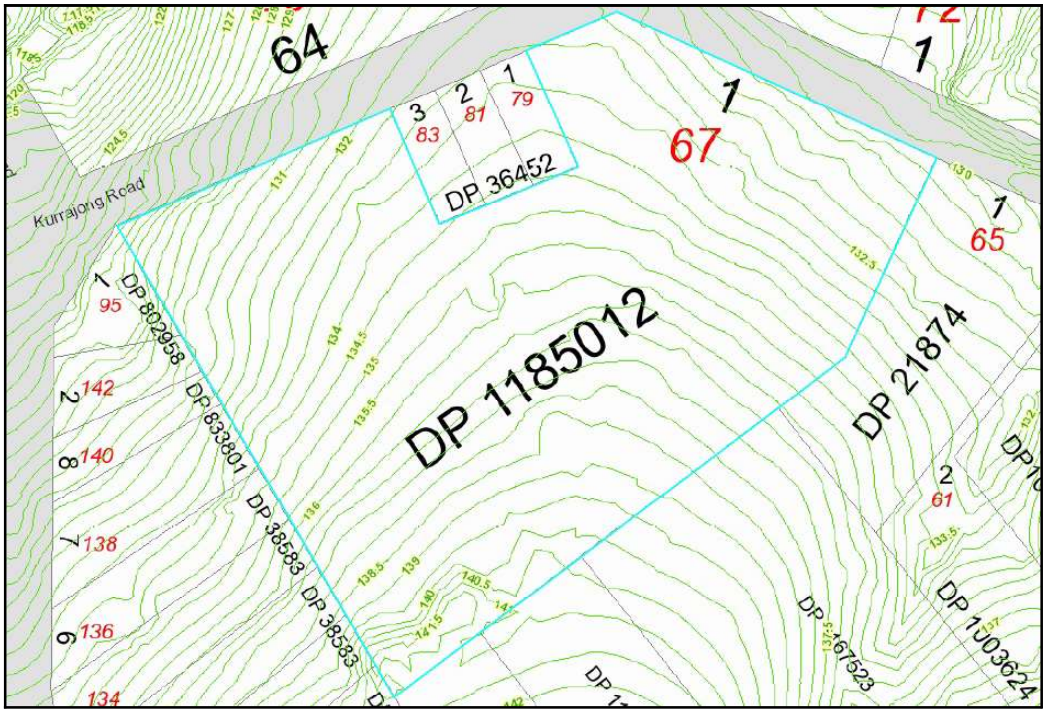


Figure 4: Extract from the Council contour map over the Site.

3. PROPOSED DEVELOPMENT

It is proposed to subdivide the Site into fifty two (52) Torrens Title lots

A Plan of Proposed Subdivision is submitted with the development application, a reduced copy of which is at **Attachment 3**. An extract from the Plan of Proposed Subdivision is at **Figure 5**.

Access to the proposed Lots 27 - 34 is to be directly from Kurrajong Road, with access to proposed Lots 2 - 25 being from a proposed road running through the centre of the proposed subdivision.

Proposed Lots 1 and 26 are to be utilised for the provision of services to the proposed subdivision as discussed in detail in later sections of the SEE.

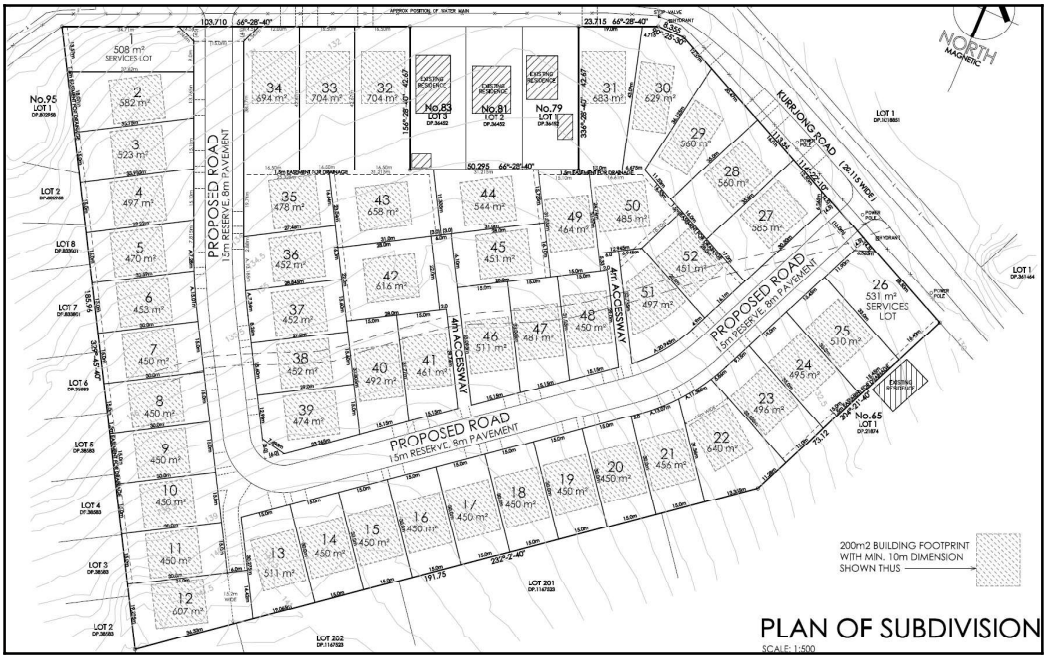


Figure 5: Extract from the Plan of Proposed Subdivision.

4. ENVIRONMENTAL IMPACT OF PROPOSED DEVELOPMENT

This section provides an analysis of the proposed development in terms of its impact on the environment. Specific reference is made to the relevant heads of consideration contained in Section 79C of the Environmental Planning and Assessment Act 1979. The relevant Section 79C head is shown in italics and bold with comments as appropriate.

Section 79C(1)(a)(i) ***(a) the provisions of:-***

(i) any environmental planning instrument.

4.1 State Environmental Planning Policy No.55 - Remediation of Land

State Environmental Planning Policy No.55 - Remediation of Land (**SEPP 55**) 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.*

Clause 7 of SEPP 55 states:

> *7. (1) A consent authority must not consent to the carrying out of any development on land unless:*

(a) it has considered whether the land is contaminated, and

(b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and

(c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

(2) Before determining an application for consent to carry out development that would involve a change of use on any of the land specified in subclause (4), the consent authority must consider a report specifying the findings of a preliminary investigation of the land concerned carried out in accordance with the contaminated land planning guidelines.

(3) The applicant for development consent must carry out the investigation required by subclause (2) and must provide a report on it to the consent authority. The consent authority may require the applicant to carry out, and provide a report on, a detailed investigation (as referred to in the contaminated land planning guidelines) if it considers that the findings of the preliminary investigation warrant such an investigation.

(4) The land concerned is:

(a) land that is within an investigation area,

(b) land on which development for a purpose referred to in Table 1 to the contaminated land planning guidelines is being, or is known to have been, carried out,

(c) to the extent to which it is proposed to carry out development on it for residential, educational, recreational or child care purposes, or for the purposes of a hospital land:

(i) in relation to which there is no knowledge (or incomplete knowledge) as to whether development for a purpose referred to in Table 1 to the contaminated land planning guidelines has been carried out, and

(ii) on which it would have been lawful to carry out such development during any period in respect of which there is no knowledge (or incomplete

knowledge).

To assess whether the Site contains any contamination, a Phase 1 Environmental Site Assessment (**ESA**) was prepared by C M Jewell & Associates, copies of which have been submitted with the development application. The objectives of the ESA were to:

- *Review the history and current status of the site;*
- *Identify potential sources of contamination and determine potential contaminants of concern;*
- *Identify areas of potential contamination;*
- *Identify potential human and ecological receptors;*
- *Identify potentially affected media (soil, sediment, groundwater, surface water, indoor and ambient air).*
- *Assess the risks posed by potential contamination under the land uses permitted by its zoning.*

The ESA concludes:

- *Review of historical aerial photography indicates that the Site was previously, and is currently, undeveloped vacant land and, prior to its purchase in 2015, was Crown Land.*
- *A review of NSW LPI mapping indicates that a fence line, a lean-to, a chicken coop, a compost bin and a clothes line relating to 79, 81 and 83 Kurrajong Road encroach onto the Site.*
- *Most of the Site is covered in medium to dense vegetation, although areas of cleared (mowed) land were observed in the northern and eastern portions of the Site and surrounding the adjoining residential properties.*
- *There were no obvious signs of vegetation die-back at the Site.*
- *The Site was free of statutory notices issued by the NSW EPA under the Contaminated Land Management Act 1997 and the Protection of the Environment Operations Act 1997.*
- *There was no evidence to suggest that any underground storage tank, aboveground storage tank, or similar has been present on the Site.*
- *There was no evidence that extensive filling activities have taken place at the Site.*
- *There was some evidence of minor cutting activity along the Kurrajong Road boundary and at the rear of 136 Old Bells Line of Road.*

- *The following issues were noted during the site visit:*

  - *an area of dumped material consisting of metal and plastic piping, tyres, bricks and tin cans;*

  - *an area of dumped rubble consisting of bricks, tiles and ACM;*

  - *a small pile of dumped soil containing bricks, pavers and concrete; and*

  - *general rubbish throughout the Site at various locations.*

Pursuant to **sub-clause 7(1)**, the Council can be satisfied that the proposed development is suitable for the Site.

4.2 State Environmental Planning Policy No.44 - Koala Habitat Protection

State Environmental Planning Policy No.44 - Koala Habitat Protection (**SEPP 44**) applies in the Hawkesbury local government area.

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation which provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

An assessment pursuant to SEPP 44 was undertaken as part of the Flora and Fauna Assessment which accompanies the development application. The assessment states:

> *SEPP 44 Koala Habitat Protection applies to land within Local Government Areas (LGAs) listed under Schedule 1 of the Policy. In addition, Part 2 of the Policy outlines a three (3) step process to assess the likelihood of the land in question being potential or core koala habitat. Part 2 applies to land which has an area of greater than 1 hectare or has, together with any adjoining land in the same ownership, an area of more than 1 hectare.*
>
> *The subject site is required to be considered under SEPP 44 as it falls within the Hawkesbury LGA, which is listed on Schedule 1 of this Policy. In addition, the total area of the subject site is greater than 1 hectare, hence Part 2 - Development Control of Koala Habitats, of the Policy applies.*
>
> *Potential Koala Habitat (PKH) is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the policy.*
>
> *Core Koala Habitat (CKH) is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (i.e.*

females with young) and recent sightings of and historical records of a population.

A Koala Plan of Management is required to be prepared where council is satisfied that the land is CKH.

Step 1 – Is the land PKH?

One (1) Koala food tree species – Forest Red Gum (Eucalyptus tereticornis), as listed on Schedule 2 of SEPP 44 – was recorded within the study area. These trees comprised less than 15% of the total number of trees present within the vegetation community Cabbage Gum Forest (Disturbed), and therefore this community area is not classified under SEPP 44 as 'potential Koala habitat' and no further consideration to this policy need apply.

4.3 Sydney Regional Environmental Plan No.20 Hawkesbury Nepean River (No.2 - 1997)

The site is located within the catchment of the Hawkesbury River.

Clause 4(1)(a) of SREP No.20 states:

> *(1) The general planning considerations set out in clause 5, and the specific planning policies and related recommended strategies set out in clause 6 which are applicable to the proposed development, must be taken into consideration:*
>
> *(a) by a **consent authority** determining an application for consent to the carrying out of development on land to which this plan applies,*

The general planning considerations detailed in clause 5 which are applicable to the subject development application are:

> *(a) the aim of this plan, and*
>
> *(c) whether there are any feasible alternatives to the development or other proposal concerned, and*
>
> *(d) the relationship between the different impacts of the development or other proposal and the environment, and how those impacts will be addressed and monitored.*

The aim of the plan is:

> *... to protect the environment of the Hawkesbury-Nepean River system by*

ensuring that the impacts of future land uses are considered in a regional context.

As detailed elsewhere in this SEE, it is considered that the impact of the proposed development will not have any significant impact on the environment.

The specific planning policies and recommended strategies listed in clause 6 are:

(1) Total catchment management

Comment: The proposed development, suitably conditioned, should not have any adverse impact on the total catchment management of the Hawkesbury Nepean River system.

(2) Environmentally sensitive areas

Comment: The impact to environmentally significant areas has been addressed in the Flora and Fauna Assessment submitted with the development application.

(3) Water quality

Comment: Water treatment facilities are to be provided on site as part of the proposed development. Suitable erosion and sediment control measures would be employed during the construction of the proposed subdivision as design by Martens & Associates, details of which have been submitted with the development application to ensure that sediment laden waters do not leave the Site.

(4) Water quantity

Comment: The proposed development would not have an impact on the quantity of water available in the catchment.

(5) Cultural heritage

Comment: No heritage items are located on the Site and there are no heritage items located in the vicinity of the Site. The Site is not located within a heritage conservation area.

(6) Flora and fauna

Comment: The proposed development is unlikely to have any adverse impact on the flora and fauna of the catchment.

(7) Riverine scenic quality

Comment: The Site is not located within the riverine corridor and no scenic quality impact will occur as a result of the proposed development.

(8) Agriculture / Aquaculture and Fishing

Comment: No impact will result from the proposed development.

(9) Rural residential development

Comment: The proposed development is not for rural residential development.

(10) Urban development

Comment: Not applicable.

(11) Recreation and tourism

Comment: The proposed development will not impact on the recreation and tourism activities in the catchment.

(12) Metropolitan Strategy

Comment: The proposed development will not be adverse to the Metropolitan Strategy.

The proposed development is consistent with the requirements of SREP No.20.

4.4 Hawkesbury Local Environmental Plan 2012 (LEP 2012)

The Site is zoned R2 Low Density Residential pursuant to LEP 2012. An extract from the LEP 2012 Map is at **Figure 6**. The proposed development is for subdivision which is permissible, with the consent of the Council, in the zone.

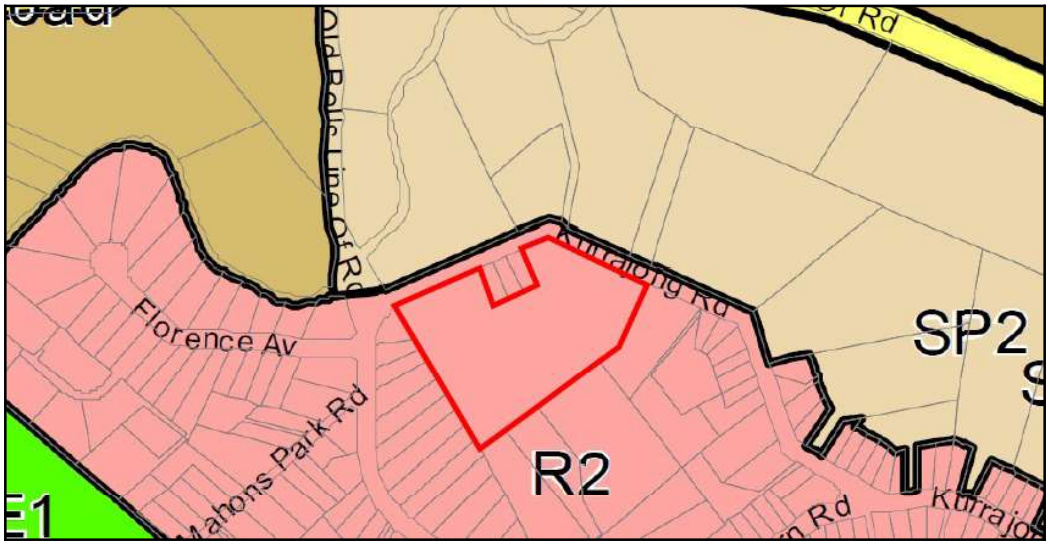


Figure 6: Extract from the LEP 2012 Zone Map with the Site outlined in red.

Sub-clause 2.3(2) of LEP 2021 states:

> *(2) The consent authority must have regard to the objectives for development in a zone when determining a development application in respect of land within the zone.*

The objectives of the R2 Low Density Residential zone are:

- *To provide for the housing needs of the community within a low density residential environment.*
- *To enable other land uses that provide facilities or services to meet the day to day needs of residents.*
- *To protect the character of traditional residential development and streetscapes.*
- *To ensure that new development retains and enhances that character.*
- *To ensure that development is sympathetic to the natural environment and ecological processes of the area.*
- *To enable development for purposes other than residential only if it is compatible with the character of the living area and has a domestic scale.*
- *To ensure that water supply and sewage disposal on each resultant lot of a subdivision is provided to the satisfaction of the Council.*
- *To ensure that development does not create unreasonable demands for the provision or extension of public amenities or services.*

The proposed development:

- would provide for the housing needs of the community.
- is sympathetic to the natural environment and ecological processes of the area.
- ensures that water supply and sewage disposal is provided.
- does not create unreasonable demands for the provision or extension of public amenities or services.

The proposal is consistent with the objectives of the R2 Low Density Residential zone.

Clause 4.1 relates to minimum lot size for subdivision. The objectives are:

> *(a) to ensure that the pattern of lots created by subdivision and the location of any buildings on those lots will minimise the impact on any threatened species, populations or endangered ecological community or regionally*

significant wetland, waterways and groundwater as well as any agricultural activity in the vicinity,

(b) to ensure that each lot created in a subdivision contains a suitable area for the erection of a dwelling house, an appropriate asset protection zone relating to bush fire hazard and a location for on-site effluent disposal if sewerage is not available,

(c) to ensure a ratio between the depth of the lot and the frontage of the lot that is satisfactory having regard to the purpose for which the lot is to be used.

Sub-clause 4.1(3) states:

(3) The size of any lot resulting from a subdivision of land to which this clause applies is not to be less than the minimum size shown on the Lot Size Map in relation to that land.

An extract from the Lot Size Map is at **Figure 7**.

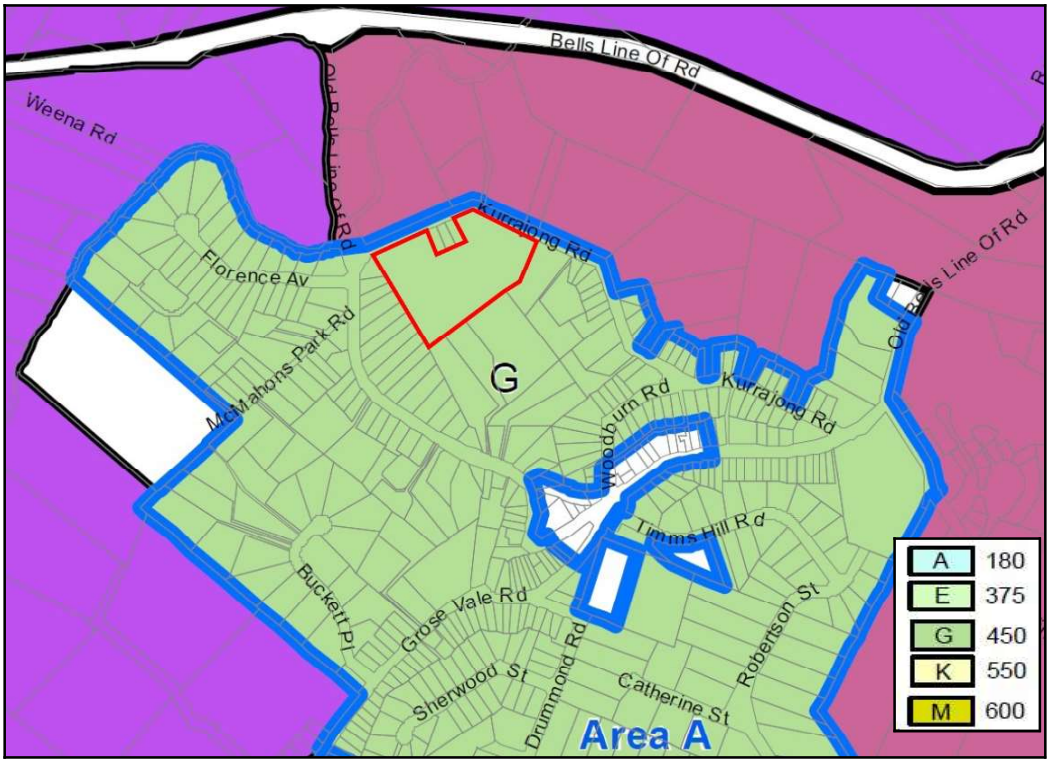


Figure 7: Extract from the Lot Size Map of LEP 2012.

The minimum lit size for subdivision is 450m^2. As seen in **Figure 7**, however, the Site is located in Area A. **Clause 4.1(D)(1)** of LEP 2012 states:

(1) Despite clauses 4.1, 4.1AA and 4.1A, development consent must not be

granted for the subdivision of land that is identified as "Area A" and edged heavy blue on the Lot Size Map if:

(a) arrangements satisfactory to the consent authority have not been made before the application is determined to ensure that each lot created by the subdivision will be serviced by a reticulated sewerage system from the date it is created, and

(b) the area of any lot created by the subdivision that contains or is to contain a dwelling house is less than 4,000 square metres.

As seen in **Attachment 3** and **Figure 5**, each of the proposed lots contains and area of minimum 450m^2 to maximum 704m^2. As such, pursuant to **sub-clause 4.1(D)(1)(a)**, arrangements satisfactory to the consent authority must be made before the application is determined to ensure that each lot created by the subdivision will be serviced by a reticulated sewerage system from the date it is created.

LEP 2012 defines a *"sewage reticulation system"* as:

sewage reticulation system *means a building or place used for the collection and transfer of sewage to a sewage treatment plant or water recycling facility for treatment, or transfer of the treated waste for use or disposal, including associated:*

(a) pipelines and tunnels, and

(b) pumping stations, and

(c) dosing facilities, and

(d) odour control works, and

(e) sewage overflow structures, and

(f) vent stacks.

A detailed design of a proposed sewage disposal system has been prepared by Martens & Associates, copies of which have been submitted with the development application. It can be seen that Dr Martens is proposing that each lot in the proposed subdivision be connected to a single holding tank, which is not a septic tank, which is emptied by tanker removal for the short to medium term pending extension of a sewerage system which will carry untreated effluent by pipe to a treatment plant.

As part of the development of the concept for the proposed subdivision, the Applicant has sought an opinion from Senior Counsel as to the meaning of the above sub-clause and, indeed, how it relates to the proposed development. In this regard, Senior Counsel has advised, among other things:

.... I think that it is arguable that the proposed subdivision development is

connected to a reticulated sewerage system notwithstanding that the connection involves a link in the chain involving transportation of sewage to a sewage treatment plant.

In light of the above, it is considered that the proposed development meets the minimum lot size development standard of LEP 2012.

Clause 9 relates to the preservation of trees or vegetation, the objective of which is:

... is to preserve the amenity of the area, including biodiversity values, through the preservation of trees and other vegetation.

Sub-clause 9(2) states:

(2) This clause applies to species or kinds of trees or other vegetation that are prescribed for the purposes of this clause by a development control plan made by the Council.

As seen on **Figure 2**, the Site contains a number of trees. To ascertain the impact the proposed subdivision would have on the flora on the Site, a detailed Flora and Fauna Assessment has been prepared, copies of which have been submitted with the development application.

The Flora and Fauna Assessment states:

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the Environmental Planning and Assessment Act 1979, the Threatened Species Conservation Act 1995, the Environment Protection and Biodiversity Conservation Act 1999 and the Fisheries Management Act 1994.

In respect of matters required to be considered under the Environmental Planning and Assessment Act 1979 and relating to the species / provisions of the Threatened Species Conservation Act 1995, no threatened fauna species, no threatened flora species, and no endangered ecological communities (EECs) were recorded within the study area.

In accordance with Section 5A of the Environmental Planning and Assessment Act 1979, the 7 part test of significance concluded that the proposed subdivision development will not have a significant impact upon threatened species, EECs or endangered populations. A Species Impact Statement is not required for the proposal.

In respect of matters required to be considered under the Environment Protection and Biodiversity Conservation Act 1999, no threatened fauna species, no protected migratory bird species, no threatened flora species, and no EECs listed under this Act were recorded within the study area.

The proposed subdivision development was not considered to have a significant impact on matters of national environmental significance. As such a referral to

Department of Environment is not required.

In respect of matters relative to the Fisheries Management Act 1994, no suitable habitat for threatened marine or aquatic species was observed within the subject site and there are no matters requiring further consideration under this Act.

Clause 6.1 relates to Acid Sulfate Soils. **Sub-clause 6.1(1)** states:

(1) The objective of this clause is to ensure that development does not disturb, expose or drain acid sulfate soils and cause environmental damage.

Figure 8 is an extract from the LEP 2012 Acid Sulfate Soils map which shows that the Site is classified as Class 5.

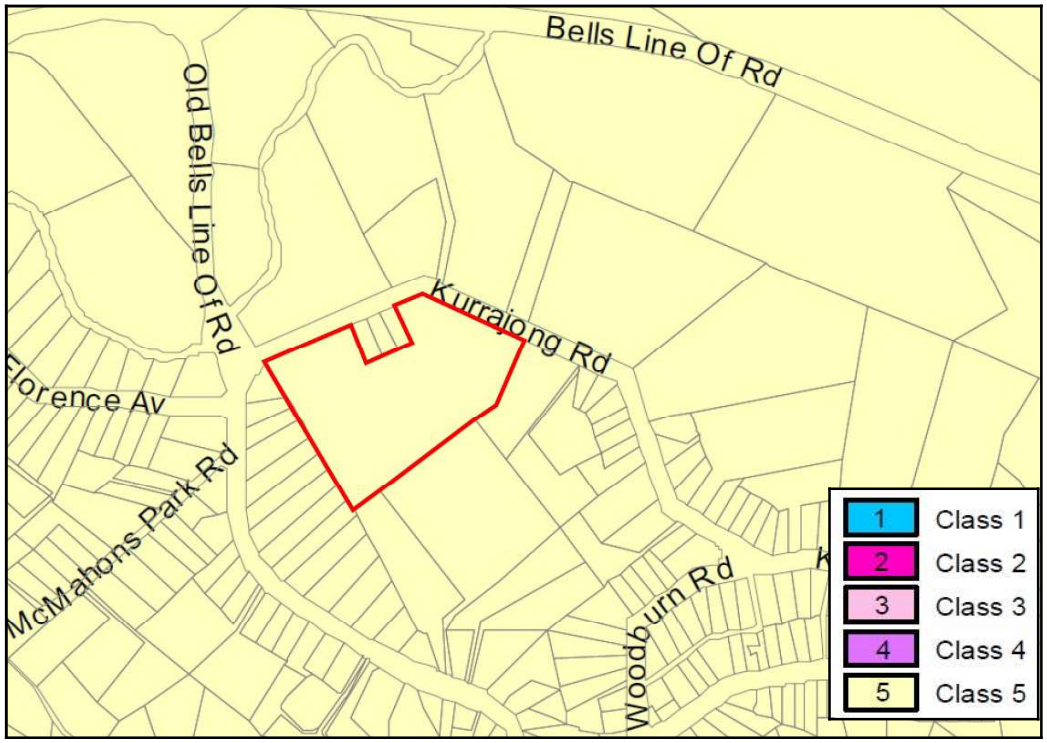


Figure 8: Extract from the LEP 2012 Acid Sulfate Soils map.

The table to **Clause 6.1** states that development consent is required for:

Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the watertable is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land.

The Site is located such that the provisions of **Clause 6.1** are not applicable.

Clause 6.4 relates to Terrestrial Biodiversity. The objective is:

.... to maintain terrestrial biodiversity by:

(a) protecting native fauna and flora, and

(b) protecting the ecological processes necessary for their continued existence, and

(c) encouraging the conservation and recovery of native fauna and flora and their habitats.

Clause 6.4 continues:

(2) This clause applies to land identified as "Significant vegetation" and "Connectivity between significant vegetation" on the Terrestrial Biodiversity Map.

(3) Before determining a development application for development on land to which this clause applies, the consent authority must consider:

(a) whether the development:

(i) is likely to have any adverse impact on the condition, ecological value and significance of the fauna and flora on the land, and

(ii) is likely to have any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna, and

(iii) has any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land, and

(iv) is likely to have any adverse impact on the habitat elements providing connectivity on the land.

(b) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

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

(b) if that impact cannot be reasonably avoided by adopting feasible alternatives—the development is designed, sited and will be managed to minimise that impact, or

(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.

The Site is identified as *"Significant Vegetation"* on the Terrestrial Biodiversity map, an extract from which is at **Figure 9**.

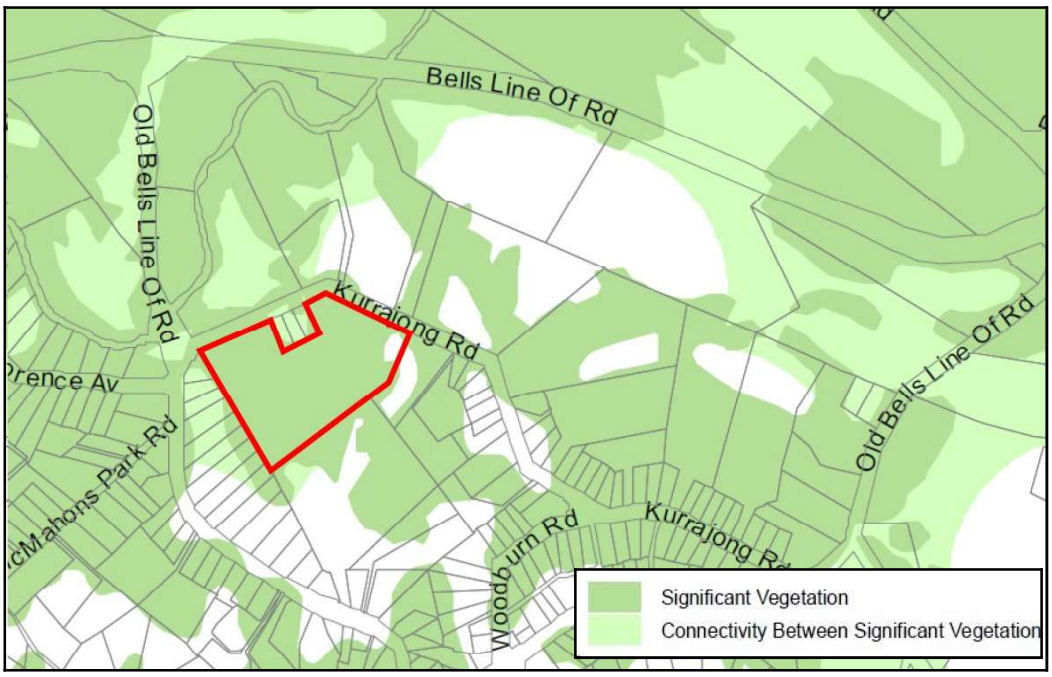


Figure 9: Extract from the LEP 2012 Terrestrial Biodiversity Map.

As noted in the Flora and Fauna Assessment submitted with the development application:

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the Environmental Planning and Assessment Act 1979, the Threatened Species Conservation Act 1995, the Environment Protection and Biodiversity Conservation Act 1999 and the Fisheries Management Act 1994.

In respect of matters required to be considered under the Environmental Planning and Assessment Act 1979 and relating to the species / provisions of the Threatened Species Conservation Act 1995, no threatened fauna species, no threatened flora species, and no endangered ecological communities (EECs) were recorded within the study area.

In accordance with Section 5A of the Environmental Planning and Assessment Act 1979, the 7 part test of significance concluded that the proposed subdivision development will not have a significant impact upon threatened species, EECs or endangered populations. A Species Impact Statement is not required for the proposal.

In respect of matters required to be considered under the Environment Protection and Biodiversity Conservation Act 1999, no threatened fauna species, no protected migratory bird species, no threatened flora species, and no EECs listed

under this Act were recorded within the study area.

The proposed subdivision development was not considered to have a significant impact on matters of national environmental significance. As such a referral to Department of Environment is not required.

In respect of matters relative to the Fisheries Management Act 1994, no suitable habitat for threatened marine or aquatic species was observed within the subject site and there are no matters requiring further consideration under this Act.

Clause 6.7 relates to the provision of essential services and states:

Development consent must not be granted to development unless the consent authority is satisfied that any of the following services that are essential for the proposed development are available or that adequate arrangements have been made to make them available when required:

(a) the supply of water,

(b) the supply of electricity,

(c) the disposal and management of sewage,

(d) stormwater drainage or on-site conservation,

(e) suitable road access.

Reticulated water, electricity supply and suitable road access are available to the Site. It is noted, however, that there may not be sufficient pressure in the existing water supply to the Site to maintain quality reticulated water supply to each of the proposed lots. To remedy this situation, is it proposed to establish a water storage system within the proposed subdivision suitable to reticulate suitable water pressure to each lot. Provision of a suitable for bush fire fighting purposes is also proposed. Full details are provided in the documentation submitted from Martens & Associates.

The proposed means for disposal of sewage, stormwater drainage and internal road construction have been developed by Martens & Associates. Details have been provided with the development application. The documentation prepared by Martens & Associates clearly shows that the requirements of **Clause 6.7** of LEP 2012 have been addressed.

There are no other provisions of the Hawkesbury LEP 2012 which are considered relevant to the proposed development.

Section 79C(1)(a)(ii) ***(a) the provisions of:***

(ii) any proposed instrument.

There are no proposed instruments affecting the proposed development of which the writer is aware.

Section 79C(1)(a)(iii) ***(a) the provisions of:***

(iii) any development control plan.

4.5 Hawkesbury Development Control Plan 2002

The Hawkesbury Development Control Plan 2002 (**DCP 2002**) is used by Council to assess development applications submitted under the Hawkesbury LEP 2012.

In assessing a development application, Council is to have regard to **Sub-clause 79C(3A)** of the Environmental Planning and Assessment Act 1979 which states:

> *(3A)* ***Development control plans***
>
> *If a development control plan contains provisions that relate to the development that is the subject of a development application, the consent authority:*
>
> *(a) if those provisions set standards with respect to an aspect of the development and the development application complies with those standards-is not to require more onerous standards with respect to that aspect of the development, and*
>
> *(b) if those provisions set standards with respect to an aspect of the development and the development application does not comply with those standards-is to be flexible in applying those provisions and allow reasonable alternative solutions that achieve the objects of those standards for dealing with that aspect of the development, and*
>
> *(c) may consider those provisions only in connection with the assessment of that development application.*
>
> *In this subsection, standards include performance criteria.*

Chapter 5.1 of **Part C** of DCP 2002 relates to bush fire prone land.

The Site is bush fire prone land as shown on the extract from the Bush Fire Prone Land Map at **Figure 10**.

To assess the risks associated with bush fire, a Bush Fire Risk Assessment has been submitted with the development application.

Figure 10: Extract from the Bush Fire Prone Land Map with the Site outlined in red.

The Bush Fire Risk Assessment concludes:

> *Building envelopes compliant with the requirements of table A2.4 of Planning for Bushfire Protection have been identified within each proposed new allotment. In addition, the proposal meets the requirements for setbacks to achieve less than BAL 29 in accordance with table 2.4.2 of AS 3959-2009 (amendment 3).*
>
> *The proposal is for the subdivision of the current 3.25 ha (approximately) lot; lot 1, DP 1185012 into 52 smaller residential allotments lots. 10 of the proposed new allotments will have direct road frontage onto Kurrajong Road with the remainder being accessed by a proposed internal road and access rights of way.*
>
> *The subject lot itself contains the unmanaged hazard within the study area for this proposal, the vast majority of this vegetation will be removed as part of the development process leaving no major hazard within 100m of any of the proposed new buildings.*
>
> *The land surrounding the proposal on all aspects contains either established residential development, managed rural residential development or land that is otherwise considered to be of minimal hazard to this proposal. All the vegetation within the study area is within the boundaries of privately owned allotments.*
>
> *This proposal could achieve the AS3959 construction level of BAL- LOW given that there is no significant hazard within the study area. However, given the proposal's location and the fire history of the area, it is considered best practice that some form of bushfire protection is built into this development. To this end, it is considered appropriate that the proposal includes complying with the*

requirements of AS3959 BAL-12.5 to all buildings.

All other aspects of this proposal can comply with the acceptable solutions for subdivision as outlined in Planning for Bushfire Protection.

Based on the assumptions and measurements contained within this assessment, the development is considered to be able to meet the requirements of clause 44 of the Rural Fires Regulation 2008 and the RFS requirements as outlined in Planning for Bushfire Protection.

Chapter 3 of **Part D** of DCP 2002 relates to subdivision.

The table at **Attachment 4** contains an assessment of the proposed development against the relevant provisions of **Chapter 3** of **Part D** of DCP 2002.

The proposed development is generally consistent with the provisions of DCP 2002.

Section 79C(1)(a)(iiia) ***(a) the provisions of:***

(iiia) any planning agreement or draft planning agreement.

There are no planning agreements or draft planning agreements relating to the proposed development.

Section 79C(1)(a)(iv) ***(a) the provisions of:***

(iv) the regulations.

There are no specific requirements of the Environmental Planning and Assessment Regulation 2000 which relate to this development application.

Section 79C(1)(a)(v) ***(a) the provisions of:***

(v) any coastal management plan.

Not applicable.

Section 79C(1)(b) ***(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.***

Impacts to the natural and built environment

The proposed development would have no adverse impact to the natural or built environment.

There may, however, be a need for demolition activities to be undertaken as part of the proposed development. Those activities would be carried out in accordance with the provisions of *Australian Standard AS 2601 - 1991: The Demolition of Structures*.

Traffic Impacts

The creation of fifty (50) new residential lots has the potential to impact the existing road network and the operation of the network.

A Traffic and Access Assessment report has been prepared, copies of which are submitted with the development application. The Traffic and Access Assessment states, among other things:

> ***Existing Road Network***
>
> *Kurrajong Road - is a local street linking Old Bells Line of Road in the east with Old Bells Line of Road in the west. The road includes a 6-7m wide pavement with unformed shoulders. The street provides access to adjacent residential properties. The street has a posted speed limit of 50km/hr. The intersections at either end of the road with Bells Line of Road are priority controlled intersections.*
>
> *Old Bells Line of Road – forms a loop around the proposed development site area and is a collector road linking in two locations with Bells Line of Road. It generally consists of a 6.0m – 7.0m wide pavement with unformed shoulders providing direct access to local rural residential properties. The intersection in the west with Bells Line of Road is a priority controlled intersection whereas in the east is controlled by traffic signals.*
>
> *Bells Line of Road – is the main east – west arterial road through the area and generally consists of a single travel lane in each direction. The road in the vicinity of Old Bells Line of Road has a posted speed limit of 60km/hr.*
>
> ***Existing Traffic Conditions***
>
> *Intersection counts were undertaken at the traffic signal controlled intersection of Bells Line of Road / Old Bells Line of Road between the hours 6:00am – 9:00am and 3:00pm – 6:00pm on a weekday. This location was chosen as it provided traffic flows in Old Bells Line of Road in the vicinity of its intersection with Kurrajong Road (east).*
>
> ***Existing Conditions Intersection Analysis***
>
> *All intersections surveyed have been analysed using the Sidra Intersection analysis program.*

Sidra Intersection determines the average delay that vehicles encounter, the degree of saturation of the intersection, and the level of service. The degree of saturation is the ratio of the arrival rate of vehicles to the capacity of the approach.

The existing weekday and weekend day intersection operating conditions are presented in Table 3. Average delay is expressed in seconds per vehicle.

Table 3 – Existing Weekday Intersection Operating Conditions

Intersection	Control	Morning Peak		Evening Peak	
		Av Delay	LOS	Av Delay	LOS
Bells Line of Rd / Old Bells Line of Rd	Signals	27.0	B	24.5	B

Avg Delay (sec/veh) is over all movements at signals, and for worst movement at priority and roundabouts

From Table 3, it can be seen that the intersection of Bells Line of Road / Old Bells Line of Road currently operates with a satisfactory level of service.

Existing Public Transport Services

Busways operates two bus routes in the vicinity of the development site along Old Bells Line of Road and Kurrajong Road (east of the site). Route 680 provides a service between Richmond and Kurrajong via Bowen Mountain. Route 682 provides a Kurrajong loop service.

Proposed Development

.... The proposed sub division would deliver a total of 52 residential lots and internal road network. As stated above, 50 lots would provide housing whereas two (2) lots would provide common servicing facilities for the development as a whole. Twelve (12) lots would have frontages to Kurrajong Road with the remainder serviced by the internal road network.

All internal roads would be constructed with a clear 15.0m road reservation width with 8.0m wide carriageways.

Potential Traffic Generation

The RTA Guide to Traffic Generating Developments suggests a peak hour traffic generation rate of 0.85 trips per dwelling. Further, 80% of this traffic would travel outbound in the AM peak and 20% would travel inbound. The reverse would occur during the PM peak.

Thus the proposed sub division ... would have the potential to generate a total of forty three (43) peak hour trips two way in Kurrajong Road.

Potential Traffic Impacts

As stated above, traffic counts were undertaken at Bells Line of Road / Old Bells

Line of Road to provide an indication of traffic flows in the vicinity of Kurrajong Road (east). The expected draw of traffic would be to / from the east of the site via the existing set of traffic signals at Bells Line of Road / Old Bells of Road.

.....

To conservatively gauge the existing traffic generation of Kurrajong Road at Old Bells Line of Road east of the site, it has been assumed all traffic generated by residential properties in Kurrajong Road would travel to / from the east. This would equate to an approximate total of 45 properties (including Woodburn Road east of Kurrajong Road). That is a peak hour traffic generation of 36 vehicles two way.

The northbound / southbound traffic flows in Old Bells Line of Road at Bells Line of Road have been conservatively assumed to pass through the intersection of Old Bells of Road / Kurrajong Road.

... future flows on Kurrajong Road would be well below the expected environmental capacity of the street. Thus the traffic impacts of the proposal are considered satisfactory.

Future Intersection Operation

The traffic generated by the proposal has been added to the surrounding road network as per the adopted trip distribution detailed above. It has been assumed that all traffic generated by the development would travel to / from the east at Bells Line of Road / Old Bells Line of Road intersection. The resulting future traffic flows are presented below.

The future traffic flows on the surrounding road network have been assessed in SIDRA. The resulting future intersection operation for the PM peak is presented below.

Table 5 – Future AM & PM Peak Intersection Operating Conditions

		Morning Peak		Evening Peak	
Intersection	Control	Av Delay	LOS	Av Delay	LOS
Bells Line of Road / Old Bells Line of Road	Signals	28.5	C	25.0	B
Old Bells Line of Road / Kurrajong Road	Give Way	6.5	A	6.6	A

Avg Delay (sec/veh) is over all movements at signals, and for worst movement at priority and roundabouts

From Table 5 it can be seen that all intersections in the vicinity of the development site would continue to operate at a satisfactory level of service in the future.

Development Design

The Hawkesbury Development Control Plan (DCP) provides design guidelines for a range of development types.

....

The internal roads within the development are consider local / minor roads serving some 40 residential lots. As stated above the development includes 8.0 wide two way carriageways and road reservations of 15.0m.

Thus the proposed internal roads exceed the minimum requirements of the DCP and thus are considered satisfactory.

The Traffic and Access Assessment concludes:

This report has assessed the potential traffic impacts of the proposed 52 lot sub division (delivering 50 houses) at the site known as 67 Kurrajong Road, Kurrajong. The findings of this assessment are presented below:

1. *The traffic impacts of the development would be minimal with future traffic flows on surrounding roads within acceptable limits.*

2. *Intersections surrounding the development would continue to operate at levels of service to that which currently occurs.*

3. *The proposed design of the internal roads exceed the minimum requirements of the DCP and are considered satisfactory.*

Overall the traffic impacts of the proposal are considered acceptable.

Social Impacts

There would be no social impact resulting from the proposed development other than the provision of a quality subdivision which would provide the opportunity for future landowners to provide quality residential development in the form of dwelling houses.

Economic Impact

The economic impact associated with the proposed development would be that employment opportunities would be available during both the demolition of any existing development on the Site (if required) and the construction of the proposed subdivision works.

Section 79C(1)(c) ***(c) the suitability of the site for the development.***

The Site is within the R2 Low Density Residential zone.

The proposed development is permitted in the zone and the Site is suitable for the proposed development.

Section 79C(1)(d) ***(d) any submissions made.***

Not applicable.

Section 79C(1)(e) ***(e) the public interest.***

It is in the public interest to have land developed according to its capabilities and, indeed, within the environmental constraints of a particular site.

The proposed development would have negligible impact on the environment and would be in accordance with the objectives of the Hawkesbury Local Environmental Plan 2012.

The proposed subdivision has been designed to accommodate dwelling houses without impact to adjoining development and would provide for additional housing stock of the locality.

It is in the public interest that such a development be approved.

5. CONCLUSION

It is proposed to subdivide the existing to into fifty two (52) lots, each with an area equal of greater than 450m^2.

It has been demonstrated that the proposal would have no adverse impact on the environment or any significant impact to existing views from the adjoining property.

The Site is located within the R2 Low Density Residential zone and the proposed development is permitted with the consent of the Council.

The development has planning merit and should be approved by the Council.

Attachment 1

NSW Land and Property Information Notice

Land and Property Information Division

ABN: 84 104 377 806
GPO BOX 15
Sydney NSW 2001
DX 17 SYDNEY Telephone: 1300 052 637

NSW GOVERNMENT Land & Property Information
A division of the Department of Finance & Services

TITLE SEARCH

Title Reference: 1/11 012

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 1/1185012

SEARCH DATE	TIME	EDITION NO	DATE
14/8/2015	11:35 AM	1	25/7/2015

LAND

LOT 1 IN DEPOSITED PLAN 1185012
AT KURRAJONG
LOCAL GOVERNMENT AREA HAWKESBURY
PARISH OF KURRAJONG COUNTY OF COOK
TITLE DIAGRAM DP1185012

FIRST SCHEDULE

PRJM PTY LTD (T AJ684006)

SECOND SCHEDULE (2 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS (S.171 CROWN LANDS ACT 1989)
2 AJ684007 MORTGAGE TO WESTPAC BANKING CORPORATION

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

PRINTED ON 14/8/2015

** ANY ENTRIES PRECEDED BY AN ASTERISK DO NOT APPEAR ON THE CURRENT EDITION OF THE CERTIFICATE OF TITLE.*
WARNING: THE INFORMATION APPEARING UNDER NOTATIONS HAS NOT BEEN FORMALLY RECORDED IN THE REGISTER.

Attachment 2

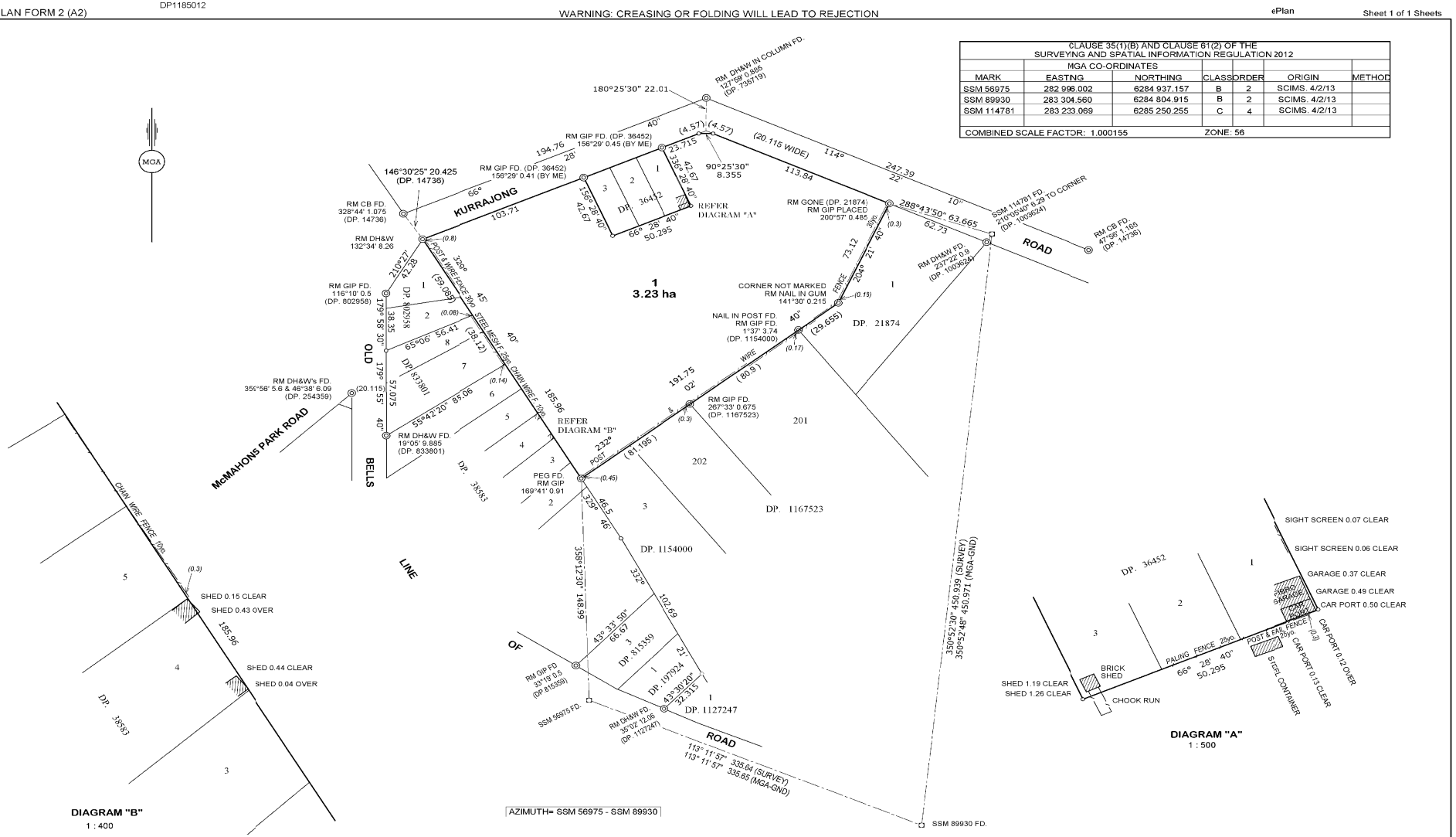
DP 1185012

PLAN FORM 2 (A2) DP1185012 WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION ePlan Sheet 1 of 1 Sheets

CLAUSE 35(1)(B) AND CLAUSE 61(2) OF THE SURVEYING AND SPATIAL INFORMATION REGULATION 2012

MARK	MGA CO-ORDINATES EASTING	NORTHING	CLASS	ORDER	ORIGIN	METHOD
SSM 56975	282 996.002	6284 937.157	B	2	SCIMS. 4/2/13	
SSM 89930	283 304.560	6284 804.915	B	2	SCIMS. 4/2/13	
SSM 114781	283 233.069	6285 250.255	C	4	SCIMS. 4/2/13	

COMBINED SCALE FACTOR: 1.000155 ZONE: 56



Surveyor: STEWART MCNEILL BLAND	PLAN OF DELIMITATION OF LOT 7304 DP. 1141427	LGA: HAWKESBURY	Registered 15.5.2013	DP1185012
Date o' Survey: 19/2/13		Locality: KURRAJONG		
Surveyor's Ref: 20/13		Subdivision No: ———		
		Lengths are in metres. Reduction Ratio 1: 1500		

PLAN FORM 6 (2012) **WARNING: Creasing or folding will lead to rejection** ePlan

DEPOSITED PLAN ADMINISTRATION SHEET

Sheet 1 of 12 sheet(s)

Office Use Only

Registered: 15.5.2013

Title System: TORRENS

Purpose: DELIMITATION

Office Use Only

DP1185012

PLAN OF

Delimitation of Lot 7304 DP. 1141427

LGA: Hawkesbury

Locality: Kurrajong

Parish: Kurrajong

County: Cook

Crown Lands NSW/Western Lands Office Approval

I, BRUCE WADDINGTON (Authorised Officer) in approving this plan certify that all necessary approvals in regard to the allocation of the land shown herein have been given.

Signature: [signature]

Date: 9/4/2013

File Number: 11/12227

Office: PARRAMATTA

~~Subdivision Certificate~~

I, ...

~~*Authorised Person/*General Manager/*Accredited Certifier, certify that the provisions of s.109J of the *Environmental Planning and Assessment Act 1979* have been satisfied in relation to the proposed subdivision, new road or reserve set out herein.~~

Signature:

Accreditation number:

Consent Authority:

Date of endorsement:

Subdivision Certificate number:

File number:

*Strike through if inapplicable.

Survey Certificate

I, Stewart McNeill Bland

of 8 Berrilee Lane Turramurra

a surveyor registered under the *Surveying and Spatial Information Act 2002*, certify that:

*(a) The land shown in the plan was surveyed in accordance with the *Surveying and Spatial Information Regulation 2012*, is accurate and the survey was completed on 19/2/13

~~*(b) The part of the land shown in the plan (*being/*excluding ^ ....) was surveyed in accordance with the *Surveying and Spatial Information Regulation 2012*, is accurate and the survey was completed on, the part not surveyed was compiled in accordance with that Regulation.~~

~~*(c) The land shown in this plan was compiled in accordance with the *Surveying and Spatial Information Regulation 2012*.~~

Signature: [signature] Dated: 16/4/13

Surveyor ID: 504

Datum Line: SSM 56975 – SSM 89930

Type: *~~Urban~~/*Rural

The terrain is *Level-Undulating / *~~Steep-Mountainous~~.

*Strike through if inapplicable.

^Specify the land actually surveyed or specify any land shown in the plan that is not the subject of the survey.

Statements of intention to dedicate public roads, public reserves and drainage reserves.

SUBDIVISION CERTIFICATE

PLAN PREPARED FOR ISSUE OF FIRST TITLE OVER CROWN LAND. EXEMPTION CLAIMED UNDER SEC.23G (B) OF THE CONVEYANCING ACT 1919.

[signature] 9/4/2013

CROWN LANDS AUTHORISED OFFICER

Plans used in the preparation of survey/compilation.

DP 254359
DP. 735719
DP. 1127247
DP. 1141427
DP. 1167523
DP. 1154000
DP. 833801
DP. 802958
DP. 36452
DP. 21874
DP. 1003624
DP. 14736

If space is insufficient continue on PLAN FORM 6A

Signatures, Seals and Section 88B Statements should appear on PLAN FORM 6A

Surveyor's Reference: ~~13/13~~ 20/13

PLAN FORM 6A (2012) WARNING: Creasing or folding will lead to rejection

DEPOSITED PLAN ADMINISTRATION SHEET

Sheet 2 of 2 Sheets

Office Use Only

Registered: 15.5.2013

Office Use Only

DP1185012

PLAN OF

Delimitation of Lot 7304 D.P.1141427

This sheet is for the provision of the following information as required:

- A schedule of lots and addresses - See 60(c) *SSI Regulation 2012*
- Statements of intention to create and release affecting interests in accordance with section 88B *Conveyancing Act 1919*
- Signatures and seals- see 195D *Conveyancing Act 1919*
- Any information which cannot fit in the appropriate panel of sheet 1 of the administration sheets.

Subdivision Certificate number: .....

Date of Endorsement: .....

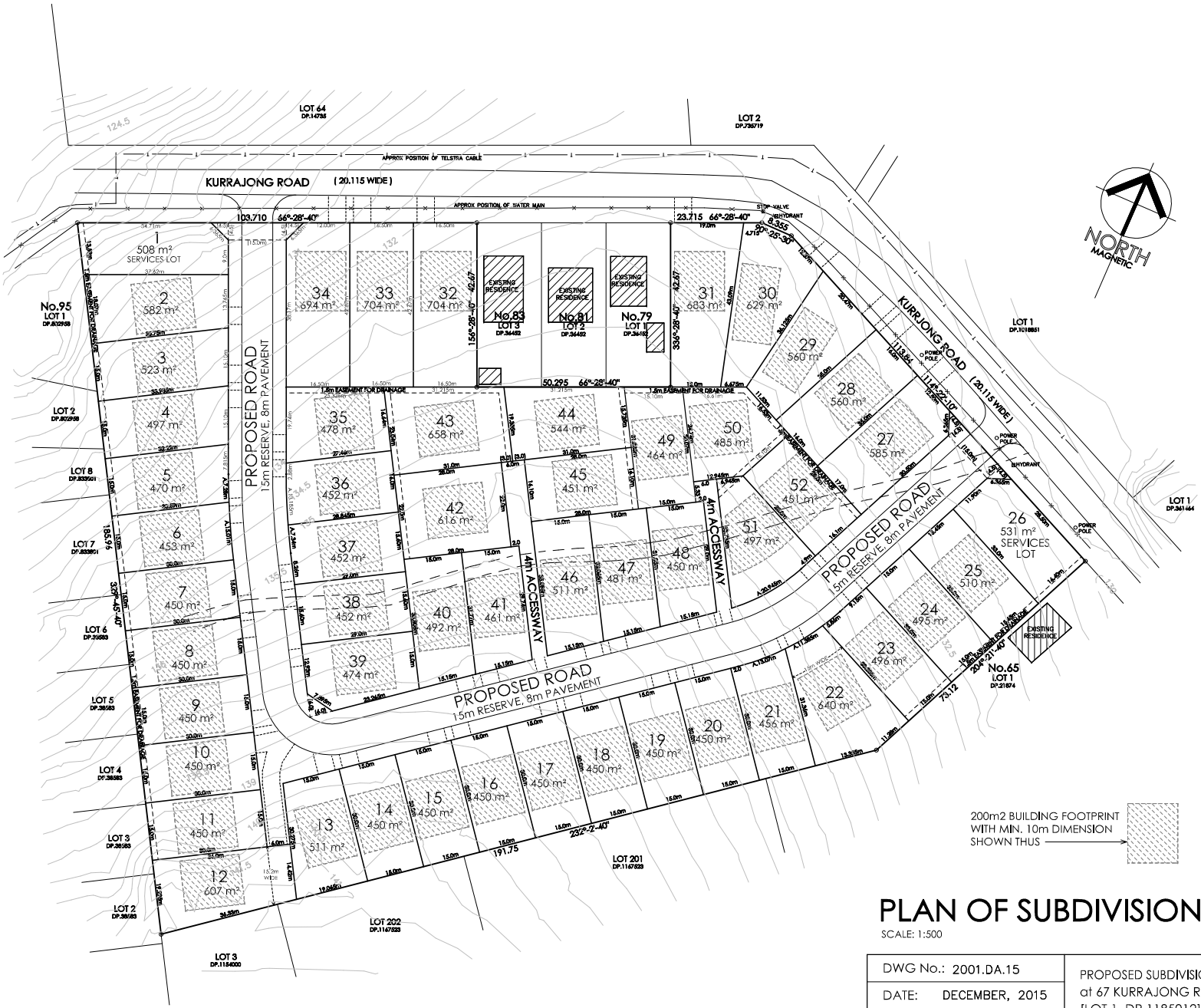
Lot 1 – No. 67 Kurrajong Road, Kurrajong

If space is insufficient use additional annexure sheet

Surveyor's Reference: 20/13

Attachment 3

Plan of Proposed Subdivision



200m2 BUILDING FOOTPRINT WITH MIN. 10m DIMENSION SHOWN THUS

TABLE OF LOTS			
LOT	Area (m²)	LOT	Area (m²)
1	SERVICES LOT 508	27	585
2	582	28	560
3	523	29	560
4	497	30	629
5	470	31	683
6	453	32	704
7	450	33	704
8	450	34	694
9	450	35	478
10	450	36	452
11	450	37	452
12	607	38	452
13	511	39	474
14	450	40	492
15	450	41	461
16	450	42	616
17	450	43	658
18	450	44	544
19	450	45	451
20	450	46	511
21	456	47	481
22	640	48	450
23	496	49	464
24	495	50	485
25	510	51	497
26	SERVICES LOT 531	52	451

PLAN OF SUBDIVISION - 52 LOTS

SCALE: 1:500

A1 SHEET

DWG No.: 2001.DA.15	PROPOSED SUBDIVISION at 67 KURRAJONG ROAD [LOT 1, DP.1185012] KURRAJONG NSW 2758 for . . .	ANDREW P GRIEVE BACHELOR OF ARCH (HONS)
DATE: DECEMBER, 2015		17 ANNABELLE CRESCENT KELLYVILLE, NSW 2155
DRAWN: APG		MOBILE. 0412 752 579
REF: . . ./KURRAJONG/SITE4		

Attachment 4

DCP Compliance Table

Control	Proposed	Complies
3.2: Flora and Fauna Protection ***Aims*** *(i) To protect bushland, significant flora and fauna habitats and wildlife corridors from the impacts of subdivision and subsequent development.* ***Objectives*** *The movement of fauna species on sites should be maximised so as to maintain biological diversity within the subdivision and road network.* *Opportunities for revegetation should be pursued as part of the subdivision process as a trade off for site development and as a means of value adding to the environment through the development process.* ***Rules*** *(a) Any subdivision proposal which is likely to result in any clearing of native vegetation or impact on any environmentally sensitive area is to be accompanied by a flora and fauna assessment report prepared by a suitably qualified person. This report is to primarily address the Eight Part Test pursuant to the Act (Section 5A) and State Environmental Planning Policy 44 - Koala Habitat Protection.* *(b) Vegetation cover should be retained where ever practicable as it acts to stabilise soils, minimise runoff, acts as a pollutant trap along watercourses and is important as a habitat for native fauna.* *(c) Degraded areas are to be*	A detailed Flora and Fauna Assessment has been submitted with the development application.	Yes

Control	Proposed	Complies
rehabilitated as part of the subdivision. *(d) Vegetation should be retained where it forms a link between other bush land areas.* *(e) Vegetation which is scenically and environmentally significant should be retained.* *(f) Vegetation which adds to the soil stability of the land should be retained.* *(g) All subdivision proposals should be designed so as to minimise fragmentation of bushland.*		
3.3: Visual Amenity ***Aims*** *(h) To ensure that subdivision proposals do not facilitate development which would detrimentally impact upon important views and vistas.* *(i) To ensure that subdivision proposals are designed so as to preserve and enhance any visual landscapes.* ***Objectives*** *A subdivision proposal should be:* *- designed to have minimal impact on significant views and vistas; and* *- compatible with the cultural and landscape characteristics of the locality or region.* ***Rules*** *(a) Building envelopes,*	The proposed subdivision, being a subdivision of one (1) lot into fifty two (52) with minimum area of 450m^2 per new allotment, would not have any impact on significant views or vistas. SREP 20 has been addressed in **Part 4.3** of the SEE.	Yes

Control	Proposed	Complies
accessways and roads shall avoid ridge tops and steep slopes. *(b) Subdivision of escarpments, ridges, and other visually interesting places should:* *- be managed in such a way that the visual impact rising from development on newly created allotments is minimal; and* *- retain visually significant vegetation such as that found on ridge tops and other visually prominent locations.* *(c) Development Applications for subdivision shall take into consideration the provisions of SREP20 in relation to scenic quality.*		
3.4 Heritage ***Aims*** *(d) To protect heritage items, their settings and conservation areas.* *(e) To ensure that the design of new subdivisions take into consideration and respect the heritage significance of heritage items and other places and features of the City's historical character.* ***Objectives*** *Subdivision should be sympathetically designed to minimise the impact on heritage items of the subject land or*	The Site does not contain any heritage items, is not located in the vicinity of a heritage item, and is not located within a Heritage Conservation Area.	Yes

Control	Proposed	Complies
adjoining lands. *The subdivision should maintain a reasonable curtilage around heritage items on the subject land or surrounding lands.* *Subdivisions should be sympathetically designed to ensure that the existing heritage value of the streetscape and character of the area is maintained.* ***Rules*** *(a) A subdivision proposal on land which contains or is adjacent to an item of environmental heritage as defined in Schedule 1 of the Hawkesbury LEP should illustrate the means proposed to preserve and protect such items. With such subdivisions a Heritage Impact Statement may be required to determine the heritage curtilage. Council staff and Council's Heritage Advisor should be consulted in this regard.*		
3.5 UTILITY SERVICES ***Aims*** *(f) To provide public utilities in a safe, efficient and cost effective manner.* *(g) To provide public utilities in such a way as to maximise retention of vegetation.* ***Objectives*** *All lots created for residential purposes should have an adequate provision of utility services and not result in a detrimental impact on the environment.*	The proposed subdivision is serviced by electricity and water. A reticulated sewerage system, stormwater drainage, and internal road construction details have been prepared by Martens &	Yes

Control	Proposed	Complies
The design and provision of public utilities should conform to the cost effective criteria of the relevant servicing authority. *Compatible public utility services should be located in common trenches so as to minimise the land required, soil erosion and the cost of providing the services.* *Adequate buffers should be maintained between utilities and houses to protect residential amenity and health.* *The provision of utility services should not detrimentally impact on the landscape character of an area.* *Adequate water supplies for both domestic and fire fighting purposes should be available.* ***Rules*** *(a) Underground power provided to all residential and industrial subdivisions. Where infill subdivision is proposed, the existing system, whether above or underground shall be maintained.* *(b) All lots created are to have the provision of power.* *(c) Where reticulated water is not available, a minimum storage of 100,000 litres must be provided. A minimum of 10,000 litres must be available at all times on Bushfire Prone Land.*	Associates. Full design details are provided with the development application.	
3.6 FLOODING, LANDSLIP & CONTAMINATED LAND ***Aims***		

Control	Proposed	Complies
(d) Subdivision proposals should be designed to minimise the risk to life and/or property from flooding, landslip and contaminated land. ***Objectives*** *Subdivision of flood prone land should not result in increased risk to life or property both on the subject land and adjoining lands.* *Subdivision of land that has been identified as being prone to landslip should not increase the risk to life or property on the subject land or adjoining lands.* ***Rules*** *(a) Compliance with clause 25 of Hawkesbury Local Environmental Plan 1989.* *(b) Access to the subdivision shall be located above the 1% AEP flood level.* *(c) Where a subdivision proposal is on land identified as being potentially subject to landslip, the applicant shall engage a geotechnical consultant to prepare a report on the viability of subdividing the land and provide recommendations as to the siting and the type of buildings which could be permitted on the subject land.* *(d) In the event that Council deems that there is the potential that land subject to a subdivision application is contaminated then the applicant shall engage a suitably qualified person to undertake a soil and ground water assessment.*	The Site is not flood prone land. The Phase 1 Environmental Assessment submitted with the development application has concluded that the Site is not contaminated to preclude the proposed subdivision and the subsequent development of a dwelling house on each of the proposed lots.	Yes

Control	Proposed	Complies
(e) Contaminated Land shall be remediated prior to the issue of the Subdivision Certificate.		
3.7.1 Residential Local Street Design ***Aims*** *(f) To create street networks in which the function of each street is clearly defined.* *(g) To ensure that vehicular and pedestrian access is simple, safe and direct.* *(h) To minimise the impact of traffic on the residential amenity of the locality.* ***Objectives*** *Street widths should reflect the role and function of the street in the road hierarchy.* *Streets should be designed to allow on street car parking.* *Streets should be designed to cater for service vehicles.* *Streets should be designed to provide interest and variety in the streetscape through kerbs (where appropriate), landscaping and paving treatments. The street design should be compatible with the existing road pattern in the locality.* *Junctions along residential streets should be spaced to create safe and convenient vehicle movements.* *The street network should create a convenient route for residents between their home and higher order roads.*	An internal street and associated accessway would be created as part of the proposed subdivision. Full details have been provided in the document prepare by Marten & Associates which have been submitted with the development application.	Yes

Control	Proposed	Complies
The street network should facilitate walking and cycling within the neighbourhood and to local activity centres. *The street network should take into account existing topography and existing open space systems.* *Streets should not operate as through traffic routes for externally generated traffic while at the same time limiting the length of time local drivers need to spend in a low speed environment.* *Streets and lots should be located so that residential dwellings are not subjected to unacceptable traffic noise.* ***Rules*** *(a) The design specifications in Figure D3.3 are met.* *(b) A minimum spacing of staggered junctions in a local street network should be 20 metres.* *(c) The street network should be orientated where practical, to promote efficient solar access for dwellings as shown in Part C Chapter 6 Energy Efficiency.* *(d) Cul-de-sacs for residential roads should have minimum seal radii of 8.5 metres and boundary radii of 12.0 metres.* *(e) Cul-de-sacs should not exceed 200 metres in length unless topographic constraints render other options impracticable.* *(f) Off street parking shall be provided in cul-de-sacs at the rate of 1 space per lot.* *(g) Streets should be designed to*		

Control	Proposed	Complies
allow for the provision of suitable and safe conditions for street trees.		
3.7.2 Residential Accessway Design *An accessway is a driveway or private road which services between one and five allotments.* ***Aims*** *(h) To ensure that vehicular access to all lots within the subdivision is simple, safe and direct.* *(i) To ensure that accessways do not detract from the amenity of localities.* ***Objectives*** *Accessways design should provide safe and efficient entrance/exit to individual lots.* *Accessways should be landscaped and treated so as to reduce the visual and environmental impact of hard paved areas.* *Accessway designs should minimise the impact on the amenity of the existing and future dwellings. They should be sited away from noise and visually sensitive components of existing and future dwellings.* *Accessways should provide interest and variety and avoid lengthy straight sections.* ***Rules*** *(a) Accessways should have a minimum width of 4 metres and sealed pavement of 2.5 metres.*	Details of access to each of the proposed lots has been prepared by Martens & Associates. Full details have been submitted with the development application.	Yes

Control	Proposed	Complies
(b) Accessways should not serve more than 5 lots. *(c) Accessways should have a maximum grade of 25% (1:4) at any point.* *(d) Where the accessways is steep or fronts a local collector or higher order road (greater than 3,000 vehicles per day) or a high pedestrian area, accessways should be designed so that vehicles can be driven both onto and off the property in a forward direction.* *(e) Where vehicles would otherwise have to reverse more than 50 metres, a turning area should be provided to enable the vehicles to enter and leave the site in a forward direction and reduce the need to reverse over long distances.* *(f) Refer to Part D Chapter 1 Residential Development for further requirements regarding accessways should a subdivision be part of a residential development.*		
3.7.4 Stormwater Management *Aims* *(d) To control the flow of water into the natural and man made drainage systems in such a way to minimise impacts from storm water runoff.* *(e) To contribute positively to the environmental enhancement of catchment areas.* *(f) To provide water quality management systems which:*	Each of the proposed lots would subsequently be developed with a dwelling house, that process being the subject of future development applications. Stormwater drainage and management has been design by Martens & Associates. Full details of the stormwater design and treatment process have been submitted with the development application.	Yes

Control	Proposed	Complies
- *ensure that disturbance to natural stream systems is minimal; and* - *storm water discharge to surface and underground receiving waters, both during construction and during residential use of the subject land, does not degrade the quality of the water at the receiving end.* ***Objectives*** *Drainage from subdivision sites should be consistent in both water quality and quantity terms with the predevelopment storm water patterns.* *Drainage systems should be designed so as to ensure safety and minimise the likelihood of storm water inundation of existing and future dwellings.* *Adequate provision should be made for measures during construction to ensure that the landform is stabilised and erosion controlled.* ***Rules*** *(a) Where site topography prevents discharge of storm water directly to the street gutter or a Council controlled pipe system, inter allotment drainage provided to accept run off from all existing or future impervious areas on the subject land. The design and construction of the inter allotment drainage system should be in accordance with the requirements of the Australian Rainfall and Runoff (1987).*		

Control	Proposed	Complies
(b) Where proposals require the creation of easements over downstream properties for drainage purposes, a letter of consent from the owner(s) of the downstream properties should be submitted with DAs. *(c) Stormwater piped in roads and through allotments in all residential subdivisions.* *(d) For subdivision proposals comprising 5 lots or more or where Council deems it necessary, a soil and water management plan should be prepared by a properly qualified practitioner with the aim of minimising erosion and maximising the quality of any water leaving the site.*		
3.7.5 Lot Size and Shape ***Aims*** *(e) To ensure that newly created allotments have dimensions which allow flexibility and choice of housing design whilst minimising development costs.* *(f) To promote allotments of varying sizes which provide pleasant streetscapes, satisfy user requirements and minimise environmental impacts.* ***Objectives*** *Lot sizes and dimensions should enable dwellings to be sited to:* *- protect natural and cultural features;* *- acknowledge site constraints*		

Control	Proposed	Complies
including soil erosion and bush fire risk; - *retain special features such as trees and views;* - *dispose of effluent on site where sewer not available; and* - *Provide for wildlife habitats and the growth of trees.* - *Lot sizes and configurations should be varied to provide a mix of allotment types which create pleasant streetscapes and encourage a variety of housing types.* ***Rules*** *(a) In calculating the area of a battle-axe or hatchet shaped allotment the accessway is to be excluded. The area of an allotment effected by a "right of carriage way" or private road should also be excluded.* *(b) Allotments should have a minimum width of 15 metres at the building line. Council may consider a lesser dimension but only as part of an integrated housing development.* *(c) Lots should be able to accommodate a building envelope of 200m^2 with a minimum dimension of 10 metres.* *(d) An allotment should not be less than 20 metres in depth to ensure there is some flexibility in the choice of housing design and siting as well as the availability of suitable space for other activities normally associated with a dwelling.*	Each of the proposed lots contains a minimum area of 450m^2 as required by LEP 2012. A minimum 15 metre building line is achieved for each of the proposed lots. The Plan of Proposed Subdivision shows a building envelope of minimum 200m^2 and width of 15 metres for each of the proposed lots. All of the proposed lots has a depth of minimum 20 metres. As much as possible of the existing vegetation on the Site would be retained. Vegetation would need to be removed as part of the development of each of the proposed lots for a dwelling house. The nature of the Site and the configuration of the proposed lots are such that future dwelling houses should be able to be constructed with a minimum amount of cut and/or fill of 1 metre.	Yes

Control	Proposed	Complies
(e) Vegetation which adds significantly to the visual amenity of a locality and/or which is environmentally significant should be conserved in the design of the subdivision proposal. *(f) Lots should be designed to allow the construction of a dwelling with a maximum cut or fill of 1 metre from the natural ground level.*		
3.7.6 Solar Access and Lot Orientation ***Aims*** *(g) To encourage the design of subdivisions which maximise solar access.* *(h) To ensure flexibility in the siting of buildings to take advantage of a northern orientation.* *(i) To maximise the number of allotments which have good solar access and therefore which optimise the design performance of energy smart homes.* ***Objectives*** *Lots should be designed to maximise solar access.* *Lots should be orientated to take advantage of micro climatic benefits and have dimensions to allow adequate on site solar access, taking into account likely future dwelling size and a relationship of each lot to the streets.* *Lots are of a suitable shape to permit the location of a dwelling with suitable*		

Control	Proposed	Complies
solar access and private open space. ***Rules*** *(a) Lots orientated to provide long access in a northerly direction (plus or minus 200).* *(b) Eighty per cent of lots in a new subdivision having 5 star solar access, and the remainder either 4 or 3 star.* *(c) On a street running north-south, lots to be increased in width to enable private open space on the northern side of the building envelope.* *(d) Lots designed so that future buildings will not overshadow neighbouring houses to the south, and have a sufficiently long northern facade to receive winter sun.*	All proposed lots are oriented such that dwelling houses would be able to be constructed on each lot with maximum solar access. The design of the subdivision is such that no lot would be configured to allow a future dwelling to overshadow existing adjoining development.	Yes

Controlled Copy ___

Phase 1 Environmental Site Assessment

67 Kurrajong Road, Kurrajong NSW

for PRJM Pty Ltd

September 2015

J1696.2R-rev0

CMJA

C. M. Jewell & Associates Pty Ltd

Phase 1 Environmental Site Assessment – 67 Kurrajong Road, Kurrajong NSW
September 2015

J1696.2R-rev0

Controlled Copy 1	PRJM Pty Ltd *Mr Michael McCarthy* Unit 6, 3-7 Cowell Street GLADESVILLE NSW 2111
2	CMJA Library

C. M. Jewell & Associates Pty Ltd
ABN: 54 056 283 295
1/13 Kalinda Road, Bullaburra, NSW 2784
PO Box 10, Wentworth Falls, NSW 2782
Phone (02) 4759 3251 Fax (02) 4759 3257
www.cm-jewell.com.au postie@cm-jewell.com.au

CHRIS JEWELL
Principal

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Background 1
1.2 Project Objectives 1
1.3 Scope of Work 1
1.4 Report Format 2
1.5 Limitations and Intellectual Property Matters 2
2.0 SITE CONDITIONS 3
2.1 Site Identification 3
2.2 Site Description 3
2.3 Current Site Use and Layout 3
2.4 Surrounding Area 3
2.5 Topography and Drainage 3
2.6 Geology and Soils 4
2.7 Acid Sulphate Soils 4
2.8 Hydrogeology 4
2.8.1 Groundwater Regime 4
2.8.2 Local Registered Groundwater Wells 5
2.9 Environmental Setting 6
2.9.1 Ecological Receptors 6
2.9.2 Endangered Ecological Communities 6
2.10 Contaminated Land Search 7
2.11 Meteorology 7
2.12 Underground Services Search 7
3.0 SITE HISTORY 8
3.1 NSW Land Titles Search 8
3.2 Council Records 8
3.3 Review of Historical Aerial Photographs 8
3.4 Historical Research of the Area 9
4.0 SITE VISIT 11
4.1 Analysis of Potential Asbestos-Containing Material 12
5.0 CONCLUSIONS AND RECOMMENDATIONS 13
5.1 Conclusions 13
5.1.1 Qualitative Risk Assessment 13
5.2 Recommendations 15
REFERENCES 17

Important Information About Your Environmental Site Assessment

TABLES

Table 1 Details of Local Registered Groundwater Wells
Table 2 Summary of Underground Services Search
Table 3 Summary of Land Title Search
Table 4 Review of Aerial Photographs
Table 5 Classification of Consequence
Table 6 Classification of Likelihood

FIGURES

Figure 1 Site Location and Setting
Figure 2 Site Layout
Figure 3 Local Ecological Receptors and Registered Groundwater Wells

APPENDICES

Appendix A Local Registered Groundwater Works Summaries
Appendix B s149 Planning Certificate
Appendix C Underground Services Reports
Appendix D Land Title Documents
Appendix E Historical Aerial Photography
Appendix F Site Photographs
Appendix G Analytical Documentation

List of Abbreviations

Measures

cm	centimetre
L/s	litre per second
m	metre
m^2	square metre
mg/L	milligram per litre
mm	millimetre

General

ACM	asbestos containing material
AHD	Australian Height Datum
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999
CMJA	C. M. Jewell & Associates Pty Ltd
Council	Hawkesbury City Council
DP	deposited plan
DPI Water	Department of Primary Industries Water
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
Hawkesbury LEP	*Hawkesbury Local Environmental Plan 2012*
LPI	Land and Property Information
MGA	Map Grid of Australia

1.0 INTRODUCTION

1.1 Background

This Phase 1 Environmental Site Assessment (ESA) report relates to land located at 67 Kurrajong Road, Kurrajong, New South Wales (the Site). Specifically, the Site is identified as Lot 1 in DP1185012.

At the time of this report, the Site is owned by PRJM Pty Ltd.

It is understood that this Phase 1 ESA is required to support a development application to be lodged with Hawkesbury Council for a proposed 49-lot residential development at the site. Accordingly, PRJM Pty Ltd commissioned C. M. Jewell & Associates Pty Ltd (CMJA) on 11 August 2015 to undertake a Phase 1 ESA in line with CMJA's proposal dated 10 August 2015 (ref. P1696.1L).

1.2 Project Objectives

The objectives of this project were to:

- Review the history and current status of the site;
- Identify potential sources of contamination and determine potential contaminants of concern;
- Identify areas of potential contamination;
- Identify potential human and ecological receptors;
- Identify potentially affected media (soil, sediment, groundwater, surface water, indoor and ambient air).
- Assess the risks posed by potential contamination under the land uses permitted by its zoning.

1.3 Scope of Work

The scope of work carried out for this Phase 1 ESA, consistent with the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM), included the following:

- Land title search.
- Historical aerial photography review.
- Identification of zoning.
- Site ownership and occupation train.
- Chronological list of previous, present and proposed site uses.
- Hawkesbury City Council (Council) development application search and provision of a Planning Certificate (under Section 149 of the *Environmental Planning and Assessment Act* 1979).
- Search for any underground services within the site (Dial Before You Dig).
- Identification of adjacent land uses.
- Desktop assessment of the local groundwater conditions.
- Assessment of environmental conditions at the site, including topography, geology, hydrogeology, soil type, surface water drainage, and flood potential.
- Identification of local sensitive environments.
- A site walkover inspection – identification of any evidence of contamination, potential contaminants of concern, and likely contamination pathways.

- Visual assessment of any capped surfaces.
- Obtaining current site photographs.
- Discussions with Council with regards to site history.
- Production of this report.

1.4 Report Format

Section 1 of this report provides background information for the assessment, the project objectives and the scope of work conducted to achieve those objectives.

Section 2 sets out basic identification and description details for the Site. It also provides a summary of the environmental conditions at the site, including the Site's topography and drainage, geology, and hydrogeological setting.

Section 3 discusses the Site's history, and also provides a brief discussion on historical aerial photographs of the Site.

Section 4 describes the condition of the Site and surrounding land as observed during a site walkover, together with the results of laboratory analysis from samples taken during the site visit.

Section 5 presents the conclusions of the assessment and recommendations.

1.5 Limitations and Intellectual Property Matters

This report has been prepared by C. M. Jewell & Associates Pty Limited for the use of the client identified in Section 1.1, for the specific purpose described in that section. The project objectives and scope of work outlined in Sections 1.2 and 1.3 were developed for that purpose, taking into consideration any client requirements and budgetary constraints set out in the proposal referenced in Section 1.1.

The work has been carried out, and this report prepared, utilising the standards of skill and care normally expected of professional scientists practising in the fields of hydrogeology and contaminated land management in Australia. The level of confidence of the conclusions reached is governed, as in all such work, by the scope of the investigation carried out and by the availability and quality of existing data. Where limitations or uncertainties in conclusions are known, they are identified in this report. However, no liability can be accepted for failure to identify conditions or issues which arise in the future and which could not reasonably have been assessed or predicted using the adopted scope of investigation and the data derived from that investigation. An information sheet – 'Important Information about your Environmental Site Assessment' – is provided with this report. The report should be read in conjunction with that information sheet.

Where data collected by others have been used to support the conclusions of this report, those data have been subjected to reasonable scrutiny but have essentially, and necessarily, been used in good faith. Liability cannot be accepted for errors in data collected by others.

This report, the original data contained in the report, and its findings and conclusions remain the intellectual property of C. M. Jewell & Associates Pty Ltd. A licence to use the report for the specific purpose identified in Section 1.1 is granted to the persons identified in that section on the condition of receipt of full payment for the services involved in the preparation of the report.

This report should not be used by other persons or for other purposes than those identified in Section 1.1, and should not be reproduced except in full and with the permission of C. M. Jewell & Associates Pty Ltd.

2.0 SITE CONDITIONS

2.1 Site Identification

This assessment relates to land identified as 67 Kurrajong Road, Kurrajong, NSW, and further identified as Lot 1 in DP1185012, in the Parish of Kurrajong, County of Cook (the Site).

The Site is located approximately 75 kilometres north-west of Sydney. It lies within Hawkesbury City Council's Local Government Area and is currently zoned R2 Low Density Residential under the *Hawkesbury Local Environmental Plan 2012* (Hawkesbury LEP).

The location and setting of the Site is shown on Figure 1.

2.2 Site Description

The Site covers an area of approximately 32,500 m^2 and is irregular in shape.

Map Grid of Australia (MGA) Zone 56H co-ordinates of the centre of the site are 283036 mE and 6285210 mN.

2.3 Current Site Use and Layout

The Site is vacant with no current land use. However, according to the NSW Land and Property Information (LPI) online map (maps.six.nsw.gov.au), the fence line and structures (chicken coop, compost bin, shed lean-to, clothes line) located at the rear of residential properties located at 79, 81 and 83 Kurrajong Road encroach onto the Site. See Section 4 for further discussion.

The Site is covered in dense bushland with the exception of several cleared areas in its eastern and northern portions and surrounding adjacent residential properties, and a dirt (vehicle) track that runs from the Site's eastern boundary (entrance on Kurrajong Road) to the rear of a residential property (136 Old Bells Line of Road) located on its western boundary.

The Site's layout is illustrated on Figure 2.

2.4 Surrounding Area

The Site is located in a rural residential area, bounded as outlined below.

To the north	Kurrajong Road and three residential properties, beyond which lies rural residential properties
To the east	Kurrajong Road beyond which lies rural residential properties and Kurrajong Baptist Church
To the south	Residential properties (under construction at the date of this report)
To the west	The rear of residential properties and Bellbird Kindergarten & Preschool, that front Old Bells Line of Road

2.5 Topography and Drainage

The Site lies at an elevation ranging from 135 metres above Australian Height Datum (AHD) at its lowest to 144 metres AHD at its highest; sloping from the south of the Site to the north-west and east.

Regionally, the landscape consists of undulating to rolling low hills on Wianamatta Group shales without crops of Minchinbury Sandstone. Hawkesbury Sandstone is exposed in the deeper valleys. Local relief is to 50 to 80 metres, and slopes are usually 5 to 20%. Narrow ridges, hillcrests and valleys are typical of the landscape. Tree cover has been extensively cleared; it was formerly tall open-forest (wet sclerophyll forest).

Drainage of the Site is via infiltration and runoff; runoff is likely to follow the flow of topography towards the north-west and towards the east.

A review of Council's Planning Certificate indicates that the land is not subject to riverine flood-related development controls.

2.6 Geology and Soils

Inspection of the Penrith 1:100,000 Geological Map (Geological Series Sheet 9030, Geological Survey of NSW 1991) indicates that the site is underlain by a thin cap of Triassic-age Ashfield Shale overlying Triassic-age Hawkesbury Sandstone, which outcrops along Little Wheeny Creek.

Ashfield Shale is part of the Wianamatta Group of shales that outcrop widely in the central part of the Sydney basin. The Ashfield Shale typically comprises dark grey shale and laminite.

The Hawkesbury Sandstone is a quartz sandstone averaging 68 per cent quartz, 2 per cent rock fragments, 1 per cent feldspar and 1 per cent mica. The sandstone usually has a clay matrix, which comprises up to 20 per cent of rock volume. The sandstone is predominantly medium to coarse grained, and varies locally from fine to very coarse-grained. Scattered pebbles of white vein quartz, usually less than 6 millimetres, are common throughout and also occur in bands.

Inspection of the Penrith Soil Landscape Series Sheet 9030 indicates that the Site is located on the Luddenham Landscape, comprised of shallow (<100 cm) dark podzolic soils or massive earthy clays on crests, moderately deep (70 to 150 cm) red podzolic soils on upper slopes, moderately deep (<150 cm) yellow podzolic soils and prairie soils on lower slopes and drainage lines. Limitations include high soil erosion hazard and moderately reactive localised impermeable highly plastic subsoil.

The Department of Infrastructure, Planning and Natural Resources' *Salinity Potential in Western Sydney 2002* map (1:100,000 scale) indicates that there is moderate potential for salinity in the region.

2.7 Acid Sulphate Soils

Because the Site lies at an elevation of at least 135 metres AHD, acid sulphate soils would not be expected to be an issue in the area around the Site.

A review of the Acid Sulphate Soil Risk Map (NSW Natural Resource Atlas) showed that the Site is not within an acid sulphate soil risk area. Therefore, acid sulphate soils are not known or expected to occur in this environment.

However, CMJA notes that Section 7.5 of the Planning Certificate indicates that Council or another public authority has adopted a policy that restricts the development of the land because of the likelihood of acid sulphate soils.

PRJM Pty Ltd may wish to query this statement as it appears anomalous.

2.8 Hydrogeology

2.8.1 Groundwater Regime

Locally, groundwater is likely to be encountered at a depth of 60 to 130 metres below ground level, within the Hawkesbury Sandstone. The potentiometric surface (the level to which water will rise in a completed bore) is likely to be 30 to 50 metres below ground level. The potential also exists for one or more perched groundwater tables to be present between the ground surface and the underlying aquifer.

Groundwater movement within the sandstone is likely to be via two processes. Groundwater would move predominantly through secondary features such as fracturing associated with the network of joints (which are generally high angle) and features such as subhorizontal bedding-plane fractures. Although these fractures do generally not conduct large volumes of water in themselves, the secondary porosity is important in providing potential contaminant transport conduits. In addition, some intergranular flow may occur in horizons of weathered sandstone, cross-stratified sandstone, and coarse poorly cemented sandstone horizons deeper within the unit. These groundwater movements would be consistent with the local structural orientation of the aquifer. Porous layers with primary permeability may be present in some of the coarser sandstone units.

Yields obtained from the Hawkesbury Sandstone are generally low, usually less than 1.5 litres per second; the groundwater would be expected to have a low salinity, typically less than 500 milligrams per litre (mg/L). The pH of the water is also generally low, usually of the order of 5.8 to 6.8.

2.8.2 Local Registered Groundwater Wells

Groundwater beneath the site is regulated by the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources, which commenced in July 2011. This groundwater is part of the Hawkesbury Nepean water management area. Groundwater from this source may only be taken subject to the grant of an aquifer access licence and works approval for the bore or other abstraction works.

A search of the NSW Department of Primary Industries Water (DPI Water) groundwater database identified no registered groundwater wells on the site and seven registered groundwater wells located within a 1-kilometre radius of the site.

Details of the groundwater wells are described in Table 1. Figure 3 shows the locations of the groundwater wells whilst Appendix A presents the groundwater works summary for each well.

TABLE 1
Details of Local Registered Groundwater Wells

ID / Location from Site	Use	SWL (m)	Well Depth (m)	Yield (L/s)	Geology (m)
GW100708 (775 metres east)	Domestic, Stock, Irrigation, Industrial	38.0	134.0	1.50	0.00 – 3.00 Clay 3.00 – 58.00 Shale 58.00 – 134.00 Sandstone
GW104396 (840 metres east)	Stock, Domestic	-	165.0	4.00	No information
GW105804 (980 m north-west)	Stock, Domestic	41.0	134.0	2.30	0.00 – 14.00 Soil 14.00 – 39.00 Shale 39.00 – 103.00 Sandstone 103.00 – 104.00 Shale 104.00 – 134.00 Sandstone
GW107452 (875 m south-east)	Stock, Domestic	2.0	108.0	9.85	0.00 – 6.00 Clay, brown shale 6.00 – 21.00 Shale 21.00 – 39.00 Sandstone / Shale 39.00 – 53.00 Sandstone 53.00 – 84.00 Sandstone / Shale 84.00 – 86.00 Shale 86.00 – 93.00 Sandstone / Shale 93.00 – 108.00 Sandstone, quartzite

TABLE 1
Details of Local Registered Groundwater Wells

ID / Location from Site	Use	SWL (m)	Well Depth (m)	Yield (L/s)	Geology (m)
GW107611 (910 m south-east)	Domestic	35.0	78.0	21.60	0.00 – 1.00 Soil (fill) 1.00 – 3.00 Clay 3.00 – 30.00 Sandstone, yellow 30.00 – 32.00 Sandstone / Shale 32.00 – 34.00 Sandstone 34.00 – 35.00 Shale 35.00 – 56.00 Sandstone / Shale 56.00 – 57.00 Shale 57.00 – 78.00 Sandstone
GW111033	Domestic	43.0	138.0	1.20	0.00 – 12.00 Clay 12.00 – 36.00 Shale 36.00 – 45.00 Sandstone / Shale 45.00 – 115.00 Sandstone 115.00 – 122.00 Shale 122.00 – 138.00 Sandstone / Quartz
GW111034 (660 m south-east)	Domestic	30.0	84.0	2.00	0.00 – 5.00 Clay 5.00 – 10.00 Sandstone 10.00 – 15.00 Sandstone / Shale 15.00 – 84.00 Sandstone

2.9 Environmental Setting

2.9.1 Ecological Receptors

CMJA carried out a 500-metre radius search around the Site to identify potential ecological receptors such as surface water bodies, wetlands and areas of ecological significance. The search indicated that Little Wheeny Creek is located approximately 50 metres north and west of the Site, tributaries of which also flow approximately 15 metres to the east, 100 metres to the south-east and 150 metres to the south-west of the Site.

The location of Little Wheeny Creek is shown on Figure 3.

2.9.2 Endangered Ecological Communities

A review of Council's Planning Certificate indicated that the Site:

- does not include or comprise a critical habitat declared under Part 3 of the *Threatened Species Conservation Act* 1995 and Part 7A of the *Fisheries Management Act* 1994;
- is not within a conservation area;
- is not biodiversity certified land within the meaning of the *Threatened Species Conservation Act* 1995;
- has not been notified as land to which a biobanking agreement under the *Threatened Species Conservation Act* 1995 relates; and
- is not subject to a property vegetation plan under the provisions of the *Native Vegetation Act* 2003.

The Hawkesbury LEP and the *Hawkesbury Development Control Plan* 2002 contain provisions which relate to the preservation of trees and vegetation throughout the local government area.

A copy of the Planning Certificate is provided as Appendix B.

2.10 Contaminated Land Search

A search of NSW Environment Protection Authority's (EPA) contaminated land register indicated that the Site is not the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act* 1997.

A search of NSW EPA's public register indicated that the Site is not the subject of a licence, application, notice, audit or pollution studies and reduction programs under the *Protection of the Environment Operations Act* 1997.

2.11 Meteorology

Records collected by the Bureau of Meteorology indicate that annual average rainfall at the Site is 1248 millimetres (mm). This has been determined from data received from the Kurrajong Heights (Bells Line of Road) weather station (located approximately 2.5 kilometres north-west of the Site), over a period of 149 years.

2.12 Underground Services Search

An online search for utilities located within the Site was conducted and is summarised in Table 2. Asset owners Endeavour Energy and Sydney Water provided information on their utilities.

Copies of underground services reports supplied by the asset owners are provided as Appendix C.

TABLE 2
Summary of Underground Services Search

Asset Owner	Utility Type	Utility Location
Sydney Water	Sewer Main	Sydney Water's map shows no sewer mains crossing the Site.
	Water Main	Sydney Water's map shows no water mains crossing the Site. A 150 cast iron cement lined pipe is located adjacent to the Site's Kurrajong Road boundary.
Endeavour Energy	Electrical Cable	Endeavour Energy's map shows that no underground assets are present within the Site.

3.0 SITE HISTORY

3.1 NSW Land Titles Search

On 14 August 2015, CMJA conducted an historical land title search for the Site through the NSW LPI website. The results of the land title search are summarised below in Table 3.

TABLE 3
Summary of Land Title Search

Date	Activity
Prior to 25 Jul 2015, the Site was Crown Land owned and managed by NSW Government.	
8 Jul 2009	Folio Lot 7304 in DP1141427 was created for the Site.
15 May 2013	Folio Lot 1 in DP1185012 was created for the Site and previous folio was cancelled.
25 Jul 2015	The title for Lot 1 in DP1185012 was transferred to PRJM Pty Ltd.

Copies of the land title documents are provided as Appendix D.

3.2 Council Records

A review of Council's Planning Certificate indicated:

- The Site does not contain an item of environmental heritage under the protection of Hawkesbury LEP.
- The Site is not affected by the operation of Sections 38 or 39 of the *Coastal Protection Act* 1979.
- The Site has not been proclaimed to be a mine subsidence district within the meaning of Section 15 of the *Mine Subsidence Compensation Act* 1961.
- The Site is not affected by any road widening / road realignment under Division 2 of Part 3 of the *Roads Act* 1993 and/or an environmental planning instrument.
- The Site **is** bush fire prone land.

3.3 Review of Historical Aerial Photographs

Historical aerial photographs of the Site were sourced from Google Earth and NSW LPI.

The information provided in Table 4 is based on a review of aerial photographs that were taken between 1958 and 2015.

Copies of the historical aerial photographs are provided as Appendix E.

TABLE 4
Review of Aerial Photographs

Date	Summary
1958	The Site appears predominantly cleared / grassed with a few trees in the western portion. No buildings are visible on the Site. The surrounding area comprises small farming properties, orchards, open land and wooded areas. Three residential properties (79, 81 and 83 Kurrajong Road) are visible adjacent to the Site's northern boundary.
1970	The Site appears mostly cleared / grassed however what appear to be tractor marks suggest the majority of the Site has recently been tilled, maybe for agricultural use. Trees / shrubs are visible in the middle and western corner of the Site. The surrounding area comprises small farming properties, orchards, open land and wooded areas. An orchard is visible adjacent to the Site's southern boundary. A few more small residential properties are visible in the area than in 1958.
1975	The Site appears mostly cleared / grassed, however, trees are now visible in the western and southern portions of the Site. The tilled areas noted in the 1970 photograph are no longer visible. The surrounding area comprises small farming properties, orchards (fewer than 1970), open land and wooded areas. Several more residential properties are visible in the area and the orchard noted to the south of the Site in the 1970 photograph is now partially cleared.
1982	The Site consists of equal grassed and wooded areas. Trees / shrubs cover the western and southern portions of the Site and are visible (sporadically) over the remainder of the Lot. A vehicle track is visible running through the centre of the Site from Kurrajong Road (in the east) to the rear of a residential property on the Site's western boundary (136 Bells Line of Road). Similar to 1975, the surrounding area comprises small farming properties, open land and wooded areas. However, more small residential properties are now visible to the west of the Site. A building is now visible where the Kurrajong Baptist Church is now situated. The orchard that appeared in the 1970 photograph to the south of the Site is no longer visible, and the area is now grassed.
1994	Most of the Site is now covered with trees and shrubs, grassed areas are still visible in the eastern portion of the Site. The vehicle track is still visible running east-west across the Site. The surrounding area comprises small farming properties, open land and wooded areas, however, several more residential allotments are visible to the south and west of the Site.
2002	Except for patches in the northern and eastern portions, the Site is covered with trees and shrubs. The vehicle track is barely visible due to tree canopies. Similar to 1994, the surrounding area comprises small farming properties, open land, wooded areas and residential allotments.
2010	Except for patches in the northern and eastern portions, the Site is covered with trees and shrubs. The vehicle track is once again visible. The surrounding area still comprises small farming properties, open land and wooded areas. However, there is an increase in the number of residential allotments to the south and east of the Site.
2015	Except for patches in the northern and eastern portions, the Site is covered with trees and shrubs. The vehicle track is barely visible due to tree canopies. Similar to 2010, the surrounding area comprises small farming properties, open land, residential allotments. Two large residential properties are now visible adjacent to the Site's southern boundary.

3.4 Historical Research of the Area

A review of Council's website and Kurrajong.org.au indicated that prior to the European settlement circa 1790, up to 3000 Dharug people lived in the Hawkesbury Valley, drawn to the banks of the Hawkesbury River (which they called the Deerubbin). The name Kurrajong came from the Aboriginal word for beautiful tree and was used as a general name for the area from the Hawkesbury River to the mountains.

The oldest settlement in Kurrajong was along Comleroy Road, which from about 1819 had been the main road north from Sydney to the Hunter Valley and was primarily used to drove cattle. By 1841, the convict built road through Kurrajong, Bells Line of Road, was opened. Several inns, catering for locals and travellers, were situated along the Bells Line of Road, one of which, the Goldfinder's Rest, established in 1851, later (in 1870) became a Post Office and Store. The original building still exists beside Little Wheeney Creek and is a private residence. The present Bells Line of Road, with easier grades, was opened in 1901.

In the late 19th century, as more settlers moved into the area, the area was found to be suitable for growing of fruit trees and became renowned for its orchards. During the 1920s and 1930s, may guest houses were established in the district, especially along Comleroy Road; the beautiful scenery of rolling hills and orchards with the mountain backdrop attracting many city people for a stay in the country. However, the 1950s and 60s saw a decline in local tourism and Kurrajong's orchards also declined with many properties being subdivided into smaller acreages and horses and cattle grazed on the paddocks once covered by fruit trees.

More recently, the scenery and rural tranquility has made Kurrajong a popular location for both tourism and people wanting an escape from the bustle of life in the city with many purchasing small acreages as hobby farms or rural retreats.

4.0 SITE VISIT

On 27 August 2015, CMJA conducted a limited surface walkover inspection of the Site and surrounding area. Photographs taken during the Site walkover are included as Appendix F.

The following observations were made:

- The Site is a partially-fenced vacant block of land located in a semi-rural area.
- A dirt vehicle track runs through the Site from the eastern boundary (entrance on Kurrajong Road) to the rear of a residential property on the western boundary (located at 136 Old Bells Line of Road) (see Photographs 1 and 2).
- There were no obvious signs of **off-site** activities which could impact the Site.
- The Site was generally flat, i.e. with little undulation, with slight slopes to the north-west and to the east.
- There was no evidence of rock outcropping within the Site.
- Most of the Site is covered in medium to dense vegetation consisting of native and foreign species of trees and shrubs, and groundcover consisting of vines, grasses, weeds, leaf / bark litter, fallen branches, etc., making some areas of the Site inaccessible during the walkover. Photographs 3 to 7 show examples of vegetation observed during the walkover.
- Areas of cleared (mowed) land were noted in the northern and south-eastern portions of the Site and surrounding the adjoining residential properties (see Photographs 8, 9 and 10).
- There were no obvious signs of vegetation die-back on the Site.
- A cleared area adjacent to 79 Kurrajong Road contained a pile of woodchips, tree logs and evidence of a bonfire (see Photograph 10). It appears that this area has also been used to park cars.
- A small (likely man-made) gully filled with tree cuttings, was observed at the rear of 83 Kurrajong Road (see Photograph 11).
- A Satin Bowerbird (*Ptilonorhynchus violaceus*) nest (conservation status: not listed) was observed in the eastern portion of the Site, adjacent to 65 Kurrajong Road, as indicated on Figure 2 (see Photograph 12).
- No surface water was observed on the Site (seepage or drainage), even though heavy rainfall had recently occurred in the area.
- General rubbish was scattered (sparsely) across the property and included glass and plastic bottles, paint cans, tarpaulin, metal pipes, lumps of concrete, wire, and a for-sale sign. Several piles of cuttings (branches) were also observed on areas of the Site that surrounded the adjoining properties.
- Although there were no obvious signs of extensive illegal dumping or contamination on the Site, several areas of concern (as indicated on Figure 2) were observed during the walkover:
    - an area of dumped material consisting of metal and plastic piping, tyres, bricks and tin cans (Area A) (see Photographs 13 and 14);
    - an area of dumped rubble consisting of bricks, tiles and potential asbestos-containing material (ACM) (Area B) (see Photograph 15). Two pieces of potential

ACM were collected from this area and analysed for asbestos content (see Section 4.1 for details); and

- a small pile of dumped soil containing bricks, pavers and concrete (Area C) (see Photograph 16).

- There was no visible surface staining within the Site.
- There was some evidence of cutting activity along the Kurrajong Road boundary (see Photograph 7) and where the vehicle track that runs through the centre of the Site met the rear of the adjoining residential property on the western boundary (see Photograph 2).
- Slight filling (gravel) was observed in the area where the vehicle track met the rear of the adjoining residential property on the western boundary (see Photograph 2); and fill (mulch) was observed on the northern boundary of the Site adjacent to 144 Old Bells Line of Road (see Photograph 17).
- No areas of pavement or hardstand were observed on the Site.
- As noted in Section 2.3, the following structures appeared to encroach onto the Site:
  - part of the chicken coop and a compost bin at the rear of 83 Kurrajong Road;
  - the fence line at the rear of 81 Kurrajong Road; and
  - a lean-to and clothes line at the rear of 79 Kurrajong Road.

  As shown in Photographs 10 and 18.

4.1 Analysis of Potential Asbestos-Containing Material

During the site walkover, CMJA observed an area of dumped material consisting of bricks, tiles and pieces of potential ACM in the south-western portion of the Site (as illustrated on Figure 2). Two pieces of the potential ACM were collected by CMJA, placed in zip-lock bags and submitted to Australian Laboratory Services (ALS) for asbestos identification.

The results of the laboratory analysis indicated that one of the pieces was bonded asbestos cement sheeting. Copies of the chain of custody, sample receipt notification, certificate of analysis and quality assurance / quality control documentation are provided as Appendix G of this report.

Section 5.2 of this report sets out CMJA's recommendations regarding the disposal of material from the area in which the ACM was observed.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the findings of this Phase 1 ESA, CMJA concludes that:

- Review of historical aerial photography indicates that the Site was previously, and is currently, undeveloped vacant land and, prior to its purchase in 2015, was Crown Land.
- A review of NSW LPI mapping (http://maps.six.nsw.gov.au/) indicates that a fence line, a lean-to, a chicken coop, a compost bin and a clothes line relating to 79, 81 and 83 Kurrajong Road encroach onto the Site (see Photographs 10 and 18).
- Most of the Site is covered in medium to dense vegetation, although areas of cleared (mowed) land were observed in the northern and eastern portions of the Site and surrounding the adjoining residential properties.
- There were no obvious signs of vegetation die-back at the Site.
- The Site was free of statutory notices issued by the NSW EPA under the *Contaminated Land Management Act* 1997 and the *Protection of the Environment Operations Act* 1997.
- There was no evidence to suggest that any underground storage tank, aboveground storage tank, or similar has been present on the Site.
- There was no evidence that extensive filling activities have taken place at the Site.
- There was some evidence of minor cutting activity along the Kurrajong Road boundary and at the rear of 136 Old Bells Line of Road.
- The following issues were noted during the site visit:
  - an area of dumped material consisting of metal and plastic piping, tyres, bricks and tin cans (Area A);
  - an area of dumped rubble consisting of bricks, tiles and ACM (Area B);
  - a small pile of dumped soil containing bricks, pavers and concrete (Area C); and
  - general rubbish throughout the Site at various locations.

5.1.1 Qualitative Risk Assessment

A qualitative risk assessment is subjective and based on professional judgement, taking into account all the information about the site that has been assembled in this report.

Risk has two components, consequence, and probability or likelihood of that consequence occurring. Consequences relevant to this assessment are defined in Table 5, and likelihood is defined in Table 6.

TABLE 5
Classification of Consequence

Classification	Definition	Examples
Severe	Long-term damage to human health (including unacceptable cancer risk) or acute hazard in the absence of remediation or management. Land declared to be significantly contaminated pursuant to Sections 11 and 12 of the *Contaminated Land Management Act* 1997. Major delays to development or construction. Major remediation costs (> $1M or >site value).	Severe groundwater contamination extending off-site. High or very high ground gas risk. Extensive and/or deep soil contamination requiring remediation.
Medium	Long-term damage to human health (including unacceptable cancer risk) or acute hazard in the absence of remediation or management. Land declared to be significantly contaminated pursuant to Sections 11 and 12 of the *Contaminated Land Management Act* 1997. Major delays to development or construction. Significant remediation costs (>$100,000 or 10-100% of site value).	Significant groundwater contamination restricted to site, or site impacted by groundwater contamination originating off-site. Ground gas risk requiring management measures. Extensive and/or deep soil contamination requiring remediation or long-term management.
Mild	Minor delays to construction (<1 month). Remediation costs up to 10% of site value.	Chemical or ACM contamination of soils extending to depth and requiring remediation or long-term management.
Minor	Short delays to development or construction (< c 1 week). Minor unplanned remediation costs (< c $10,000).	Minor chemical or asbestos-containing material (ACM) contamination of shallow soil restricted to a small proportion of site.

TABLE 6
Classification of Likelihood

Classification	Definition
High likelihood	A credible linkage exists between the site and a current or historical source of contamination, and a hazardous event is very likely to exist or occur in the short term, and almost inevitable over the full timeframe of concern (typically the planning and construction process and the effective life of a building or development). The likelihood of the stated consequence is high.
Likely	A credible linkage exists and all necessary elements required for a hazardous event to exist or occur are present. Occurrence is not inevitable, but it is possible in the short-term and probable over the full timeframe of concern. The stated consequence is likely.
Low likelihood	A credible linkage exists and circumstances under which a hazardous event could exist or occur are possible. However, it is by no means certain that the event exists or will occur within the timeframe of concern, and it is less likely in the short term. Thus there is a low likelihood that that the stated consequence exists or will occur.
Unlikely	It is improbable that a hazardous event would occur within the timeframe of concern, and therefore unlikely that the stated consequence exists or will occur.

Risk is calculated as the product of these two qualities, using the matrix.

		Consequence			
		Severe	Medium	Mild	Minor
Probability	Highly likely	Very high risk	High risk	Moderate risk	Moderate/low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

Based on the scope of work undertaken, CMJA considers that the proposed development of the Site as a 49-lot residential subdivision (R2 Low Density Residential) is subject to the following levels of risk arising from potential contamination.

1) The risk of the Site being impacted by chemical contamination originating from adjacent sites is considered to be very low.

2) The risk of the Site being impacted by hazardous ground gases is considered to be very low.

3a) The risk of the Site being impacted by soil contamination arising from previous uses is very low.

3b) Except for the dumping of asbestos waste materials, the risk of the Site being impacted by asbestos (e.g. resulting from burial of demolition waste from on-site structures) is considered to be very low.

3c) There is a very low risk of chemical contamination of site soils and groundwater arising from previous land uses.

5.2 Recommendations

CMJA recommends that **prior to clearing the site** for the proposed development:

- The dumped material consisting of metal and plastic piping, tyres, bricks and tin cans (Area A), together with the metal pipes, wire, tin cans, etc. indicated on Figure 2 be removed from the Site and disposed of appropriately (i.e. to premises that may lawfully receive it).

- The area of dumped material consisting of bricks, tiles and ACM (Area B) together with the small pile of dumped soil containing bricks, pavers and concrete (Area C) be removed from the Site and disposed of appropriately (i.e. to premises that may lawfully receive it) by a suitably-qualified asbestos removal contractor. Following the removal of the material, Areas B and C should be inspected for ACM and a clearance certificate provided.

  Note: Removal of more than 10 m^2 of ACM requires a Class B asbestos removal licence. Pieces of ACM smaller than 7 mm x 7 mm in size should be treated as friable asbestos. Removal of friable asbestos requires a Class A asbestos removal licence, with an

exemption for removal of minor asbestos fines or asbestos-containing debris contamination.

- A walkover of the Site be carried out and any general rubbish (tarpaulin, bottles, etc.) be removed and disposed of appropriately.

As some areas of the Site were inaccessible during the walkover, CMJA recommends that if any unexpected finds are observed during the clearing of the Site (e.g. dumped soil, building materials, general waste, etc.) work should cease and the area be inspected for potential ACM. If potential ACM is observed it should be removed from the Site and disposed of appropriately prior to clearing recommencing to prevent spreading the material to other sections of the Site.

Following a survey of the Site by a registered surveyor, if the fence line, lean-to, chicken coop, compost bin and clothes line relating to 79, 81 and 83 Kurrajong Road are found to be encroaching onto the Site and require removal, CMJA recommends that materials associated with the demolition of the structures (if not retrieved by the occupiers of the adjacent properties) be disposed off-site appropriately.

The findings of this report and any subsequent investigation should be noted on the workplace asbestos register for the Site.

Any materials to be removed from the Site during development work are to be appropriately waste classified, and transported to a waste facility that may lawfully receive them.

Also, CMJA suggests that caution be taken when clearing the area in which the Bowerbird nest is located so as not to harm the bird or any eggs / chicks that may be present.

REFERENCES

ASC NEPM 1999, *National Environment Protection (Assessment of Site Contamination) Measure*, revised 2013, National Environment Protection Council

Websites Referenced

Dial Before You Dig, www.1100.com.au
NSW Land and Property Information, http://www.lpi.nsw.gov.au/
NSW DPI, Office of Water, http://allwaterdata.water.nsw.gov.au/water.stm
Six NSW Spatial Information Exchange, http://maps.six.nsw.gov.au/
Hawkesbury City Council, http://www.hawkesbury.nsw.gov.au
Kurrajong, http://www.kurrajong.org.au/kjhist.html

CMJA
C. M. Jewell & Associates Pty Ltd
Water and Environmental Management
ABN 54 056 283 295

Important Information About Your Environmental Site Assessment

These notes will help you to interpret your hydrogeological and Environmental Site Assessment (ESA) reports.

Why are ESAs conducted?

An ESA is conducted to assess the environmental condition of a site. It is usually, but not always, carried out in one of the following circumstances.

- As a pre-purchase assessment, on behalf of either purchaser or vendor, when a property is to be sold.
- As a pre-development assessment, if a property or area of land is to be redeveloped, or if its use is to change (for example, from a factory to a residential subdivision) – to meet a requirement for development approval.
- As a pre-development assessment of a 'greenfield' (undeveloped) site - to establish baseline conditions and to assess environmental, geological and hydrological constraints to the proposed development.
- As an audit of the environmental effects of an ongoing operation.

Each type of assessment requires its own specific approach. In all cases, however, the aim is to identify and if possible quantify the risks posed by unrecognised contamination. Such risks may be financial (for example, clean-up costs or limitations on site use), or physical (for example, health risks to site users or the public).

What are the limitations of an ESA?

Although the information provided by an ESA can reduce exposure to these risks, no ESA, however diligently carried out, can eliminate risks altogether. Even a rigorous professional assessment may not detect all contamination on a site. The following paragraphs explain why.

ESA 'findings' are professional estimates

The ground surface conceals a complex 3-dimensional subsurface environment. Subsurface materials, whether placed by geological processes or human activities, are always heterogeneous. Large variations in lithology and hydraulic properties can occur over short distances. Surface observation, and data obtained from boreholes and test pits, can never give us a complete picture of the subsurface.

All data from sampling and laboratory testing must be interpreted by a qualified professional – a geologist, engineer or scientist. They then render an opinion - about overall subsurface conditions, the nature and extent of contamination, its likely impact on the proposed development, and appropriate remediation measures.

Interpretation and professional judgement are thus essential to the assessment process.

Accuracy depends on the scope of work

Site assessment identifies actual subsurface conditions only at those specific points where samples are taken and when they are taken. The accuracy of the entire process depends on sampling frequency and sampling methods - yet the extent of sampling and soil analysis must necessarily be limited.

Sampling generally targets those areas where contamination is considered to be most likely, on the basis of visual observation and the site's history. This approach does maximise the probability of identifying contaminants, but it may not identify contamination in unexpected locations or from unexpected sources.

No professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. For example, there may be contaminants in areas not surveyed or sampled; furthermore, they may migrate to areas that showed no signs of contamination at the time of sampling.

Conditions between sample locations can only be inferred – from estimates of geological and hydrogeological conditions, and from the nature and extent of identified contamination. Soil, rock and aquifer conditions are often variable, and so the distribution of contaminants across a site can be difficult to assess. Actual conditions in areas not sampled may differ from predictions.

The accuracy of an assessment is therefore limited by the scope of work undertaken.

Statistical tools can be helpful, but the validity of conclusions still depends entirely on the degree to which the original data reflect site conditions.

Uncertainty is also inevitable when it comes to assessing chemical fate and transport in groundwater and surface water systems, and calculating human health and environmental exposure risks. It is inevitable, too, when estimating remediation performance and time frames.

Your CMJA report includes a statement of the uncertainty associated with this particular project; you should read it carefully.

We can offer solutions

We cannot prevent the unanticipated, but we can minimise its impact. For this reason we recommend that you retain CMJA's services through the remediation and development stages. We can identify differences from predicted conditions, conduct additional tests as required, and recommend solutions for problems encountered on site.

Don't rely on out-of-date information

Subsurface conditions are changed by natural processes and the activity of people. Your ESA report is based on conditions that existed at the time of subsurface exploration. Don't make decisions on the basis of an ESA report whose adequacy may have been affected by time. Speak with CMJA to learn if additional tests are advisable.

If things change, contact us

Every report is based on a unique set of project-specific factors. If any one of these factors changes after the report is produced, its conclusions and recommendations may no longer be appropriate for the site.

Your environmental report should not be used:

- if the nature of the proposed development is changed - for example, if a residential development is proposed instead of a commercial one;
- if the size or configuration of the proposed development is altered;
- if the location or orientation of the proposed structure is modified;
- if there is a change of ownership; or
- for application to an adjacent site.

To help avoid expensive problems, talk to CMJA. We will help you to determine how any factors that have changed since the date of the report may affect its recommendations.

Your ESA report is prepared specifically for you

Every hydrogeological study and ESA report is prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even for another consulting civil engineer. A report should not be used by anyone other than the client, and it should not be used for any purpose other than that originally intended. Any such proposed use must first be discussed with CMJA.

Beware of misinterpretation

Costly problems can occur if plans are based on misinterpretations of an ESA. These problems can be avoided if CMJA is retained to work with appropriate design professionals. We will explain the relevant findings and review the adequacy of plans and specifications.

Logs and laboratory data should not be separated from the report

Final borehole or test pit logs are developed by CMJA's environmental scientists, engineers or geologists, using field logs (assembled by site personnel) and laboratory evaluation of field samples. Our reports usually include only the final logs, which must not under any circumstances be redrawn for inclusion in other documents.

Similarly, our reports often include field and laboratory data, and laboratory reports. These data should not be reproduced separately from the main report, which provides guidance on their interpretation and limitations.

To reduce the likelihood of misinterpretation, only the complete report should be made available for the use of persons or organisations involved in the project, such as contractors. Consult CMJA before distributing reports, and we will assist with any additional interpretation that is required.

Always read responsibility clauses closely

To avoid misunderstandings, our report includes qualifying statements that explain the level of certainty associated with our findings and recommendations, and responsibility clauses that indicate where our responsibilities to clients and other parties begin and end.

These qualifying statements and responsibility clauses are an important part of your report. Please read them carefully. They are not there to transfer our responsibilities to others but to help all parties understand where individual responsibilities lie.

These notes were prepared by C. M. Jewell & Associates Pty Ltd (CMJA) using guidelines prepared by the National Ground Water Association (NGWA) and other sources.

Source: NSW LPI

200 metres

C. M. Jewell & Associates Pty Ltd

Report Ref: J1696.2R
Rev: 0
Rev Date: 1-Sep-15
Author: naa

Figure 1

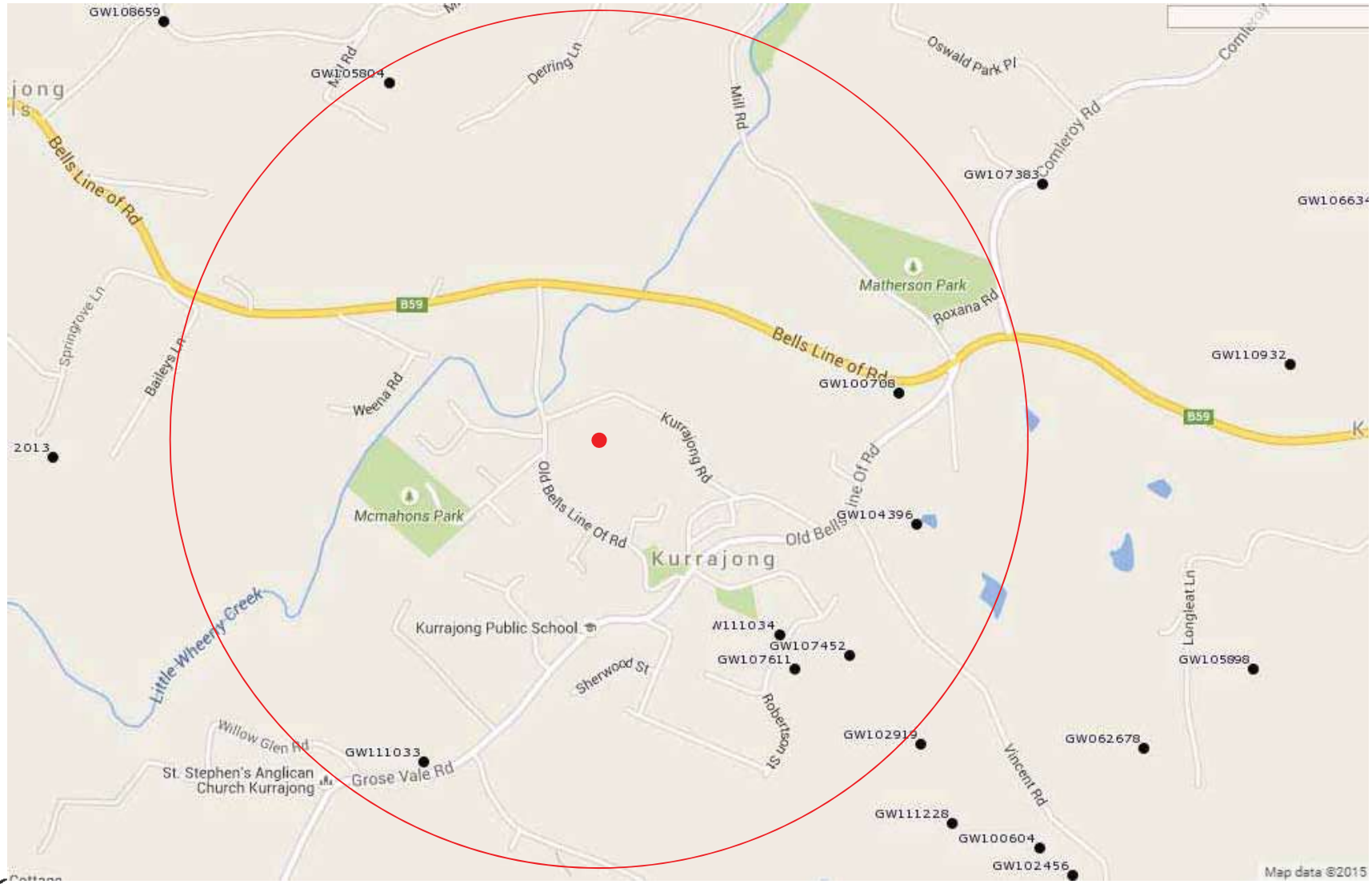
Site Location and Setting

Report Ref: J1696.2R
Rev: 0
Rev Date: 1-Sep-15
Author: naa

Site Boundary
Rubbish observed (tin cans, bricks, etc.)
Trees / Foliage
Areas of Cutting

C. M. Jewell & Associates Pty Ltd

Figure 2
Site Layout



C. M. Jewell & Associates Pty Ltd

Report Ref: J1696.2R
Rev: 0
Rev Date: 1-Sep-15
Author: naa

Registered Boreholes
Centre of Site
1-Kilometre Radius

Figure 3

Local Ecological Receptors and Registered Groundwater Wells

APPENDIX A

Local Registered Groundwater Works Summaries

NSW Office of Water
Work Summary

GW100708

Licence: 10BL157597 **Licence Status:** CONVERTED

Authorised Purpose(s): DOMESTIC,STOCK,IRRIGATION,INDUSTRIAL
Intended Purpose(s): STOCK, INDUSTRIAL, DOMESTIC, IRRIGATION

Work Type: Bore
Work Status: Supply Obtained
Construct.Method: Other
Owner Type: Private

Commenced Date:
Completion Date: 20/08/1996
Final Depth: 134.00 m
Drilled Depth: 134.00 m

Contractor Name: Ultra Drilling
Driller: Bradley Alan Dodd
Assistant Driller:

Property: MINIMBAH 10 OLD BELLS LINE OF RD KURRAJONG 2758
GWMA: -
GW Zone: -
Standing Water Level: 38.000
Salinity:
Yield: 1.500

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	COOK	COOK.25	271//661435
Licensed:	COOK	KURRAJONG	Whole Lot 271//661435

Region: 10 - Sydney South Coast
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6285346.0
Easting: 283898.0
Latitude: 33°32'58.9"S
Longitude: 150°40'20.5"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	6.00	171			Other
1		Hole	Hole	6.00	134.00	145			Other
1	1	Casing	Pvc Class 9	-0.20	6.00	150			Driven into Hole
1	1	Casing	Steel	-0.20	3.00	168	158		Driven into Hole

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
125.00	128.00	3.00	Unknown	38.00	128.00	1.50	134.00	03:00:00	38.00

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	3.00	3.00	CLAY/SHALE	Clay	
3.00	58.00	55.00	SHALE	Shale	
58.00	134.00	76.00	SANDSTONE	Sandstone	

Remarks

25/01/2013: Nat Carling, 25-Jan-2013; Added rock type codes to driller's log & added missing information (based on existing data).

***** End of GW100708 *****

NSW Office of Water
Work Summary

GW104396

Licence: 10BL160809 **Licence Status:** CONVERTED

Authorised Purpose(s): STOCK,DOMESTIC
Intended Purpose(s): STOCK, DOMESTIC

Work Type: Bore
Work Status: Supply Obtained
Construct.Method: Rotary
Owner Type:

Commenced Date:
Completion Date: 30/08/1982
Final Depth: 165.00 m
Drilled Depth:

Contractor Name: Ultra Drilling
Driller: Alan Marcus Dodd
Assistant Driller:

Property: N/A
GWMA: -
GW Zone: -
Standing Water Level:
Salinity:
Yield: 4.000

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	COOK	COOK.025	LT 19 DP 874188
Licensed:	COOK	KURRAJONG	Whole Lot 19//874188

Region: 10 - Sydney South Coast
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6284968.0
Easting: 283958.0
Latitude: 33°33'11.2"S
Longitude: 150°40'22.5"E

GS Map: -
MGA Zone: 0
Coordinate Source: Map Interpretation

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	52.00	203			Down Hole Hammer
1		Hole	Hole	52.00	165.00	140			Down Hole Hammer
1	1	Casing	Steel	0.30	52.00	140	130		Driven into Hole, Welded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
121.00	122.00	1.00	Unknown		124.00	0.80	124.00		100.00
152.00	153.00	1.00	Unknown		154.00	1.70	154.00		100.00
156.00	160.00	4.00	Unknown			4.00	165.00	02:00:00	100.00

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

30/08/1982: Form A Remarks:
No strata details on file.

***** End of GW104396 *****

NSW Office of Water
Work Summary

GW105804

Licence: 10BL160836 **Licence Status:** CONVERTED

Authorised Purpose(s): STOCK,DOMESTIC
Intended Purpose(s): STOCK, DOMESTIC

Work Type: Bore
Work Status: Supply Obtained
Construct.Method: Down Hole Hammer
Owner Type: Private

Commenced Date:
Completion Date: 13/09/2002
Final Depth: 134.00 m
Drilled Depth: 134.00 m

Contractor Name: Ultra Drilling
Driller: Bradley Alan Dodd
Assistant Driller:

Property: N/A
GWMA: -
GW Zone: -
Standing Water Level: 41.000
Salinity: Good
Yield: 2.300

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	COOK	COOK,25	1//803195
Licensed:	COOK	KURRAJONG	Whole Lot 1//803195

Region: 10 - Sydney South Coast
River Basin: 212 - HAWKESBURY RIVER
Area/District:
CMA Map: 9030-4N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6286216.0
Easting: 282388.0
Latitude: 33°32'29.5"S
Longitude: 150°39'22.8"E

GS Map: -
MGA Zone: 0
Coordinate Source: GIS - Geographic Information System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	43.00	165			Down Hole Hammer
1		Hole	Hole	43.00	134.00	140			Down Hole Hammer
1	1	Casing	Pvc Class 9	-0.30	43.00	140			Driven into Hole, Riveted and Glued

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
60.00	61.00	1.00	Unknown			0.40		01:00:00	
91.00	92.00	1.00	Unknown			0.70		01:00:00	
127.00	128.00	1.00	Unknown	41.00		1.20		01:00:00	

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	14.00	14.00	soil, clay	Soil	
14.00	39.00	25.00	shale	Shale	
39.00	103.00	64.00	sandstone,	Sandstone	
103.00	104.00	1.00	shale	Shale	
104.00	134.00	30.00	sandstone	Sandstone	

Remarks

16/11/2009: updated from original form A

***** End of GW105804 *****

NSW Office of Water
Work Summary

GW107452

Licence: 10BL163415 **Licence Status:** CONVERTED

Authorised Purpose(s): STOCK,DOMESTIC
Intended Purpose(s): STOCK, DOMESTIC

Work Type: Bore
Work Status: Supply Obtained
Construct.Method: Down Hole Hammer
Owner Type: Private

Commenced Date:
Completion Date: 02/04/2005
Final Depth: 108.00 m
Drilled Depth: 108.00 m

Contractor Name: Ultra Drilling
Driller: Peter Edward Davidson
Assistant Driller:

Property: DALKEITH HOLDINGS 2 VINCENT RD KURRAJONG 2758
GWMA: -
GW Zone: -
Standing Water Level: 2.000
Salinity: Good
Yield: 9.850

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	COOK	COOK.25	13//1036297
Licensed:	COOK	KURRAJONG	Whole Lot 13//1036297

Region: 10 - Sydney South Coast
River Basin: 212 - HAWKESBURY RIVER
Area/District:
CMA Map: 9030-4N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6284580.0
Easting: 283769.0
Latitude: 33°33'23.6"S
Longitude: 150°40'14.9"E

GS Map: -
MGA Zone: 0
Coordinate Source: GIS - Geographic Information System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	24.00	171			Down Hole Hammer
1		Hole	Hole	24.00	108.00	145			Down Hole Hammer
1		Annulus	Concrete	6.00	24.00	171			
1	1	Casing	Steel	-0.30	24.00	168	158		Driven into Hole, Welded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
60.00	61.00	1.00	Unknown	18.00	62.00	0.35		00:05:00	

72.00	73.00	1.00	Unknown			0.50		00:05:00	
96.00	97.00	1.00	Unknown			1.00		01:00:00	
100.00	102.00	2.00	Unknown	2.00		8.00		02:00:00	

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	6.00	6.00	clay, brown shale	Clay	
6.00	21.00	15.00	shale	Shale	
21.00	39.00	18.00	sandstone/shale	Sandstone	
39.00	53.00	14.00	sandstone,	Sandstone	
53.00	84.00	31.00	sandstone/shale	Sandstone	
84.00	86.00	2.00	shale	Shale	
86.00	93.00	7.00	sandstone/shale	Sandstone	
93.00	108.00	15.00	sandstone, quartzite	Sandstone	

Remarks

01/04/2010: updated from original form A

***** End of GW107452 *****

NSW Office of Water
Work Summary

GW107611

Licence: 10BL165451 **Licence Status:** CONVERTED

Authorised Purpose(s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status: Supply Obtained
Construct.Method: Rotary Air
Owner Type: Private

Commenced Date:
Completion Date: 16/11/2005
Final Depth: 78.00 m
Drilled Depth: 78.00 m

Contractor Name: Ultra Drilling
Driller: Peter Edward Davidson
Assistant Driller:

Property: MISON 42 ROBERTSON ST KURRAJONG 2758 NSW
GWMA: -
GW Zone: -
Standing Water Level: 35.000
Salinity:
Yield: 21.600

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	COOK	COOK.25	46//248295
Licensed:	COOK	KURRAJONG	Whole Lot 46//248295

Region: 10 - Sydney South Coast
River Basin: 212 - HAWKESBURY RIVER
Area/District:
CMA Map: 9030-4N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6284537.0
Easting: 283610.0
Latitude: 33°33'24.9"S
Longitude: 150°40'08.7"E

GS Map: -
MGA Zone: 0
Coordinate Source: GIS - Geographic Information System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	5.00	241			Rotary Air
1		Hole	Hole	5.00	36.00	171			Down Hole Hammer
1		Hole	Hole	36.00	78.00	145			Down Hole Hammer
1		Annulus	Concrete	35.00	42.00	145			
1	1	Casing	Pvc Class 9	-0.30	42.00	140			Driven into Hole, Riveted and Glued
1	1	Casing	Steel	-0.30	2.00	168			Driven into Hole

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth	Duration (hr)	Salinity (mg/L)

						(m)			
28.00	30.00	2.00	Unknown	35.00		1.00		01:00:00	1100.00
42.00	48.00	6.00	Unknown	35.00		1.60		01:00:00	460.00
68.00	70.00	2.00	Unknown	35.00		4.50		01:05:00	380.00

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	soil (fill)	Soil	
1.00	3.00	2.00	clay	Clay	
3.00	30.00	27.00	sandstone, yellow	Sandstone	
30.00	32.00	2.00	sandstone/shale	Sandstone	
32.00	34.00	2.00	sandstone	Sandstone	
34.00	35.00	1.00	shale	Shale	
35.00	56.00	21.00	sandstone/shale	Sandstone	
56.00	57.00	1.00	shale	Shale	
57.00	78.00	21.00	sandstone	Sandstone	

Remarks

16/11/2005: Form A Remarks:
residval pumping yield up to 3.5L/S pump depth 50-55m
08/04/2010: updated from original form A

***** End of GW107611 *****

NSW Office of Water
Work Summary

GW111033

Licence: 10BL604135 **Licence Status:** CONVERTED

Authorised Purpose(s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status: Supply Obtained
Construct.Method: Rotary Air
Owner Type: Private

Commenced Date:
Completion Date: 25/08/2010
Final Depth: 138.00 m
Drilled Depth: 138.00 m

Contractor Name: Ultra Drilling
Driller: Bradley Alan Dodd
Assistant Driller:

Property: PAULL 1033 GROSE VALE ROAD KURRAJONG 2758 NSW
GWMA:
GW Zone:
Standing Water Level: 43.000
Salinity:
Yield: 1.200

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	COOK	COOK.25	1//1153901
Licensed:			

Region: 10 - Sydney South Coast
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6284246.0
Easting: 282533.0
Latitude: 33°33'33.5"S
Longitude: 150°39'26.7"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	24.00	170			Rotary Air
1		Hole	Hole	24.00	138.00	145			Rotary Air
1	1	Casing	Pvc Class 9	-0.50	40.00	145			Driven into Hole, Glued

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
90.00	93.00	3.00	Unknown			0.40			1600.00
126.00	132.00	6.00	Unknown	43.00		1.20		01:00:00	600.00

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	12.00	12.00	CLAY	Clay	
12.00	36.00	24.00	SHALE	Shale	
36.00	45.00	9.00	SANDSTONE/ SHALE	Sandstone	
45.00	115.00	70.00	SANDSTONE	Sandstone	
115.00	122.00	7.00	SHALE	Shale	
122.00	138.00	16.00	SANDSTONE / QUARTZ	Sandstone	

Remarks

***** End of GW111033 *****

NSW Office of Water
Work Summary

GW111034

Licence: 10BL603973 **Licence Status:** CONVERTED

Authorised Purpose(s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status: Supply Obtained
Construct.Method:
Owner Type: Private

Commenced Date:
Completion Date: 27/07/2010
Final Depth: 84.00 m
Drilled Depth: 84.00 m

Contractor Name: Ultra Drilling
Driller: Bradley Alan Dodd
Assistant Driller:

Property: SALLUSTIO 45 ROBERTSTON STREET KURRAJONG 2758 NSW
Standing Water Level: 30.000
GWMA:
GW Zone:
Salinity:
Yield: 2.000

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	COOK	COOK.25	49//248295
Licensed:			

Region: 10 - Sydney South Coast
CMA Map:
River Basin: - Unknown
Area/District:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6284636.0
Easting: 283565.0
Latitude: 33°33'21.6"S
Longitude: 150°40'07.0"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	5.00	200			Rotary Air
1		Hole	Hole	5.00	84.00	150			Rotary Air
1	1	Casing	Steel	-0.50	5.00	168			Driven into Hole

Water Bearing Zones

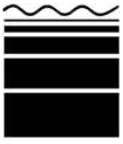
From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
66.00	80.00	14.00	Unknown	30.00		2.00	84.00	01:00:00	650.00

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	5.00	5.00	CLAY	Clay	
5.00	10.00	5.00	SANDSTONE	Sandstone	
10.00	15.00	5.00	SANDSTONE / SHALE	Sandstone	
15.00	84.00	69.00	SANDSTONE	Sandstone	

Remarks

***** End of GW111034 *****



APPENDIX B
S149 Planning Certificate

149 l/h

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

Certificate No. PC0441/16

C M Jewell & Associates Pty Ltd
PO Box 10
WENTWORTH FALLS NSW 2782

HAWKESBURY CITY COUNCIL

PLANNING CERTIFICATE

ISSUED UNDER SECTION 149

ENVIRONMENTAL PLANNING AND ASSESSMENT ACT, 1979, AS AMENDED

Your Ref: **J1696**

LAND DESCRIPTION: **Lot 1 DP 1185012,**
67 Kurrajong Road
KURRAJONG NSW 2758

The following information is only applicable as of the date of this certificate and is provided pursuant to Section 149 of the Environmental Planning and Assessment Act 1979, as prescribed by Schedule 4 of the Environmental Planning and Assessment Regulation 2000.

INFORMATION PURSUANT TO SECTION 149 (2) OF THE ACT

---

1. **Names of relevant planning instruments and Development Control Plans.**

1.1 The land is affected by the following environmental planning instruments:

Hawkesbury Local Environmental Plan 2012

Sydney Regional Environmental Plan No 9 - Extractive Industry (No 2 - 1995)

Identifies regionally significant extractive resources within the Sydney Region to facilitate their utilisation. The plan ensures extraction is carried out in an environmentally acceptable manner and prohibits extraction from certain environmentally sensitive areas. It ensures that decisions on future urban expansion take into account the ability to realise the full potential of important deposits.

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

Sydney Regional Environmental Plan No 20 - Hawkesbury Nepean River (No 2 - 1997)

SREP No 20 (No 2 - 1997) was gazetted on 6 November 1997, and is accompanied by the 'Hawkesbury-Nepean Action Plan 1997' and 'Codes of Practice for Consultation'.

The aim of SREP No 20 (No 2 - 1997) is to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context.

SREP No 20 (No 2 - 1997) requires development consent for the purpose of caravan parks or camping grounds; composting facilities or works; buildings works or land uses within conservation area sub-catchments; remediation of contaminated land; filling; certain activities in relation to items of non-aboriginal heritage; intensive horticulture industries; some intensive animal industries; manufactured home estates; marinas; recreational facilities; land uses in or near the river; land uses in riverine scenic areas; sewerage systems or works.

Development for extractive industries is prohibited in some areas. Consent of Council and the concurrence of the Director-General is required for maintenance dredging and extractive operations carried out downstream of the Wallacia Bridge as a consequence of, and ancillary to, works for flood mitigation, bank stabilisation, the construction of bridges or other instream structures (such as marinas) or the licensed or unlicensed withdrawal of water where extraction is necessary to carry out the works. Some intensive animal industries and potentially hazardous or offensive industries are prohibited if carried out on a floodway. Development in mapped wetlands requires the consent of Council and the concurrence of the Director-General of Urban Affairs and Planning.

State Environmental Planning Policy No 19 - Bushland in Urban Areas

Protects and preserves bushland within certain urban areas, as part of the natural heritage or for recreation, educational and scientific purposes. The policy is designed to protect bushland in public open space zones and reservations, and to ensure that bush preservation is given a high priority when local environmental plans for urban development are prepared.

State Environmental Planning Policy No 21 - Caravan Parks

Ensures that where caravan parks or camping grounds are permitted under an environmental planning instrument, movable dwellings, as defined in the Local Government Act 1993, are also permitted. The specific kinds of movable dwellings allowed under the Local Government Act in caravan parks and camping grounds are subject to the provisions of the Caravan Parks Regulation. The policy ensures that development consent is required for new caravan parks and camping grounds and for additional long-term sites in existing caravan parks. It also enables, with the

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

council's consent, long-term sites in caravan parks to be subdivided by leases of up to 20 years.

State Environmental Planning Policy No 30 - Intensive Agriculture

Requires development consent for cattle feedlots having a capacity of 50 or more cattle or piggeries having a capacity of 200 or more pigs. The policy sets out information and public notification requirements to ensure there are effective planning control over this export-driven rural industry. The policy does not alter if, and where, such development is permitted, or the functions of the consent authority.

State Environmental Planning Policy No 32 - Urban Consolidation (Redevelopment of Urban land)

States the Government's intention to ensure that urban consolidation objectives are met in all urban areas throughout the State. The policy focuses on the redevelopment of urban land that is no longer required for the purpose it is currently zoned or used, and encourages local councils to pursue their own urban consolidation strategies to help implement the aims and objectives of the policy. Councils will continue to be responsible for the majority of rezonings. The policy sets out guidelines for the Minister to follow when considering whether to initiate a regional environmental plan (REP) to make particular sites available for consolidated urban redevelopment. Where a site is rezoned by an REP, the Minister will be the consent authority.

State Environmental Planning Policy No 33 - Hazardous and Offensive Development

Provides definitions for 'hazardous industry', 'hazardous storage establishment', 'offensive industry' and 'offensive storage establishment'. The definitions apply to all planning instruments, existing and future. The definitions enable decisions to approve or refuse a development to be based on the merit of proposal. The consent authority must carefully consider the specifics of the case, the location and the way in which the proposed activity is to be carried out. The policy also requires specified matters to be considered for proposals that are 'potentially hazardous' or 'potentially offensive' as defined in the policy. For example, any application to carry out a potentially hazardous or potentially offensive development is to be advertised for public comment, and applications to carry out potentially hazardous development must be supported by a preliminary hazard analysis (PHA). The policy does not change the role of councils as consent authorities, land zoning, or the designated development provisions of the Environmental Planning and Assessment Act 1979.

State Environmental Planning Policy No 44 - Koala Habitat Protection

Encourages the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range. Local councils cannot approve development in an area affected by the policy without an investigation of core koala habitat. The

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

policy provides the state-wide approach needed to enable appropriate development to continue, while ensuring there is ongoing protection of koalas and their habitat.

State Environmental Planning Policy No 50 - Canal Estate Development

Bans new canal estates from the date of gazettal, to ensure coastal and aquatic environments are not affected by these developments.

State Environmental Planning Policy No 55 - Remediation of Land

Introduces state-wide planning controls for the remediation of contaminated land. The policy states that land must not be developed if it is unsuitable for a proposed use because it is contaminated. If the land is unsuitable, remediation must take place before the land is developed. The policy makes remediation permissible across the State, defines when consent is required, requires all remediation to comply with standards, ensures land is investigated if contamination is suspected, and requires councils to be notified of all remediation proposals.

State Environmental Planning Policy No 62 - Sustainable Aquaculture

Encourages the sustainable expansion of the industry in NSW. The policy implements the regional strategies already developed by creating a simple approach to identify and categorise aquaculture development on the basis of its potential environmental impact. The SEPP also identifies aquaculture development as a designated development only where there are potential environmental risks.

State Environmental Planning Policy No 64 - Advertising and Signage

Aims to ensure that outdoor advertising is compatible with the desired amenity and visual character of an area, provides effective communication in suitable locations and is of high quality design and finish.

State Environmental Planning Policy No 65 - Design Quality of Residential Flat Development

Raises the design quality of residential flat development across the state through the application of a series of design principles. Provides for the establishment of Design Review Panels to provide independent expert advice to councils on the merit of residential flat development.

State Environmental Planning Policy No 70 - Affordable Housing (Revised Schemes)

Extends the life of affordable housing provisions relating to: Sydney Regional Environmental Plan No. 26 - City West, Willoughby Local Environmental Plan 1995, South Sydney Local Environmental Plan 1998. Schemes such as these are helping to provide affordable housing in areas undergoing significant redevelopment.

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004

This SEPP operates in conjunction with Environmental Planning and Assessment Amendment (Building Sustainability Index: BASIX) Regulation 2004 to ensure the effective introduction of BASIX in NSW. The SEPP ensures consistency in the implementation of BASIX throughout the State by overriding competing provisions in other environmental planning instruments and development control plans, and specifying that SEPP 1 does not apply in relation to any development standard arising under BASIX.

State Environmental Planning Policy (Major Development) 2005

Defines certain developments that are major projects under Part 3A of the *Environmental Planning & Assessment Act 1979* and determined by the Minister for Planning. The SEPP also lists State significant sites.

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The Policy aims to provide for the proper management and development of mining, petroleum and extractive material resources for the social and economic welfare of the State. The Policy establishes appropriate planning controls to encourage ecologically sustainable development.

State Environmental Planning Policy (Miscellaneous Consent Provisions) 2007

Provides for the erection of temporary structures. The SEPP supports the transfer temporary structures (such as tents, marquees and booths) from the *Local Government Act 1993* to the *Environmental Planning and Assessment Act 1979*.

State Environmental Planning Policy (Repeal of Concurrence and Referral Provisions) 2004

Amends various environmental planning instruments so as to omit provisions requiring consent authorities to obtain certain concurrences or refer matter to various persons or bodies.

State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004

Encourage the development of high quality accommodation for our ageing population and for people who have disabilities - housing that is in keeping with the local neighbourhood.

State Environmental Planning Policy (State and Regional Development) 2011

The aims of this Policy are to identify development that is State significant development, to identify development that is State significant infrastructure and

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

critical State significant infrastructure, to confer functions on joint regional planning panels to determine development applications.

State Environmental Planning Policy (Repeal of Concurrence and Referral Provisions) 2008

Removes duplicative or unnecessary requirements in environmental planning instruments which require concurrence from or referral to government agencies.

State Environmental Planning Policy (Exempt and Complying Development Codes) 2008

Aims to provide streamlined assessment processes for development that complies with specified development standards.

State Environmental Planning Policy (Affordable Rental Housing) 2009

Aims to provide a consistent planning regime for the retention and provision of affordable rental housing.

State Environmental Planning Policy (Infrastructure) 2007

Provides a consistent planning regime for infrastructure and the provision of services across NSW, along with providing for consultation with relevant public authorities during the assessment process. The SEPP supports greater flexibility in the location of infrastructure and service facilities along with improved regulatory certainty and efficiency.

1.2 The land is affected by the following proposed environmental planning instruments that is or has been the subject of community consultation or on public exhibition under the Act (excludes instruments where the Director-General has notified the council that the making of the proposed instrument has been deferred indefinitely or has not been approved):

Draft State Environmental Planning Policy - Integrating Land Use and Transport

Draft State Environmental Planning Policy (Application of Development Standards) 2004

Draft State Environmental Planning Policy (Competition) 2010

Draft State Environmental Planning Policy (Infrastructure) Amendment (Shooting Ranges) 2013

1.3 The land is affected by the following development control plans.

Hawkesbury Development Control Plan 2002

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

1.4 In this clause, proposed environmental planning instrument includes a planning proposal for a LEP or a draft environmental planning instrument.

2. Zoning and land use under relevant LEPs

2.1 The land is zoned: **R2 Low Density Residential under Hawkesbury Local Environmental Plan 2012**

2.2 Under the provisions of Hawkesbury Local Environmental Plan 2012 the purposes for which development may be carried out within the zone without development consent are referred to in the Land Use Table Annexure.

2.3 Under the provisions of Hawkesbury Local Environmental Plan 2012 the purposes for which development may not be carried out within the zone except with development consent are referred to in the Land Use Table Annexure.

2.4 Under the provisions of Hawkesbury Local Environmental Plan 2012 the purposes for which the carrying out of development is prohibited within the zone are referred to in the Land Use Table Annexure.

The following special provisions of Hawkesbury Local Environmental Plan 2012 may apply to the subject land.

Clause 2.5 Additional permitted uses for particular land
Clause 2.6 Subdivision – consent requirements
Clause 2.7 Demolition requires development consent
Clause 2.8 Temporary use of land
Part 3 Exempt and complying development
Clause 4.2 Rural subdivision
Clause 4.2A Residential development and subdivision prohibited on certain land
Clause 5.1 Relevant acquisition authority
Clause 5.1A Development on land intended to be acquired for public purposes
Clause 5.3 Development near zone boundaries
Clause 5.7 Development below mean high water mark
Clause 5.8 Conversion of fire alarms
Clause 5.9 Preservation of trees or vegetation
Clause 5.9AA Trees or vegetation not prescribed by development control plan
Clause 5.10 Heritage conservation
Clause 5.11 Bush fire hazard reduction
Clause 5.12 Infrastructure development and use of existing buildings of the Crown
Clause 6.1 Acid sulfate soils
Clause 6.2 Earthworks

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

Clause 6.11 Residential accommodation at Johnston and New Streets, Windsor

These special provisions may alter the development shown in the Land Use Table which may be carried out with or without development consent and prohibited land uses. Please refer to the above mentioned provisions of Hawkesbury Local Environmental Plan 2012 to determine applicability.

2.5	Has Hawkesbury City Council adopted a development standard relating to a minimum dimension of land to permit the erection of a dwelling house on the land?	**No**
2.6	Does the subject property include or comprise critical habitat?	**No**
2.7	Is the subject property in a local conservation area, however described?	**No**
2.8	Is an item of environmental heritage situated on the subject property?	**No**

The land may also be subject to a proposed environmental planning instrument (see 1.2) which may change the information given in this section of the certificate.

3. Complying Development under each of the codes for complying development because of the provisions of clauses 1.17A (1) (c) to (e), (2), (3) and (4), 1.18 (1) (c3), and 1.19 of State Environmental Planning Policy (Exempt and Complying Development Codes) 2008

3.1 **General Housing Code**

Can complying development under the General Housing Code be carried out on the subject land?

Yes

3.2 **Housing Alterations Code**

Can complying development under the Housing Alterations Code be carried out on the subject land?

Yes

3.3 **Commercial and Industrial Alterations Code**

Can complying development under the Commercial and Industrial Alterations Code be carried out on the subject land?

Yes

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

3.4 **Subdivisions Code**

Can complying development under the Subdivisions Code be carried out on the subject land?

Yes

3.5 **Rural Housing Code**

Can complying development under the Rural Housing Code be carried out on the subject land?

Yes

3.6 **General Development Code**

Can complying development under the General Development Code be carried out on the subject land?

Yes

3.7 **Demolition Code**

Can complying development under the Demolition Code be carried out on the subject land?

Yes

3.8 **Commercial and Industrial (New Buildings and Additions) Code**

Can complying development under the Commercial and Industrial (New Buildings and Additions) Code be carried out on the subject land?

Yes

4. Coastal Protection

Has Council been notified by the Department of Services, Technology and Administration that the land is affected by the operation of section 38 or 39 of the *Coastal Protection Act 1979*? **No**

4A Certain information relating to beaches and coasts

(1) Has an order been made under Part 4D of the *Coastal Protection Act 1979* in relation to temporary coastal protection works (within the meaning of that Act) on the land (or on public land adjacent to that land)? **No**

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

2(a)	Has Council been notified under section 55X of the *Coastal Protection Act 1979* that temporary coastal protection works (within the meaning of that Act) have been placed on the land (or on public land adjacent to that land)?	**No**
2(b)	Is Council satisfied that the works have been removed and the land restored in accordance with that Act?	**Not Applicable**

4B Annual charges under Local Government Act 1993 for coastal protection services that relate to existing coastal protection works

Has the owner (or any previous owner) of the land consented in writing to the land being subject to annual charges under section 496B of the *Local Government Act 1993* for coastal protection services that relate to existing coastal protection works (within the meaning of section 553B of that Act)?	**No**

Note. "Existing coastal protection works" are works to reduce the impact of coastal hazards on land (such as seawalls, revetments, groynes and beach nourishment) that existed before the commencement of section 553B of the *Local Government Act 1993*.

5. Mine Subsidence

Is the subject land within a mine subsidence district within the meaning of Section 15 of the *Mine Subsidence Compensation Act 1961*?	**No**

6. Road widening and road realignment

Is the subject land affected by road widening or road re-alignment under Division 2 of Part 3 of the *Roads Act 1993* or any environmental planning instruments, or any resolution of Hawkesbury City Council?	**No**

7. Council and other public authority policies on hazard risk restrictions

Has Hawkesbury City Council or any other public authority adopted a policy that restricts the development of the land because of the likelihood of :

7.1	Landslip?	**No**
7.2	Bushfire Risk?	**No**
7.3	Tidal inundation?	**No**
7.4	Subsidence?	**No**

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

7.5 Acid Sulfate Soils? **Yes**

7.6 Any other risk? **No**

7A Flood Related Development Controls Information

(1) Whether or not development on that land or part of the land for the purposes of dwelling houses, dual occupancies, multi dwelling housing or residential flat buildings (not including development for the purposes of group homes or seniors housing) is subject to flood related development controls.

The land is not subject to riverine flood related development controls.

(2) Whether or not development on that land or part of the land for any other purpose is subject to flood related development controls.

The land is not subject to riverine flood related development controls.

(3) Words and expressions in this clause have the same meanings as in the standard instrument set out in the *Standard Instrument (Local Environmental Plans) Order 2006.*

The above responses are provided in relation to the flood related development controls of Hawkesbury Local Environmental Plan 2012. Some State or Regional planning instruments may contain flood related development controls which affect the land. These include, but are not necessarily restricted to, State Environmental Planning Policy (Exempt and Complying Development Code) 2008, State Environmental Planning Policy No 30 – Intensive Agriculture, State Environmental Planning Policy (Infrastructure) 2007, State Environmental Planning Policy No 62 – Sustainable Aquaculture, SEPP (Sydney Regional Growth Centre) 2006, Sydney Regional Environmental No 9 – Extractive Industry (No 2 – 1995), and Sydney Regional Environmental Plan No 20 – Hawkesbury – Nepean River (No 2 – 1997).

8. Land Reserved for Acquisition

Is the land affected by any environmental planning instrument, or proposed environmental planning instrument referred to in clause 1, which makes provision for the acquisition of the land by a public authority, as referred to in Section 27 of the Act? **No**

9. Contributions Plans

The "Hawkesbury Section 94 Contributions Plan 2015" applies to the subject land.

The Hawkesbury City Council "Section 94A Development Contributions Plan 2006" applies to the subject land.

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

9A. *Biodiversity certified land*

Is the land biodiversity certified land (within the meaning of the Part 7AA of the *Threatened Species Conservation Act 1995*)? **No**

10. *Biobanking Agreements*

Has Council been notified that the land is subject to a biobanking agreement under Part 7A of the *Threatened Species Conservation Act 1995*? **No**

11. *Bush fire prone land*

Is the land bush fire prone? **All of the land is bush fire prone**

12. *Property Vegetation Plan*

Has Council been notified that the land is land to which a property vegetation plan under the *Native Vegetation Act 2003* applies? **No**

13. *Orders under Trees (Disputes Between Neighbours) Act 2006*

Has Council been notified whether an order has been made under the *Trees (Disputes Between Neighbours) Act 2006* to carry out work in relation to a tree on the land? **No**

14. *Directions under Part 3A*

Is the land subject to a direction by the Minister in force under section 75P (2) (c1) of the *Environmental Planning and Assessment Act 1979*? **No**

15. *Site compatibility certificate and conditions for seniors housing*

15.1 Is the land subject to a current site compatibility certificate (seniors housing), of which the council is aware, issued under *State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004*? **No**

15.2 Has Council granted a development consent after 11 October 2007 in respect of the land, setting out any terms of a kind referred to in clause 18 (2) of the *State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004*? **No**

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

16. Site compatibility certificate for infrastructure

	Is the land subject to a valid site compatibility certificate (infrastructure), of which the council is aware?	**No**

17. Site compatibility certificates and conditions for affordable rental

17.1	Is the land subject to a current site compatibility certificate (affordable rental housing), of which the council is aware?	**No**
17.2	Is the land subject to a statement setting out any terms of a kind referred to in clause 17(1) or 37(1) of *State Environmental Planning Policy (Affordable Rental Housing) 2009* that have been imposed as a condition of consent to a development application?	**No**

18. Paper subdivision information

18.1	Is the land subject to a development plan adopted by a relevant authority that applies to the land or that is proposed to be subject to a consent ballot?	**No**
18.2	Is the land subject to a subdivision order?	**No**
18.3	Words and expressions used in this clause have the same meaning as they have in Part 16C of the *Environmental Planning and Assessment Regulation 2000*.	

Additional Matters

Certain prescribed matters under Section 59(2) of the *Contaminated Land Management Act 1997* (CLMA1997).

a)	Is the land significantly contaminated land within the meaning of the CLMA 1997?	**No**
b)	Is the land subject to a management order within the meaning of the CLMA 1997?	**No**
c)	Is the land subject to an approved voluntary management proposal within the meaning of the CLMA 1997?	**No**
d)	Is the land subject to an ongoing maintenance order within the meaning of the CLMA 1997?	**No**
e)	Is the land subject to a site audit statement within the meaning of the CLMA 1997?	**No**

149 I/h

Hawkesbury City Council
366 George Street (PO Box 146) Windsor NSW 2756 Phone: (02) 4560 4444 Facsimile: (02) 4587 7740 DX: 8601 Windsor

INFORMATION PURSUANT TO SECTION 149 (5) OF THE ACT

Applicants are advised that Council does not accept any liability in respect of any advice provided under the heading "Development Consent".

1. Preservation of trees and vegetation

The Hawkesbury Local Environmental Plan 2012 and the Hawkesbury Development Control Plan 2002 contain provisions which relate to the preservation of trees and vegetation throughout the local government area.

2. Development Consent

Has a development consent which applies to the subject land been issued within the past five 5 years? If a development consent has been issued within the past 5 years, reference should be made to Section 95 of the Act to determine whether or not the consent has lapsed.

No

Peter Jackson
General Manager.

Per: ..... Date: 21 August 2015

Hawkesbury City Council

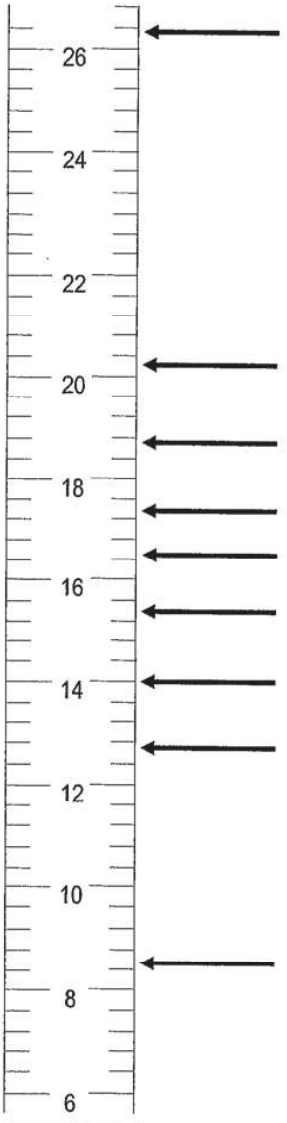
366 George Street (PO Box 146) Windsor NSW 2756 DX 8601 WINDSOR
Phone: (02) 4560 4444 **Facsimile:** (02) 4587 7740 **Email:** council@hawkesbury.nsw.gov.au

Flood Awareness - City of Hawkesbury

North Richmond

Please note that there is a risk of flooding above Council's residential floor height control. The table below indicates levels to Australian Height Datum (above sea level) for estimated flooding probabilities and historical flood peaks.

Flood chance of occurrence per year and historical floods



26.5m	1 in 100,000 chance per year (Probable Maximum Flood)
20.4m	1 in 500 chance per year
18.9m	1 in 200 chance per year
17.5m	1 in 100 chance per year - Residential Floor Standard
16.4m	1 in 50 chance per year
15.3m	1 in 20 chance per year
14.0m	1 in 10 chance per year
12.5m	1 in 5 chance per year

Please Note: Figures are average estimated occurances

8.4m Level of North Richmond Bridge

Flood heights obtained from:

Webb, McKeown & Associates Pty Ltd and Sydney Water 1996 Warragamba Dam Auxiliary Spillway Environmental Impact Study Flood Study / prepared by Webb, McKeown & Associates Pty for Sydney Water

New South Wales Department of Urban Affairs and Planning 1998 Warragamba Dam Auxiliary Spillway: Director-General's Report Section 115C of the Environmental Planning and Assessment Act / Department of Urban Affairs and Planning

April 2014

Hawkesbury City Council

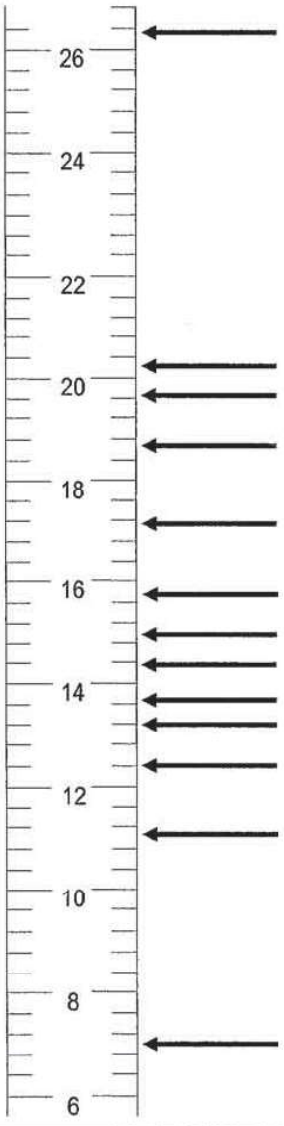
366 George Street (PO Box 146) Windsor NSW 2756 DX 8601 WINDSOR
Phone: (02) 4560 4444 **Facsimile:** (02) 4587 7740 **Email:** council@hawkesbury.nsw.gov.au

Flood Awareness - City of Hawkesbury

Windsor

Please note that there is a risk of flooding above Council's residential floor height control. The table below indicates levels to Australian Height Datum (above sea level) for estimated flooding probabilities and historical flood peaks.

Flood chance of occurrence per year and historical floods



26.4m	1 in 100,000 chance per year (Probable Maximum Flood)
20.2m	1 in 500 chance per year
19.7m	June 1867 flood peak
18.7m	1 in 200 chance per year
17.3m	1 in 100 chance per year - Residential Floor Standard
15.7m	1 in 50 chance per year
14.95m	November 1961 flood peak
14.46m	March 1978 flood peak
13.7m	1 in 20 chance per year
13.5m	August 1990 flood peak
12.3m	1 in 10 chance per year
11.1m	1 in 5 chance per year
7.0m	Level of Windsor Bridge

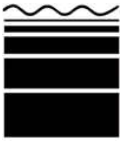
Please Note: Figures are average estimated occurances

Flood heights obtained from:

Webb, McKeown & Associates Pty Ltd and Sydney Water 1996 Warragamba Dam Auxiliary Spillway Environmental Impact Study Flood Study / prepared by Webb, McKeown & Associates Pty for Sydney Water

New South Wales Department of Urban Affairs and Planning 1998 Warragamba Dam Auxiliary Spillway: Director-General's Report Section 115C of the Environmental Planning and Assessment Act / Department of Urban Affairs and Planning

April 2014



APPENDIX C
Underground Services Reports

Job No 9539121

Phone: 1100
www.1100.com.au

Caller Details

Contact:	Ms Natalie Addison	**Caller Id:**	1205271	**Phone:**	0247593251
Company:	CM Jewell & Associates Pty Ltd	**Mobile:**	Not Supplied	**Fax:**	0247593257
Address:	PO Box 10 Wentworth Falls NSW 2782	**Email:**	natalie@cm-jewell.com.au		

Dig Site and Enquiry Details

WARNING: The map below only displays the location of the proposed dig site and does not display any asset owners' pipe or cables. The area highlighted has been used only to identify the participating asset owners, who will send information to you directly.

User Reference: J1696
Working on Behalf of:
Private

Enquiry Date:	**Start Date:**	**End Date:**
14/08/2015	18/08/2015	19/08/2015

Address:
67 Kurrajong Road
Kurrajong NSW 2758

Job Purpose: Design
Onsite Activity: Subdivision
Location of Workplace: Private Property
Location in Road: Not Supplied

- Check that the location of the dig site is correct. If not you must submit a new enquiry.
- Should the scope of works change, or plan validity dates expire, you must submit a new enquiry.
- Do NOT dig without plans. Safe excavation is your responsibility. If you do not understand the plans or how to proceed safely, please contact the relevant asset owners.

Notes/Description of Works:
Not Supplied

Your Responsibilities and Duty of Care

- If plans are not received within 2 working days, contact the asset owners directly & quote their Sequence No.
- ALWAYS perform an onsite inspection for the presence of assets. Should you require an onsite location, contact the asset owners directly. Please remember, plans do not detail the exact location of assets.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- Ensure you adhere to any State legislative requirements regarding Duty of Care and safe digging requirements.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using this service, you agree to Privacy Policy and the terms and disclaimers set out at **www.1100.com.au**
- **For more information on safe excavation practices, visit www.1100.com.au**

Asset Owner Details

The assets owners listed below have been requested to contact you with information about their asset locations within 2 working days. Additional time should be allowed for information issued by post. It is **your responsibility** to identify the presence of any underground assets in and around your proposed dig site. Please be aware, that not all asset owners are registered with the Dial Before You Dig service, so it is **your responsibility** to identify and contact any asset owners not listed here directly.
** Asset owners highlighted by asterisks ** require that you visit their offices to collect plans.
# Asset owners highlighted with a hash require that you call them to discuss your enquiry or to obtain plans.

Seq. No.	Authority Name	Phone	Status
47275334	Endeavour Energy	0298534161	NOTIFIED
47275336	Sydney Water	132092	NOTIFIED
47275335	Telstra NSW, Central	1800653935	NOTIFIED

END OF UTILITIES LIST

Lodge Your Free Enquiry Online – 24 Hours a Day, Seven Days a Week

If further clarification is required, please contact:
Endeavour Energy
Phone: (02) 9853 4161 (8:00am-4:30pm Mon-Fri)
Emergency Phone Number: 131 003

Endeavour Energy

DBYD Underground Search Report
Date: 14/08/2015

DBYD Sequence No: 47275334 **DBYD Job No:** 9539121

ENDEAVOUR ENERGY ASSETS NOT AFFECTED

To:	Ms Natalie Addison		Company:	CM Jewell & Associates Pty Ltd	
Address:	PO Box 10, Wentworth Falls, NSW 2782				
Cust. ID:	1205271	Email:	natalie@cm-jewell.com.au		
Phone:	0247593251	Mobile:	Not Supplied	Fax:	0247593257
Enquiry Location: 67 Kurrajong Road, Kurrajong, NSW 2758					

Our Search has shown that **NO UNDERGROUND ASSETS ARE PRESENT** on our plans within the nominated enquiry location. However all persons planning excavation shall read and understand the warnings below. This search is based on the graphical position of the excavation site as denoted in the DBYD customer confirmation sheet.

WARNING

- **All electrical apparatus shall be regarded as live until proved de-energised.** Contact with live electrical apparatus will cause severe injury or death.
- In accordance with the *Electricity Supply Act 1995*, you are obliged to report any damage to Endeavour Energy Assets immediately by calling **131 003**.
- The customer must obtain a new set of plans from Endeavour Energy if work has not been started or completed within twenty **(20)** working days of the original plan issue date.
- The customer must contact Endeavour Energy if any of the plans provided have blank pages, as some underground asset information may be incomplete.
- Endeavour Energy underground earth grids may exist and their location **may not** be shown on plans. Persons excavating are expected to exercise all due care, especially in the vicinity of padmount substations, pole mounted substations, pole mounted switches, transmission poles and towers.
- Endeavour Energy plans **do not** show any underground customer service mains or information relating to service mains within private property.
- Asbestos or asbestos-containing material may be present on or near Endeavour Energy's underground assets.
- Organo-Chloride Pesticides (OCP) may be present in some sub-transmission trenches.
- All plans must be printed and made available at the worksite where excavation is to be undertaken. Plans must be reviewed and understood by the crew on site prior to commencing excavation.

SUPPLEMENTARY MATERIAL

Material	Purpose	Location
DBYD Cover Letter	Endeavour Energy DBYD response Cover Letter	Attached
DBYD Important Information & Disclaimer	Endeavour Energy disclaimer, responsibilities and information on understanding plans	Attached
DBYD Response Plans	Endeavour Energy DBYD plans	Attached
Work Cover NSW *"Work near underground assets: Guide"*	Guideline for anyone involved in construction work near underground assets	Contact Work Cover NSW for a copy
Work Cover NSW *"Excavation work: Code of practice"*	Practical guidance on managing health and safety risks associated with excavation	URL [Click Here]
Safe Work Australia *"Working in the vicinity of overhead and underground electric lines guidance material"*	Provides information on how to manage risks when working in the vicinity of overhead and underground electric lines at a workplace	URL [Click Here]
Endeavour Energy Safety Brochures & Guides	To raise awareness of dangers of working on or near Endeavour Energy's assets	URL [Click Here]

Endeavour Energy

ENDEAVOUR ENERGY WARNING

This plan shows the approximate location of underground cables relative to fixtures existing when the cables were laid, and has been prepared solely for Endeavour Energy's own use. Endeavour Energy has taken all reasonable steps to ensure that the information is accurate as possible but will accept no liability for inaccuracies in the information shown on such plans from any cause whatsoever arising. Persons excavating are expected to exercise all due care in the vicinity where cables are indicated and will be held responsible for any damage caused to Endeavour Energy's property.

ALL ELECTRICAL APPARATUS SHALL BE CONSIDERED LIVE UNTIL PROVED DE-ENERGISED.
Contact with live electrical apparatus will cause severe injury or death.

Those excavating near Endeavour Energy's cables should be aware that ASBESTOS OR ASBESTOS - CONTAINING MATERIAL MAY BE PRESENT in Endeavour Energy's underground assets and that Organo-Chloride Pesticides(OCP) may be present in some sub-transmission trenches.

N

DO NOT SCALE

DBYD Sequence Number:	47275334
Issued Date:	14/08/2015

If further clarification is required, please contact:
Endeavour Energy
Phone: (02) 9853 4161 (8:00am-4:30pm Mon-Fri)
Emergency Phone Number: 131 003

BEFORE COMMENCING EXCAVATION YOU MUST READ AND UNDERSTAND ALL INFORMATION PROVIDED IN THE DBYD RESPONSE AND LISTED BELOW

BACKGROUND

Endeavour Energy is able to make available plans of its underground assets to persons who intend to undertake excavation works in Endeavour Energy's distribution area. Any plans provided to you are made available subject to the provisions set out below, in the provided plans, and in the Endeavour Energy DBYD response Cover Letter.

We have set out below important information regarding the recommended procedures that should be followed when using this service and also the extent of our responsibility in respect of any plans provided. It is very important that you read and understand all the information and disclaimers provided below before excavating.

Information Provided by Endeavour Energy:

- Any plans provided pursuant to this service are intended to show the approximate location of underground assets relative to road boundaries, property fences and other structures at the time of installation.
- Depth of underground assets may vary significantly from information provided on plans as a result of changes to road, footpath or surface levels subsequent to installation.
- Such plans have been prepared solely for use by Endeavour Energy staff for design, construction and maintenance purposes.
- All enquiry details and results are kept in a register.

DISCLAIMER

Whilst Endeavour Energy has taken all reasonable steps to ensure that the information contained in the plans is as accurate as possible it will accept no liability for inaccuracies in the information shown on such plans.

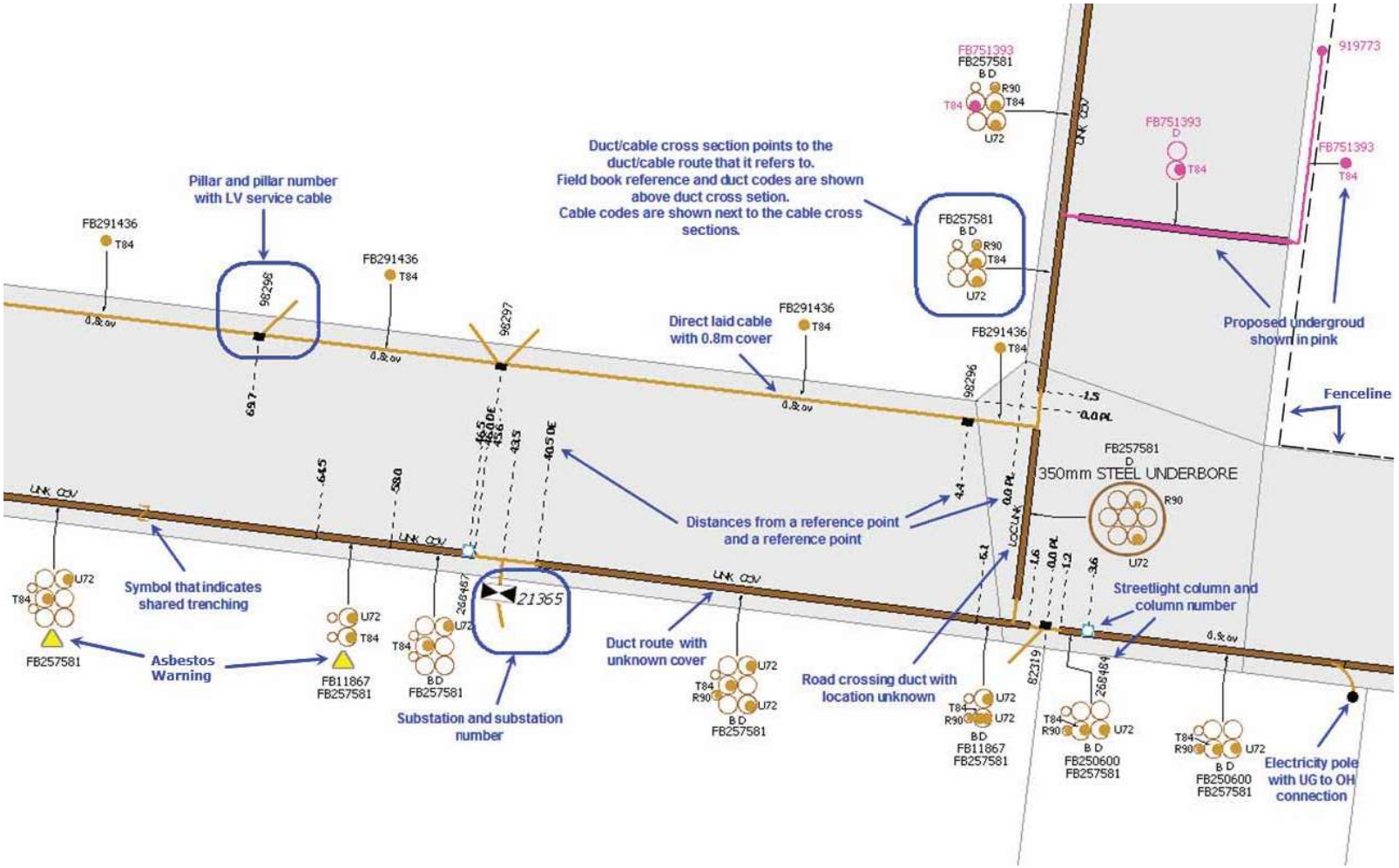
CUSTOMER REQUESTS AND RESPONSIBILITIES

- Endeavour Energy expects to be able to provide relevant plans within 48 hours after a request is made.
- If the enquiry falls within the Transmission Mains area, additional notification requirements shall be complied with as per the instructions in the response Cover Letter.
- Endeavour Energy retains copyright over all plans and details provided in response to a customer's request.
- Persons excavating are expected to exercise all due care in the vicinity where underground assets are indicated and will be held responsible for any damage to any underground assets (including any Endeavour Energy property) or any other loss caused (including consequential losses) as a result of such excavations.
- All underground assets should be visually located by soft digging (pot holing) or hand digging.
- A person who undertakes excavation work is subject to duties and responsibilities under the *Work Health and Safety Act 2011* and *Work Health and Safety Regulation 2011*. Please refer to the Work Cover NSW "*Work near underground assets: Guide*" and "*Excavation work: Code of practice*" which contain practical advice for working near underground utility services.
- Any damage to Endeavour Energy's assets must be immediately reported on **131 003**.
- In all cases of electric shock or suspected electric shock the victim shall immediately be transported to hospital or medical centre for treatment.
- If conduit material cannot be identified, it should be assumed to contain asbestos material.
- Endeavour Energy plans are frequently updated to record changes to underground assets. All plans are valid for **20** working days from the date of issue.

If further clarification is required, please contact:
Endeavour Energy
Phone: (02) 9853 4161 (8:00am-4:30pm Mon-Fri)
Emergency Phone Number: 131 003

Endeavour Energy

EXAMPLE OF HOW TO READ ENDEAVOUR ENERGY PLANS

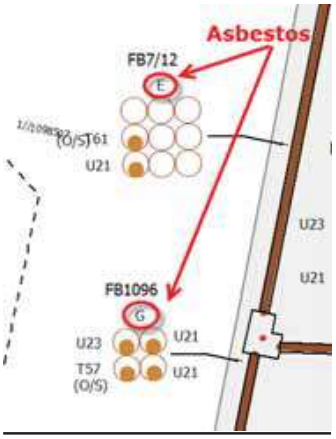


If further clarification is required, please contact:
Endeavour Energy
Phone: (02) 9853 4161 (8:00am-4:30pm Mon-Fri)
Emergency Phone Number: 131 003

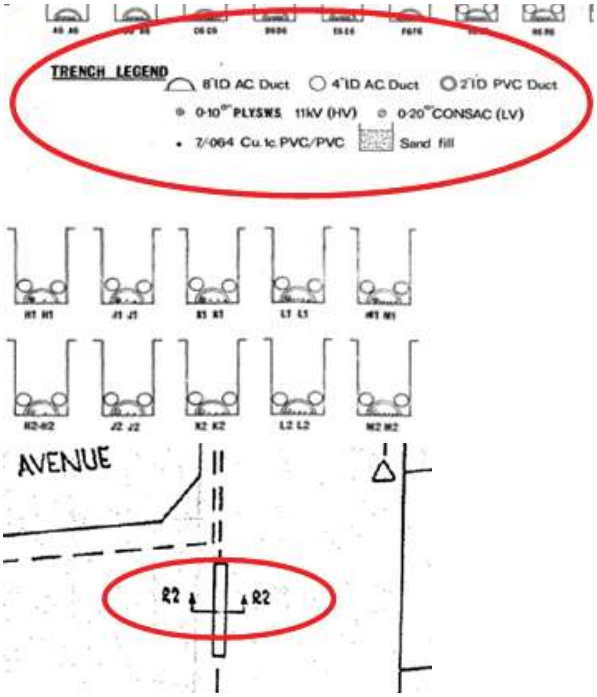
Endeavour Energy

IDENTIFYING ASBESTOS DUCTS

1. Duct codes **E, F** and **G** identify Fibro Conduits

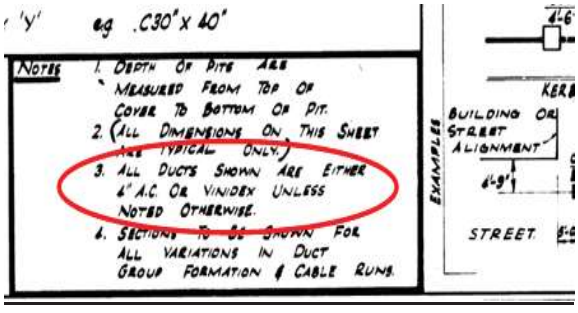


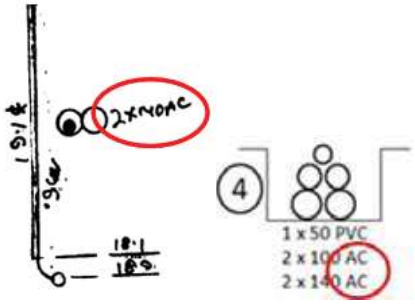
2. The duct codes **G,H,J,K,L,M Q,R,S,T,U,V,W & X** under each configuration are used on old Blue Mountains drawings to identify Asbestos



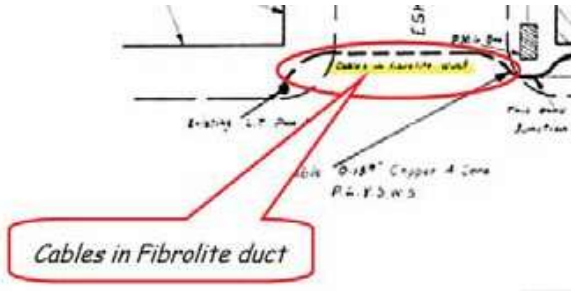
If underground details have not been captured and drawings are used, the method for identifying asbestos ducts and standards are different for the different utilities that amalgamated with Endeavour Energy. Using Reticulation Drawings, there are numerous ways to determine if a duct route has asbestos ducts, refer to following examples:

3. **AC** (Asbestos Cement) acronym

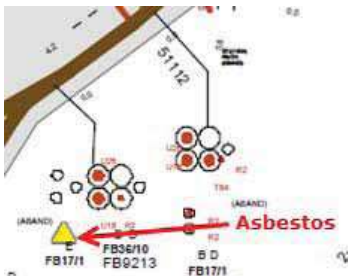




4. **Fibrolite** (asbestos) ducts



5. Yellow **triangle** identifies Fibro Conduits



Document Set ID: 5267666
Version: 1, Version Date: 24/12/2015

If further clarification is required, please contact:
Endeavour Energy
Phone: (02) 9853 4161 (8:00am-4:30pm Mon-Fri)
Emergency Phone Number: 131 003

STANDARD UNDERGROUND SYMBOLS / LABELS

NOTE: *If symbology has not been provided on the plan use symbols as shown below.*

SYMBOLS & ACRONYMS

- or — Street light column
- Padmount substation
- or — Overground pillar (O.G.Box)
- Underground pit
- Duct run
- Cable run
- Typical duct section
- Typical underbore section
- Blocked duct
- Cable section
- Asbestos warning
- STJ, PBJ, TTJ
- **STJ** Straight through joint
- **PBJ** Parallel branch joint
- **TTJ** Transition through joint
- Underground to overhead pole
- **SL** Streetlight conductor
- **SC** Service cable
- **SE** Cable sealed end
- **SF** Service Feeder
- **OS** Out of Service
- **O.A.M.** Over awning main
- **U.A.M.** Under awning main
- **N.I.S.** Not in service
- Fence/dimensioning
- Shared trenching
- Service point of attachment

DUCT CODE LABLES

B = 50 mm PVC

D = 125mm PVC

E = 100mm Fibro Conduit (Asbestos)

F = 140mm Fibro Conduit (Asbestos)

G = 150mm Fibro Conduit (Asbestos)

DEPTH & LOCATION LABELS

0.5- 0.7 COV = 0.5m – 0.7m

0.9 COV = 0.9m Depth

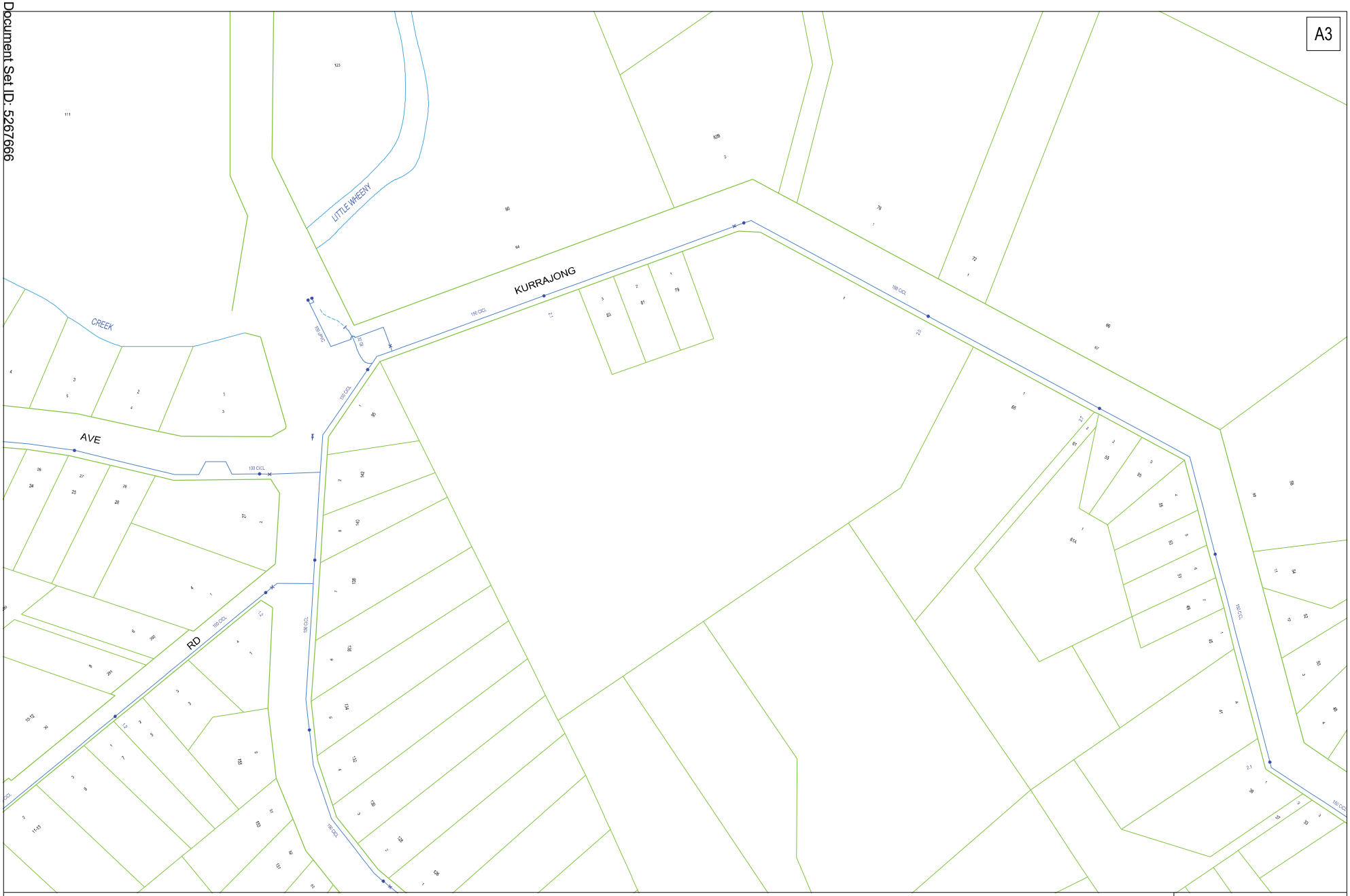
UNK COV = Depth Unknown

LOC UNK = Location Unknown

0.9 PL = Located 0.9m from Property Line

Document Set ID: 5267666
Version: 1, Version Date: 24/12/2015

A3



DBYD Address:
67 Kurrajong Road
Kurrajong NSW 2758

DBYD Job No: 9539121

DBYD Sequence No: 47275336

Scale: 1:1500

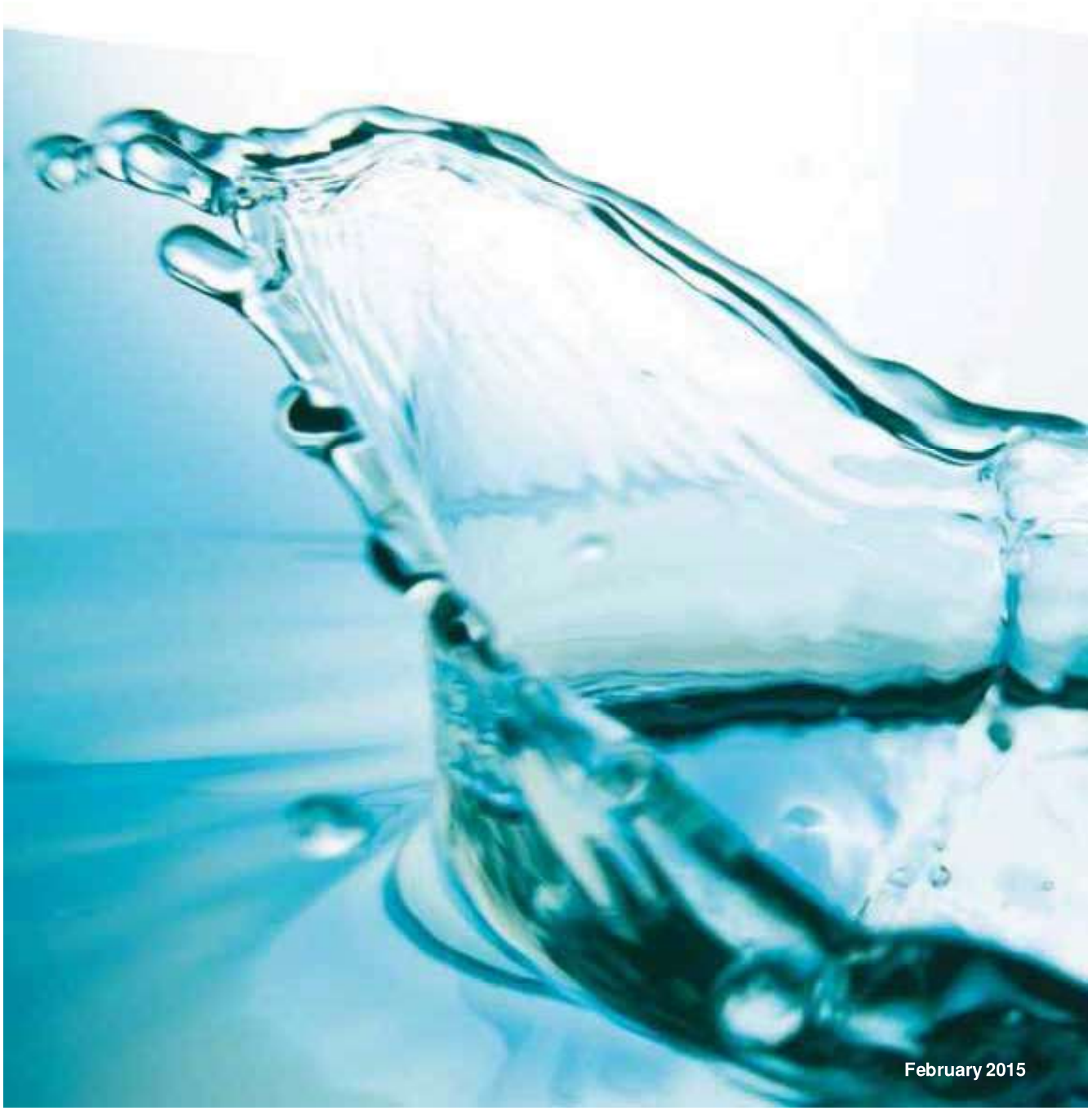
Date of Production: 14/08/2015

Plan 1 of 1

N

0m 9m 18m 27m 36m

Guide to reading Sydney Water DBYD Plans



Document Set ID: 5267666
Version: 1, Version Date: 24/12/2015

Asset Information

Legend

Sewer

Sewer Main (with flow arrow & size type text) — 225 PVC
Disused Main
Rising Main
Maintenance Hole (with upstream depth to invert) — 1.7
Sub-surface chamber
Maintenance Hole with Overflow chamber
Ventshalft EDUCT — VSE
Ventshaft INDUCT — VSI
Property Connection Point (with chainage to downstream MH) — 10.5
Concrete Encased Section — Concrete Encased
Terminal Maintenance Shaft — TMS
Maintenance Shaft — MS
Rodding Point — RP
Lamphole
Vertical — VENT
Pumping Station — SP0882
Sewer Rehabilitation

Pressure Sewer

Pressure Sewer Main
Pump Unit (Alarm, Electrical Cable, Pump Unit) — A
Property Valve Boundary Assembly
Stop Valve
Reducer / Taper
Flushing Point — FP

Vacuum Sewer

Pressure Sewer Main
Division Valve
Vacuum Chamber
Clean Out Point

Stormwater

Stormwater Pipe
Stormwater Channel
Stormwater Gully
Stormwater Maintenance Hole

Property Details

Boundary Line
Easement Line
House Number
Lot Number
Proposed Land
25 6 8 26 27 10 12 28
Sydney Water Heritage Site (please call **132 092** and ask for the **Heritage Unit**)

Water

WaterMain - Potable (with size type text) — 200 PVC
Disconnected Main - Potable
Proposed Main - Potable
Water Main - Recycled
Special Supply Conditions - Potable
Special Supply Conditions - Recycled
Restrained Joints - Potable
Restrained Joints - Recycled
Hydrant
Maintenance Hole
Stop Valve
Stop Vale with By-pass
Stop Valve with Tapers
Closed Stop Valve
Air Valve
Valve
Scour
Reducer / Taper
Vertical Bends
Reservoir
Recycled Water is shown as per Potable above. Colour as indicated

Private Mains

Potable Water Main
Recycled Water Main
Sewer Main
Symbols for Private Mains shown grey

Asset Information

Pipe Types

ABS	Acrylonitrile Butadiene Styrene	**AC**	Asbestos Cement
BRICK	Brick	**CI**	Cast Iron
CICL	Cast Iron Cement Lined	**CONC**	Concrete
COPPER	Copper	**DI**	Ductile Iron
DICL	Ductile Iron Cement (mortar) Lined	**DIPL**	Ductile Iron Polymeric Lined
EW	Earthenware	**FIBG**	Fibreglass
FL BAR	Forged Locking Bar	**GI**	Galvanised Iron
GRP	Glass Reinforced Plastics	**HDPE**	High Density Polyethylene
MS	Mild Steel	**MSCL**	Mild Steel Cement Lined
PE	Polyethylene	**PC**	Polymer Concrete
PP	Polypropylene	**PVC**	Polyvinylchloride
PVC - M	Polyvinylchloride, Modified	**PVC - O**	Polyvinylchloride, Oriented
PVC - U	Polyvinylchloride, Unplasticised	**RC**	Reinforced Concrete
RC-PL	Reinforced Concrete Plastics Lined	**S**	Steel
SCL	Steel Cement (mortar) Lined	**SCL IBL**	Steel Cement Lined Internal Bitumen Lined
SGW	Salt Glazed Ware	**SPL**	Steel Polymeric Lined
SS	Stainless Steel	**STONE**	Stone
VC	Vitrified Clay	**WI**	Wrought Iron
WS	Woodstave		

Further Information

Please consult the Dial Before You Dig enquiries page on the Sydney Water website

For general enquiries please call the Customer Contact Centre on **132 092**

In an emergency, or to notify Sydney Water of damage or threats to its structures, call 13 20 90 (24 hours, 7 days)

IMPORTANT INFORMATION - DIAL BEFORE YOU DIG

Attention: You must read the information below

The material provided or made available to you by Sydney Water (including on the Sydney Water website) in relation to your Dial Before You Dig enquiry (**Information**) is provided on each of the following conditions, which you are taken to have accepted by using the Information:

1 The Information has been generated by an automated system based on the area highlighted in the "Locality Indication Only" window on your Caller Confirmation. It is your responsibility to ensure that the dig site is properly defined when submitting your Dial Before You Dig enquiry and, if the Information does not match the dig site, to resubmit your enquiry for the correct dig site.

2 Neither Sydney Water nor Dial Before You Dig make any representation or give any guarantee, warranty or undertaking (express or implied) as to the currency, accuracy, completeness, effectiveness or reliability of the Information. The Information, including Sydney Water plans and work-as-executed diagrams, amongst other things:

(a) may not show all existing structures, including Sydney Water's pipelines, particularly in relation to newer developments and in relation to structures owned by parties who do not participate in the Dial Before You Dig service;

(b) may be out of date and not show changes to surface levels, road alignments, fences, buildings and the like;

(c) is approximate only and is therefore not suitable for scaling purposes; and

(d) does not show locations of property services (often called house service lines) belonging to or servicing individual customers, which are usually connected to Sydney Water's structures.

3 You are responsible for, amongst other things:

(a) exposing underground structures, including Sydney Water's pipelines, by pot-holing using hand-held tools or vacuum techniques so as to determine the precise location and extent of structures before any mechanical means of excavation are used;

(b) the safe and proper excavation of and for underground works and structures, including having regard to the fact that asbestos cement pipelines, which can pose a risk to health, may form part of Sydney Water's water and sewerage reticulation systems;

(c) protecting underground structures, including Sydney Water's pipelines, from damage and interference;

(d) maintaining minimum clearances between Sydney Water's structures and structures belonging to others;

(e) ensuring that backfilling of excavation work in the vicinity of Sydney Water's structures complies with Sydney Water's standards contained on its website or otherwise communicated to you;

(f) notifying Sydney Water immediately of any damage caused or threat of damage to Sydney Water's structures;

(g) ensuring that plans are approved by Sydney Water (usually signified by stamping) prior to landscaping or building over or in the vicinity of any Sydney Water structure; and

(h) ensuring that the Information is used only for the purposes for which Sydney Water and Dial Before You Dig intended.

4 You acknowledge that you use the Information at your own risk. In consideration for the provision of the Dial Before You Dig service and the Information by Sydney Water and Dial Before You Dig, to the fullest extent permitted by law:

(a) all conditions and guarantees concerning the Information (whether as to quality, outcome, fitness, care, skill or otherwise) expressed or implied by statute, common law, equity, trade, custom or usage or otherwise are expressly excluded and to the extent that those statutory guarantees cannot be excluded, the liability of Sydney Water and Dial Before You Dig to you is limited to either of the following as nominated by Sydney Water in its discretion, which you agree is your only remedy:

(i) the supplying of the Information again; or

(ii) payment of the cost of having the Information supplied again;

(b) in no event will Sydney Water or Dial Before You Dig be liable for, and you release Sydney Water and Dial Before You Dig from, any Loss arising from or in connection with the Information, including the use of or inability to use the Information and delay in the provision of the Information:

(i) whether arising under statute or in contract, tort or any other legal doctrine, including any negligent act, omission or default (including wilful default) by Sydney Water or Dial Before You Dig; and

(ii) regardless of whether Sydney Water or Dial Before You Dig are or ought to have been aware of, or advised of, the possibility of such loss, costs or damages;

(c) you will indemnify Sydney Water and Dial Before You Dig against any Loss arising from or in connection with Sydney Water providing incorrect or incomplete information to you in connection with the Dial Before You Dig service; and

(d) you assume all risks associated with the use of the Dial Before You Dig and Sydney Water websites, including risk to your computer, software or data being damaged by any virus, and you release and discharge Sydney Water and Dial Before You Dig from all Loss which might arise in respect of your use of the websites.

5 "**Sydney Water**" means Sydney Water Corporation and its employees, agents, representatives and contractors. "**Dial Before You Dig**" means Dial Before You Dig Incorporated and its employees, agents, representatives and contractors. References to "**you**" include references to your employees, agents, representatives, contractors and anyone else using the Information. References to "**Loss**" include any loss, cost, expense, claim, liability or damage (including arising in connection with personal injury, death or any damage to or loss of property and economic or consequential loss, lost profits, loss of revenue, loss of management time, opportunity costs or special damages). To the extent of any inconsistency, the conditions in this document will prevail over any other information provided to you by Sydney Water and Dial Before You Dig.

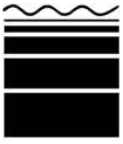
In an emergency, or to notify Sydney Water of damage or threats to its structures, call 13 20 90 (24 hours, 7 days)

Further information and guidance is available in the Building Development and Plumbing section of Sydney Water's website at www.sydneywater.com.au, where you will find the following documents under 'Dial Before You Dig':

- Avoid Damaging Water and Sewer Pipelines
- Water Main Symbols
- Depths of Mains
- Guidelines for Building Over/Adjacent to Sydney Water Assets
- Clearances Between Underground Services

Or call **13 20 92** for Customer Enquires.

Note: The lodging of enquiries via **www.1100.com.au** will enable you to receive colour plans in PDF format 24 hours a day, 7 days a week via email.



APPENDIX D
Land Title Documents

Land and Property Information Division

ABN: 84 104 377 806
GPO BOX 15
Sydney NSW 2001
DX 17 SYDNEY Telephone: 1300 052 637

NSW GOVERNMENT Land & Property Information
A division of the Department of Finance & Services

HISTORY OF TITLE TRANSACTION

Title Reference: 7304/1141427

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - HISTORICAL SEARCH

SEARCH DATE
14/8/2015 11:22AM

FOLIO: 7304/1141427

First Title(s): THIS FOLIO
Prior Title(s): CROWN LAND

Recorded	Number	Type of Instrument	C.T. Issue
8/7/2009	DP1141427	DEPOSITED PLAN	FOLIO CREATED CT NOT ISSUED
8/7/2009	CA146628	CONVERSION ACTION	
15/5/2013	DP1185012	DEPOSITED PLAN	FOLIO CANCELLED

*** END OF SEARCH ***

PRINTED ON 14/8/2015

Land and Property Information Division

ABN: 84 104 377 806
GPO BOX 15
Sydney NSW 2001
DX 17 SYDNEY Telephone: 1300 052 637

NSW GOVERNMENT Land & Property Information
A division of the Department of Finance & Services

TITLE SEARCH

Title Reference: 1/11 012

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 1/1185012

SEARCH DATE	TIME	EDITION NO	DATE
14/8/2015	11:35 AM	1	25/7/2015

LAND

LOT 1 IN DEPOSITED PLAN 1185012
AT KURRAJONG
LOCAL GOVERNMENT AREA HAWKESBURY
PARISH OF KURRAJONG COUNTY OF COOK
TITLE DIAGRAM DP1185012

FIRST SCHEDULE

PRJM PTY LTD (T AJ684006)

SECOND SCHEDULE (2 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS (S.171 CROWN LANDS ACT 1989)
2 AJ684007 MORTGAGE TO WESTPAC BANKING CORPORATION

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

PRINTED ON 14/8/2015

** ANY ENTRIES PRECEDED BY AN ASTERISK DO NOT APPEAR ON THE CURRENT EDITION OF THE CERTIFICATE OF TITLE.*
WARNING: THE INFORMATION APPEARING UNDER NOTATIONS HAS NOT BEEN FORMALLY RECORDED IN THE REGISTER.

APPENDIX E
Historical Aerial Photography

1958

1958

1970

1970

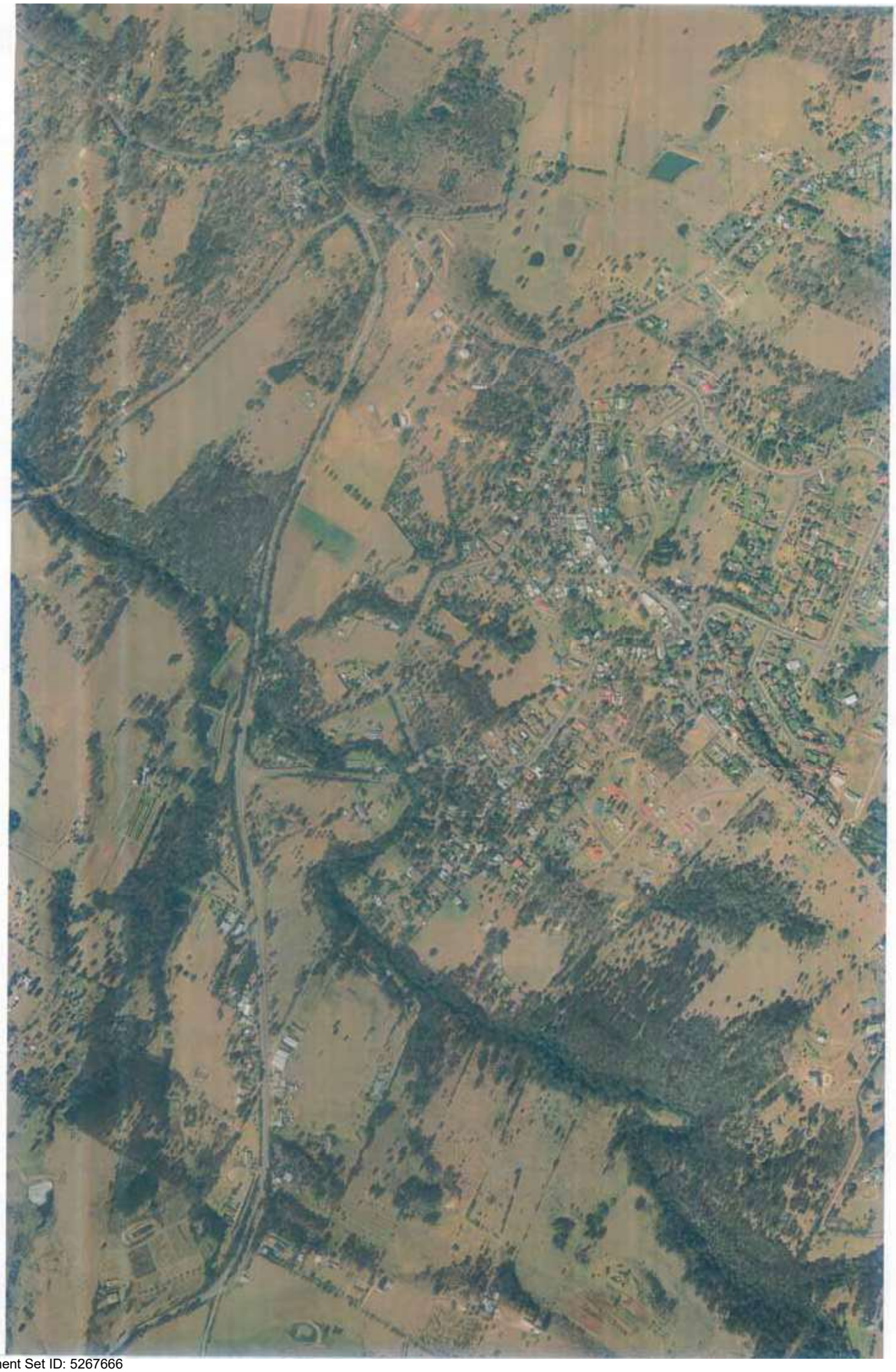
1975

1975

1982

1982

1994



1994

2002

2002

2010

2010

2015

2015

APPENDIX F
Site Photographs

Photograph 1: Entrance of dirt track on Kurrajong Road.

Photograph 2: End of dirt track at the rear of 136 Old Bells Line of Road. Note gravel fill and also area of cutting on the left of the photograph

Photograph 3: Looking from the west to the east along southern fenced boundary. Note the dense vegetation on the Site (inaccessible area).

Photograph 4: An example of vegetation on the Site - Groundcover consisting of vines.

Photograph 5: An example of vegetation on the Site – bushes / trees and groundcover consisting of fallen branches, leaf / bark litter.

Photograph 6: An example of vegetation on the Site – small clear area and groundcover consisting of leaf / bark litter.

Photograph 7: Looking north along Kurrajong Road boundary. Note the dense (inaccessible) vegetation and the area of cutting (natural drainage) along the boundary.

Photograph 8: Looking east towards the south-eastern corner of the Site. Note area of maintained cleared (mowed) land.

Photograph 9: Looking north along the western boundary of the Site. Note the cleared areas at the rear of adjoining residential properties.

Photograph 10: Looking north from the middle of the Site – 79 Kurrajong Road is on the left. Note the cleared area used for car parking, evidence of bonfire and tree logs. Also note the lean-to attached to the shed appears to encroach onto the Site.

Photograph 11: Small (possibly man-made) gully filled with cuttings (branches) at the rear of 83 Kurrajong Road.

Photograph 12: Bowerbird ground nest observed in the eastern portion of the Site.

Photograph 13: Area A (see Figure 2) containing metal, plastic and metal piping, tyres, bricks, tin cans, etc.

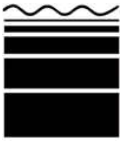
Photograph 14: Area A (see Figure 2) containing metal, plastic and metal piping, tyres, bricks, tin cans, etc.

Photograph 15: Area B (see Figure 2) where pieces of ACM, bricks and tiles were observed.

Photograph 16: Area C (see Figure 2) where an area of dumped soil containing bricks, pavers and concrete was observed.

Photograph 17: On Kurrajong Road looking south along the western boundary – 144 Old Bells Line of Road is on the right. Note pile of mulch fill.

Photograph 18: Looking east along the rear boundaries of 79-83 Kurrajong Road. Noting that the rear of chicken coop, compost bin, clothesline appear to encroach onto the Site.



APPENDIX G
Analytical Documentation

Document Set ID: 5267666
Version: 1, Version Date: 24/12/2015

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: CM Jewell & Associates Pty Ltd
POSTAL ADDRESS: PO Box 10, Wentworth Falls NSW 2782
SEND REPORT TO: Chris Jewell — SEND INVOICE TO: Chris Jewell
DATA NEEDED BY: — REPORT NEEDED BY:
PROJECT ID: J1696 — QUOTE NO.:
P.O. NO.: J1696 — COMMENTS/SPECIAL HANDLING/STORAGE OR DIPOSAL:

LABORATORY BATCH NO.:
SAMPLERS:
PHONE: FAX: E-MAIL:
REPORT FORMAT: HARD:☐ FAX:☐ DISK:☐ BULLETIN BOARD:☐ E-MAIL:☑
QC LEVEL: QCS1:☐ QCS2:☐ QCS3:☐ QCS4:☐

FOR LAB USE ONLY
COOLER SEAL
Yes ..... No .....
Broken ..... Intact ...
COOLER TEMP: deg.C

ANALYSIS REQUIRED

SAMPLE DATA				CONTAINER DATA			Asbestos Presence/Absence	NOTES
SAMPLE ID	MATRIX	DATE	TIME	TYPE & PRESERVATIVE	NO.	Ph		
Asb1 1	Bulk Solid	27/08/2015	10:30				X	
Asb2 2	Bulk Solid	27/08/2015	10:30				X	

Environmental Division
Sydney
Work Order Reference
ES1529700

Telephone : +61-2-8784 8555

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
NAME: Natalie Addison.	DATE: 31/8/15	NAME: Front	DATE: 31/8	CONSIGNMENT NOTE NO.
OF: CMJA	TIME:	OF: ALS	TIME: 1345	
NAME: GD	DATE: 31-5-15	NAME:	DATE:	TRANSPORT CO. NAME.
OF: COURIER PLEASE	TIME: 10-15	OF:	TIME:	

*Container Type and Preservative Codes: P = Neutral Plastic; N = Nitric Acid Preserved; C = Sodium Hydroxide Preserved; J = Solvent Washed Acid Rinced Jar; S = Solvent Washed Acid Rinced Glass Bottle; VC = Hydrochloric Acid Preserved Vial; VS = Sulfuric Acid Preserved Vial; BS = Sulfuric Acid Preserved Glass Bottle; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; O = Other.

AUSTRALIAN LABORATORY SERVICES P/L

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **ES1529700**

Client	: **C M JEWELL & ASSOC PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR CHRIS JEWELL	Contact	:
Address	: P O BOX 10 WENTWORTH FALLS NSW, AUSTRALIA 2782	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: chris@cm-jewell.com.au	E-mail	:
Telephone	: +61 02 4759 3251	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4759 3257	Facsimile	: +61-2-8784 8500
Project	: J1696	Page	: 1 of 2
Order number	: J1696	Quote number	: ES2014CMJEWE0287 (SY/489/14)
C-O-C number	: ----	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
Sampler	:		

Dates

Date Samples Received	: 31-Aug-2015 1:45 PM	Issue Date	: 01-Sep-2015
Client Requested Due Date	: 07-Sep-2015	Scheduled Reporting Date	: **07-Sep-2015**

Delivery Details

Mode of Delivery	: Undefined	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 22.2'C
Receipt Detail	:	No. of samples received / analysed	: 2 / 2

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- **Asbestos analysis will be conducted by ALS Newcastle.**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exist.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

Matrix: **SOLID**

Laboratory sample ID	Client sampling date / time	Client sample ID	SOLID - EA200B Asbestos Identification in Bulk Solids (Excluding
ES1529700-001	27-Aug-2015 10:30	ASB 1	✓
ES1529700-002	27-Aug-2015 10:30	ASB 2	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

CHRIS JEWELL

- *AU Certificate of Analysis - NATA (COA)	Email	chris@cm-jewell.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	chris@cm-jewell.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	chris@cm-jewell.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	chris@cm-jewell.com.au
- A4 - AU Tax Invoice (INV)	Email	chris@cm-jewell.com.au
- Chain of Custody (CoC) (COC)	Email	chris@cm-jewell.com.au
- EDI Format - ENMRG (ENMRG)	Email	chris@cm-jewell.com.au
- EDI Format - ESDAT (ESDAT)	Email	chris@cm-jewell.com.au

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1529700**	Page	: 1 of 2
Client	: **C M JEWELL & ASSOC PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR CHRIS JEWELL	Contact	:
Address	: P O BOX 10 WENTWORTH FALLS NSW, AUSTRALIA 2782	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: chris@cm-jewell.com.au	E-mail	:
Telephone	: +61 02 4759 3251	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4759 3257	Facsimile	: +61-2-8784 8500
Project	: J1696	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: J1696	Date Samples Received	: 31-Aug-2015 13:45
C-O-C number	: ----	Date Analysis Commenced	: 02-Sep-2015
Sampler	: ----	Issue Date	: 02-Sep-2015 16:07
Site	: ----		
		No. of samples received	: 2
Quote number	: ----	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Descriptive Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Gerrad Morgan	Asbestos Identifier	Newcastle - Asbestos

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

- EA200: Asbestos Identification Samples were analysed by Polarised Light Microscopy including dispersion staining.
- EA200: Negative results for vinyl tiles should be confirmed by an independent analytical technique.
- EA200 Legend
- EA200 'Am' Amosite (brown asbestos)
- EA200 'Ch' Chrysotile (white asbestos)
- EA200 'Cr' Crocidolite (blue asbestos)
- EA200: 'UMF' Unknown Mineral Fibres. "-" indicates fibres detected may or may not be asbestos fibres. Confirmation by alternative techniques is recommended.

Analytical Results

Sub-Matrix: SOLID (Matrix: SOLID)				Client sample ID	ASB 1	ASB 2	----	----	----
				Client sampling date / time	27-Aug-2015 10:30	27-Aug-2015 10:30	----	----	----
Compound	CAS Number	LOR	Unit		ES1529700-001	ES1529700-002	---------	---------	---------
					Result	Result	Result	Result	Result
EA200: AS 4964 - 2004 Identification of Asbestos in bulk samples									
Asbestos Detected	1332-21-4	0.1	g/kg		**Yes**	**No**	----	----	----
Asbestos Type	1332-21-4	-	--		**Ch + Am + Cr**	**-**	----	----	----
Sample weight (dry)	----	0.01	g		**113**	**97.8**	----	----	----
APPROVED IDENTIFIER:	----	-	--		**G.MORGAN**	**G.MORGAN**	----	----	----

Analytical Results

Descriptive Results

Sub-Matrix: **SOLID**

Method: Compound	Client sample ID - Client sampling date / time	Analytical Results
EA200: AS 4964 - 2004 Identification of Asbestos in bulk samples		
EA200: Description	ASB 1 - 27-Aug-2015 10:30:00	One piece of bonded asbestos cement sheeting approximately 125 x 95 x 5mm.
EA200: Description	ASB 2 - 27-Aug-2015 10:30:00	One piece of organic fibre board approximately 120 x 85 x 7mm.

Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1529700**	Page	: 1 of 4
Client	: **C M JEWELL & ASSOC PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR CHRIS JEWELL	Contact	:
Address	: P O BOX 10 WENTWORTH FALLS NSW, AUSTRALIA 2782	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: chris@cm-jewell.com.au	E-mail	:
Telephone	: +61 02 4759 3251	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4759 3257	Facsimile	: +61-2-8784 8500
Project	: J1696	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: J1696	Date Samples Received	: 31-Aug-2015
C-O-C number	: ----	Date Analysis Commenced	: 02-Sep-2015
Sampler	: ----	Issue Date	: 02-Sep-2015
Site	: ----	No. of samples received	: 2
Quote number	: ----	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Gerrad Morgan	Asbestos Identifier	Newcastle - Asbestos

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:0% - 20%.

- **No Laboratory Duplicate (DUP) Results are required to be reported.**

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

- **No Method Blank (MB) or Laboratory Control Spike (LCS) Results are required to be reported.**

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

ALS Environmental

QA/QC Compliance Assessment for DQO Reporting

Work Order	: **ES1529700**	Page	: 1 of 4
Client	: **C M JEWELL & ASSOC PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR CHRIS JEWELL	Telephone	: +61-2-8784 8555
Project	: J1696	Date Samples Received	: 31-Aug-2015
Site	: ----	Issue Date	: 02-Sep-2015
Sampler	: ----	No. of samples received	: 2
Order number	: J1696	No. of samples analysed	: 2

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOLID** Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA200: AS 4964 - 2004 Identification of Asbestos in bulk samples							
Snap Lock Bag - ACM/Asbestos Grab Sample bag (EA200)							
ASB 1, ASB 2	**27-Aug-2015**	**----**	----	----	**02-Sep-2015**	23-Feb-2016	✓

Quality Control Parameter Frequency Compliance

- **No Quality Control data available for this section.**

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Asbestos Identification in Bulk Solids	EA200	SOLID	AS 4964 - 2004 Method for the qualitative identification of asbestos in bulk samples Analysis by Polarised Light Microscopy including dispersion staining

PRJM Pty Ltd

Kurrajong STP

Odour Impact Assessment

October 2018

Table of contents

1. Introduction....1
   1.1 Overview....1
   1.2 Limitations....1
2. Existing environment....2
   2.1 Site location....2
   2.2 Sensitive receptors....2
   2.3 Background odour concentration....2
3. Odour criteria....5
   3.1 Approved Methods....5
   3.2 Proposal odour criteria....6
4. Sewage Treatment Plant....7
   4.1 Process flow and tank layout....7
   4.2 Odour emission rates....8
5. Dispersion Modelling....10
   5.1 Meteorology....10
   5.2 Terrain and land use....11
   5.3 Dispersion model....12
   5.4 Assumptions....12
6. Impact assessment....13
   6.1 Dispersion modelling results....13
7. Conclusion....16

Table index

Table 1 Odour criteria for the assessment of odour (EPA, 2016)....5
Table 2 Emission rate inputs in the model....9
Table 3 Summary of TAPM configuration....10
Table 4 Summary of CALPUFF configuration....12
Table 5 Predicted 99th percentile odour concentration....13

Figure index

Figure 1 Site location (Source: Google Earth, 2018)....3
Figure 2 Location of sensitive receptors....4
Figure 3 Process flow diagram for sewage treatment....7

Figure 4 Tank lay-out for the proposed STP 8
Figure 5 CALMET derived annual wind rose at proposal site - 2016 11
Figure 6 Terrain elevation in the project domain 11
Figure 7 Land use within the project domain 12
Figure 8 Predicted 99th percentile peak odour concentration contours 15

Appendices

Appendix A – Subdivision Plan

1. Introduction

1.1 Overview

PRJM Pty Ltd. (PRJM) propose to develop a residential community subdivision at 67 Kurrajong Road, Kurrajong ('the project'). As part of the development, PRJM propose to construct a self-contained sewage treatment plant (STP) at the site.

GHD Pty Ltd (GHD) has been engaged by PRJM to assess odour air quality impacts from the STP at the occupants of the planned subdivision and at existing nearby sensitive receptors.

The assessment has been undertaken in response to a request for information from Independent Pricing and Regulatory Tribunal (IPART) and in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods) (EPA, 2016).

1.2 Limitations

This report: has been prepared by GHD for PRJM Pty Ltd and *may only be used and relied on by PRJM Pty Ltd for the purpose agreed between GHD and the PRJM Pty Ltd as set out in section 1.1 of this report.*

GHD otherwise disclaims responsibility to any person other than PRJM Pty Ltd 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.

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 emissions to air) 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.

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 PRJM Pty Ltd and others who provided information to GHD, 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.

2. Existing environment

2.1 Site location

The subdivision will be located in Kurrajong Town in the local government area of Hawkesbury City, New South Wales. It is approximately 75 kilometres north-west of Sydney.

The proposed STP is located in the north-west corner of the subdivision. The location of the proposed STP and subdivision is shown in Figure 1.

Kurrajong hills is located approximately 1.9 kilometres to the northwest of the site while Bowen Mountain is located approximately 4.0 kilometres southwest of the project site.

2.2 Sensitive receptors

The sensitive receptors most affected by the potential odour emissions from the STP will be the occupants of the subdivision and existing nearby residences. There are a total of 41 identified sensitive receptors for this odour assessment.

The sensitive receptors are shown in Figure 2 below, with the 35 proposed dwellings inside the subdivision shown as yellow icons, while the 16 existing residences within 150 metres of the proposed STP are shown as green icons.

2.3 Background odour concentration

There are no identified sources of significant odour in the project area. Therefore, cumulative odour impacts are not anticipated at the identified sensitive receptors.

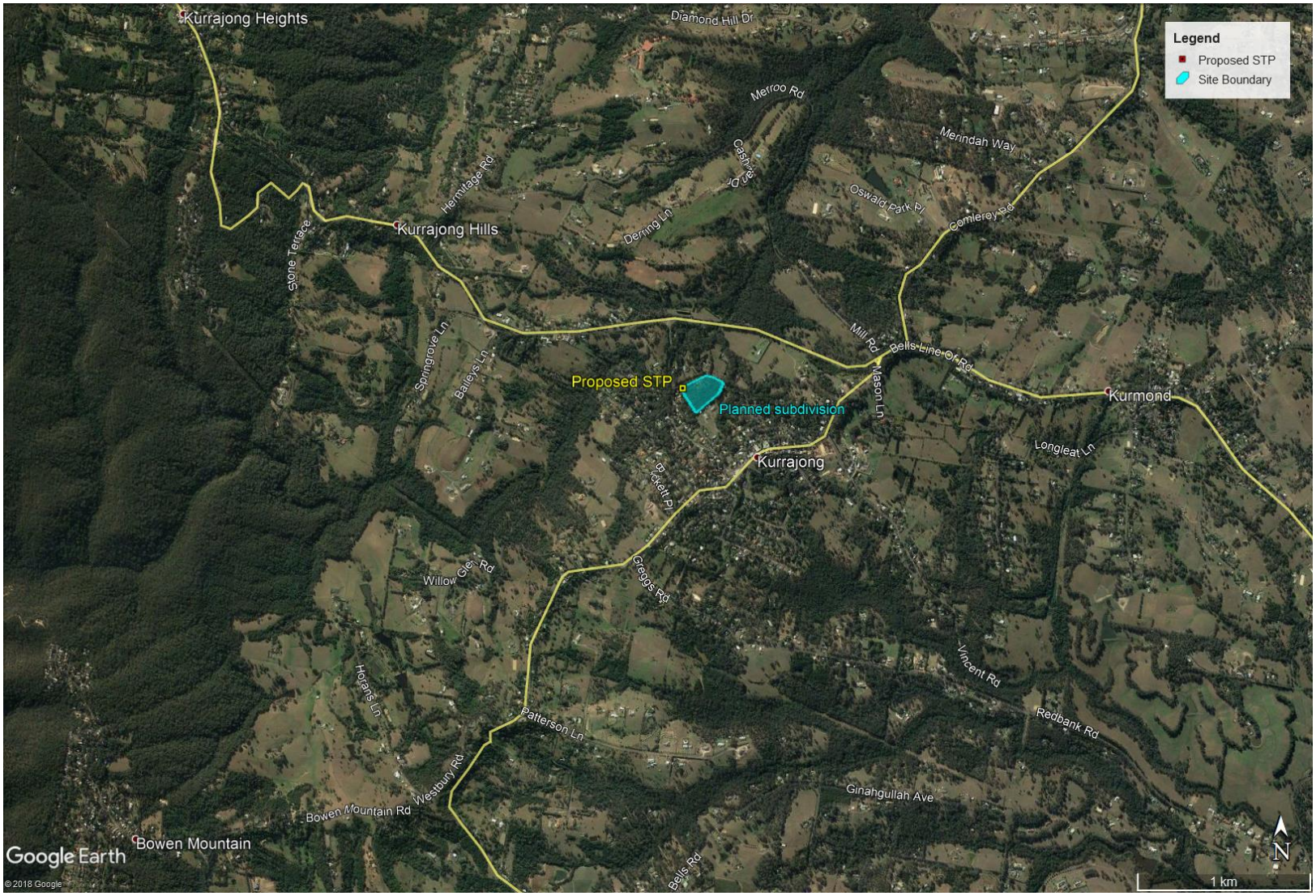


Figure 1 Site location (Source: Google Earth, 2018)

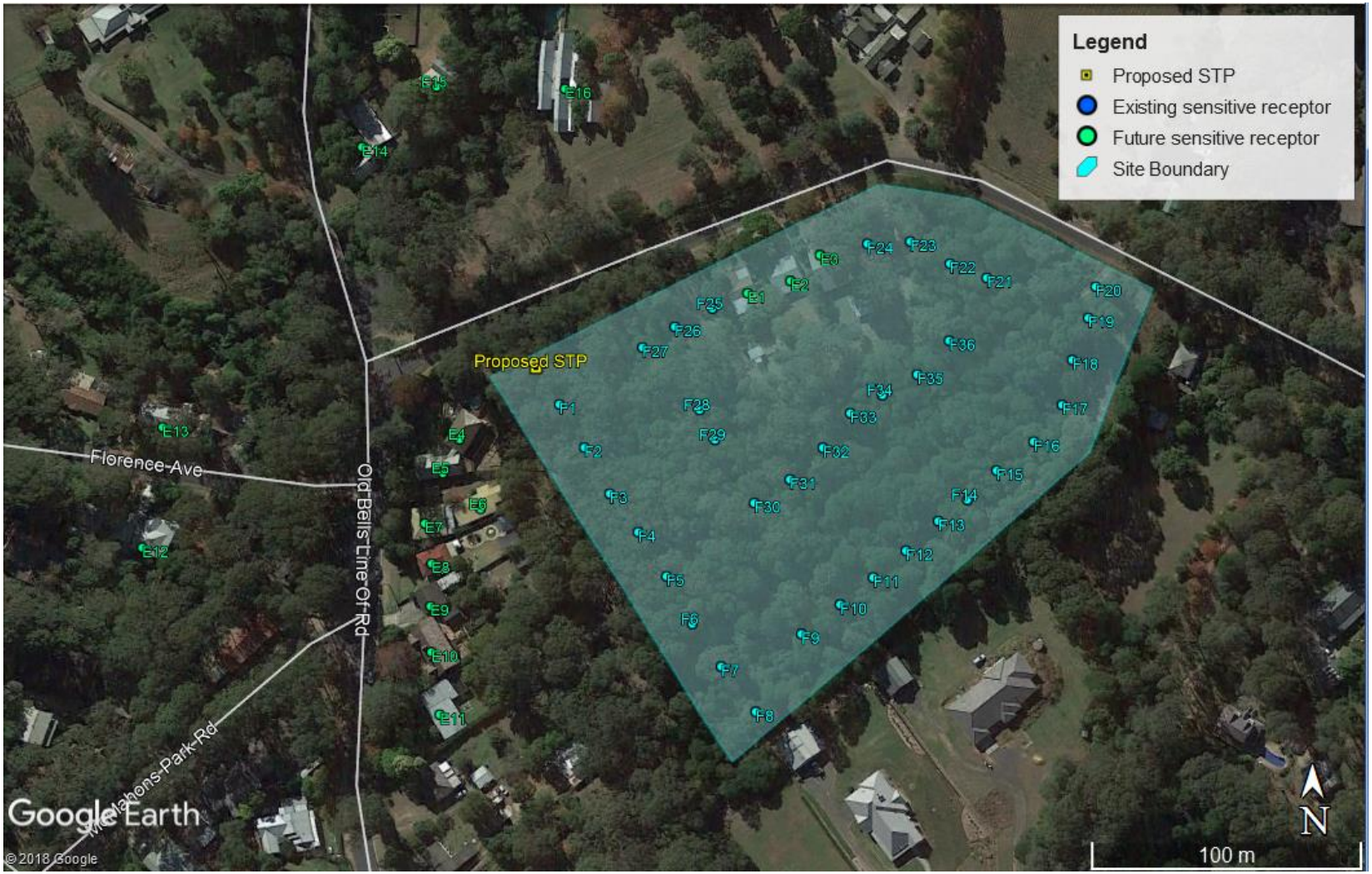


Figure 2 Location of sensitive receptors

3. Odour criteria

3.1 Approved Methods

The Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales ('the Approved Methods') (NSW EPA, 2016) lists the statutory methods for modelling and assessing emissions of air pollutants from stationary sources in NSW. The assessment criteria for odour is applied at the nearest existing or likely future off-site sensitive receptor.

The Approved Methods also defines odour assessment criteria and specifies how they should be applied in dispersion modelling to assess the likelihood of nuisance impact arising from the emission of odour.

3.1.1 Odour assessment criteria

Odour impact is a subjective experience and has been found to depend on many factors, the most important of which are the:

- **F**requency of the exposure
- **I**ntensity of the odour
- **D**uration of the odour episodes
- **O**ffensiveness of the odour
- **L**ocation of the source.

These factors are often referred to as the FIDOL factors.

The odour assessment criteria is defined to take account of two of these factors (**F** is set at 99th percentile; **I** is set at from 2 to 7 OU). The choice of assessment criteria is also dependent on the population of the affected area as shown in Table 1.

Table 1 Odour criteria for the assessment of odour (EPA, 2016)

Population of affected community	Odour performance criteria (nose response odour certainty units at 99th percentile[1])
Single Residence (≤ ~2)	7
~ 10	6
~ 30	5
~ 125	4
~ 500	3
Urban (≥~2,000)	2

Note 1: This is a prediction of the odour level that may occur 1% of the time, or one hour in one hundred. Odour performance criteria are designed to be precautionary, so that impacts on sensitive receivers can be minimised.

The criteria assumes that 7 OU at the 99th percentile would be acceptable to the average person, but as the number of exposed people increases there is a chance that sensitive individuals would be encountered. The criteria of 2 OU at the 99th percentile is considered to be acceptable for large populations (more than 2,000 people).

The criteria have also been specified at an averaging time of nominally 1 second. The choice of the short averaging time recognises that the human nose has a response time of less than 1 second, so that modelling of odour impact should allow for the short-term concentration fluctuations in an odour plume due to turbulence.

As the dispersion model cannot predict concentrations for a 1 second average, a ratio between the 1 second peak concentration and 60 minute average concentration has been applied in

accordance with Section 6.6 of the Approved Methods. This is known as the peak to mean ratio (PM60). PM60 is a function of source type, stability category and range (that is, near or far-field), and values are tabulated in the Approved Methods

3.2 Proposal odour criteria

GHD has reviewed the number existing and future dwellings in the project area that may be impacted by odour from the proposal. All dwellings that are situated within the 1 OU peak odour contour (refer Section 6) have been assumed to be included in the community potentially affected by odour as per Section 7.5 of the Approved Methods. The number of dwellings is identified as nine dwellings. NSW Government census data for Kurrajong in 2016 shows the average people per household is 2.9 meaning the affected community by the project is approximately 26 individuals.

In order to provide a conservative assessment, a criteria of 4 OU (which assumes a population of 125 people) was applied for the whole assessment area.

4. Sewage Treatment Plant

4.1 Process flow and tank layout

An on-site self-contained STP is to be installed to service all 35 dwellings inside the subdivision. The STP is composed of pre-screening, aerobic biological treatment and membrane bioreactor for tertiary treatment. The STP process flow diagram is shown in Figure 3.

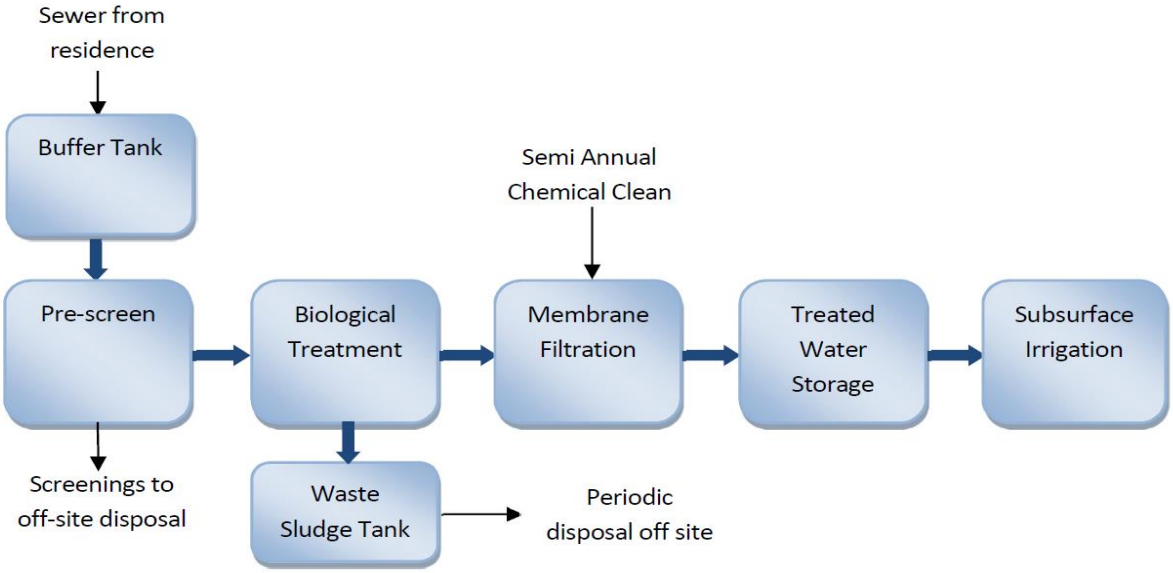


Figure 3 Process flow diagram for sewage treatment

Sewage from the homes on the site flows by gravity through the sewerage network to the buffer tank. The buffer tank is a 100 kilolitre concrete tank. It can provide up to 6 days of storage capacity given an expected wastewater of 15.8 kilolitres per day when the 35 dwellings have been occupied.

Primary treatment involves passing the wastewater through a two-millimetre sieve from the buffer tank into an enclosed pre-screen. Screenings are captured in a sealed bag and discharged off-site while the screened wastewater is transferred to biological treatment.

Biological treatment involves aerobic treatment to break down and digest the organic matter. The aerobic zone uses air blowers and diffusers to distribute air. The sludge is transferred to the waste sludge tank and disposed off-site for further processing. The treated water is further cleaned through membrane filtration.

Advance treatment, such as membrane filtration, involves passing the water through ultrafiltration membrane that removes suspended solids and pathogens. This will be the final water treatment before discharge.

The treated water is stored in a water tank with a maximum volume of 46 kilolitres. This water is discharged to the environment via sub-surface irrigation.

The tank layout of the STP that will service the 35 dwellings of 67 Kurrajong Road subdivision is shown in Figure 4. It can be seen in this layout that the treatment of system is undertaken in enclosed tanks with controlled environment.

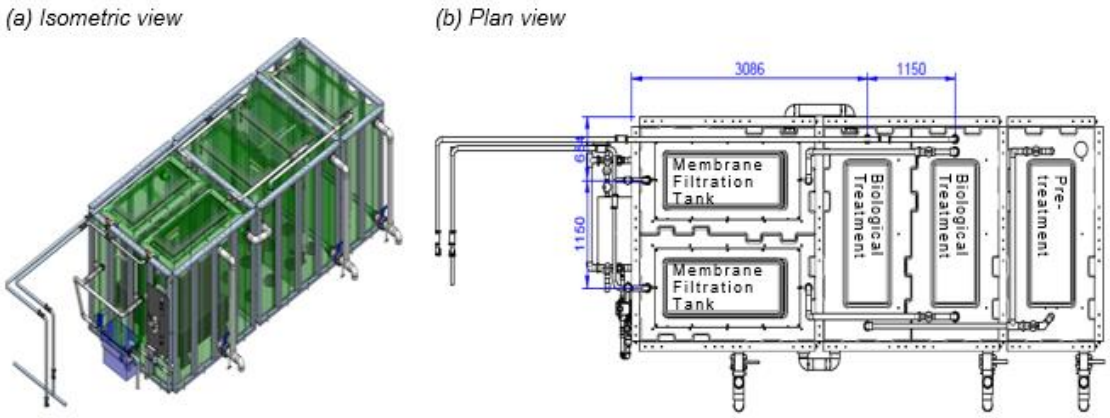


Figure 4 Tank lay-out for the proposed STP

4.2 Odour emission rates

Emission rates used in the dispersion model were based on typical odour concentrations of potential sources, air flow rate and the application of the peak odour concentration factor.

Potential sources of odour emission from this STP were identified as the primary treatment tank and the aerated biological treatment tanks. Odour emission rates used in this assessment were based on conservative assumptions in an assessment of a similar plant at Narara, NSW. The odour assessment (Narara Ecovillage Air Quality (Odour) Impact Assessment, Aubin Environment 2013) states that the odour concentration from primary treatment is typically at 10,000 odour units (OU).

In order to be conservative, this assessment assumes that the primary tank has an odour concentration of 20,000 OU from 5 am to midnight and an odour concentration of 10,000 for the remaining time periods. These peaks would generally correspond with peak flows which occur in the morning and evening time periods only.

Aubin Environment state that emissions from biological treatment through aerobic processes are typically between 270 and 440 OU (2013). A conservative peak level of 500 OU has been used in this assessment.

STP tanks were designed to allow airflow at a rate of 0.005 cubic meter per second through the 50 millimetre vent at a height of 2.1 meters. These design specifications were used as stack parameters in the model.

The 2016 Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (Approved Methods) requires the use of peak concentration factors in the evaluation odour impacts. This factor improves the model from an hourly averaging to a more accurate simulation of the short-term atmospheric dispersion of odours and instantaneous perception of odours by the human nose. A peak concentration factor of 2.3 for wake-affected point source was used in this model.

Summary of emission rate calculations for this dispersion modelling is shown in Table 2. The odour concentrations from primary treatment tank and the three biological tanks were multiplied with the flow rate and peak concentration factor to get the modelled odour emission rates.

Table 2 Emission rate inputs in the model

Source	STP Process	Odour concentration	Flow rate (m^3/seconds)	Peak concentration factor	Odour emission rates (OU*m^3/s)
Tank 1	Primary treatment (12 am to 5 am)	10,000	0.005	2.3	121.4
	Primary treatment (5 am to 12 am)	20,000	0.005	2.3	242.8
Tank 2	Biological treatment	500	0.005	2.3	6.1
Tank 3	Biological treatment	500	0.005	2.3	6.1

5. Dispersion Modelling

5.1 Meteorology

The monitoring station nearest the project site is the Office of Environment and Heritage (OEH) air quality monitoring site located at the University of Western Sydney, in Richmond. A comprehensive analysis from hourly meteorological data in the recent five years from this station was used to determine the representative year and generate a prognostic meteorological model as input into the dispersion modelling.

Year 2016 was identified as the most representative year based on the analysis of the 2013-2017 data from the OEH Richmond site.

A site-representative prognostic meteorological model was established using The Air Pollution Model (TAPM) using the parameters presented in Table 3. Hourly meteorological data was generated.

Table 3 Summary of TAPM configuration

Parameter	Value
Modelled Year	01 December 2015 to 01 January 2017
Domain centre	Latitude: -33 degrees 33 minutes Longitude: 150 degrees 40 minutes
Site location	283042 m E; 6285197 m S Zone 56
Number of vertical levels	25
Number of Easting Grid Points	25
Number of Northing Grid Points	25
Outer Grid Spacing Number of Grids (nests)	30,000 m x 30,000 m 4
Grid Resolution	Level 1 – 30,000 m Level 2 – 10,000 m Level 3 – 3,000 m Level 4 – 1,000 m

The TAPM meteorological data was then processed through the CALMET pre-processor for input into the dispersion model. The resulting wind profile is presented through a wind rose diagram as shown in Figure 5. The diagram shows that winds are generally coming from either the north-east and/or south-west directions with calm winds occurring 3.1% of the time for the entire year.

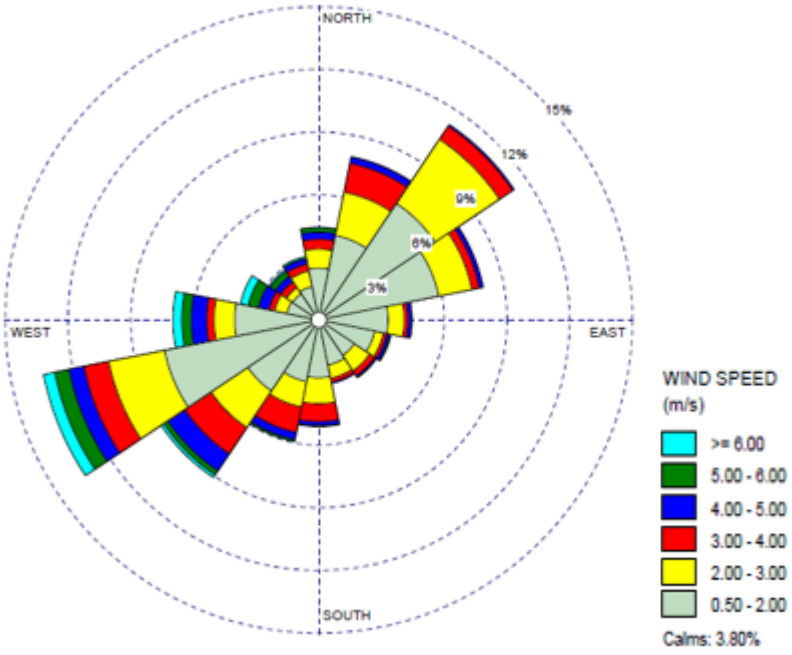


Figure 5 CALMET derived annual wind rose at proposal site - 2016

5.2 Terrain and land use

Terrain elevation was taken from NASA's Shuttle Radar Topography Mission (SRTM) dataset. Figure 6 shows the terrain elevation data within the modelling domain. High elevations at the Kurrajong Hills were observed approximately 5 kilometres northwest of the site at an elevation of 500 to 600 meters above mean sea level. The site was observed at a base elevation of 140 meters above mean sea level.

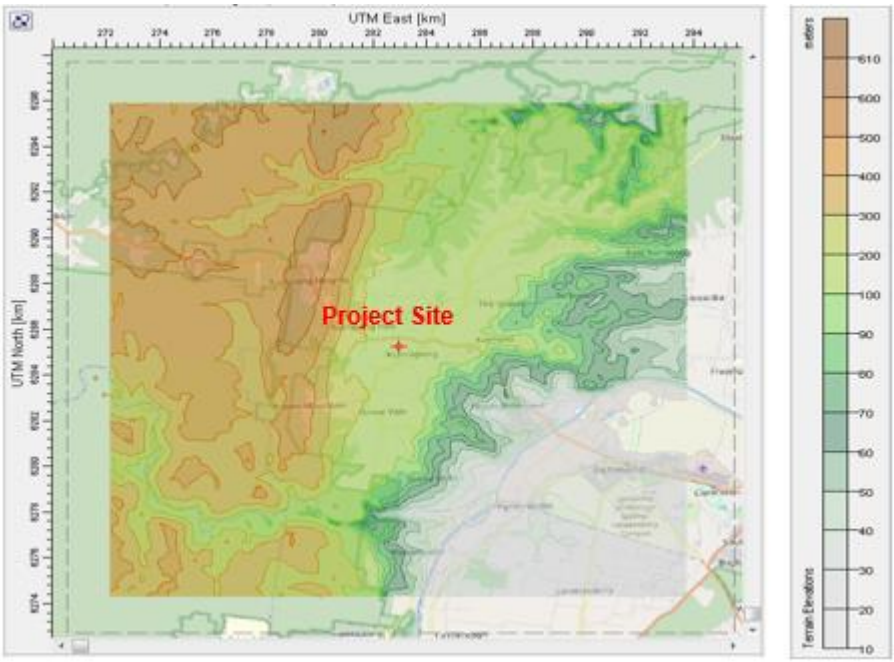


Figure 6 Terrain elevation in the project domain

Land use for the project area was based from USGS Land Use Land Cover (LULC) and refined to be more representative in the vicinity of the project as shown in Figure 7. The land use was observed as mainly Forest Land in the northwest and Rangeland in the southeast.

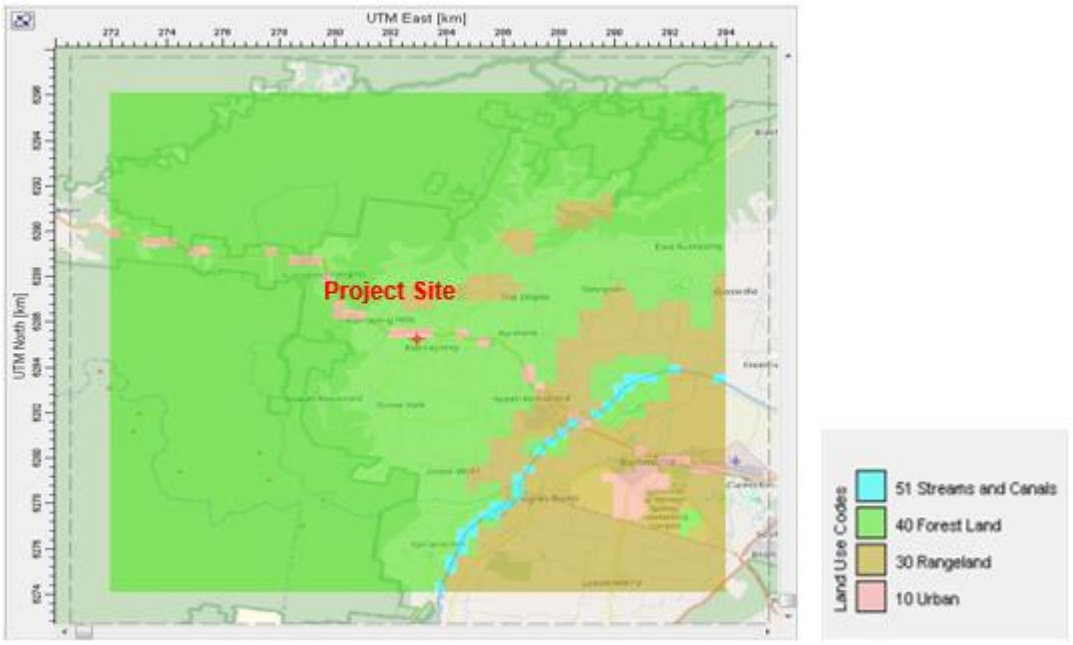


Figure 7 Land use within the project domain

5.3 Dispersion model

An odour impact assessment on the surrounding sensitive receptors has been conducted using the CALPUFF atmospheric dispersion model. CALPUFF is an advanced non-steady-state meteorological conditions and air quality modelling system. The summary of CALPUFF model inputs are shown in Table 4.

Table 4 Summary of CALPUFF configuration

Parameters	Configuration
Model Version	CALPUFF EPA Approved Version 5.8.5 CALPOST EPA Approved Version 6.221
Run Period	01 January 2016 00:00 to 01 January 2017 00:00
Meteorological Data	Prognostic data from TAPM
Grid	24 x 24 km 400 m grid spacing
Building inputs	STP structure
Averaging period	Adjusted one-hour average (adjusted based on peak concentration factor)
Percentile	99th percentile

5.4 Assumptions

The following assumptions were made in the assessment:

- Odour emission data obtained from Narara Ecovillage Air Quality (Odour) Impact Assessment, Aubin Environment 2013 is representative of this proposal
- Conservative modelling assumptions would cover worst-case operating conditions
- The modelling and assessment was based on information provided to GHD
- The location of the STP and future receptors on the lot are indicative only

6. Impact assessment

6.1 Dispersion modelling results

Dispersion modelling was undertaken to predict the maximum ground level odour concentrations resulting from normal operations of the STP. The outputs were compared against the Approved Methods assessment criteria of 4 OU in order to determine the potential impact of the proposed STP.

Predicted 99th percentile odour concentrations at all assessed sensitive receptors are presented in Table 5 from highest to lowest concentration values. All predicted odour concentrations are below the relevant impact assessment criteria of 4 OU.

The maximum predicted concentration at an existing sensitive receptor (E4) was predicted to be 2.2 OU.

The maximum predicted odour concentration at future dwellings is 3.9 OU. This was predicted at Receptor F1 in this study which corresponds with Subdivision Lot 2 on the Subdivision Plan (2002.DA.16 Rev D) as shown in Appendix A. This Lot 2 is located directly adjacent to Lot 1 where the STP is to be located.

Table 5 Predicted 99th percentile odour concentration

Receptor	Type of receptor	Predicted concentration, OU
F1	Future	3.9
F27	Future	2.7
E4	Existing	2.2
F29	Future	1.3
F26	Future	1.3
F28	Future	1.1
F2	Future	1.0
E5	Existing	1.0
F33	Future	1.0
F31	Future	0.9
F13	Future	0.8
F25	Future	0.7
F16	Future	0.7
F32	Future	0.6
F21	Future	0.6
F34	Future	0.6
F22	Future	0.5
F14	Future	0.5
F3	Future	0.5
F20	Future	0.5
F15	Future	0.5
E1	Existing	0.5
E7	Existing	0.4
E6	Existing	0.4
F4	Future	0.4
E2	Existing	0.4
F10	Future	0.3
F12	Future	0.3
F17	Future	0.3

Receptor	Type of receptor	Predicted concentration, OU
E3	Existing	0.3
F9	Future	0.3
F36	Future	0.3
F19	Future	0.3
E8	Existing	0.3
F5	Future	0.2
F24	Future	0.2
F35	Future	0.2
F30	Future	0.2
F23	Future	0.2
E12	Existing	0.2
F6	Future	0.2
E9	Existing	0.2
F7	Future	0.2
E13	Existing	0.1
E10	Existing	0.1
E16	Existing	0.1
F8	Future	0.1
F11	Future	0.1
F18	Future	0.1
E11	Existing	0.1
E14	Existing	0.1
E15	Existing	0.1

The 99th percentile odour concentrations are presented as a contour plot in Figure 8 below. Results show no odour concentrations higher than 4 OU at sensitive receptor locations, which is the odour criteria for this study.

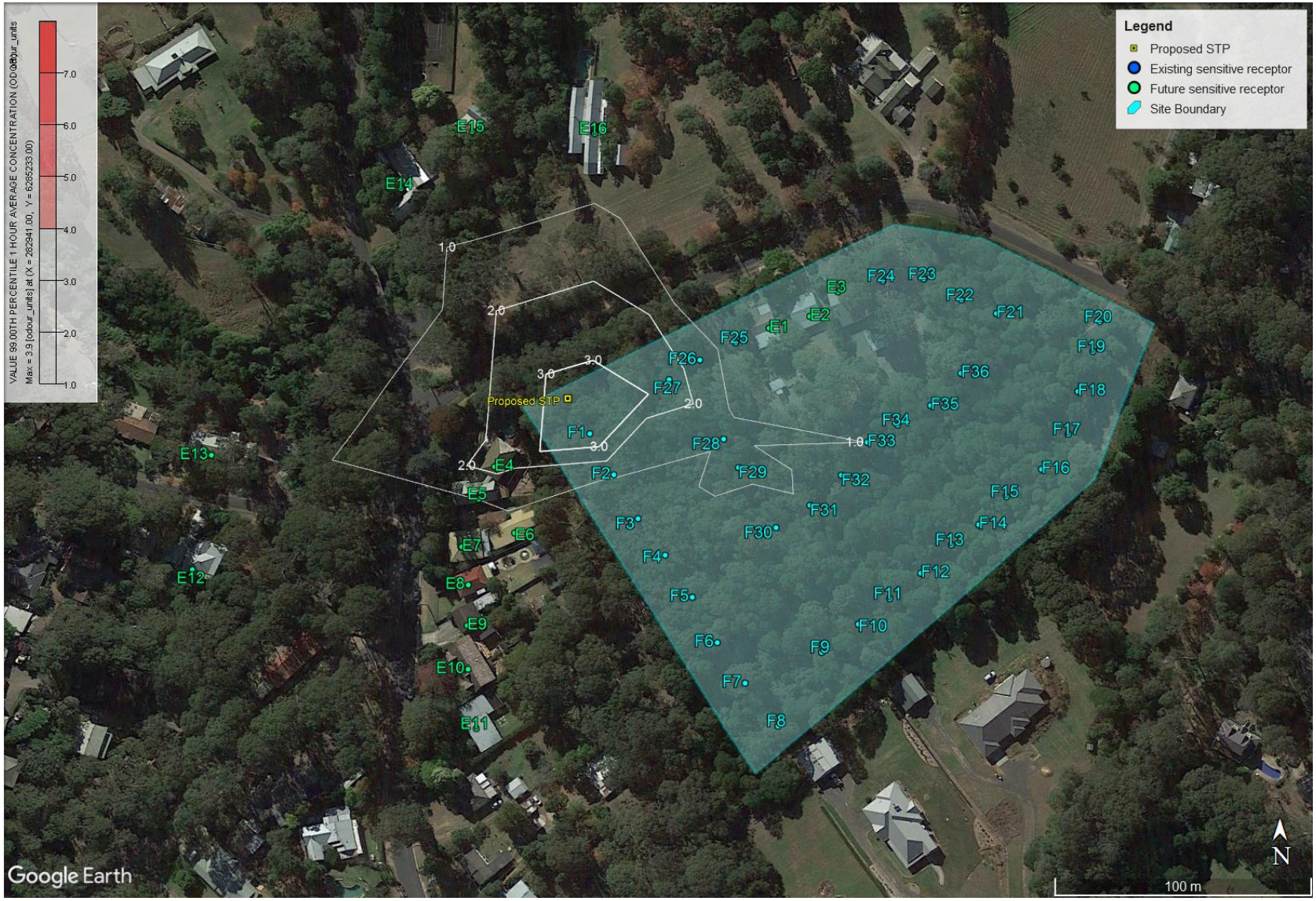


Figure 8 Predicted 99th percentile peak odour concentration contours

7. Conclusion

GHD has undertaken an odour assessment of the STP to be located at the proposed subdivision at 67 Kurrajong Road, Kurrajong. The proposed STP is a modular system consisting of pre-treatment tank, biological tanks and membrane tanks.

GHD has used odour emission rates based on the proposed design and odour concentrations used in an assessment of this same type of plant at another site in NSW.

The predicted peak 99th percentile odour concentration complies with the relevant odour criteria at all existing and future receptors. The assessments finds the proposal would be acceptable from an air quality perspective providing implementation and compliance with the Sewage Management Plan for the proposal.

Appendices

Appendix A – Subdivision Plan

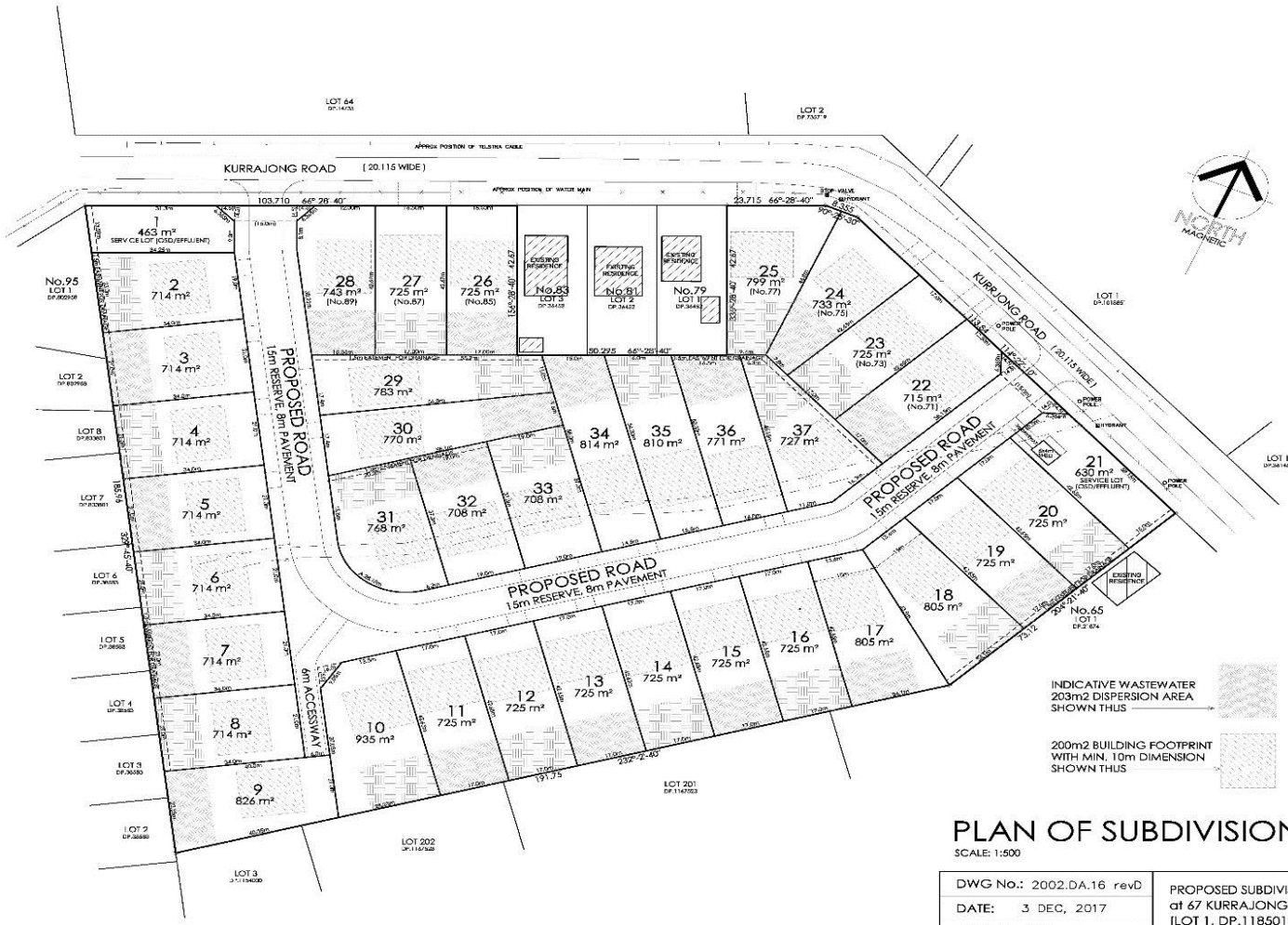


TABLE OF LOTS			
LOT	Area (m²)	LOT	Area (m²)
1	463	20	725
2	714	21	630
3	714	22	715
4	714	23	725
5	714	24	733
6	714	25	799
7	714	26	725
8	714	27	725
9	826	28	743
10	935	29	783
11	725	30	770
12	725	31	768
13	725	32	708
14	725	33	708
15	725	34	814
16	725	35	810
17	805	36	771
18	805	37	727
19	725		
Total=	27,286 m²	Average	737 m²

PLAN OF SUBDIVISION - 37 LOTS

SCALE: 1:500

A1 SHEET

DWG No.: 2002.DA.16 revD DATE: 3 DEC, 2017 DRAWN: APG REF: . . ./KURRAJONG/SITE37	PROPOSED SUBDIVISION at 67 KURRAJONG ROAD [LOT 1, DP.1185012] KURRAJONG NSW 2758 for . . .	ANDREW P GRIEVE BACHELOR OF ARCH (HONS) 17 ANNABELLE CRESCENT KELLYVILLE, NSW 2155 MOBILE. 0412 752 579

GHD

Level 15
133 Castlereagh Street
T: 61 2 9239 7100 F: 61 2 9239 7199 E: sydmail@ghd.com

GHDDocId/https://projects.ghd.com/oc/sydney2/kurrajongstpodourass/Delivery/Documents/REP-2127762 Kurrajong STP Odour Assessment.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	N Dela Cruz	P Pandey		E Smith		31/10/2018

www.ghd.com

Our Reference: **PT15042**

Michael McCarthy
Director PRJM Pty Ltd
ATF. Kurrajong Trust
Suite 6
3-7 Cowell Street
Gladesville. NSW 2111

27 April 2020

Dear Mr McCarthy

Lot 1 DP 1185012 67 Kurrajong Road, Kurrajong – Proposed Residential Sub Division
Response to Statement of Contentions and Facts

Further to the recent Section 34 proceedings, please find below comments on the proposed revised development for the above site which includes a reduction in the number of lots from 52 as originally proposed to 37.

Background

Positive Traffic Pty Ltd prepared a Traffic Impact Assessment report for inclusion in the DA submission for a 52-lot residential sub division at the above site. In summary, this report found:

1. The traffic impacts of the development would be minimal with future traffic flows on surrounding roads within acceptable limits.
2. Intersections surrounding the development would continue to operate at levels of service to that which currently occurs.
3. The proposed design of the internal roads exceeds the minimum requirements of the DCP and are considered satisfactory.

Following submission of the proposal, Hawkesbury City Council refused the 52 lot sub division application and the development is currently subject to Section 34 proceedings. However, during the course of these proceedings a revised proposal with a smaller lot yield and revised sewerage treatment system was tabled and is the subject of this traffic assessment.

Statement of Facts and Contentions

It is noted that the majority of issues with the proposal were related to sewerage arrangements and servicing of the site. The issues pertaining to traffic and access matters

1. The development application does not demonstrate compliance with Clause 4.1D subclause (1) (a) and (b) of LEP 2012 because:

3. A system that relies on transport of sewage via road will have an adverse impact on the locality in terms of traffic, noise, odour and general management issues on both the residents and surrounding residential properties.

g. The residential subdivision relies on the use of a pump out tanker to transfer waste from the land to a sewage treatment facility contrary to the requirements of DCP 2002.

I. The development is not directly accessible to commercial areas and public recreational areas and has not considered any pedestrian access associated with the creation of an additional fifty residential lots.

b. The traffic assessment report does not assess details in respect to traffic impacts associated with the proposed sewerage pump out tanker and its associated impacts such as servicing, maneuvering and frequency of traffic.

c. The traffic assessment report does not consider kerb-side waste collection. The number of waste bins, length of access ways and space available along the proposed road has not been considered. Particularly in respect to proposed lots 11, 12, 42, 43, 44, 45, 49 and 50.

Revised Proposal

The key elements of the revised proposal include a 37 lot sub division which includes an on-site sewerage treatment system. The significant majority of all sewerage generated by the proposal would be treated and returned to the site via the watering of landscaped areas. The system requires pump out 1 – 2 times annum where vehicles can be located within the existing road shoulder of Kurrajong Road without a formal need to enter the subdivision.

The proposed sewerage reticulation system has been designed to minimise the need for sewerage pump out even during / after long periods of rain. Plans of the revised proposal are provided in **Appendix A** of this report.

It was noted during discussions during the course of the Section 34 proceedings that on the basis that a smaller yield proposal was developed to respond to the issues raised with the 52 lot proposal, the potential traffic impacts of the proposal would no longer be considered an issue.

Comments on Revised Proposal

The revised development includes a central spine road at a width which complies with Council's minimum width requirements with two road connections with Kurrajong Road (as was the case with the original proposal).

The revised yield includes larger lots (totalling 37) with an average lot size of 737m^2.

The formal vehicle loading bay has been removed as any pumping out of sewerage 1 – 2 times per annum can occur from the shoulder within Kurrajong Road adjacent to the sewerage facility.

The comment on consideration of the kerbside waste collection is unclear and further information was not provided at the Section 34 proceedings. Of note, the revised proposal includes a central spine road which exceeds the minimum requirements of the DCP (as was the case with the 52 lot proposal).

To confirm the suitability of the road, turning paths of a 9.8m long vehicle (representative of a large garbage truck have been prepared and are provided in **Appendix B** of this report. The proposed design can fully accommodate a 9.8m long garbage truck without issue.

The original traffic report included an assessment of potential traffic generation of the 52 lot sub division applying the standard RMS rate of 0.85 trips per dwelling. The 37 lot proposal would result in a potential for 30 peak hour trips two-way, a 33% reduction in potential traffic generation compared to the 52 lot proposal.

Overall the potential traffic impacts of the less intensive 37 lot proposal are considered satisfactory and would not impact to the point of detriment on the surrounding road network.

We trust the additional information assists you in your planning for the site. Should you require any further information please do not hesitate to contact myself on 0414 462247.

Yours sincerely

DEAN BRODIE
Managing Director

Appendix A – Revised Plans for a 37 Lot Subdivision

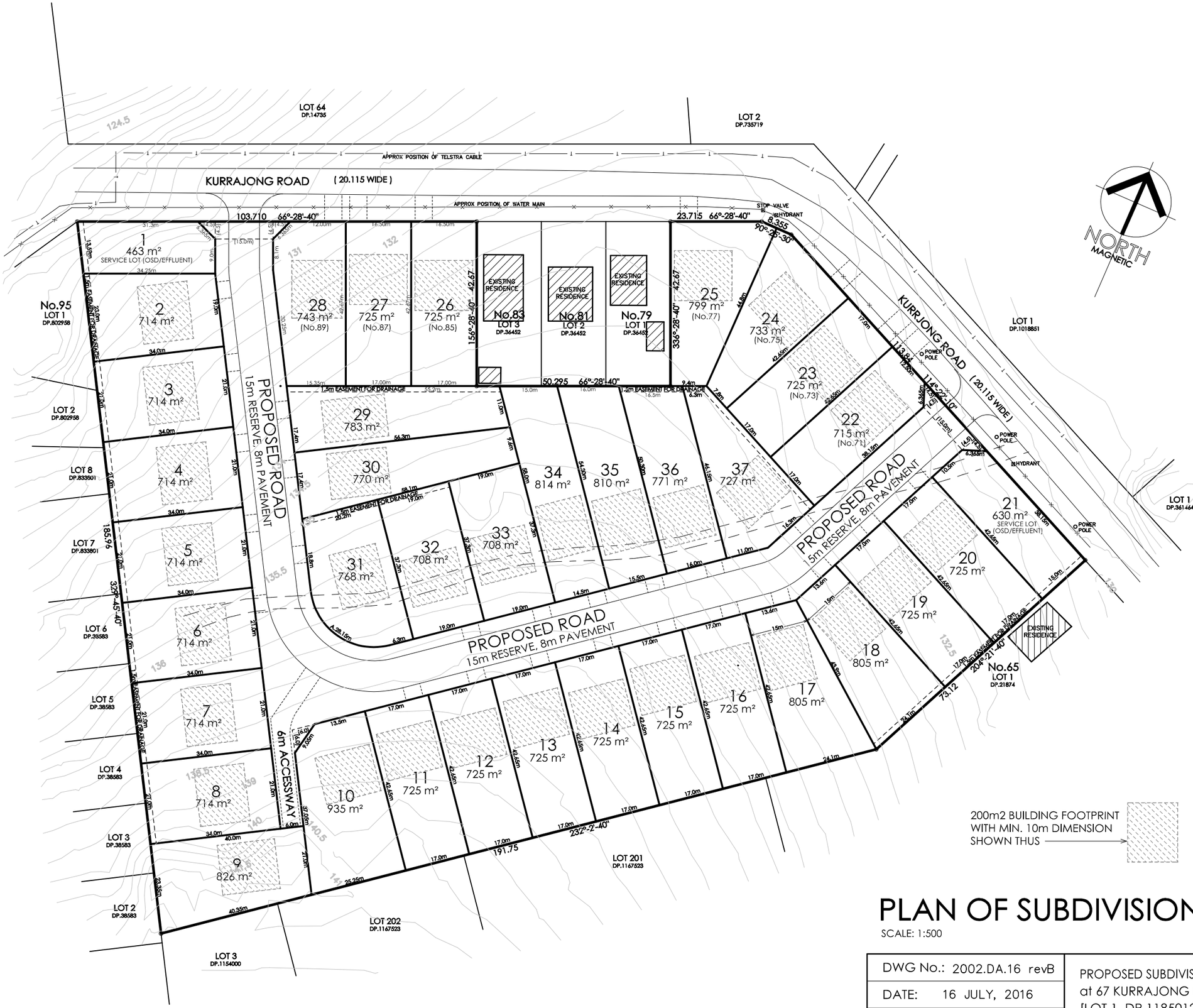


TABLE OF LOTS			
LOT	**Area (m²)**	**LOT**	**Area (m²)**
1	463	20	725
2	714	21	630
3	714	22	715
4	714	23	725
5	714	24	733
6	714	25	799
7	714	26	725
8	714	27	725
9	826	28	743
10	935	29	783
11	725	30	770
12	725	31	768
13	725	32	708
14	725	33	708
15	725	34	814
16	725	35	810
17	805	36	771
18	805	37	727
19	725		
Total=	27,286 m²	Average	737 m²

PLAN OF SUBDIVISION - 37 LOTS

SCALE: 1:500

A1 SHEET

DWG No.: 2002.DA.16 revB	PROPOSED SUBDIVISION at 67 KURRAJONG ROAD [LOT 1, DP.1185012] KURRAJONG NSW 2758 for . . .	ANDREW P GRIEVE BACHELOR OF ARCH (HONS)
DATE: 16 JULY, 2016		17 ANNABELLE CRESCENT KELLYVILLE, NSW 2155
DRAWN: APG		MOBILE. 0412 752 579
REF: . . ./KURRAJONG/SITE37		

Appendix B – Turning Path Assessment of 9.8m Garbage Truck

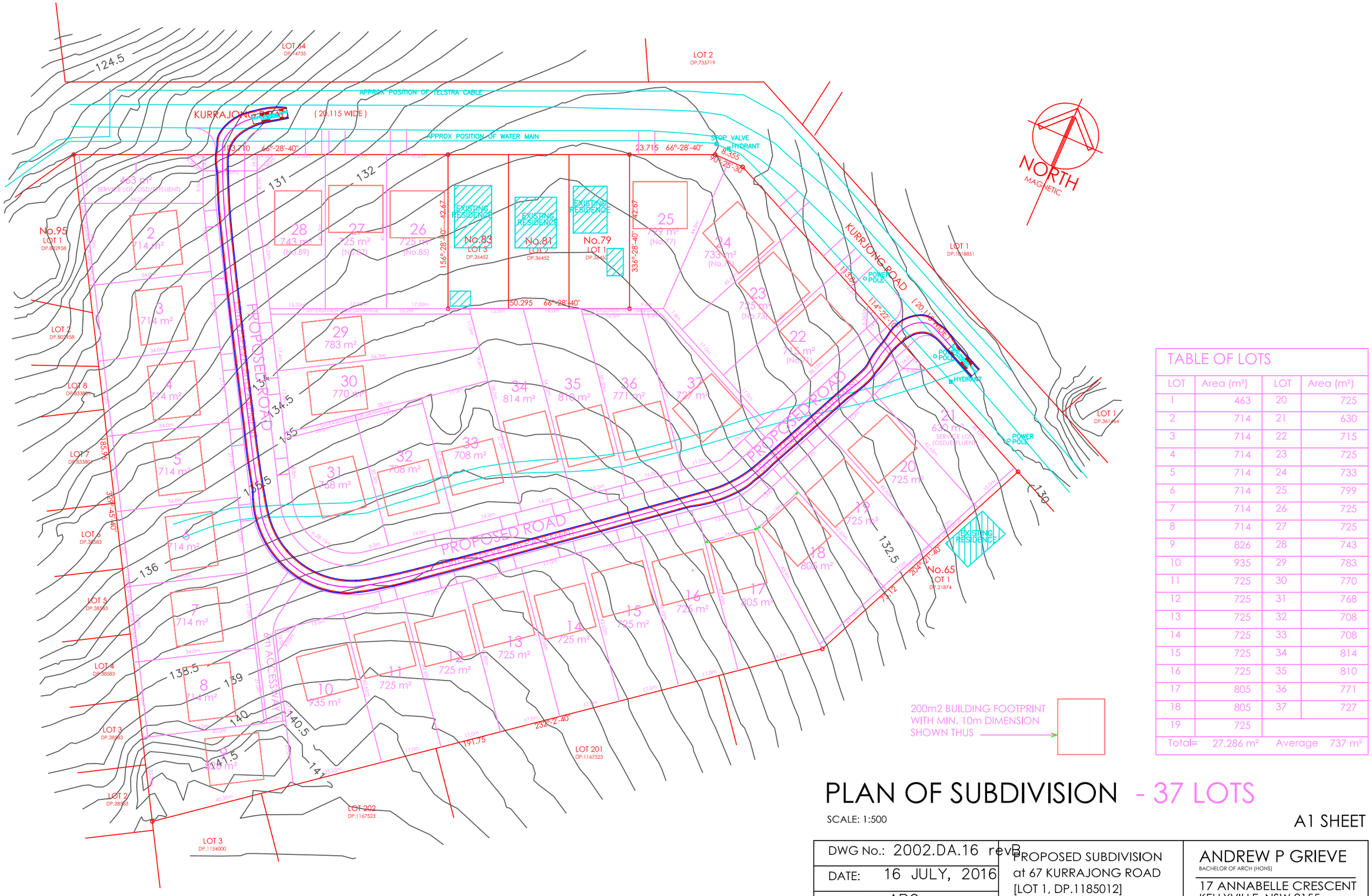


TABLE OF LOTS

LOT	Area (m²)	LOT	Area (m²)
1	463	20	725
2	714	21	630
3	714	22	715
4	714	23	725
5	714	24	733
6	714	25	799
7	714	26	725
8	714	27	725
9	826	28	743
10	935	29	783
11	725	30	770
12	725	31	768
13	725	32	708
14	725	33	708
15	725	34	814
16	725	35	810
17	805	36	771
18	805	37	727
19	725		
Total=	27,286 m²	Average	737 m²

PLAN OF SUBDIVISION - 37 LOTS

SCALE: 1:500

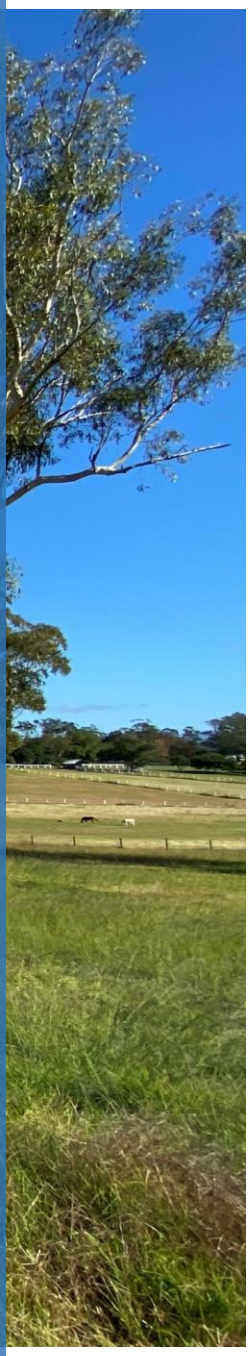
A1 SHEET

DWG No.: 2002.DA.16 revB	PROPOSED SUBDIVISION at 67 KURRAJONG ROAD [LOT 1, DP.1185012] KURRAJONG NSW 2758 for	ANDREW P GRIEVE BACHELOR OF ARCH (HONS)
DATE: 16 JULY, 2016		17 ANNABELLE CRESCENT KELLYVILLE, NSW 2155
DRAWN: APG		MOBILE. 0412 752 579
REF: . . ./KURRAJONG/SITE37		

Review of Environmental Factors

Wastewater Management System

67 Kurrajong Road, Kurrajong NSW 2758



Prepared for PRJM Pty Ltd ATF Kurrajong Trust

Report No: P1706231JR03V01

September 2020

Project Details

Project Item	Detail
Name	Review of Environmental Factors for Wastewater Management System at 67 Kurrajong Road, Kurrajong NSW 2758
Client	PRJM Pty Ltd ATF Kurrajong Trust
Number	P1706231
Document	P1706231JR03V01.docx
Manager	M. Shahrokhian
Principal Author	J. Watkins

Document History

Issue	Issue Date	Status	Description / Comment	Author	Reviewer	Approved
1	8 September 2020	Final	IPART Submission	JW	MS	DM

All enquiries regarding this project are to be directed to the Project Manager.

© Copyright Martens & Associates Pty Ltd
Suite 201, 20 George St, Hornsby, NSW 2077, Australia
ACN 070 240 890 ABN 85 070 240 890
P +61-2-9476-9999 | mail@martens.com.au | www.martens.com.au

Contents

1 Introduction 5
1.1 Overview 5
1.2 Approved Wastewater Management Scheme 5
1.3 Proposed Modification 6
1.4 WICA Licencing 7
1.5 Justification for selected Option 7
1.6 Scope 8
2 Site Description and Environmental Settings 10
2.1 Location 10
2.2 Local Drainage 11
2.3 Geology 11
2.4 Topography 12
2.5 Soils 12
2.6 Groundwater 12
2.7 Flora and Fauna 13
2.8 Heritage 13
2.9 Bushfire 13
3 Planning Framework 14
3.1 Environmental Planning & Assessment Act 1979 (NSW) 14
3.2 Environmental Planning & Assessment Regulation 2000 (NSW) 14
3.3 Protection of the Environment Operations Act 1997 (NSW) 17
3.4 Biodiversity Conservation Act 2016 (NSW) 17
3.5 Water Management Act NSW (2000) 18
3.6 Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River (No 2 – 1997) 19
3.7 State Environmental Planning Policy (Koala Habitat Protection) 2019 21
3.8 State Environmental Planning Policy No 55 – Remediation of Land 21
3.9 Hawkesbury Local Environmental Plan 2012 21
3.10 Hawkesbury Development Control Plan 2012 25
4 Environmental Impact Assessment 26
4.1 Overview 26
4.2 Topography 26
4.3 Soils 26
4.4 Surface Water 27
4.5 Groundwater 28
4.6 Noise 28
4.7 Odour 28
4.8 Traffic 29
4.9 Visual 29
4.10 Landscaping Analysis 30
4.11 Flora and Fauna 30
4.12 Heritage 31
4.13 Bushfire 31

5 Conclusion 32
6 References 33
7 Attachment A – Mapset 34
8 Attachment B – IPART RFI 35
9 Attachment C – Wastewater Management Plan 36
10 Attachment D – Landscape Plan 37
11 Attachment E – Bushfire Assessment 38
12 Attachment F – Traffic Assessment 39
13 Attachment G – Odour Assessment 40
14 Attachment H – Acoustic Report 41

1 Introduction

1.1 Overview

This Review of Environmental Factors ("**REF**") has been prepared by Martens & Associates ("**MA**") on behalf of PRJM Pty Ltd ATF Kurrajong Trust ("**Client**") to support an application to the Independent Pricing and Regulatory Tribunal ("**IPART**") to construct and operate a private sewage management scheme ("**activity**") servicing 35 residential lots at 67 Kurrajong Road, Kurrajong ("**Site**"). The residential lots are subject to a Part 4 development consent (DA 0830/15) issued by Land and Environment Court ("**LEC**") on 30 June 2017 for creation of 37 community title lots, including 35 residential lots and two community association lots with wastewater and stormwater services ("**Subdivision Development Consent**").

The proposed wastewater management system includes a centralised tertiary treatment grade sewage treatment plant (the "**STP**") followed by sub surface application to a centralised treated effluent management area (the "**EMA**"). The proposed EMA system modifies that originally conceived under the Subdivision Development Consent, which consisted of application of treated effluent to discrete disposal fields within each approved Lot. The modified scheme now proposed consolidates the effluent disposal area into a single centralised area, this assisting with access, maintenance and long-term management.

1.2 Approved Wastewater Management Scheme

The wastewater management scheme approved under the Subdivision Development Consent comprised the following (Figure 1):

1. A centralised tertiary treatment grade STP located on community lot 21.
2. Pump station located on community lot 1.
3. Reticulated sewer line throughout the development.
4. Rising main running between the pump station and sewage treatment plant.
5. Individual effluent disposal areas within each residential lot comprising an irrigation area of 150 m^2 (excluding buffer areas) for each lot.

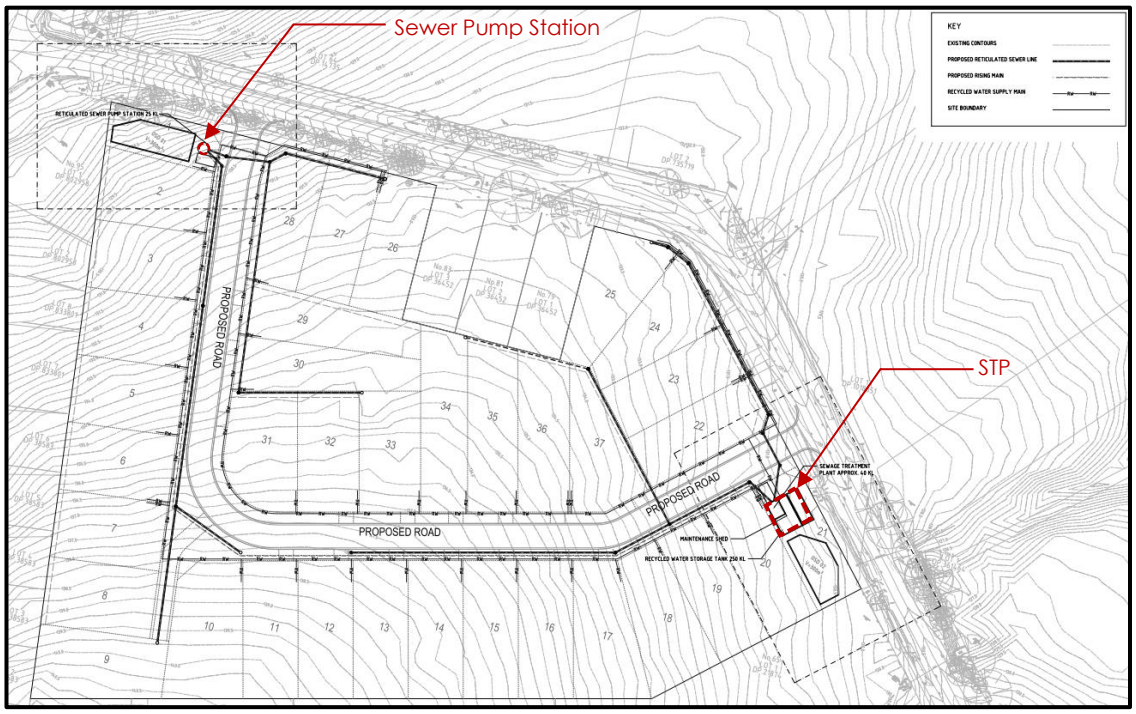


Figure 1: Approved wastewater management scheme.

1.3 Proposed Modification

Rather than relying on small irrigation areas located on each allotment, it is proposed to construct a consolidated EMA within the southern portion of the Site (Figure 2). The EMA has been allocated an area of 1,880 m^2 and is to be located in the southern portions of lots 10 to 20. The following design elements are noted:

1. The disposal field will be fenced to prevent public access.
2. All effluent to be disposed of below ground.
3. Trenches have been conservatively designed in accordance with AS/NZS 1547 methods.
4. Design of trenches is based on detailed soil investigations in the disposal area.
5. No amendments are proposed to the STP, the pump station or rising main.
6. Tertiary treated and disinfected effluent will be delivered uniformly to trenches by a pressure compensating distribution pipe network.

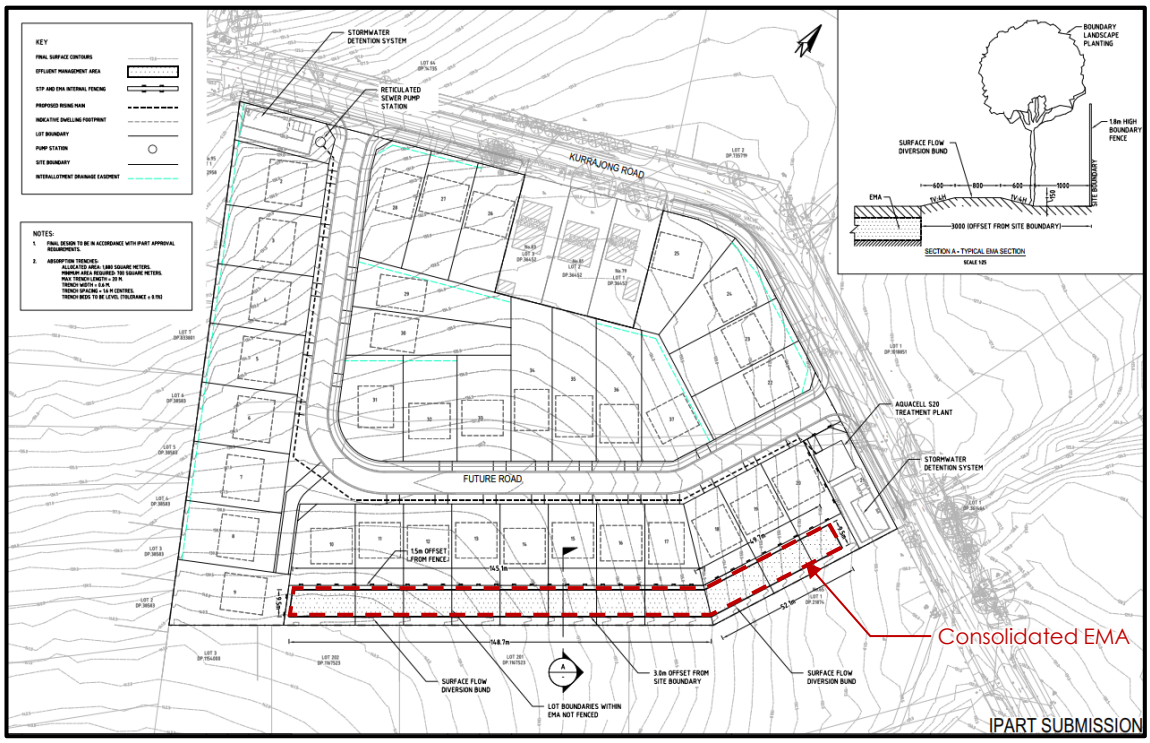


Figure 2: Proposed consolidated EMA.

1.4 WICA Licencing

The proposed wastewater management system requires licensing from IPART under the *Water Industry Competition Act 2006* (NSW) ("**WIC Act**"). A network operator's license is required to construct and operate the scheme, and a retail supplier's license is required to provide sewerage services to the community.

1.5 Justification for selected Option

Three options were considered for the activity, and are detailed in the following sections. The preferred option is a consolidated effluent management area.

1.5.1 Do Nothing

The "do nothing" option was not an option as the site is to be developed for residential purposes as per the Subdivision Development Consent (DA 0830/15) and requires sewage services.

1.5.2 Connection to Public Infrastructure

This option would comprise an underground sewer network constructed along Bells Line of Road and would direct sewage to the North Richmond Wastewater Treatment Facility approximately 7 km to the southeast. The network would be gravity fed but also require a number of sewage pump stations and rising mains in areas of flat to rising topography including along Old Bells Line of Road.

This option has several issues which render it undesirable, including:

1. Significant cost for construction and ongoing maintenance.

2. Works undertaken along a classified road with ramifications for traffic flows and pedestrian crossings throughout the works period.

3. Crossing of drainage channels marked as a "blue line" on the 1:25,000 topographic map and located at the corner of Crooked Lane and Old Bells Line of Road, likely requiring further environmental investigations.

4. Issues with operation, including:

    a. Increased septicity due to longer transfer times from the source to point of treatment.

    b. Potential for wet weather overflows from the sewer network and/or pump stations.

1.5.3 Individual Effluent Disposal Areas

Under the Subdivision Development Consent (DA 0830/15), effluent was approved to be disposed of on 150 m^2 irrigation areas (excluding buffer areas) located on each of the 35 residential lots via subsurface irrigation. This option can be improved by consolidating the effluent disposal area into a single centralised disposal area, this assisting with access, maintenance and long-term management. Refer to Section 1.5.4 for further details.

1.5.4 Consolidated Effluent Disposal Area

This option comprises consolidating effluent disposal areas, in form of trenches, into a single location providing an efficient and orderly land use arrangement for effluent disposal.

This option provides the following benefits:

1. More efficient maintenance and inspection due to the consolidated location of the disposal area.

2. Reduction in the overall footprint of effluent disposal are over the Site, with an associated reduction in restriction on residential land titles.

3. Reduction in traffic generation for inspection and maintenance of the EMA due to one consolidated EMA as opposed to 35 individual areas.

1.5.5 Preferred Option

The preferred option that is assessed in this REF is the consolidated effluent disposal field as described in Section 1.5.4.

1.6 Scope

This REF has been prepared in response to correspondence issued by the Independent Pricing and Regulatory Tribunal ("**IPART**") dated 1 June 2020 requiring an assessment of the environmental impacts of construction and operation of the treated sewage disposal area (Attachment B). We understand the impact assessment requested by IPART relates

to the proposed modifications to the effluent disposal area as described in Section 1.3 of this REF.

The scope of this REF is as follows:

1. Describe the Site and surrounding context.
2. Describe the proposed activity for which WICA Licence is sought with detailed description of the DA approved sewage system and amendments to wastewater disposal area.
3. Undertake an assessment of the activity against the relevant planning framework.
4. Assess the environmental impacts of the activity.

While WICA licensing from IPART is required for the wastewater management system in its entirety, this REF only assesses the amended effluent management area, in accordance with the IPART correspondence and given the wastewater management systems has previously been assessed and approved under the Subdivision Development Consent.

2 Site Description and Environmental Settings

2.1 Location

The Site is located at 67 Kurrajong Road, Kurrajong and is legally described as Lot 1 DP 1185012 with an approximate area of 3.23 ha. The Site has an irregular shape with a street frontage of approximately 240 m to Kurrajong Road. This is broken into two sections due to the three existing residential properties to the northwest of the Site (Figure 3).

Figure 3: Aerial image of the subject site and surrounding land (Source: SIX Maps, 2020).

Further information on existing site features and surrounding environment is provided in Table 1.

Table 1: Site background information.

Element	Description/Detail
Site Address	67 Kurrajong Road, Kurrajong, NSW.
Site Area	Approximately 3.23 ha.
Lot/DP	Lot 1 DP 1185012.
Existing site development	Primarily regrowth vegetation with unsealed road providing informal access to another property.
Neighbouring environment	The site is bordered by residential allotments and Kurrajong Road to the north, residential allotments to the east, west and south.
Local Government Area (LGA)	Hawkesbury City Council.
Easements	The Site does not currently include any easements based on review of survey. Inter allotment drainage easements are proposed for the future lots in accordance with DA 0830/15. The proposed wastewater management system shall not cause any conflicts with the future inter allotment drainage easements.

2.2 Local Drainage

Based on the 1:25,000 Topographic Map (Figure 4), the Site is located in the catchment of Little Wheeny Creek. The following comments are made:

1. Little Wheeny Creek is located approximately 60 m from the Site's northwest corner.

2. An overland flow path is located more than 40 m to the east of the Site.

3. An unnamed drainage line is located approximately 115 m to the northeast.

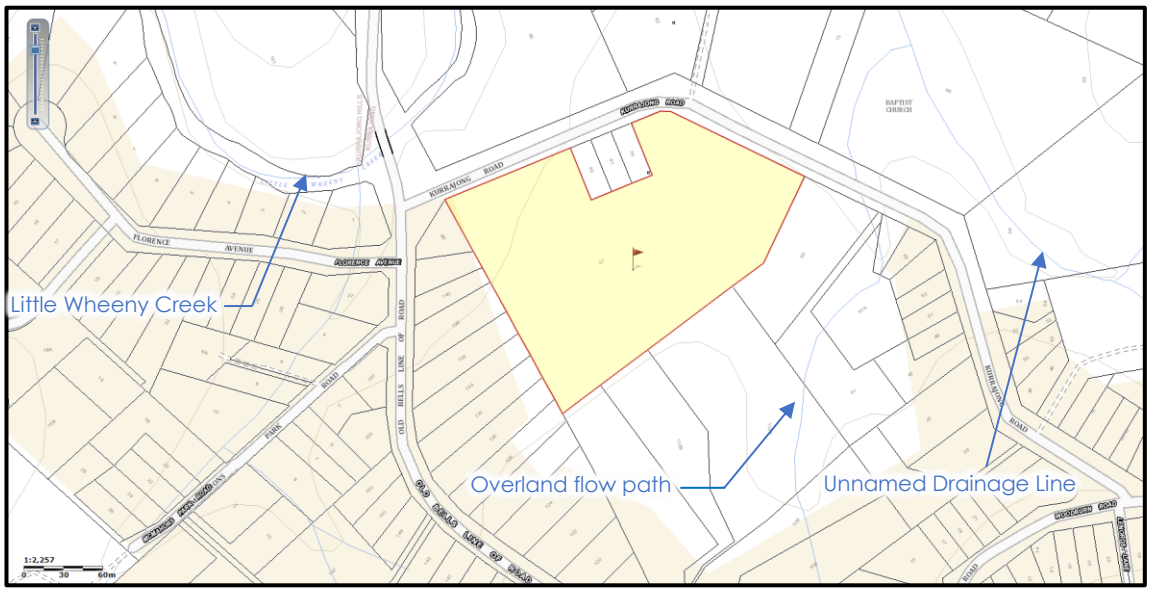


Figure 4: 1:25,000 Topographic Map (source: SIX Maps, 2020).

2.3 Geology

Review of the Penrith 1:100,000 Geological Series Sheet shows that the site is underlain by two geological units:

1. Hawkesbury Sandstone: Consisting of medium to very coarse grained quartz sandstone, minor laminated mudstone and siltstone lenses. This geological unit is predominantly in the northwestern part of the site.

2. Ashfield Shale: Consisting of claystone-siltstone and fine sandstone-siltstone laminite. This geological unit is in the southern and eastern parts of the site (towards the upper part of the ridgeline).

The map also suggests that there may be some small localised areas of the Michinbury Sandstone and Bringelly Shale formations towards the top of the ridgeline.

2.4 Topography

The site is located on a north / south running ridgeline to the north of Kurrajong township. The site slopes generally towards the northeast and northwest from the top of the ridge at grades of generally between 5 – 10%. Site slopes are generally concave. Elevations range between 141 mAHD at the southern corner and 130 mAHD to northeast and 126.5 mAHD to northwest corners of the Site.

2.5 Soils

Local soil landscapes are documented in the Penrith 1:100,000 Soil Landscape Sheet. Two soil landscapes were identified to occur close to or on the Site:

1. Luddenham: This is the predominant soil landscape of the site consisting of loams overlying clay loams grading to light to medium clay at depth.

2. Agnes Banks: This landscape is generally limited to areas adjacent to Little Wheeny Creek and consists of sands overlying loamy sands then bedrock. This soil profile is unlikely to occur on the site itself.

Soil investigations were undertaken and show that site soils are generally categorised into three profiles as follows:

1. Sandstone profile: To the west and north of the site. Consisting of loam overlying clay loam grading to sandy light clay at depth then sandstone bedrock.

2. Transitional profile: Between the sandstone and shale profiles in the middle of the site ridge. Consisting of sandy loams and loams overlying clay loams grading to light clays then shale / sandstone bedrock.

3. Shale profile in the eastern part of the site: Consisting of sandy loam topsoils overlying well drained clay loam subsoils grading to light to medium clays then shale bedrock. Total soil depth is greater than 1.5 m.

The soil profiles within the disposal area (shale profile) are suitable to accept treated wastewater and do not present a constraint to the operation of the wastewater management system.

Results of laboratory testing of site boreholes show that site soils are generally acidic and non-dispersive, have low electrical conductivity, moderate cation exchange capacity and moderate phosphorus sorption capacity. In summary, the soil chemistry indicates that site soils are well suited to the application of treated wastewater.

2.6 Groundwater

Groundwater was not encountered during excavation of subsurface boreholes. It is expected that permanent groundwater will be located at depths of greater 3 m and likely deeper. There may be a layer of ephemeral groundwater flowing over bedrock at the soil / bedrock interface following periods of prolonged or heavy rainfall at the site.

A search of the Water NSW groundwater bore register showed that there are no bores within 250 m of the proposed EMA.

2.7 Flora and Fauna

The Site is identified by Hawkesbury LEP (Attachment A, Map 04) as having significant vegetation and connectivity between significant vegetation.

Site specific flora and fauna surveys were previously undertaken for the subdivision DA with the following vegetation communities identified within the Site:

1. Eucalyptus Amplifolia (Cabbage Gum Forest): This is weed infested and disturbed within the Site, and is not likely to be the original species of the Site, as Eucalyptus Amplifolia is a species usually associated with watercourses and low-lying sites, not of well-drained slopes.

2. Acacia Forest: This is disturbed within the Site.

3. Privet Forest (Exotic).

4. Cleared Land.

The ecological assessment found no threatened fauna species, threatened flora species, or endangered ecological communities ("**EECs**") pursuant to the Threatened Species Conservation Act 1995. No threatened fauna species, protected migratory bird species, threatened flora species or EECs were recorded pursuant to the Environment Protection and Biodiversity Conservation Act 1999.

We note the Subdivision Development Consent includes partial removal of existing vegetation on site to facilitate the approved residential subdivision.

2.8 Heritage

The Site is located within proximity to a heritage item named "Goldfinders Inn Group" located approximately 75 m northwest of the Site at 164 Old Bells Line of Road, Kurrajong (Attachment A, Map 03). This heritage item is listed in Hawkesbury LEP (Item 357) as a local significance, and by NSW Office of Environment and Heritage as a State significance.

The Goldfinders Inn Group comprises three buildings located at the southern end of the property, near the junction of Bells Line of Road with Little Wheeny Creek. The buildings are a single storey timber cottage, a two-storey, sandstone building constructed as an inn and a timber barn structure. They are set in a garden of mature trees.

2.9 Bushfire

The Site is identified on the NSW RFS Bushfire Prone Land map as "Vegetation Category 1", "Vegetation Category 2", "Vegetation Category 3" and "Vegetation Buffer". Previous bushfire assessment prepared for the subdivision DA identified the vegetation within the proximity to the site as managed/developed. The report states that the Site once developed will also be considered managed and all significant bushfire vegetation will be removed. We understand General Terms of Approval ("**GTAs**") have been provided by NSW RFS for the Subdivision Development Consent.

3 Planning Framework

3.1 Environmental Planning & Assessment Act 1979 (NSW)

The *Environmental Planning & Assessment Act 1979* (NSW) ("**EP&A Act**") is the principle planning and development legislation in NSW.

Although this application is not under Part 5 as Subdivision Development Consent has been granted under Part 4 of the EP&A Act, this REF has been prepared in accordance with Section 5.5 of Part 5 of the EP&A Act, requiring a determining authority to take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of an activity. An assessment of all matters which may affect the environment as a result of the proposal is provided in Section 4 of this REF.

3.2 Environmental Planning & Assessment Regulation 2000 (NSW)

The *Environmental Planning & Assessment Regulation 2000* (NSW) ("**EP&A Reg**") provides the operating framework for the EP&A Act.

For the purposes of Part 5 of the EP&A Act, Clause 228 (2) of the EP&A Reg provides factors that must be taken into account concerning the impact of an activity on the environment. Table 2 provides an assessment for these factors.

Table 2: Clause 228 (2) assessment.

Factor	Assessment
(a) any environmental impact on a community,	The environmental impacts of the wastewater management system have previously been assessed under s 4.15 (1) (b) of the EP&A Act as part of the LEC proceedings prior to Subdivision Development Consent being granted by the LEC. The revised EMA is not expected to result in additional environmental impacts on communities because: <u>Amenity impacts</u> 1. The findings of the acoustic assessment (Attachment H) with respect of the STP will be unchanged. The EMA will not result in any additional acoustic impacts. 2. The EMA is not anticipated to be a source of odour (Attachment G). 3. The EMA shall not impact the local road network (Attachment F), but rather reduce traffic generation associate with inspection and maintenance of the system due to the consolidated location. <u>Social impacts</u> The proposal will have a positive effect on the future residential community on the Site, given the consolidated EMA and reduction in maintenance needs.
(b) any transformation of a locality,	The proposal is unlikely to transform the locality because: 1. The EMA is ancillary to the approved residential subdivision and is minor in nature.

Factor	Assessment
	2. The EMA is underground and therefore not visible from public domain or neighbouring properties. 3. The EMA will be obscured from public domain by boundary planting.
(c) any environmental impact on the ecosystems of the locality,	The environmental impacts of the wastewater management system have previously been assessed under s 4.15 (1) (b) of the EP&A Act as part of the LEC proceedings prior to Subdivision Development Consent being granted by the LEC. The revised EMA is not expected to result in additional environmental impacts on the ecosystems because: 1. Land is capable with suitable soils to accept treated effluent. 2. The trenches have been designed with appropriate Design Loading Rates ("**DLR**") of combined with depth of trenches and appropriate buffers to minimise the risk of effluent resurfacing / mixing with surface flows. 3. Permanent groundwater depths are greater than 3.0 m below natural surface level providing sufficient separation between the trenches and groundwater table. 4. A surface water diversion bund is provided to the south of the EMA diverting upslope surface water away from the EMA. 5. Boundary trees are provided between the EMA and southern site boundary. Further, it is expected that the proposed modifications result in an environmental benefit given the reduction in the EMA overall footprint from 5,250 m^2 (approved under the Subdivision Development Consent comprising 150 m^2 for 35 lots) to 1,880 m^2 (consolidated EMA for trenches).
(d) any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality,	The proposed EMA is ancillary to the approved residential lots and is to be located in an area where there will not be any effect on aesthetic, recreational, scientific or other environmental values of the locality.
(e) any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations,	The EMA will not have any detrimental effects on heritage values of nearby heritage item. Refer to Section 4.12 for further assessment.
(f) any impact on the habitat of protected animals (within the meaning of the *Biodiversity Conservation Act 2016*),	Impacts of the development on the habitat of protected animals (if any) were previously considered as part of the assessment of the subdivision DA and prior to the Subdivision Development Consent being granted. The modified EMA does not require tree removal and has been designed in accordance with relevant guidelines and buffer distances. No further impacts are therefore expected as a result of the proposed EMA.
(g) any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air,	The proposal will not result in endangering of any species of flora or fauna because the effluent disposal area is already approved to be cleared and receive treated effluent as per the Subdivision Development Consent. The effluent is to be treated to high quality with UV disinfection prior to delivery to EMA. Therefore, no impacts on soils and surrounding environment are expected.

Factor	Assessment
(h) any long-term effects on the environment,	The EMA will not have any long-term impact on the environment because: 1. Land is capable with suitable soils to accept treated effluent. 2. The trenches have been designed adopting low DLR. 3. Tertiary treatment will result in high quality effluent before being disposed of in the EMA. 4. Permanent groundwater depths are greater than 3.0 m below natural surface level providing sufficient separation between the trenches and groundwater table. 5. A surface water diversion bund is provided to the south of the EMA diverting upslope surface water away from the EMA. 6. Regular monitoring and inspections will be carried out.
(i) any degradation of the quality of the environment,	For the reasons outlined above, the proposal will not degrade the quality of the receiving environment.
(j) any risk to the safety of the environment,	The proposed amendment will not pose a safety risk as the EMA will be appropriately fenced and screened, with management practices in place to ensure no harm to humans or the subsoil environment is caused.
(k) any reduction in the range of beneficial uses of the environment,	The wastewater management system is ancillary to the approved residential lots and the EMA is proposed to be located to the southernmost part of the Site within lots 10 to 20. Given the size and dimensions of Lots 10 to 20, whilst the effluent disposal area will be fenced limiting access to Aquacell, this will not adversely affect these lots in terms of private open space, solar access or other factors with respect to the uses of the environment.
(l) any pollution of the environment,	The EMA will not cause any pollution to the environment given the mitigation measures adopted in the design of the system as outlined in Section 4.
(m) any environmental problems associated with the disposal of waste,	As above.
(n) any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply,	The proposal will not result in an excessive requirement for resources for its operation.
(o) any cumulative environmental effect with other existing or likely future activities,	Assessments undertaken for this REF (including noise, odour, traffic and flora and fauna) have determined that adverse impacts are unlikely to occur as a result of the proposal. As such, the proposal is unlikely to contribute to any cumulative impacts associated with management of effluent in the area.
(p) any impact on coastal processes and coastal hazards, including those under projected climate change conditions.	The Site is not in a coastal area.

3.3 Protection of the Environment Operations Act 1997 (NSW)

The object of the *Protection of the Environment Operations Act 1997* NSW ("**POEO Act**") is to protect, restore and enhance the quality of the environment in New South Wales.

Schedule 1 of the POEO Act stipulates "scheduled activities" for which an Environment Protection Licence ("**EPL**") is required. Clause 36 (2) identifies sewage treatment as a "scheduled activity". An EPL is required if the facility has a processing capacity that exceeds:

> *(a) 2,500 persons equivalent, as determined in accordance with guidelines established by an EPA Gazettal notice, or*
>
> *(b) 750 kilolitres per day,*
>
> *whichever is the greater.*

The proposal activity is to service approximately 105 persons (3 persons / dwelling with 35 dwellings total) at a design rate of 21 kL / day. An EPL is therefore not required.

3.4 Biodiversity Conservation Act 2016 (NSW)

The purpose of the *Biodiversity Conservation Act 2016* NSW ("**BC Act**") is to, inter alia, maintain a healthy, productive and resilient environment for the greatest well being of the community.

Clause 6.12 (a) of the BC Act requires a Biodiversity Development Assessment Report ("**BDAR**") in relation to a proposed development to assess the "biodiversity values" of the subject land. The triggers for a BDAR are listed as follows:

1. Prescribed activities (such as clearing of native vegetation) on land identified as purple shade on the "Biodiversity Values Map". A portion of the Site within the northeast is identified on the "Biodiversity Values Map" (Figure 5). However, the EMA is located within the southern portion of the Site and outside the biodiversity vales mapping.

2. Clearing of native vegetation on to the extent that is exceeds the Biodiversity Offsets Scheme threshold. Vegetation clearing has previously been assessed under the Part 4 development assessment prior to Subdivision Development Consent being granted by the LEC. The modification to the wastewater management system results in a reduced EMA footprint, therefore a reduction in vegetation clearing (if any).

3. A "significant effect" on threatened species or ecological communities. The impacts of the wastewater management system have previously been assessed under the Part 4 development assessment process by LEC. The modification to the wastewater management system only relates to the EMA resulting in a reduced EMA footprint. There is no change to the outcome of previous flora and fauna assessment given the effluent disposal area is located where there has already been approved to clear vegetation and receive treated effluent as per the Subdivision Development Consent.

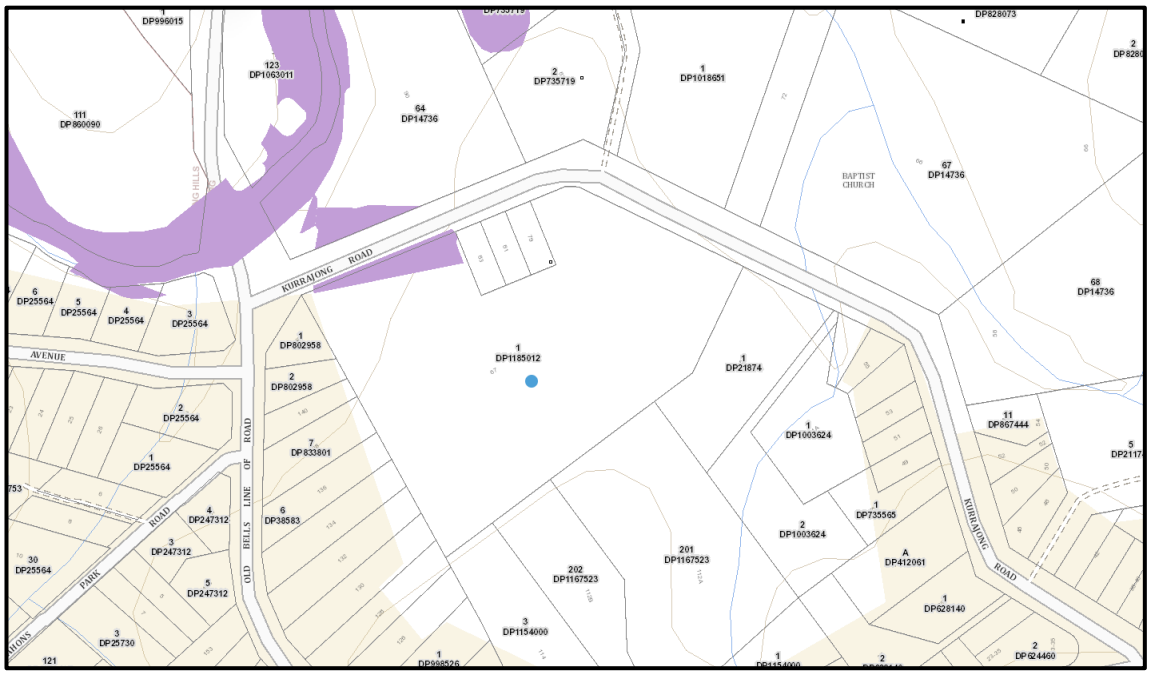


Figure 5: Biodiversity Values Map (Source: Department of Planning, Industry & Environment).

3.5 Water Management Act NSW (2000)

The object of the *Water Management Act 2000* NSW ("**WM Act**") is to, inter alia, provide for the sustainable and integrated management of the water sources of the state.

Clause 91 of the WM Act stipulates the requirements for a Controlled Activity Approval ("**CAA**"). Any development carried out on waterfront land (land within 40 m of any river banks, lake sore or estuary mean high water mark) requires concurrence from the Natural Resources Access Regulator ("**NRAR**") as a Controlled Activity Approval ("**CAA**").

The 1:25,000 Topographic Map (Figure 4) shows an unnamed drainage line to the southeast of the Site. Whilst we have not inspected this drainage line to confirm whether or not it constitutes a "river" for the purposes of WM Act, we note the proposed EMA is located approximately 50 m from this drainage line. As such, the proposal does not require a CAA nor does it trigger the requirement for concurrence from NRAR.

3.6 Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River (No 2 – 1997)

The aim of *Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River (No 2 – 1997)* ("**SREP 20**") is to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context.

Table 3 provides an assessment of the proposal against relevant provisions of SREP 20.

Table 3: SREP 20 considerations.

SREP 20 Consideration	Assessment
6 Specific planning policies and recommended strategies	
(1) Total catchment management	
Policy: Total catchment management is to be integrated with environmental planning for the catchment.	
Strategies:	
(a) Refer the application or other proposal for comment to the councils of each adjacent or downstream local government area which is likely to suffer a significant adverse environmental effect from the proposal.	No significant adverse environmental effects will arise to adjacent or downstream local government areas. The amendments are minor in nature with no potential for material offsite impacts.
(b) Consider the impact of the development concerned on the catchment.	The impacts of the development on the Hawkesbury Nepean River Catchment have previously been assessed under the part 4 development assessment. The modification to the approved system only relates to reconfiguration of the effluent disposal area to a consolidated area as opposed to individual irrigation fields within each residential lot. The proposed effluent management will not result in additional impact to the catchment of Hawkesbury Nepean River because: 1. The site soils are suitable and capable of accepting treated effluent. 2. Conservative design loading rates have been adopted for design of the trenches. 3. Effluent will be adequately treated to high quality and disinfected. 4. The EMA is sufficiently distant from local drainage lines. 5. There will be adequate separation between the trenches and the groundwater table given the depth of groundwater being more than 3 m.
(c) Consider the cumulative environmental impact of development proposals on the catchment.	Provided that all onsite wastewater management systems within the catchment are designed appropriately to the relevant standards adopting appropriate soil loading rates compliant with Australian Standards, the cumulative impacts of these activities on Hawkesbury Nepean River Catchment are acceptable.

SREP 20 Consideration	Assessment
11 Development controls	
(17) Sewerage systems or works	
Additional matters for consideration by the consent authority:	
(a) Whether the proposed development will be capable of connection to a Sydney Water Corporation Limited or council sewerage system either now or in the future.	The proposal is not required to be connected to a public infrastructure.
(b) The suitability of the site for on-site disposal of effluent or sludge and the ability of the sewerage systems or works to operate over the long-term without causing significant adverse effects on adjoining property.	Water and nutrient balance assessments detailed in the Wastewater Management Plan (Attachment C) indicate that all treated wastewater shall be assimilated within the Site. The wastewater management system can operate over a long term period without significant adverse impacts on the neighbouring properties because: 1. The land is capable with suitable soils for effluent disposal. 2. The EMA has sufficient buffer distances from site boundaries and adjoining dwelling. 3. The STP complies with acoustic requirements.
(c) The likely effect of any on-site disposal area required by the proposed development on:	
any water bodies in the vicinity (including dams, streams and rivers), or	Proximity of the proposed disposal area to local waterways is greater than the minimum required setbacks. Refer to Wastewater Management Plan (Attachment C) for detailed assessment.
any mapped wetlands, or	There are no mapped wetlands near to the site.
any groundwater, or	Groundwater is expected to occur at levels greater than 3 m below ground level and is not anticipated to be impacted by application of high quality treated wastewater.
the floodplain.	The site is not located within a floodplain.
(d) The scope for recycling and reusing effluent or sludge on the site.	Treated wastewater is being applied to the site in a sustainable manner. It is not proposed to reuse treated wastewater for any non potable purpose.
(e) The adequacy of wet weather storage and the wet weather treatment capacity (if relevant) of the proposed sewerage system or works.	The proposed treatment process includes 65 kL tank as wet weather storage. Soil moisture probes will assist in determining when the disposal area is too wet to accept additional treated wastewater.
(f) Downstream effects of direct discharge of effluent to watercourses.	Treated wastewater is being applied to subsurface absorption trenches. There shall be no direct discharge to the downstream environment.
(g) The need for ongoing monitoring of the system or work.	Ongoing monitoring shall include monitoring and reporting of groundwater quality from downslope of treated wastewater disposal area, soil moisture probes and visual inspection of the disposal area. Monitoring details are provided in the Wastewater Management Plan (Attachment C).

3.7 State Environmental Planning Policy (Koala Habitat Protection) 2019

The aim of *State Environmental Planning Policy (Koala Habitat Protection) 2019* ("**Koala SEPP**") is to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to support a permanent free living population over their present range and reverse the current trend of koala population decline.

Pursuant to Clause 9(1), the Koala SEPP applies to the Site as the Site is identified on the Koala Development Application Map, has an area of at least 1 hectare (approximate 3.23 Ha area) and no current koala plan of management applies. However, the Site is not identified as a "site investigation area", thereby it is unlikely to have a high probability of koala habitat. Notwithstanding, the proposal will not result in any direct impacts to koala habitat as no additional tree removal is proposed for the revised EMA, and the indicative new trees included in the Subdivision Development Consent will be achieved along the southern Site boundary (Attachment D).

3.8 State Environmental Planning Policy No 55 – Remediation of Land

The aim of *State Environmental Planning Policy No 55 – Remediation of Land* ("***SEPP 55***") is to provide for a State wide planning approach to the remediation of contaminated land. Clause 7 of SEPP 55 requires a consent authority to consider in respect of any development whether the land is contaminated, and if it is, whether the land is suitable in its contaminated state or requires remediation.

Contamination assessment was previously undertaken as part of the residential subdivision DA. The *Phase 1 Environmental Site Assessment* prepared by C. M. Jewell and Associates Pty Ltd identified areas on the Site as having potential sources of contamination with a recommendation for removal of this material as part of site preparation works. The proposed EMA is not located within these areas and the remediation works can take place in accordance with the recommendation of the contamination assessment. The proposal therefore raises no inconsistencies with SEPP 55 provisions.

3.9 Hawkesbury Local Environmental Plan 2012

The *Hawkesbury Local Environmental Plan 2012* ("**HLEP**") is the primary environmental planning instrument applying to the site. This section proves an assessment of the proposal against the relevant provisions of HLEP.

3.9.1 Zoning

The Site is zoned R2 Low Density Residential (Attachment A, Map 02). The activity is ancillary to residential lots approved under the Residential Subdivision Consent. The activity therefore remains to be permissible within the R2 zone. Table 4 provides an assessment against the objectives of R2 zone.

Table 4: R2 zone objective assessment.

R2 zone objectives	Assessment
To provide for the housing needs of the community within a low density residential environment.	The proposed EMA does not raise any inconsistencies with this objective and the approved residential lots will continue to provide for the housing needs of the community.
To enable other land uses that provide facilities or services to meet the day to day needs of residents.	The proposed EMA will provide sewage disposal services to meet the daily needs of the future residents.
To protect the character of traditional residential development and streetscapes.	The proposed EMA is minor in nature and is ancillary to the residential lots. No impacts on the character of traditional residential development and streetscapes are therefore expected.
To ensure that new development retains and enhances that character.	
To ensure that development is sympathetic to the natural environment and ecological processes of the area.	The proposed EMA does not require further tree removal, and does not result in any adverse impact on ecological processes as effluent will be treated to a high quality standard prior to disposal to EMA.
To enable development for purposes other than residential only if it is compatible with the character of the living area and has a domestic scale.	The activity enables the residential development.
To ensure that water supply and sewage disposal on each resultant lot of a subdivision is provided to the satisfaction of the Council.	The proposal will continue to provide effluent disposal for each approved residential lot.
To ensure that development does not create unreasonable demands for the provision or extension of public amenities or services.	The amendments do not result in an intensification of the approved subdivision. No additional demand is therefore created.

3.9.2 Remaining HLEP Provisions

Table 5 provides an assessment against the relevant provisions of HLEP.

Table 5: Remaining HLEP provisions.

Clause	Requirements	Assessment	Compliance
4.1AA	**<u>Minimum subdivision lot size for community title schemes</u>** *(3) The size of any lot resulting from a subdivision of land to which this clause applies (other than any lot comprising association property within the meaning of the Community Land Development Act 1989) is not to be less than the minimum size shown on the Lot Size Map in relation to that land.* Minimum 450 m² (Attachment A, Map 05).	No changes to the approved lot sizes or lot boundaries are proposed and the approved lots shall remain greater than 450 m². Lots 10 to 20 shall include a positive covenant and easement providing access to Aquacell and restricting the land owners to build upon the EMA.	Y

Clause	Requirements	Assessment	Compliance
4.1D	***Exceptions to minimum subdivision lot size for certain land*** *(1) Despite clauses 4.1, 4.1AA and 4.1A, development consent must not be granted for the subdivision of land that is identified as "Area A" and edged heavy blue on the Lot Size Map if:* *(a) arrangements satisfactory to the consent authority have not been made before the application is determined to ensure that each lot created by the subdivision will be serviced by a reticulated sewerage system from the date it is created, and* *(b) The area of any lot created by the subdivision that contains or is to contain a dwelling house is less than 4,000 square metres.*	The Site is located within "Area A" identified on HLEP Lot Size Map. The future residential lots will continue to be serviced by the reticulated sewerage system approved under the Subdivision Development Consent.	Y
6.1	***Acid Sulfate Soils*** *(2) Development consent is required for the carrying out of works described in the Table to this subclause on land shown on the Acid Sulfate Soils Map as being of the class specified for those works.* *Class 5* *Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the watertable is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land.*	The Site is located within Class 5 Acid Sulfate Soils under the HLEP mapping. No works are proposed below 5 mAHD and therefore development will not disturb, expose or drain acid sulfate soils.	Y
6.4	***Terrestrial Biodiversity*** *(3) Before determining a development application for development on land to which this clause applies, the consent authority must consider—* *(a) whether the development—* *(i) is likely to have any adverse impact on the condition, ecological value and significance of the fauna and flora on the land, and* *(ii) is likely to have any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna, and* *(iii) has any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land, and*	The site is identified on the Terrestrial Biodiversity map as containing "significant vegetation" and "connectivity between significant vegetation" (Attachment A, Map 04). The proposed EMA will not result in any adverse impact on ecological values of the land because the southern portion of the Site subject to the proposed EMA is already approved to be cleared and receive treated effluent as per the Subdivision Development Consent. Further, the effluent is to be treated to high quality with UV disinfection prior to delivery to EMA. Therefore, no impacts on soils and surrounding environment are expected.	Y

Clause	Requirements	Assessment	Compliance
	(iv) is likely to have any adverse impact on the habitat elements providing connectivity on the land. *(b) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.* *(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that—* *(a) the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or* *(b) if that impact cannot be reasonably avoided by adopting feasible alternatives—the development is designed, sited and will be managed to minimise that impact, or* *(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.*		
6.7	***Essential Services*** *Development consent must not be granted to development unless the consent authority is satisfied that any of the following services that are essential for the proposed development are available or that adequate arrangements have been made to make them available when required:*		
	(a) the supply of water, *(b) the supply of electricity,*	The proposal does not affect supply of water or electricity.	Y
	(c) the disposal and management of sewage,	Wastewater management system including STP, sewage reticulation network and EMA, shall be available for the future residential lots.	Y
	(d) stormwater drainage or on-site conservation,	No amendments are proposed to the approved stormwater drainage design and the development will continue to be services by stormwater drainage.	Y
	(e) suitable road access.	Access to lots shall continue to be via the approved internal road as per the Subdivision Development Consent.	Y

3.10 Hawkesbury Development Control Plan 2012

Table 6 provides an assessment of the proposal against the relevant provisions of the *Hawkesbury Development Control Plan 2012* ("**HDCP**"). It is noted that the proposal subject of this REF does not raise any inconsistencies with any HDCP provisions.

Table 6: HDCP Assessment.

Rules	Assessment	Compliance
Part C: General Guidelines		
Chapter 7 Effluent Disposal		
(a) Waste water feasibility studies	A comprehensive land capability assessment including site landscape, soil and environmental setting assessment as well as details of operation and maintenance of the scheme by Aquacell and details of system monitoring of the disposal area, is provided in the Wastewater Management Plan (Attachment C).	Y
(b) Availability of Council Pump Out Service	The proposal provides a sewerage management system for the DA approved residential subdivision.	Y
(c) Connection to Reticulated Sewage Service	The proposal provides reticulated sewage connection for the DA approved residential development.	Y
(d) Subdivision of Rural or Environmental Protection zoned land	N/A	N/A

4 Environmental Impact Assessment

4.1 Overview

This section provides a detailed description of all potential environmental impacts associated with construction and operation of the EMA with minimisation and mitigation measures where required.

4.2 Topography

The proposal will not have any impacts on topography because:

1. The EMA is below ground with no material changes proposed in existing ground levels.

2. Construction is of a minor nature and located on land not subject to land instability. Effluent loading rates are low and will not lead to an increase in risk of slope instability.

3. No bulk earthworks are proposed.

4.3 Soils

The potential impacts of the EMA on soils is summarised in Table 7. The assessment shows that the EMA will not lead to any long term detrimental impacts on soils.

Table 7: Soils assessment.

Potential Risks	Mitigation Measures	Impact Assessment
Soil loss during construction	1. Appropriate soil and environmental controls have been adopted. 2. EMA is in one consolidated area which shall be constructed at early phases of subdivision works.	No impacts anticipated to soils during construction.
Degradation of soil profile	1. The adopted DLRs are in accordance with AS/NZS 1547. 2. The STP will result in high quality effluent prior to delivery to EMA.	No impacts associated with degradation of soil profile are anticipated.

4.4 Surface Water

This section discusses potential impacts to surface water. Based on Table 8, the EMA will not lead to any long term surface water impacts.

Table 8: Surface water assessment.

Potential Risks	Mitigation Measures	Impact Assessment
Effluent ponding and human contact	1. The adopted DLRs are in low and are in accordance with AS/NZS 1547. 2. The proposed EMA is 2.2 times larger than the required size. 3. A diversion bund is provided upslope of the EMA to prevents run on. 4. Water balance assessment in the accompanying Wastewater Management Plan (Attachment C) shows no effluent resurfacing. 5. The STP will result in high quality effluent prior to delivery to EMA. 6. Ongoing maintenance and monitoring of EMA shall take place including repairs as necessary.	No impacts on surface water are anticipated as a result of effluent ponding and human contact.
Pollution of receiving waters	1. Proposed EMA is located outside minimum required buffers from local drainage lines. 2. There are no overland flow paths within or near EMA. 3. The adopted DLRs are in low and are in accordance with AS/NZS 1547. 4. The proposed EMA is 2.2 times larger than the required size. 5. A diversion bund is provided upslope of the EMA to prevents run on. 6. Water balance assessment in the accompanying Wastewater Management Plan (Attachment C) shows no effluent resurfacing. 7. The STP will result in high quality effluent prior to delivery to EMA. 8. Ongoing maintenance and monitoring of EMA shall take place including repairs as necessary. 9. Effluent being applied via subsurface application.	No impacts on surface water are anticipated as a result of polluted receiving waters.

4.5 Groundwater

Table 9 below provides an assessment of potential risks to groundwater with associated mitigation measures for each risk. Based on this, there will be no adverse impacts.

Table 9: Groundwater assessment.

Potential Risks	Mitigation Measures	Impact Assessment
Quantity impacts	1. The adopted DLRs are in low and are in accordance with AS/NZS 1547. 2. Significant separation between the EMA and groundwater is provided. 3. No Groundwater Dependent Ecosystems ("**GDE**") are located within 100 m of EMA. 4. Volume of treated effluent applied is low.	No impacts on groundwater quantity are anticipated.
Quality impacts	1. The STP will result in high quality effluent prior to delivery to EMA. 2. Routine maintenance shall be undertaken. 3. Environmental monitoring shall be undertaken. 4. Annual nutrient loads are low and will be assimilated within or at close proximity to EMA so there is no material off site impact. 5. Significant separation between the EMA and groundwater is provided.	No impacts on groundwater quality are anticipated.

4.6 Noise

Subsurface disposal of treated wastewater is a passive process that does not require any plant or other machinery. Noise impacts associated with the STP have been assessed by Rodney Stevens Acoustics Pty Ltd and concluded to be compliant with regulatory requirements (Attachment H). No further noise impacts will arise from the operation of the EMA.

The noise associated with the construction of the trenches is expected to be minimal given the shallow depth of the trenches requiring excavation of less than 0.5 m deep.

4.7 Odour

There are no proposed changes to the operation of the STP or associated odour management measures. Given the effluent is being disposed of below ground and as concluded in the accompanying odour assessment (Attachment G), the EMA is not anticipated to be a source of odour (Table 10).

Table 10: Odour assessment.

Potential Risks	Mitigation Measures	Impact Assessment
Odour	The following mitigation measures have been adopted: 1. Disposal of effluent to suitably sized sub surface trenches and selection of appropriate DLR to minimise risk of effluent resurfacing. 2. Treatment of effluent to tertiary treatment standard and UV disinfection prior to disposal. 3. All system delivery infrastructure (mains, valves, etc.) to be located in ground (in all weather valve boxes with Class A lids where necessary). 4. Regular system maintenance and monitoring (STP and EMA) shall take place.	No odour impacts are anticipated.

4.8 Traffic

The site is within a rural residential area accessed from Kurrajong Road. An assessment has been undertaken by Positive Traffic Pty Ltd with respect of additional traffic impacts (Attachment F), which concludes the modification to the EMA would not result in any additional traffic impacts because

1. The revised scheme does not modify the arrangements of the lots apart from wastewater disposal area,

2. The proposal does not result in any additional frequency of service to that of the original scheme assumptions (1-2 per annum).

Overall, the arrangements of the new scheme would not result in a traffic impact to the detriment of the surrounding road network nor the scheme itself, but rather we expect the revised scheme to result in a reduction in traffic generation due to the consolidated EMA as opposed to 35 individual lots.

4.9 Visual

The existing environment is a rural residential area described in Section 2. There are a small number of residences located approximately 25-30 m from and upslope of the proposal to the southern boundary of the site. The EMA is ancillary to the approved residential lots. The EMA will not have any impact to the context or setting of the area given it is under ground with boundary landscaping to screen the effluent disposal area.

4.10 Landscaping Analysis

The approved landscape plan shows an average pf three indicative trees in the rear of lots 10 to 20. It is noted on this plan that "*some trees may be removed in the future to accommodate effluent disposal areas*". The proposed landscape plan (Attachment D), shows a very similar number of indicative trees. Table 11 below provides a comparison on the number of indicative trees between the approved and proposed landscape plan in the rear of lots 10 to 20.

Table 11: Number of indicative trees within the rear of lots 10 to 20.

Lots	Approved Rev E	Proposed Rev F
10	6	6
11	0	0
12	3	3
13	3	3
14	3	3
15	3	2
16	3	3
17	3	3
18	2	2
19	2	2
20	4	4
Total number of indicative trees	**32**	**31**
Mean per lot	**2.9**	**2.8**

4.11 Flora and Fauna

The proposed EMA will not result in any adverse impact on flora and fauna because:

1. The southern portion of the Site subject to the proposed EMA is already approved to be cleared and receive treated effluent as per the Subdivision Development Consent.

2. Effluent is to be treated to high quality with UV disinfection prior to delivery to EMA, causing no impacts on soils and surrounding environment.

3. As outlined in previous sections of this REF, there are no impacts on soils, surface water or groundwater, therefore no associated ecological impacts are anticipated.

4. As outlined in previous section the proposed landscaping provides almost the same number of indicative trees within the rear of lots 10 to 20.

4.12 Heritage

The Site is located within proximity to a heritage item named "Goldfinders Inn Group" located approximately 75 m northwest of the Site at 164 Old Bells Line of Road, Kurrajong (Attachment A, Map 03). This heritage item is listed in Hawkesbury LEP (Item 357) as a local significance, and by NSW Office of Environment and Heritage as a State significance.

The proposal will not result in any adverse impacts on this heritage item because:

1. The EMA is underground with no material changes to existing ground surface.
2. The EMA is sufficiently distant from the heritage item.
3. Future dwellings will be located between the heritage item and EMA, therefore no direct views from the heritage item to the EMA.

4.13 Bushfire

Previous bushfire assessment prepared for the subdivision DA identified the vegetation within the proximity to the site as managed/developed. The report states that the Site once developed will also be considered managed and all significant bushfire vegetation will be removed. We understand GTAs have been provided by NSW RFS for the Subdivision Development Consent.

Further consideration with respect of the revised EMA has been undertaken by Bushfire Planning Services Pty Ltd concluding it will not adversely affect the results of the original assessment and RFS approvals (Attachment E).

5 Conclusion

The proposed wastewater management plan includes a centralised tertiary treatment grade sewage treatment plant followed by sub surface application to a centralised treated EMA. The proposed EMA system modifies that originally conceived under the Residential Subdivision Consent (DA 0830/15), which consisted of application of treated effluent to discrete disposal fields within each approved Lot. The modified scheme now proposed consolidates the effluent disposal area into a single centralised area, this assisting with access, maintenance and long-term management.

We conclude:

1. The proposal consolidates the effluent disposal into a single area improving access, maintenance and long-term management.

2. The soils are suitable to accept treated effluent.

3. The trenches have been designed adopting low loading rates, while the STP will treat effluent to high quality tertiary level and disinfected.

4. The wastewater management system is sustainable allowing long term operation to meet the needs of future residents.

5. Monitoring and maintenance of the system will take place ensuring the long-term efficiency of the system.

6. The proposal satisfies the factors listed under clause 228 (2) of the *Environmental Planning & Assessment Regulation 2000* (NSW).

7. The proposal does not present a significant risk of harm to the environment.

Accordingly, we consider the proposal warrants the granting of WICA Licencing.

6 References

Bush Fire Planning Services (2020), Bushfire Advice Letter

Clark, N.R. and Jones, D. C. (1991) Penrith 1:100,000 Geological Series Sheet 9030

C. M. Jewell and Associates Pty Ltd (2015), Phase 1 Environmental Site Assessment

GHD (2020), Odour from effluent irrigation

Hazelton, P.A. (1992) Soil Landscapes of the Penrith 1:100,000 Sheet, NSW Department of Conservation and Land Management

IPART (2020), Further Information Required

Martens and Associates (2020), Wastewater Management Plan

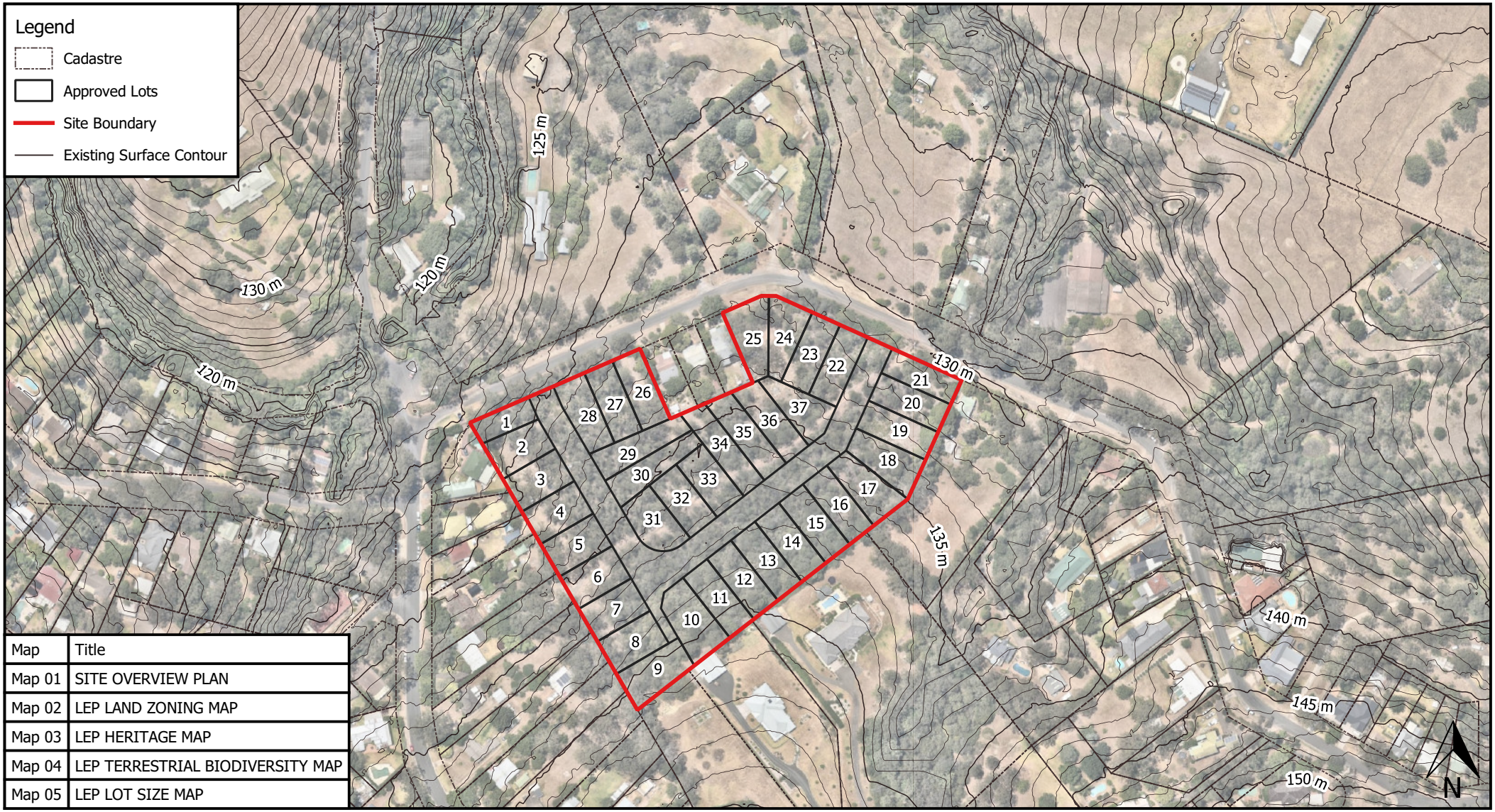
Narelle Sonter Botanica (2020), Landscape Plan

NSW Department of Planning, Industry and Environment, Office of Environment and Heritage website

Positive Traffic (2020), Traffic Assessment

Rodney Stevens Acoustics (2020), Noise Assessment

7 Attachment A – Mapset



Map	Title
Map 01	SITE OVERVIEW PLAN
Map 02	LEP LAND ZONING MAP
Map 03	LEP HERITAGE MAP
Map 04	LEP TERRESTRIAL BIODIVERSITY MAP
Map 05	LEP LOT SIZE MAP

0 30 60 90 120 150 m

1:3000 @ A4

Viewport 1

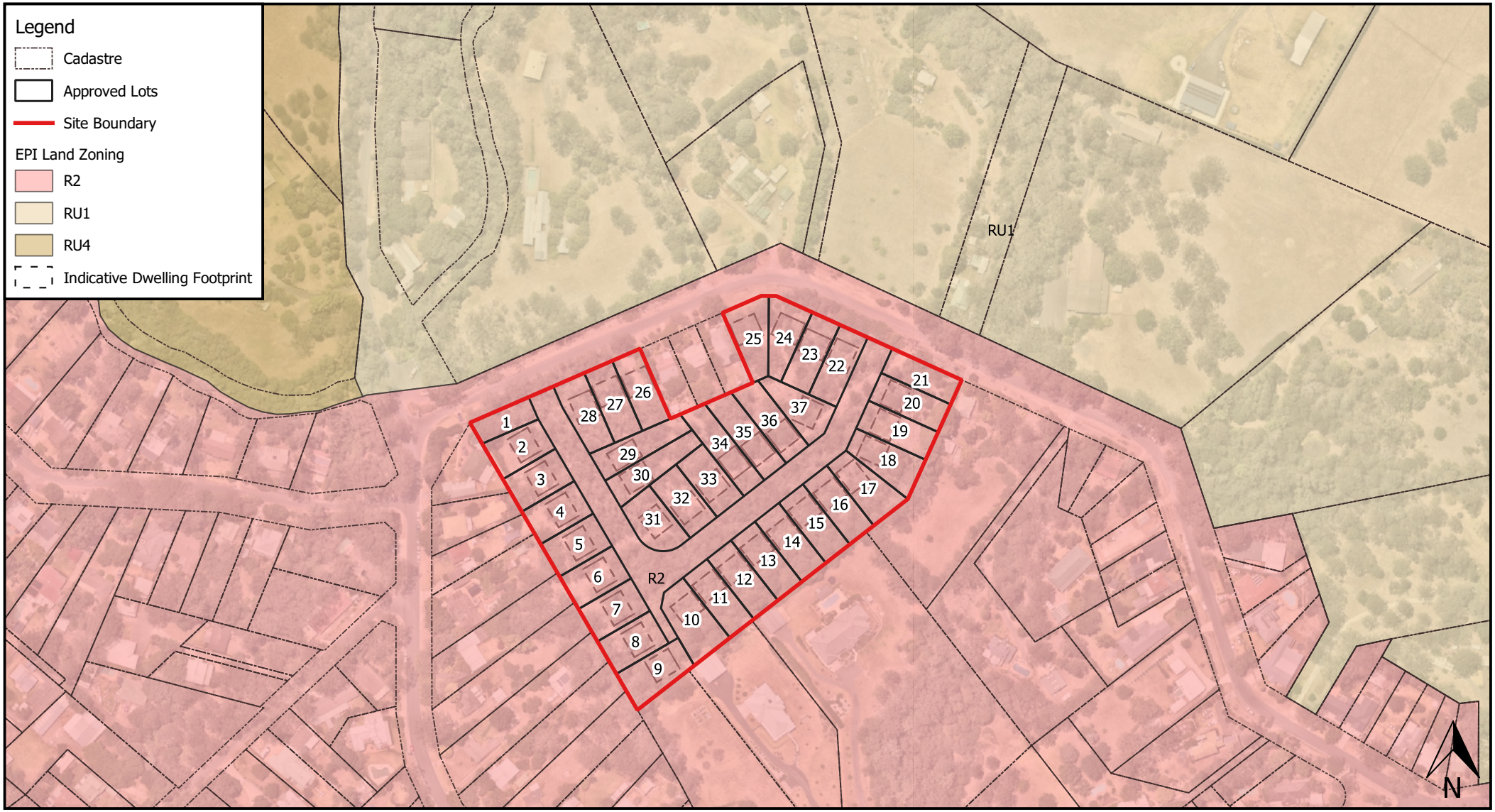
Project No: P1706231 Map Set: MS01-R02 EPSG: 28356

Map Title / Figure:

SITE OVERVIEW PLAN

Map 01	Map
67 KURRAJONG ROAD, KURRAJONG, NSW	Site
RESIDENTIAL SUBDIVISION	Project
WASTEWATER MANAGEMENT SYSTEM	Sub-Project
MMLM TRUST, PRJM P/L	Client
07/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects



Project No: P1706231 Map Set: MS01-R02 EPSG: 28356

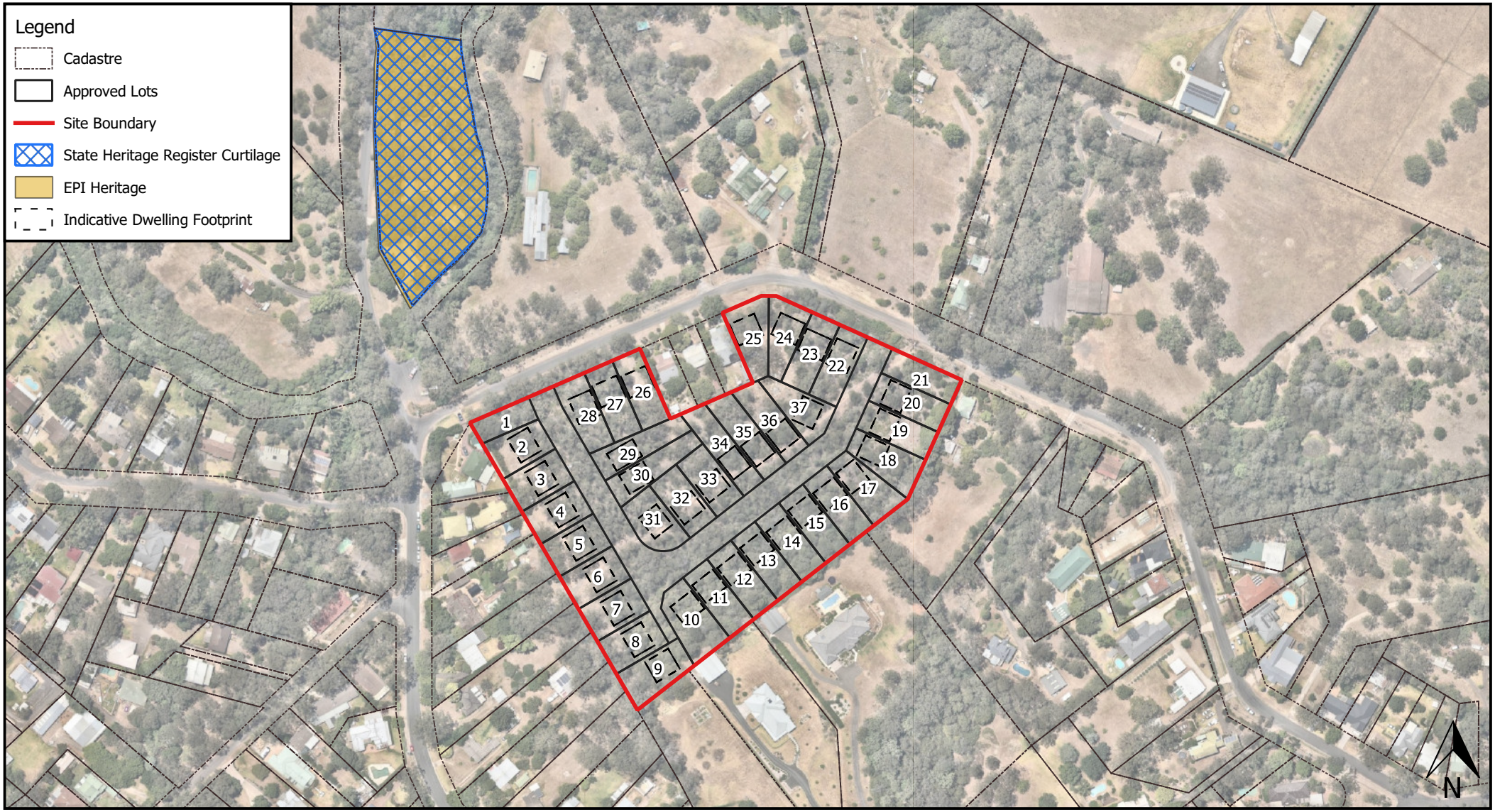
0 30 60 90 120 150 m

1:3000 @ A4
Viewport 1

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:
LEP LAND ZONING MAP

Map 02	Map
67 KURRAJONG ROAD, KURRAJONG, NSW	Site
RESIDENTIAL SUBDIVISION	Project
WASTEWATER MANAGEMENT SYSTEM	Sub-Project
MMLM TRUST, PRJM P/L	Client
07/09/2020	Date



0 30 60 90 120 150 m

1:3000 @ A4
Viewport 1

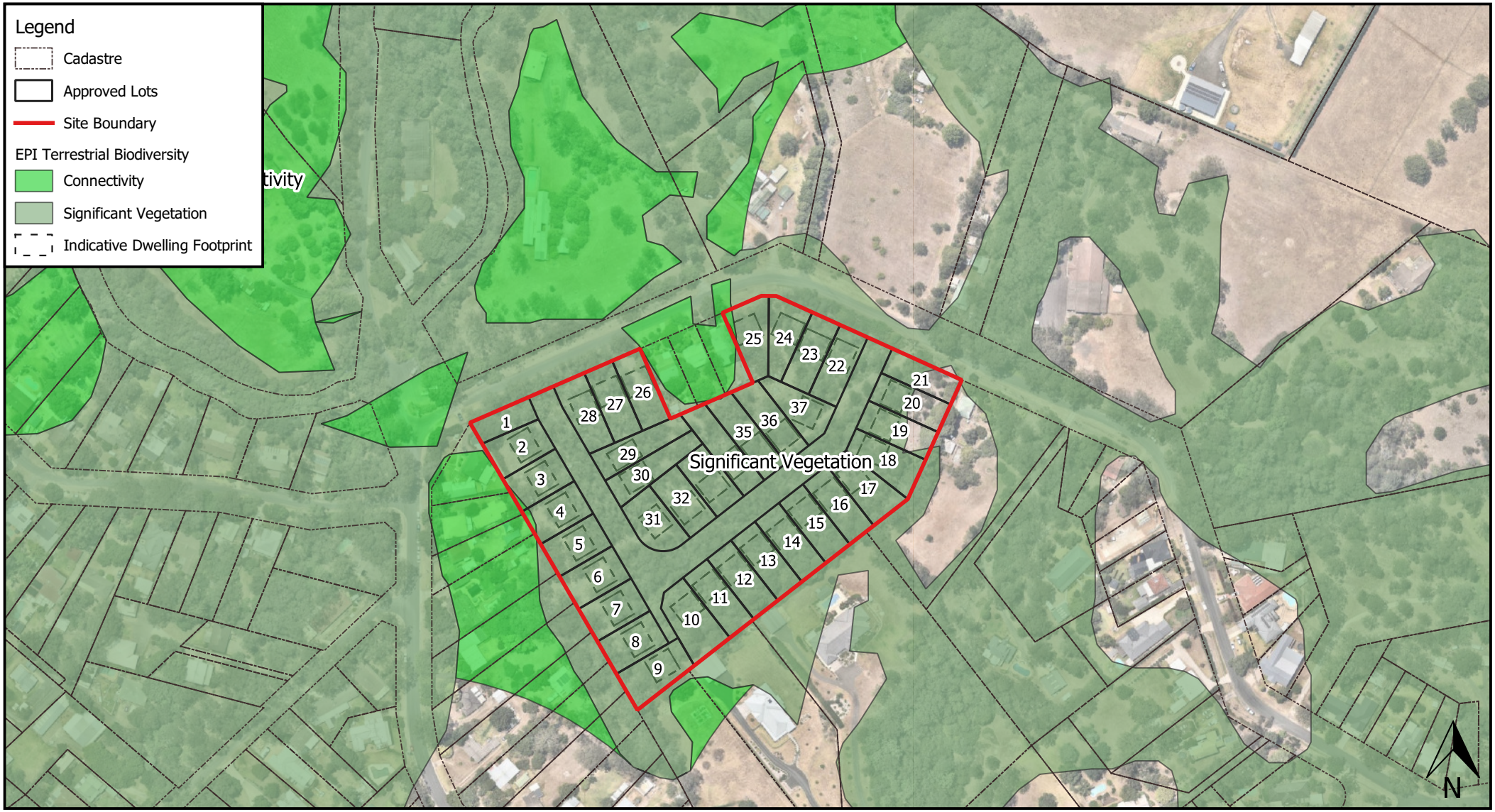
Project No: P1706231 Map Set: MS01-R02 EPSG: 28356

Map Title / Figure:

LEP HERITAGE MAP

Map 03	Map
67 KURRAJONG ROAD, KURRAJONG, NSW	Site
RESIDENTIAL SUBDIVISION	Project
WASTEWATER MANAGEMENT SYSTEM	Sub-Project
MMLM TRUST, PRJM P/L	Client
07/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects



0 30 60 90 120 150 m

1:3000 @ A4
Viewport 1

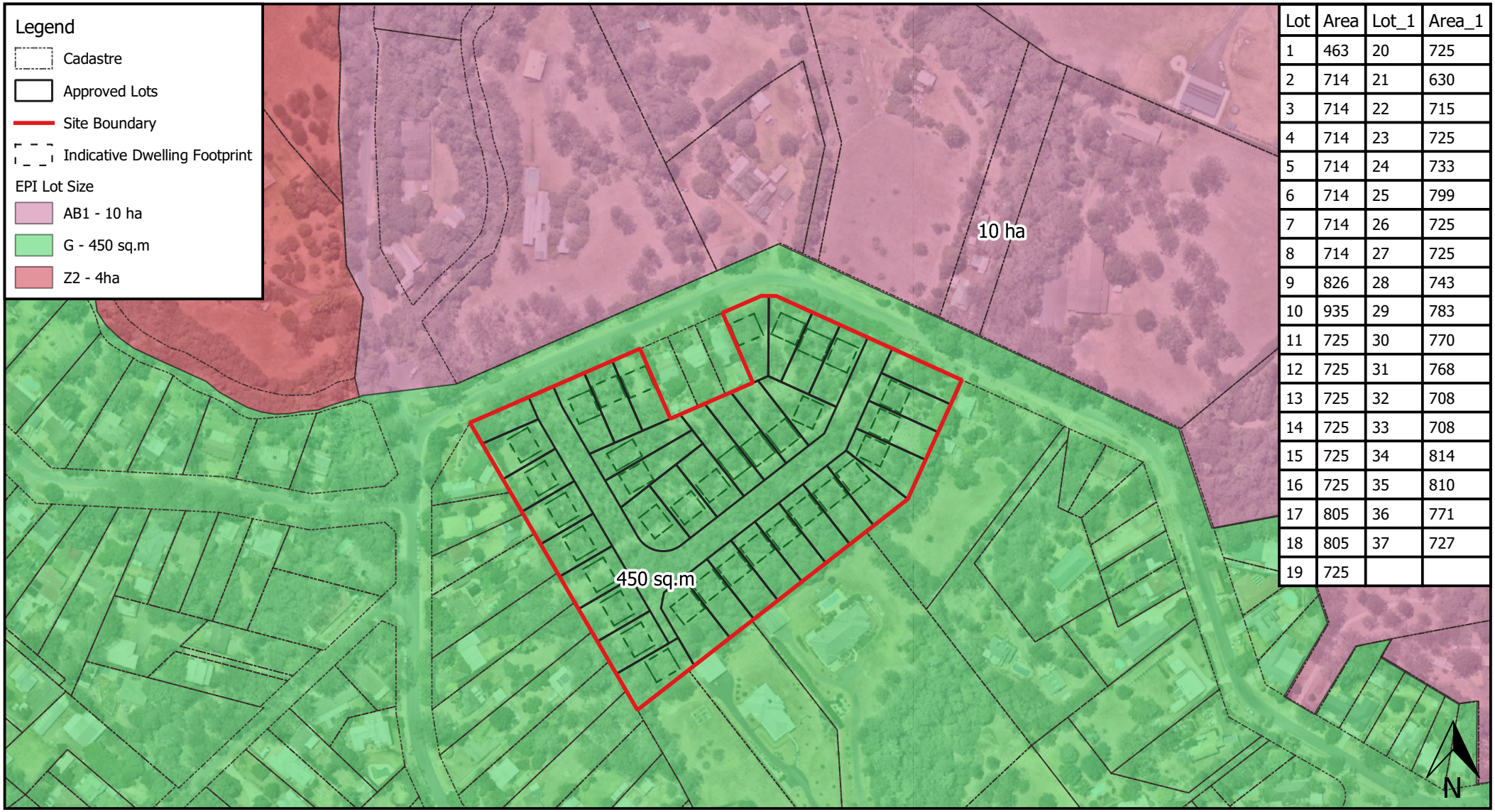
Project No: P1706231 Map Set: MS01-R02 EPSG: 28356

Map Title / Figure:

LEP TERRESTRIAL BIODIVERSITY MAP

Map 04	Map
67 KURRAJONG ROAD, KURRAJONG, NSW	Site
RESIDENTIAL SUBDIVISION	Project
WASTEWATER MANAGEMENT SYSTEM	Sub-Project
MMLM TRUST, PRJM P/L	Client
07/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects



Lot	Area	Lot_1	Area_1
1	463	20	725
2	714	21	630
3	714	22	715
4	714	23	725
5	714	24	733
6	714	25	799
7	714	26	725
8	714	27	725
9	826	28	743
10	935	29	783
11	725	30	770
12	725	31	768
13	725	32	708
14	725	33	708
15	725	34	814
16	725	35	810
17	805	36	771
18	805	37	727
19	725		

Project No: P1706231 Map Set: MS01-R02 EPSG: 28356

0 30 60 90 120 150 m

1:3000 @ A4
Viewport 1

Map Title / Figure:
LEP LOT SIZE MAP

Map 05	Map
67 KURRAJONG ROAD, KURRAJONG, NSW	Site
RESIDENTIAL SUBDIVISION	Project
WASTEWATER MANAGEMENT SYSTEM	Sub-Project
MMLM TRUST, PRJM P/L	Client
07/09/2020	Date

martens
Environment | Water | Geotechnics | Civil | Projects

8 Attachment B – IPART RFI

9 Attachment C – Wastewater Management Plan

10 Attachment D – Landscape Plan

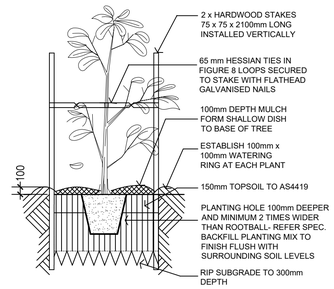
Appendix C14(e)(i) - Attachment D

01 LANDSCAPE PLAN
1:500

EXISTING TREES TO BE RETAINED

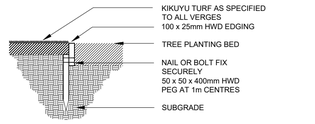
T0001	Eucalyptus amplifolia	T0102	Eucalyptus amplifolia
T0003	Acacia parramattensis	T0107	Eucalyptus amplifolia
T0006	Acacia parramattensis	T0109	Eucalyptus amplifolia
T0009	Eucalyptus amplifolia	T0110	Eucalyptus amplifolia
T0010	Eucalyptus amplifolia	T0115	Eucalyptus amplifolia
T0011	Eucalyptus amplifolia	T0116	Eucalyptus amplifolia
T0013	Eucalyptus amplifolia	T0117	Eucalyptus amplifolia
T0014	Eucalyptus amplifolia	T0122	Eucalyptus amplifolia
T0015	Eucalyptus amplifolia	T0123	Eucalyptus amplifolia
T0016	Eucalyptus amplifolia	T0124	Eucalyptus amplifolia
*T0017	Eucalyptus amplifolia	T0125	Eucalyptus amplifolia
*T0018	Eucalyptus amplifolia	T0126	Eucalyptus amplifolia
*T0019	Eucalyptus amplifolia	T0128	Eucalyptus amplifolia
*T0020	Eucalyptus amplifolia	T0135	Eucalyptus amplifolia
T0021	Eucalyptus amplifolia	T0136	Eucalyptus amplifolia
T0022	Eucalyptus amplifolia	T0138	Eucalyptus amplifolia
T0023	Eucalyptus amplifolia	T0139	Eucalyptus amplifolia
T0024	Eucalyptus amplifolia	T0141	Eucalyptus amplifolia
T0025	Eucalyptus amplifolia	T0142	Eucalyptus amplifolia
*T0026	Eucalyptus amplifolia	T0144	Eucalyptus amplifolia
*T0027	Eucalyptus amplifolia	T0145	Eucalyptus amplifolia
*T0028	Eucalyptus amplifolia	T0153	Eucalyptus amplifolia
T0030	Eucalyptus amplifolia	T0154	Eucalyptus amplifolia
*T0039	Eucalyptus amplifolia	T0159	Eucalyptus amplifolia
*T0040	Eucalyptus amplifolia	T0161	Eucalyptus amplifolia
T0041	Eucalyptus amplifolia	T0163	Eucalyptus amplifolia
T0042	Eucalyptus amplifolia	T0165	Eucalyptus amplifolia
T0045	Eucalyptus amplifolia	T0166	Eucalyptus amplifolia
T0047	Eucalyptus amplifolia	T0167	Eucalyptus amplifolia
T0056	Eucalyptus amplifolia	T0168	Eucalyptus amplifolia
T0057	Eucalyptus amplifolia		
T0068	Eucalyptus amplifolia		
T0080	Eucalyptus amplifolia		
T0091	Eucalyptus amplifolia		
T0092	Eucalyptus amplifolia		
T0094	Acacia parramattensis		
T0095	Eucalyptus amplifolia		
T0096	Eucalyptus amplifolia		
T0097	Eucalyptus amplifolia		
T0098	Eucalyptus amplifolia		

* Trees located on verge of Kurrajong Road



TREE PLANTING DETAIL

Note: 600mm DEPTH ROOT GAURD TO BE INSTALLED IMMEDIATELY ADJACENT PATHS AND LOT BOUNDARIES AND CENTRED ON STREET TREE. ROOT GAURD TO EXTEND TO 2m FROM CENTRE LINE IN BOTH DIRECTIONS TO PREVENT ROOT PENETRATION TO SUBSOIL DRAINAGE AND SUB GRADE OF ROAD



TIMBER EDGE DETAIL
NTS

LEGEND

PROPOSED STREET TREES

DISTRIBUTION OF RETAINED TREES (Refer Travers Bushfire & Ecology Plan: Tree Retention Plan)

INDICATIVE TREE LOCATION

EFFLUENT MANAGEMENT AREA

NOTE: SOME TREES MAY BE REMOVED IN THE FUTURE TO ACCOMMODATE EFFLUENT DISPOSAL AREAS

STREET TREE INDICATIVE SPECIES

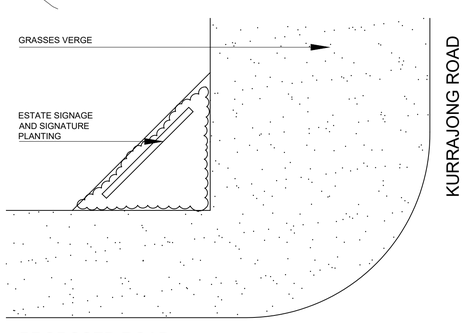
Botanical Name	Common Name	Mature Ht
Acacia elongata	Coast Myall	6m
Brachychiton populneus	Kurrajong	6-8m
Hymenosporum flavum	Native Frangipani	8m
Melaleuca decora	Paper Bark	8m

OSD BASIN INDICATIVE SPECIES

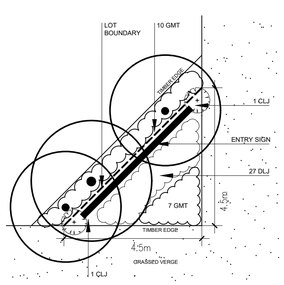
Botanical Name	
Acacia belongata	*Ficinia nodosa*
Baumea rubiginosa	*Jucus Kraussii*
Carex apressa	*Melaleuca linarifolia*
Eleocaris acuta	*Viminaria juncea*

ENTRY SIGN PLANT SCHEDULE

Key	Botanical Name	Common Name	Mature Ht	Pot Size	Nos
Shrubs					
CLJ	*Callistemon 'Little John'*	Little John	1m	25 litre	2
Grasses, Groundcovers & Climbers					
DLJ	*Dianella 'Little Jess'*	Little Jess	0.4m	150mm	27
GMT	*Grevillea 'Mt Tamboritha'*	Mt Tamboritha	0.2m	150mm	17



ENTRY SIGN LAYOUT PLAN
1:100



ENTRY SIGN PLANTING PLAN
1:100

INDICATIVE ESTATE SIGNAGE ELEVATION
NTS

Amendments:

F	Effluent Management area added	28.08.20
E	Issue for Council	07.02.17
	- Some existing trees removed for Inner Protection Zone requirements	
	- Effluent disposal fields removed.	
	- Screen shrubs surrounding buildings in service lots added	
	- Title of plan changed	
	- Note added re: possible future tree removal	
	- Tree 42 retained	
D	Issue for Council	15.08.16
C	Re-Issue for Council	18.07.16
B	Issue for Council	01.07.16
A	Issue for Review	10.06.16

N° Amendments: Date:

NARELLE SONTER
BOTANICA
LANDSCAPE AND HORTICULTURAL SPECIALISTS
PO Box 611 Avalon NSW 2107
Tel: (02) 9918 4016 Mobile: 0419 501 144

TITLE:

LANDSCAPE PLAN

67 KURRAJONG
KURRAJONG

SCALE: AS SHOWN@A1 DATE: AUG 2020

JOB N°: 150525 DWG. N°: LP.01/F
SHEET 1 of 1

11 Attachment E – Bushfire Assessment

Bushfire Planning Services Pty Limited. (02) 9654 3228 0428 408 577

Corporate member of the Fire Protection Association of Australia

Tuesday, 8 September 2020

- **Purpose;** To provide advice with regard to the changes to the effluent disposal area for the proposal will have on the bushfire requirements for the development.
- **Address;** 67 Kurrajong Road Kurrajong.
- **Lot and DP number;** Lot 1, Dp 1185012.
- **Referenced documents**; Bushfire Risk Assessment dated 21/12/2015, 100b Bushfire Safety Authority dated 29/1/2016, letter by Bushfire Planning Services dated 15/8/2016, RFS letter dated 2/11/2016, revised plans 8/9/2020.
- **Proposed works;** Amendment to effluent disposal area.

To whom it may concern.

Dear Sir/Madam.

The proposed new works are for an amended effluent disposal area. This will not require change in the boundaries of the lots nor will it increase the previous development footprint. The vegetation proposed within the area has been described as “mown grass”.

This company has undertaken a review of the original report, letters and RFS approvals and compared any new variables contained within the revised plans against the outcomes of the previous assessment.

It is my considered opinion as a person recognised by the New South Wales Rural Fire Service as a qualified consultant in Bushfire Risk Assessment that this revised proposal does not adversely affect the results of the original bushfire assessment and subsequent RFS approvals.

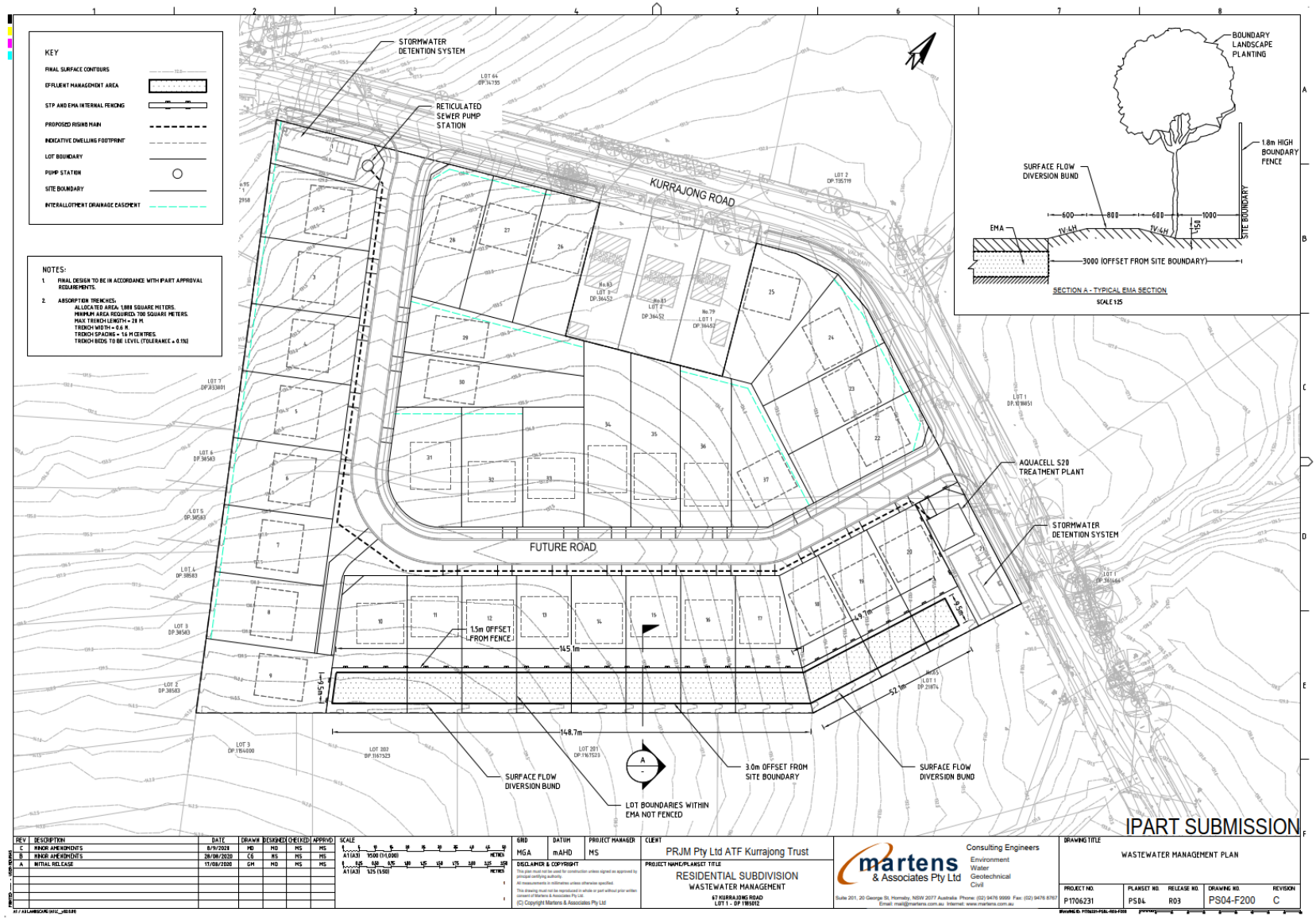
Should any further clarification be necessary please do not hesitate to contact me.

Yours Sincerely

Matthew Willis

*Grad Dip Planning for Bushfire Prone Areas (**FPAA BPAD Level 3 BPD-PA 09337)***

Bushfire Planning Services Pty Limited.


KEY
FINAL SURFACE CONTOURS
EFFLUENT MANAGEMENT AREA
STP AND EMA INTERNAL FENCING
PROPOSED RISING MAIN
INDICATIVE DWELLING FOOTPRINT
LOT BOUNDARY
PUMP STATION
SITE BOUNDARY
INTERALLOTMENT DRAINAGE EASEMENT
NOTES:
1. FINAL DESIGN TO BE IN ACCORDANCE WITH IPART APPROVAL REQUIREMENTS.
2. ABSORPTION TRENCHES:
ALLOCATED AREA: 1,800 SQUARE METERS.
MINIMUM AREA REQUIRED: 700 SQUARE METERS.
MAX TRENCH LENGTH = 20 M.
TRENCH WIDTH = 0.6 M.
TRENCH SPACING = 1.6 M CENTRES.
TRENCH BEDS TO BE LEVEL (TOLERANCE = 0.1%)
STORMWATER DETENTION SYSTEM
RETICULATED SEWER PUMP STATION
KURRAJONG ROAD
FUTURE ROAD
AQUACELL S20 TREATMENT PLANT
STORMWATER DETENTION SYSTEM
1.5m OFFSET FROM FENCE
14.5.1m
14.8.7m
SURFACE FLOW DIVERSION BUND
LOT BOUNDARIES WITHIN EMA NOT FENCED
3.0m OFFSET FROM SITE BOUNDARY
SURFACE FLOW DIVERSION BUND
BOUNDARY LANDSCAPE PLANTING
1.8m HIGH BOUNDARY FENCE
SURFACE FLOW DIVERSION BUND
EMA
SITE BOUNDARY
600
800
600
1000
1V:4H
1V:4H
1:150
3000 (OFFSET FROM SITE BOUNDARY)
SECTION A - TYPICAL EMA SECTION
SCALE 1:25
IPART SUBMISSION
REV C DESCRIPTION MINOR AMENDMENTS DATE 8/9/2020 DRAWN MD DESIGNED MD CHECKED MS APPROVED MS
REV B DESCRIPTION MINOR AMENDMENTS DATE 28/08/2020 DRAWN CG DESIGNED MS CHECKED MS APPROVED MS
REV A DESCRIPTION INITIAL RELEASE DATE 17/08/2020 DRAWN GM DESIGNED MD CHECKED MS APPROVED MS
SCALE A1 (A3) 1:500 (1:1,000) METRES
A1 (A3) 1:25 (1:50) METRES
GRID MGA DATUM mAHD PROJECT MANAGER MS
CLIENT PRJM Pty Ltd ATF Kurrajong Trust
PROJECT NAME/PLANSET TITLE RESIDENTIAL SUBDIVISION WASTEWATER MANAGEMENT
67 KURRAJONG ROAD LOT 1 - DP 1185012
DISCLAIMER & COPYRIGHT
(C) Copyright Martens & Associates Pty Ltd
martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au
DRAWING TITLE WASTEWATER MANAGEMENT PLAN
PROJECT NO. P1706231
PLANSET NO. PS04
RELEASE NO. R03
DRAWING NO. PS04-F200
REVISION C

12 Attachment F – Traffic Assessment

Our Reference: **PT15042**

Martens & Associates Pty Ltd
Suite 201
20 George Street
Hornsby, NSW 2077

8 September 2020

Dear Mr Shahrokhian

Lot 1 DP 1185012 67 Kurrajong Road, Kurrajong – Proposed Residential Sub Division
Revised Wastewater Treatment Plan Traffic Review

Further to your email below, our original traffic report for the subject site stated the following regarding servicing of the waste water etc:

Original Proposal

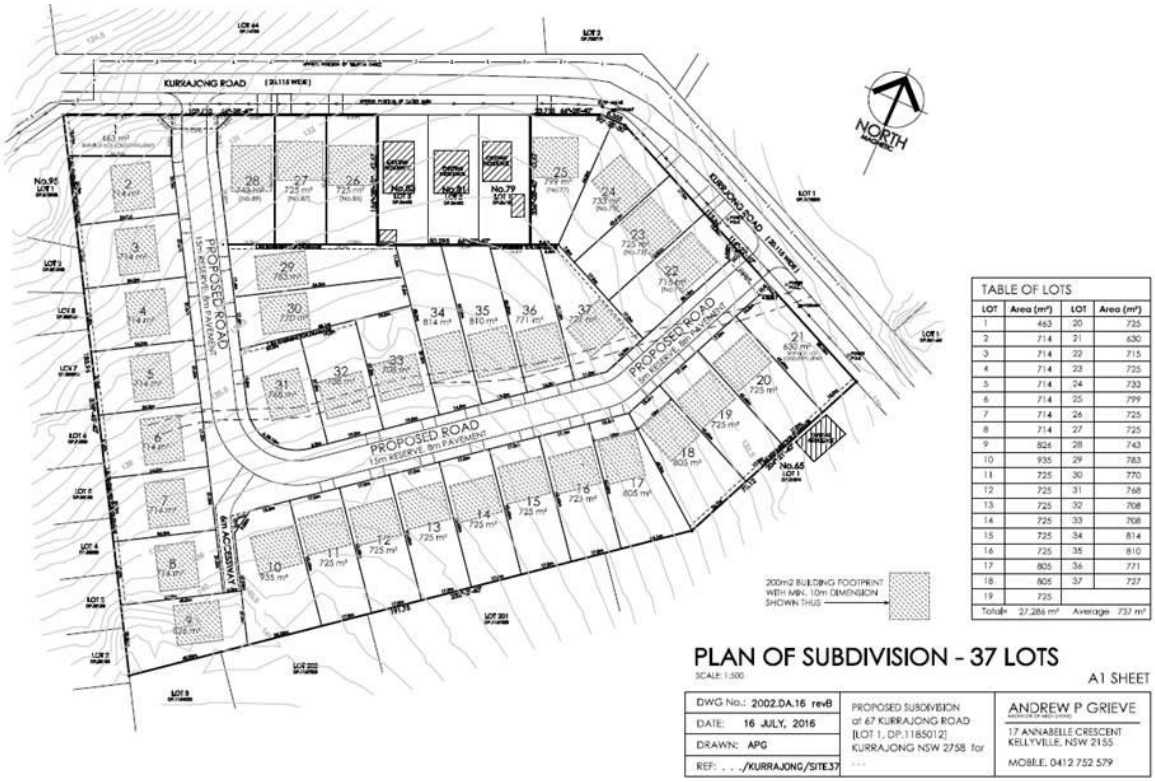
The formal vehicle loading bay has been removed as any pumping out of sewerage 1 – 2 times per annum can occur from the shoulder within Kurrajong Road adjacent to the sewerage facility.

The comment on consideration of the kerbside waste collection is unclear and further information was not provided at the Section 34 proceedings. Of note, the revised proposal includes a central spine road which exceeds the minimum requirements of the DCP (as was the case with the 52 lot proposal).

To confirm the suitability of the road, turning paths of a 9.8m long vehicle (representative of a large garbage truck have been prepared and are provided in Appendix B of this report. The proposed design can fully accommodate a 9.8m long garbage truck without issue.

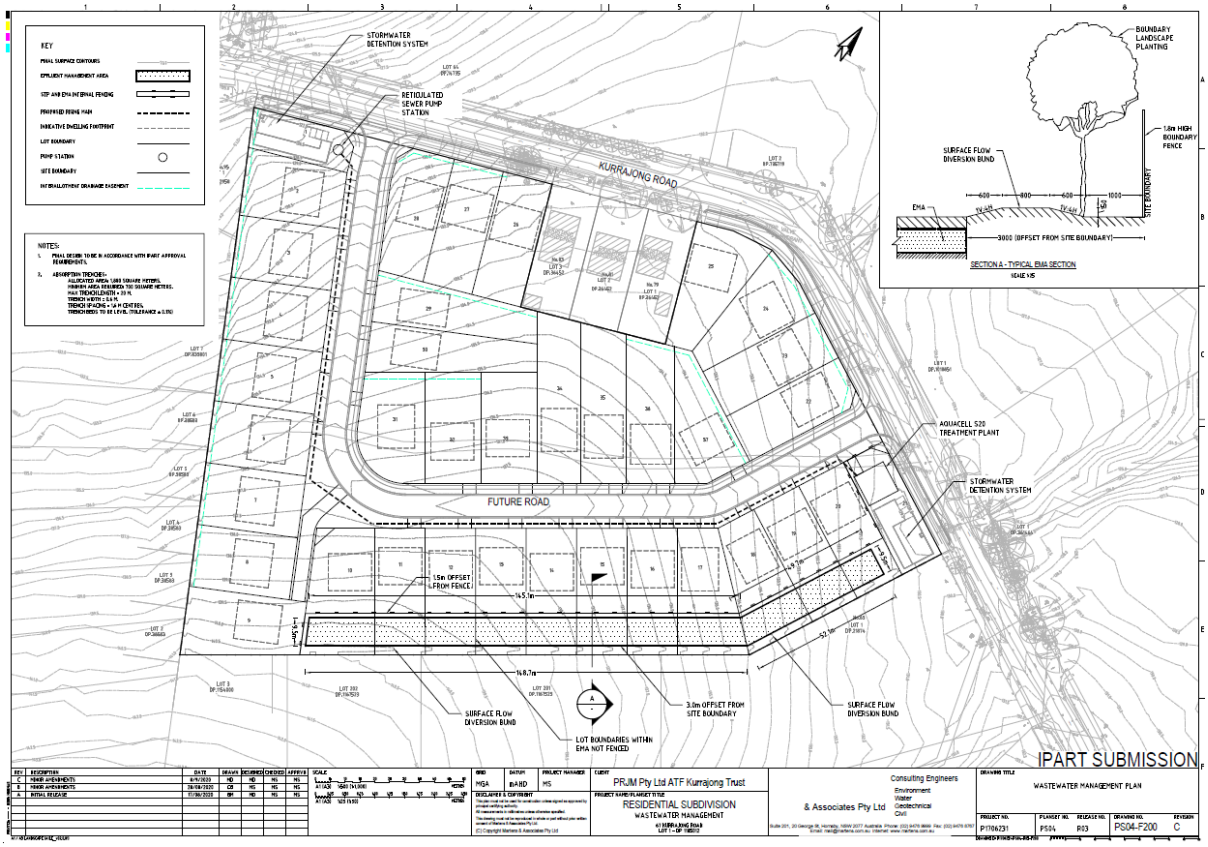
As detailed above, the servicing of the pump out station would require 1-2 vehicle trips per annum which negated the need for any formal separate service vehicle bay to undertake such servicing. Further, the arrangement of the pump out station with the proposed sub division at that time is shown below

Positive Traffic Pty Ltd ATF Positive Traffic Trust
PO Box 3457, Rouse Hill NSW 2155
T: 0414 462247 / E: dean@positivetraffic.com.au



Current Proposal

It is noted that the location of the of the pump out station and OSD of the current scheme mirrors that of the previous scheme which was the subject of our previous Joint Expert Traffic report as part of the Land and Environment Court Proceedings. The current scheme is shown below:



As the proposed revised scheme does not modify the arrangements of the lots set aside for wastewater treatment, nor result in any additional frequency of service to that of the original scheme assumptions, the change in arrangements would not result in any additional traffic impacts to that which was assessed previously. Thus, the assumptions of the previous traffic report in terms of 1-2 annum service trips of the new facility would remain.

Overall, the arrangements of the new scheme would not result in a traffic impact to the detriment of the surrounding road network nor the scheme itself.

We trust this information assists you in your planning for the development. Should you require any further information please do not hesitate to contact myself on 0414 462247.

Yours sincerely

DEAN BRODIE
Managing Director

13 Attachment G – Odour Assessment

8 September 2020

Michael McCarthy
Director
PRJM Pty Ltd

Our ref: 12537169-41961-1
Your ref:

Dear Michael

67 Kurrajong Road, Kurrajong
Odour from effluent irrigation

GHD has reviewed the amended effluent irrigation area associated with the proposed development at 67 Kurrajong Road, Kurrajong. This letter provides a summary of the review with regards to potential odour impacts from irrigation area at the site. This letter should be read alongside the GHD Kurrajong STP Odour Assessment (GHD, October 2018).

To inform the assessment, extracts from the Wastewater Management Plan (Ref. P1706231JR04V01 - Martens and Associates, 2020) were provided to GHD, along with a drawing showing the proposed treated wastewater irrigation area which is provided in Attachment A.

Martens advised 'The STP will be designed and managed in accordance with NSW DWE (2008) Management of Private Recycled Water Schemes. NSW DWE (2008) performance targets are based on end uses with a low level of contact. "Low level of contact" is defined as end uses with a low level of human contact including: urban irrigation with enhanced restricted access and application irrigation, in this case subsurface disposal to absorption trenches which effectively precludes any human contact with treated wastewater.'

The proposed STP includes tertiary waste water treatment with membrane filtration, and providing the STP meets the recommended STP effluent compliance and monitoring requirements (NSW DWE, 2008) then the effluent is not anticipated to be a source of odour.

The effluent will be pumped along the length of the new area shown in Attachment A and the effluent will be absorbed through a media (likely gravel or sand) into the underlying soil. Effluent should not be allowed to pool, or runoff to an area not designated for disposal in order to ensure correct operation and prevent odours occurring. If effluent is managed appropriately as per the design and recommended disposal rates outlined in the Wastewater Management Plan, odour from effluent disposal is not anticipated to be an issue at the site.

Amendments to the effluent disposal area location are not likely to be a source of odour providing the site is appropriately managed in accordance with the Wastewater Management Plan and therefore would be acceptable from an odour perspective.

GHD Pty Ltd ABN 39 008 488 373
Level 15 133 Castlereagh Street Sydney New South Wales 2000 Australia
T +61 2 9239 7100 **F** +61 2 9475 0725 **E** sydmail@ghd.com **W** www.ghd.com

This letter has been prepared by GHD for PRJM Pty Ltd and may only be used and relied on by PRJM Pty Ltd for the purpose agreed between GHD and PRJM Pty Ltd as described in this letter. GHD otherwise disclaims responsibility to any person other than PRJM Pty Ltd 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.

GHD has prepared this report on the basis of information provided by PRJM Pty Ltd 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 assumptions made by GHD described throughout this report. GHD disclaims liability arising from any of the assumptions being incorrect. GHD does not guarantee or warrant that should the proposal proceed, impacts on the site operations in Kurrajong would be as described in this report. GHD does not accept responsibility where actual impacts from the proposal differ or are greater than identified in this report.

Sincerely
GHD

Evan Smith
Senior Engineer
+61 2 92397695

Attachment A – Wastewater management plan drawing

KEY

- FINAL SURFACE CONTOURS
- EFFLUENT MANAGEMENT AREA
- STP AND EMA INTERNAL FENCING
- PROPOSED RISING MAIN
- INDICATIVE DWELLING FOOTPRINT
- LOT BOUNDARY
- PUMP STATION
- SITE BOUNDARY
- INTERALLOTMENT DRAINAGE EASEMENT

NOTES:

1. FINAL DESIGN TO BE IN ACCORDANCE WITH IPART APPROVAL REQUIREMENTS.
2. ABSORPTION TRENCHES:
   - ALLOCATED AREA: 1,880 SQUARE METERS.
   - MINIMUM AREA REQUIRED: 700 SQUARE METERS.
   - MAX TRENCH LENGTH = 20 M.
   - TRENCH WIDTH = 0.6 M.
   - TRENCH SPACING = 1.6 M CENTRES.
   - TRENCH BEDS TO BE LEVEL (TOLERANCE ± 0.1%)

STORMWATER DETENTION SYSTEM

RETICULATED SEWER PUMP STATION

KURRAJONG ROAD

FUTURE ROAD

LOT 64 DP.14735

LOT 2 DP.735719

LOT 7 DP.833801

LOT 6 DP.38583

LOT 5 DP.38583

LOT 4 DP.38583

LOT 3 DP.38583

LOT 2 DP.38583

LOT 3 DP.1154000

LOT 202 DP.1167523

LOT 201 DP.1167523

LOT 1 DP.1018851

LOT 1 DP.361464

No.83 LOT 3 DP.36452

No.81 LOT 2 DP.36452

No.79 LOT 1 DP.36452

No.65 LOT 1 DP.21874

EXISTING RESIDENCE

1.5m OFFSET FROM FENCE

145.1m

9.5m

148.7m

49.7m

52.1m

AQUACELL S20 TREATMENT PLANT

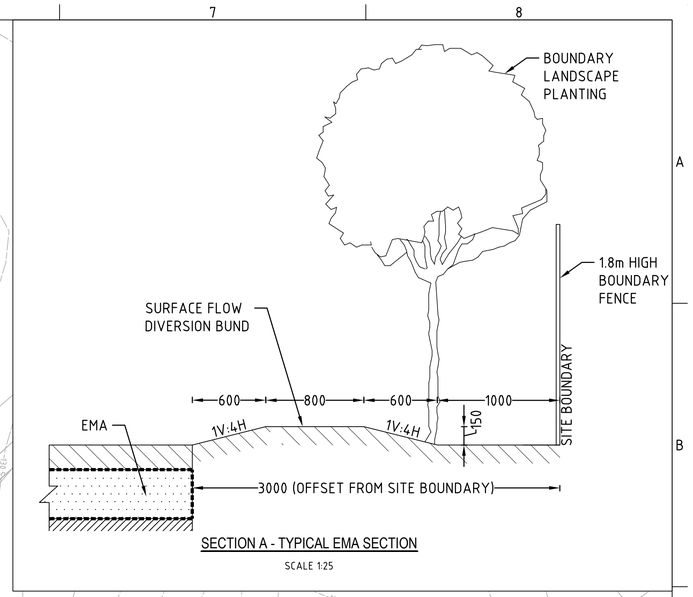
STORMWATER DETENTION SYSTEM

SURFACE FLOW DIVERSION BUND

LOT BOUNDARIES WITHIN EMA NOT FENCED

3.0m OFFSET FROM SITE BOUNDARY

SURFACE FLOW DIVERSION BUND



SECTION A - TYPICAL EMA SECTION

SCALE 1:25

IPART SUBMISSION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
C	**MINOR AMENDMENTS**	**8/9/2020**	**MD**	**MD**	**MS**	**MS**
B	MINOR AMENDMENTS	28/08/2020	CG	MS	MS	MS
A	INITIAL RELEASE	17/08/2020	GM	MD	MS	MS

SCALE

A1 (A3) 1:500 (1:1,000) METRES

A1 (A3) 1:25 (1:50) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	MS

CLIENT

PRJM Pty Ltd ATF Kurrajong Trust

PROJECT NAME/PLANSET TITLE

RESIDENTIAL SUBDIVISION

WASTEWATER MANAGEMENT

67 KURRAJONG ROAD
LOT 1 - DP 1185012

martens & Associates Pty Ltd

Consulting Engineers
Environment
Water
Geotechnical
Civil

Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE

WASTEWATER MANAGEMENT PLAN

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1706231	PS04	R03	PS04-F200	C

PRINTED: --- USER: MDAMS

A1 / A3 LANDSCAPE (A1LC_v02.0.01)

DRAWING ID: P1706231-PS04-R03-F200

14 Attachment H – Acoustic Report

Appendix C14(e)(i) - Attachment H

REPORT R180561

Revision 0

Noise Assessment,

Proposed Mechanical Noise Assessment

Aquacell S20 Blackwater Treatment Plant

67 Kurrajong Road

Kurrajong

29 October 2018

PO Box 522
Wahroonga NSW 2076
P 02 9943 5057
F 02 9475 1019
mail@rodneystevensacoustics.com.au

ABN 78 149 311 455
rodneystevensacoustics.com.au

TABLE OF CONTENTS

1 INTRODUCTION 3

2 SITE LOCATION 3

3 PROPOSED DEVELOPMENT 4

4 BASELINE NOISE SURVEY 5

5 AMBIENT NOISE LEVEL RESULTS 5

6 NOISE GUIDELINES AND CRITERIA 5

6.1 Mechanical Services Noise Criteria – *Noise Policy for Industry* 5
6.1.1 Intrusiveness Criterion 6
6.1.2 Amenity Criterion 6
6.1.3 Area Classification 6
6.1.4 Project Specific Noise Levels 6

7 NOISE IMPACT ASSESMENT 7

8 CONCLUSION 9

Table 5-1 Ambient Noise Results 5
Table 6-1 Operational Project Trigger Noise Levels 7
Table 7-1 Predicted Noise Levels at the closest residential receivers within the 67 Kurrajong Road subdivision. 7

Figure 2-1 Site Location 3
Figure 3-1 Aquacall Blackwater System 4
Figure 7-1 Acoustic Treatment 8

1 INTRODUCTION

Rodney Stevens Acoustics has been engaged by PRJM Pty Ltd to undertake an acoustical assessment for the sewerage package plant.

The 67 Kurrajong Road Residential Community Development is a 37-dwelling residential estate. It is located on the southern side of Kurrajong Road to the east of the intersection of Kurrajong Road and Old Bells Line of Road.

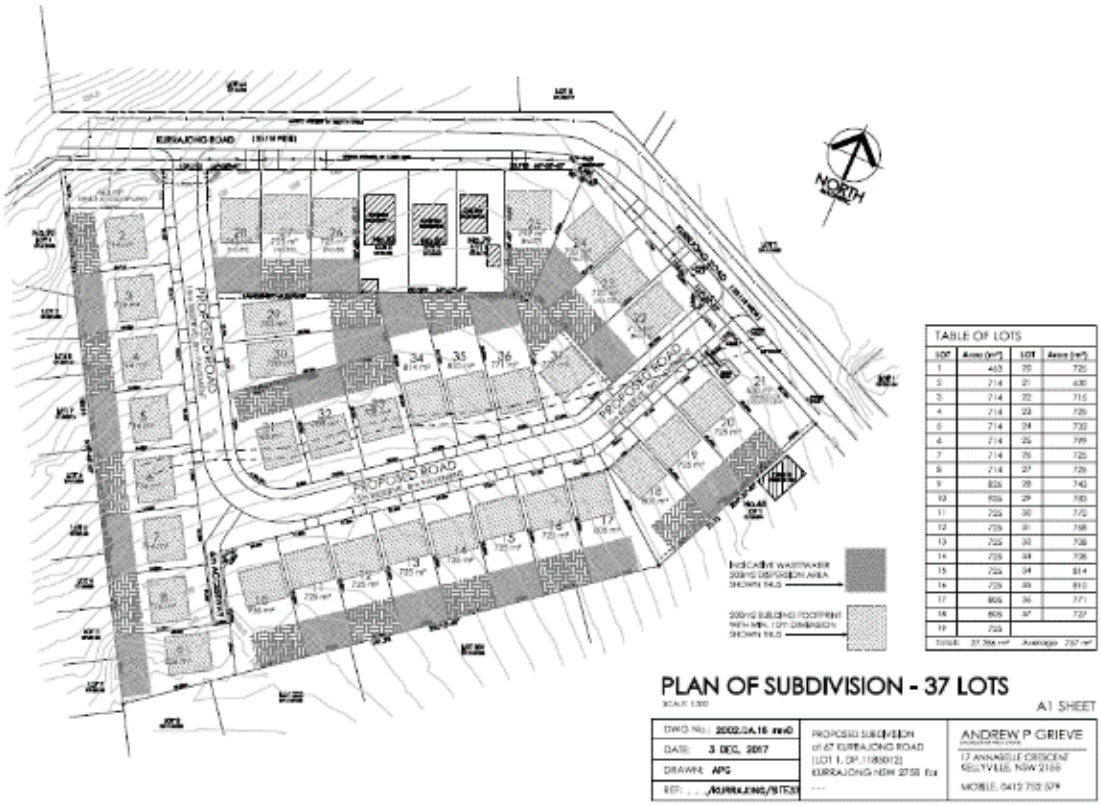
The development was approved subject to granting by IPART of a Network Operator Licence and Retail Supplier Licence and construction of a Blackwater Treatment Plant with designated areas for sub-surface irrigation. Potable water is being supplied by Hawkesbury Council's existing potable water reticulation; however, Council does not intend to provide sewer reticulation for this area.

IPART NOL 4.3.3 states: "No definitive analysis has been presented in the application to clearly demonstrate that there will be no offensive odours and 'noise' emanating from the future operation of the proposed sewerage scheme."

2 SITE LOCATION

The proposed development site is located at 67Kurrajong Road, Kurrajong.

Figure 2-1 Site Location



3 PROPOSED DEVELOPMENT

An Aquacell S20 blackwater treatment plant is to be installed to service all 37 dwellings within the development. There is no effluent reuse/recycling proposed for this site, only waste water disposal. The treated effluent is to be discharged to the environment via sub-surface irrigation, in compliance with WICA and Council s68 approvals.

The proposed Aquacell blackwater system is self-contained. The treated effluent is disposed of via sub-surface irrigation of allotted areas within the boundaries of the development. The proposed blackwater treatment plant will utilise wastewater discharged from the facility and irrigate via sub-surface irrigation at a rate of 21kl/day.

Noise monitoring of an existing Aquacell blackwater system was carried out within the Tallowood 'Over 55' residential development, 19-27 Vincent Road, Kurrajong on Wednesday 24th October 2018.

The Aquacell blackwater system within the Tallowood Development, as shown below, is identical to the proposed system to be with the development within the subdivision, 67 Kurrajong Road, Kurrajong.

Figure 3-1 Aquacall Blackwater System

4 BASELINE NOISE SURVEY

In order to characterize the existing acoustical environment of the area unattended noise monitoring was conducted between 24th and 28th October 2018 in the rear of the Tallowood residential development at a distance from the Aquacell Blackwater system that it was inaudible.

Logger location was selected with consideration to other noise sources that may influence readings, security issues for noise monitoring equipment and gaining permission for access from residents and landowners.

Instrumentation for the survey comprised of a RION NL-42 environmental noise logger (serial number 572559) fitted with microphone windshields. Calibration of the loggers was checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dB(A). All equipment carried appropriate and current NATA (or manufacturer) calibration certificates. Measured data was filtered to remove data measured during adverse weather conditions upon consultation with historical weather reports provided by the Bureau of Meteorology (BOM).

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10}, L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary for definitions in Appendix A).

5 AMBIENT NOISE LEVEL RESULTS

In order to assess the acoustical implications of the proposed development the measured data was processed according to the NSW Noise Policy for Industry.

Table 5-1 Ambient Noise Results

Noise Level – dBA re 20 µPa					
Day		Evening		Night	
RBL [1]	L_{Aeq} [2]	RBL [1]	L_{Aeq} [2]	RBL [1]	L_{Aeq} [2]
43	49	38	49	30	42

Note 1: The RBL noise level is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

Note 2: The L_{Aeq} is essentially the average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

6 NOISE GUIDELINES AND CRITERIA

6.1 Mechanical Services Noise Criteria – *Noise Policy for Industry*

Responsibility for the control of noise emissions in New South Wales is vested in Local Government and the EPA. The EPA oversees the Noise Policy for Industry (NPfI) October 2017 which provides a framework and process for deriving noise criteria. The NPfI criteria for industrial noise sources have two (2) components:

- Controlling the intrusive noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level amenity for particular land uses for residents and sensitive receivers in other land uses.

6.1.1 Intrusiveness Criterion

For assessing intrusiveness, the background noise generally needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (LAeq) of the source should not be more than 5 dB(A) above the measured Rated Background Level (RBL), over any 15 minute period.

6.1.2 Amenity Criterion

The amenity criterion is based on land use and associated activities (and their sensitivity to noise emission). The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. The criteria relate only to other industrial-type noise sources and do not include road, rail or community noise. The existing noise level from industry is measured.

If it approaches the criterion value, then noise levels from new industrial-type noise sources, (including air-conditioning mechanical plant) need to be designed so that the cumulative effect does not produce total noise levels that would significantly exceed the criterion.

6.1.3 Area Classification

The NPfI characterises the “Rural” noise environment

Receiver	**Noise amenity area**	**Time of day**	**L_{Aeq}, dB(A)**
(see Table 2.3 to determine which residential receiver category applies)			**Recommended amenity noise level**
Residential	Rural	Day	50
		Evening	45
		Night	40

6.1.4 Project Specific Noise Levels

Having defined the area type, the processed results of the attended noise monitoring have been used to determine project specific noise criteria. The intrusive and amenity criteria for nearby residential premises are presented in Table 6-1. These criteria are nominated for the purpose of assessing potential noise impacts from the proposed Aquacell Blackwater system.

In this case, the ambient noise environment is not controlled by industrial noise sources and therefore the project amenity noise level are assigned as per Table 2.2 of the NPfI (Recommended Amenity Noise Levels).

For each assessment period, the lower (i.e. the more stringent) of the amenity or intrusive criteria are adopted.

Table 6-1 Operational Project Trigger Noise Levels

Receiver	Time of Day	ANL [1] $L_{Aeq(15min)}$	Measured		Project Trigger Noise Levels	
			RBL [2] $L_{A90(15min)}$	L_{Aeq} Noise Level)	Intrusive $L_{Aeq(15min)}$	Amenity $L_{Aeq(15min)}$
Residential	Day	50	43	49	**48**	50
	Evening	45	38	49	**43**	45
	Night	40	30	42	**35**	40

Note 1: ANL = "Amenity Noise Level" for residences in Rural Areas.

Note 2: RBL = "Rating Background Level".

The project trigger noise levels for the sensitive receivers are derived to be $L_{Aeq(15min)}$ 48 dB(A) for the daytime period, $L_{Aeq(15min)}$ 43 dB(A) for the evening period and $L_{Aeq(15min)}$ 35 dB(A) for the night time period.

7 NOISE IMPACT ASSESMENT

Potential for noise emissions from the proposed development will be from the Aquacell Blackwater system. Noise from the Aquacell Blackwater system was measured on the 24th October 2018.

Table 7-1 Predicted Noise Levels at the closest residential receivers within the 67 Kurrajong Road subdivision.

Receiver Location	Predicted $L_{Aeq(15min)}$ Noise Level – dB(A)	Noise Criterion at Receiver Location – dB(A)	Compliance (Yes/No)
Lots A			
Day Time	24	48	Yes
Evening	24	43	Yes
Night Time	24	35	Yes
Lots B			
Day Time	22	48	Yes
Evening	22	43	Yes
Night Time	22	35	Yes
Lots C			
Day Time	20	48	Yes
Evening	20	43	Yes
Night Time	22	35	Yes

The predicted noise levels at the nearest and worst affected residential receivers within the development comply with the established noise criteria.

It is envisaged that the project specific noise goals can be achieved, however, the following measures are to be incorporated with the Aquacell Blackwater system design:

- The compressors will need to be contained within an enclosure having an Rw 30 wall and ceiling. This could be an enclosure from Flexshield
- Air flow into and from the enclosure is to be via an acoustic louvers.
- The enclosure is to have removable side panels for maintenance and to be internal lined with an acoustic insulation.

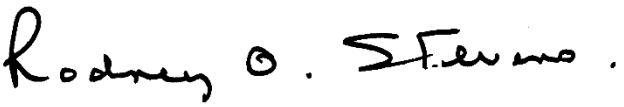
Figure 7-1 Acoustic Treatment

8 CONCLUSION

RSA has conducted a noise impact assessment for PRJM Pty Ltd of the proposed Aquacell Blackwater system to be located at 67 Kurrajong Road, Kurrajong as part of the subdivision of 37 lots. The assessment has comprised the establishment of noise criteria and assess noise impacts with regard to relevant statutory requirements.

Based on the noise impact study conducted, including the enclosure for the compressor, the Aquacell blackwater system will comply with the regulatory requirements

Approved:-



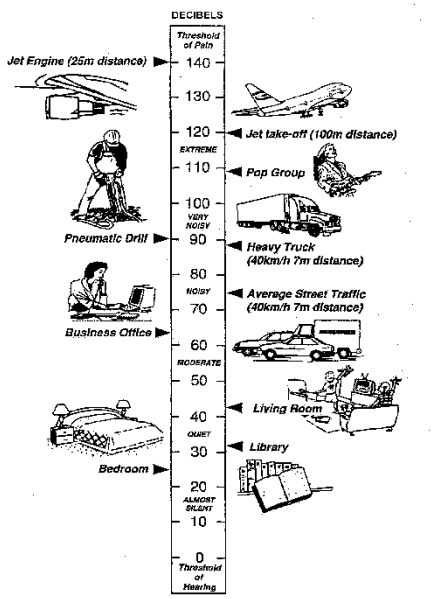
Rodney Stevens

Manager/Principal

Appendix A – Acoustic Terminology

A-weighted sound pressure	The human ear is not equally sensitive to sound at different frequencies. People are more sensitive to sound in the range of 1 to 4 kHz (1000 – 4000 vibrations per second) and less sensitive to lower and higher frequency sound. During noise measurement an electronic '*A-weighting*' frequency filter is applied to the measured sound level *dB(A)* to account for these sensitivities. Other frequency weightings (B, C and D) are less commonly used. Sound measured without a filter is denoted as linear weighted dB(linear).
Ambient noise	The total noise in a given situation, inclusive of all noise source contributions in the near and far field.
Community annoyance	Includes noise annoyance due to: character of the noise (e.g. sound pressure level, tonality, impulsiveness, low-frequency content) character of the environment (e.g. very quiet suburban, suburban, urban, near industry) miscellaneous circumstances (e.g. noise avoidance possibilities, cognitive noise, unpleasant associations) human activity being interrupted (e.g. sleep, communicating, reading, working, listening to radio/TV, recreation).
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Cumulative noise level	The total level of noise from all sources.
Extraneous noise	Noise resulting from activities that are not typical to the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Feasible and reasonable measures	Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors: Noise mitigation benefits (amount of noise reduction provided, number of people protected). Cost of mitigation (cost of mitigation versus benefit provided). Community views (aesthetic impacts and community wishes). Noise levels for affected land uses (existing and future levels, and changes in noise levels).

Impulsiveness	Impulsive noise is noise with a high peak of short duration or a sequence of these peaks. Impulsive noise is also considered annoying.
Low frequency	Noise containing major components in the low-frequency range (20 to 250 Hz) of the frequency spectrum.
Noise criteria	The general set of non-mandatory noise levels for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (e.g. noise levels for various land use).
Noise level (goal)	A noise level that should be adopted for planning purposes as the highest acceptable noise level for the specific area, land use and time of day.
Noise limits	Enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.
Performance-based goals	Goals specified in terms of the outcomes/performance to be achieved, but not in terms of the means of achieving them.
Rating Background Level (RBL)	The rating background level is the overall single figure background level representing each day, evening and night time period. The rating background level is the 10th percentile min L_{A90} noise level measured over all day, evening and night time monitoring periods.
Receptor	The noise-sensitive land use at which noise from a development can be heard.
Sleep disturbance	Awakenings and disturbance of sleep stages.
Sound and decibels (dB)	Sound (or noise) is caused by minute changes in atmospheric pressure that are detected by the human ear. The ratio between the quietest noise audible and that which should cause permanent hearing damage is a million times the change in sound pressure. To simplify this range the sound pressures are logarithmically converted to decibels from a reference level of 2 x 10-5 Pa. The picture below indicates typical noise levels from common noise sources.



dB is the abbreviation for decibel – a unit of sound measurement. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

Sound power Level (SWL)

The sound power level of a noise source is the sound energy emitted by the source. Notated as SWL, sound power levels are typically presented in *dB(A)*.

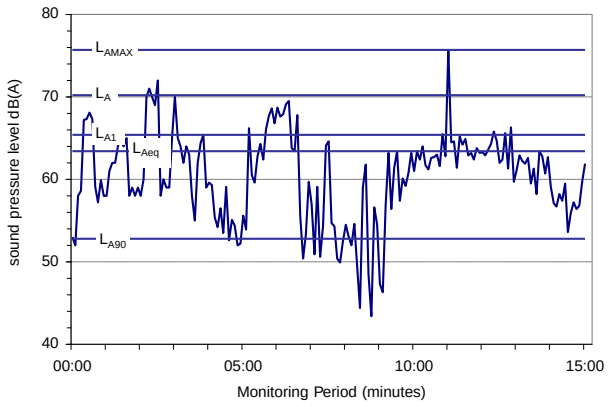
Sound Pressure Level (SPL)

The level of noise, usually expressed as SPL in *dB(A)*, as measured by a standard sound level meter with a pressure microphone. The sound pressure level in *dB(A)* gives a close indication of the subjective loudness of the noise.

Statistic noise levels

Noise levels varying over time (e.g. community noise, traffic noise, construction noise) are described in terms of the statistical exceedance level.

A hypothetical example of A weighted noise levels over a 15 minute measurement period is indicated in the following figure:



Key descriptors:

	L_{Amax} Maximum recorded noise level.
	L_{A1} The noise level exceeded for 1% of the 15 minute interval.
	L_{A10} Noise level present for 10% of the 15 minute interval. Commonly referred to the average maximum noise level.
	L_{Aeq} Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound.
	L_{A90} Noise level exceeded for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration).
Threshold	The lowest sound pressure level that produces a detectable response (in an instrument/person).
Tonality	Tonal noise contains one or more prominent tones (and characterised by a distinct frequency components) and is considered more annoying. A 2 to 5 dB(A) penalty is typically applied to noise sources with tonal characteristics.