STATEMENT OF ENVIRONMENTAL EFFECTS

Application under Division 4.3

of the *Environmental Planning and Assessment Act 1979*

Dual occupancy (detached) – moveable dwellings

Lot 7 DP 17774

65-67 Columbus Street, Ivanhoe

Central Darling Shire Council

December 2023

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1. Introduction

Desim Pty Ltd has been commissioned by Mr Adam Elgarhy (the owner of the site) to prepare a Statement of Environmental Effects (SEE) for a dual occupancy (detached) installed as manufactured homes (moveable dwellings) at 65-67 Columbus Street, Lot 6, DP17774, Ivanhoe NSW.

The advice received from the Council (email dated 31 May 2023) was that the development consent is required for the use of land in association with the installation of a relocatable home (that land not being in a caravan park or manufactured home estate). In determining a development application (DA) to install a relocatable home, the consent authority would be required to consider such of the matters referred to in section 4.15(1) of the *Environmental Planning & Assessment Act 1979* (EP&A Act) as are relevant to the subject development.

The purpose of this report is to provide Central Darling Shire Council with the relevant information necessary to assess the subject development proposal and to determine the development application in accordance with Section 4.15 of the EP&A Act and the *Environmental Planning* and *Assessment Regulation 2000*.

Desim Pty Ltd has expertise in planning, architecture, construction, urban design, heritage regulation and asset management.

1.1 Proposal

The subject site is located on the southern side of Columbus Street and has an approximate area of 1,233m^2. There is a dilapidated dwelling and some existing vegetation on the site.

The proposal is for demolishing the existing dwelling, preserving existing trees and constructing two (2) single storey two-bedroom moveable dwellings with associated services.

The existing development is not within any heritage conservation area nor listed as a heritage item.

The merits of the proposal are considered in the context of the relevant State and Central Darling Council planning instruments, codes, and policies.

In our opinion, the proposed development satisfies the relevant zone objectives in the Central Darling Local Environmental Plan 2012 (LEP). It is sympathetic to the existing surroundings ensuring that development retains the existing village character. The proposal will not create adverse impacts on adjoining properties.

1.2 Project Team

The preparation of the DA has been a collaborative effort by a team of consultants as specified in Table 1 below.

Table 1: The Project Team	
Town Planning	DESIM Pty Ltd
Architectural and landscape	DESIM Pty Ltd
Survey	Barnson Pty Ltd
Site and soil assessment and on site effluent management system	Barnson Pty Ltd

Residential Site Investigation Report (geotechnical assessment)	Barnson Pty Ltd
Structural Letter of compliance	Greycat Consulting Pty Ltd

2. Site analysis

Location

The subject site is located on the western side of Columbus Street, Lot 7, DP 17774, known as 65-67 Columbus Street, Ivanhoe within the Local Government Area (LGA) of Central Darling Shire Council (see Figure 1 & 2 below).

Figure 1: Site Location. Source: https://maps.six.nsw.gov.au/

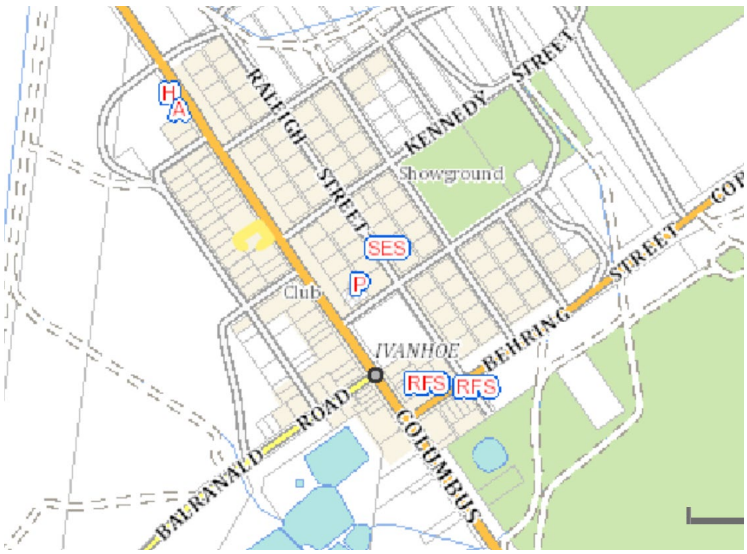

Figure 2: Site Location. Source: NSW Planning Portal

Site Description

The rectangular site has following characteristics:

- A frontage to Columbus Street of 20.23m
- A north west boundary of 60.95m
- A south east boundary of 60.95m
- A rear (south west boundary) of 20.23m

The land is oriented approximately east to west with a direct frontage to Columbus street and has a total area of 1,233m^2.

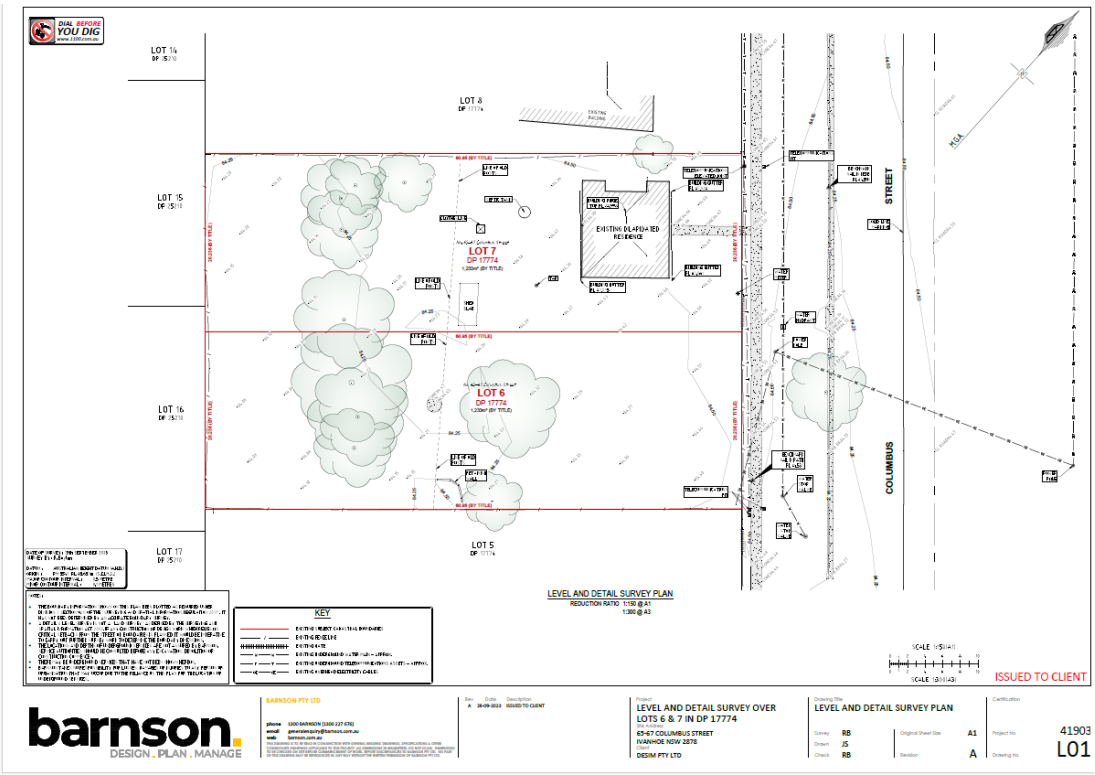

Figure 3: Survey Plan. Source: Barnson Pty Ltd

The site is relatively flat and falls approximately 0.50m (max) from north to the south side (Figure 3).

Existing building and landscape

The site is occupied by a single-storey dilapidated fibre-cement dwelling with a pitched roof and a shed/carport along the southern boundary and a pathway from the house to the main street (see Figure 4 and 5 below). The building has an existing gross floor area of approximately 103m^2.

Figure 4: Facade fronting Columbus Street (Oct 2023)

Figure 5: Backyard (Oct 2023)

The Survey Plan (dated 23 Sep 2023) identified 5 trees at the rear of the site (See **Attachment B** Survey). There is no significant vegetation with some grass typical of the locality.

A septic tank is located behind the existing house in the middle of the site.

Existing Character and Context

The surrounding, adjacent context comprises residential development on the similar lot size like the subject site. The character of the Columbus Street streetscape is defined by single storey dwellings on large residential lots with scattered trees of varying size and types on both sides.

Columbus Street is a two-way bitumen sealed road with a kerb and a gutter. The subject site has vehicular access to Columbus Street.

The site is largely cleared and has no affect on any threatened species or ecological communities or their habitats. The existing trees are not proposed to be removed.

3. The Proposal

The proposal is for the instalment of a dual occupancy (detached) utilising manufactured homes and, includes demolition of the existing dwelling and a carport on the site. The proposal does not include a removal of any of the existing trees on the property.

Further details of the development include:

- Demolition of the existing house, shed, clothes line, concrete footpath from the main street to the house and other above the ground structures. Removal of the existing septic tank.
- Installation of two (2) pre fabricated moveable dwellings: Unit Type 01 and Unit Type 02. Unit Type 01 has 33 m^2 and Unit Type 02 has 68 m^2. Total proposed gross floor area on the site is 101 m^2.
- Each of these two pre fabricated moveable dwellings include: two (2) bedrooms, living, dining, kitchen, one (1) bathroom and a terrace/deck.
- Compacted gravel/blue metal footpath from the house entry to the driveway.
- Two on-site individual effluent will be provided, one for each unit.
- Shared driveway with adjacent Lot 6 DP 17774 along the south east boundary, 3m width, gravel.

  Note: Lot 6 DP 17774 is owned by the same owner as Lot 7 DP 17774, the subject of this application. A separate DA for Lot 6 DP 17774 for a dual occupancy (detached), manufactured homes is submitted together with this application.

In relation to demolition works, it will be carried out in accordance with *Australian Standard AS2601: The Demolition of Structures.*

The following Attachments are provided:

Attachment A	Architectural and landscape plan for moveable dwellings
Attachment B	Survey
Attachment C	Site and soil assessment for on site effluent management system
Attachment D	Residential Site Investigation Report
Attancment E	Structural - Letter of compliance
Attachment F	Cost Summary

The DA includes core information required for all DAs as per Council's officer advice. The DA will be submitted via NSW Planning Portal.

4. Planning and development controls

Pursuant to Section 4.15 of the EPA Act, this section assesses compliance with the planning instruments applicable to the site in accordance with the relevant matters for consideration. The relevant planning instruments include:

- Far West Regional Plan 2036
- Central Darling Local Strategic Planning Statement
- Central Darling Local Environmental Plan (LEP) 2012, and
- State Environmental Planning Policy (SEPP) BASIX – 2004.

4.1 NSW State and local strategic planning

Far West Regional Plan 2036 identifies Ivanhoe as a local centre to provide ancillary service industries to support agriculture and mining.

As stated in the Shire's Local Strategic Planning Statement (LSPS), population figures for the Shire are one of the lowest in NSW. Ivanhoe is the centre of a traditional pastoral area and remains a prominent agricultural sector in the Shire, particularly sheep grazing.

The proposed development will provide additional housing opportunity in Ivanhoe which is aligned with goals and objectives of both State Regional Pland and the LSPS.

4.2 Central Darling Local Environmental Plan (LEP) 2012

The subject site is zoned RU5 Village under the LEP (see Figure 5).

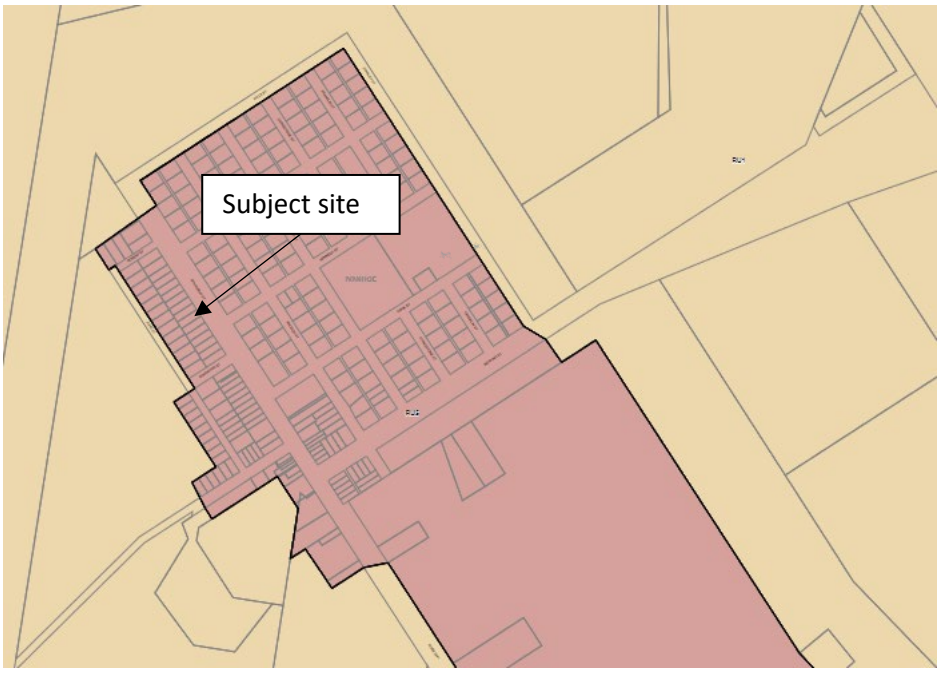

Figure 5: LEP Zoning Map – Sheet LZN_013A

Zone objectives of RU5 Village

The LEP Land Use Table contains the following objectives for the RU5 Village zone:

- *To provide a range of retail, business and community uses that serve the needs of people who live in, work in or visit the area.*
- *To retain and facilitate expansion and redevelopment of the existing centres of Menindee and Ivanhoe and to further strengthen the core commercial functions of those areas.*
- *To ensure that development retains and enhances the existing village character.*

The proposed residential development will provide additional housing for people who live or work in the area. It may also potentially contribute to an increase in the number of residents in the area which would ultimately contribute to the economic development facilitating the expansion and redevelopment of the village. The proposal is also compatible with the existing village character.

Accordingly, in our opinion, the proposal satisfies the relevant objectives of the RU5 Zone.

Land Use Table

Under Central Darling LEP 2012, the zoning of RU5 Village has following land uses and permissibility:

> ***2*** *Permitted without consent*
> *Environmental protection works; Home-based child care; Home occupations; Roads; Water reticulation systems*
>
> ***3*** *Permitted with consent*
> *Centre-based child care facilities; Community facilities; Dwelling houses; Liquid fuel depots; Neighbourhood shops; Oyster aquaculture; Places of public worship; Recreation areas; Recreation facilities (indoor); Recreation facilities (outdoor); Respite day care centres; Schools; Tank-based aquaculture; Any other development not specified in item 2 or 4*
>
> ***4*** *Prohibited*
> *Extractive industries; Forestry; Heavy industrial storage establishments; Heavy industries; Marinas; Open cut mining*

The proposed development is for ***'dual occupancy (detached)'*** in a form of ***'moveable dwelling'***. The LEP definitions are:

dual occupancy (detached) *means 2 detached dwellings on one lot of land, but does not include a secondary dwelling.*

Note: Dual occupancies are a type of residential accommodation

moveable dwelling *has the same meaning as in the Local Government Act 1993.*

Note—

The term is defined as follows—

moveable dwelling means—

(a) any tent, or any caravan or other van or other portable device (whether on wheels or not), used for human habitation, or

(b) a manufactured home, or

(c) any conveyance, structure or thing of a class or description prescribed by the regulations (under the Local Government Act 1993) for the purposes of this definition.

Response: The proposed development is considered permissible with consent in the RU5 Zone as *'any other development not specified in item 2 or 4'.*

Compliance with other LEP provisions

Clause 5.10 Heritage Conservation

The subject site has not been identified on the LEP Heritage maps as part of the conservation areas. The existing house have not been listed as a heritage item under Schedule 5 of the LEP. There were also no heritage items listed as being within proximity of the locality.

The search of the Aboriginal Heritage Information Management System shows that there are no Aboriginal items nor places within a 200m radius of the subject site.

Clause 5.21 Flood planning

The subject site is not identified within a flood planning area. No flood plannin or groundwater vulnerable maps were available of the proposed site.

Clause 6.1 Earthworks

Clause 6.1 'Earthworks' applies to the subject application as minor earthworks are included as part of the development works. The site is relatively flat throughout. There shall be no disruption on existing drainage patterns or soil stability in the area. Appropriate erosion and sediment controls will be undertaken on the site during development works to prevent and reduce any soil erosion that would occur on the site.

For more details on soil evaluation please refer to **Attachment C** – Site and Soil Assessment for on-site Effluent Management System (Barnson P/L).

Clause 6.4 Essential services

The required services that are available in the area, including town water supply, are available to the site. Additionally, disposal and management of sewerage will be provided onsite.

The onsite effluent management system proposed for this lot consists of a AWTS with secondary treated effluent disposed into evapotranspiration beds. For more details please refer to **Attachment C** – Site and Soil Assessment for on-site Effluent management system (Barnson P/L).

4.2 State Environmental Planning Policy (SEPP) BASIX – 2004

Planning Circular PS 21-016 published by the Department of Planning and Environment (DPE) confirms that BASIX certificate is not required for relocatable homes. A BASIX certificate is presently only required for residential development that involves the erection of a 'BASIX building', as defined in the EP&A Regulation. As a relocatable home is not within the definition of '*building*' under the EP&A Act, a BASIX certificate is not required for that type of residential development.

5. Local Government Act 1993

Planning Circular PS 21-016 (DPE) provides the clarification of the approval requirements for the installation of relocatable homes outside a caravan park or manufacture home estate. The EP&A Act defines '*moveable dwelling'* the same as the *Local Government Act 1993* (LG Act).

The installation of a relocatable home or associated structure on land other than in a caravan park of manufactured home estate requires approval under section 68 of the LG Act.

Relationship of the LG Act with the EP&A Act

Development consent is required for the use of land in association with the installation of a relocatable home if required by an environmental planning instrument, i.e. an LEP. In determining a DA to install a relocatable

home ,the consent authority would be required to consider such of the matters referred to in section 4.15(1) of the EP& A Act as are relevant to the subject development.

Comment: The proposed moveable dwellings will utilise an onsite effluent management system. A Section 68 Application will be lodged in conjunction with the DA prior to construction.

6. Other matters for consideration pursuant to S.4.15 of the Act

5.1 Impacts on the natural and built environment and the social and economic impacts

There will be no significant impact on the natural and built environment. The proposal does not involve the removal on any tree on the site. The siting, height, form and scale of the proposed development is acceptable and compatible with the existing building and surrounding area. The existing neighbourhood is characterised by a similar type of development.

The design and layout of the proposal will maintain aural and visual privacy for residents of neighbouring sites.

The proposal will only have positive social or economic impacts in the locality. In addition, the proposal will generate short term employment opportunities during the construction stage.

5.2 The site suitability

There are no site constraints that limit the potential to accommodate proposed dual occupancy attached. The proposal is considered to represent a very practical and sensitive design response to the site and the locality.

As the site is within village area, electricity, water and telecommunication are readily available and sufficient for the proposal.

The site is not in an area recognised by Council as being subject to flooding, bushfire or any other particular hazards. The proposed development will not increase the likelihood of such hazards.

5.3 The public interest

The public interest is considered in terms of compliance with the relevant planning and development controls applicable to the proposed development. In this regard the proposal is consistent with the relevant zone objectives under Council's planning instrument.

The proposal will contribute to housing availability which serves the public interest.

7. CONCLUSION

The proposed dual occupancy (detached) installed as moveable dwellings at Lot 7 DP 17774, No. 65-67 Columbus Street have been assessed in accordance with Section 4.15 of the EP&A Act and State and Council's planning instruments. The proposal is permissible in the RU 5 Village zone under the Central Darling LEP and in our opinion is consistent with the relevant objectives of the zone.

The proposal provides consistency in scale, form, proportions, setbacks and materials to other development within the area.

The proposal will not create any adverse impact on the present amenities of adjoining properties or the environment in general.

ATTACHMENT A (see Architectural Drawings)

ATTACHMENT B Survey Plan

DIAL BEFORE YOU DIG
www.1100.com.au

LOT 14
DP 25210

LOT 15
DP 25210

LOT 16
DP 25210

LOT 17
DP 25210

LOT 8
DP 17774

LOT 5
DP 17774

EXISTING BUILDING

60.95 (BY TITLE)

20.235 (BY TITLE)

LINE OF OLD POSTS

SEPTIC TANK

CLOTHESLINE

No. 65-67 Columbus Street
LOT 7
DP 17774
1,233m² (BY TITLE)

EXISTING DILAPIDATED RESIDENCE

BUILDING RIDGE TOP RL 88.998
FFL 84.90

BUILDING GUTTER RL 87.028
BUILDING GUTTER RL 87.061
BUILDING GUTTER RL 87.075

TAP

SHED SLAB

RETAINING WALL

No. 65-67 Columbus Street
LOT 6
DP 17774
1,233m² (BY TITLE)

TELECOMMUNICATIONS ELEVATED JOINT

TELECOMMUNICATIONS PIT

BENCHMARK NAIL IN KERB RL 84.390

SOLID LINE MARKING

WATER METER

WATER HYDRANT

POWER POLE

BENCHMARK NAIL IN PATH RL 84.537

WATER STOP VALVE

TELECOMMUNICATIONS PIT

M.G.A.

STREET

COLUMBUS

DATE OF SURVEY : 15th SEPTEMBER 2023
SURVEY BY : R. Boylan

DATUM : AUSTRALIAN HEIGHT DATUM (A.H.D.)
ORIGIN : PM 5541 RL 85.637m (S.C.I.M.S.)
MAJOR CONTOUR INTERVAL : 0.5 METRE
MINOR CONTOUR INTERVAL : 0.1 METRES

NOTES:

- THE BOUNDARY INFORMATION SHOWN ON THIS PLAN BEEN PLOTTED AS REQUIRED UNDER DIVISION 1, SECTION 9.(1) OF THE "SURVEYING AND SPATIAL INFORMATION REGULATION 2017". IT HAS NOT BEEN DETERMINED BY AN ACCURATE BOUNDARY SURVEY.
- A DETAIL & LEVEL SURVEY IS NOT A "LAND SURVEY" AS DEFINED BY THE SURVEYING AND SPATIAL INFORMATION ACT 2002. IF ANY CONSTRUCTION OR DESIGN WORK WHICH RELIES ON CRITICAL SETBACKS FROM THE STREET OR BOUNDARIES IS PLANNED, IT WOULD BE IMPERATIVE TO CARRY OUT FURTHER SURVEY WORK TO DETERMINE THE BOUNDARY DIMENSIONS.
- THE LOCATIONS AND DEPTHS OF UNDERGROUND SERVICES ARE NOT ASSURED BY BARNSON. SERVICE AUTHORITIES SHOULD BE CONSULTED BEFORE ANY EXCAVATION, DEMOLITION OR CONSTRUCTION COMMENCES.
- THERE MAY BE UNDERGROUND SERVICES THAT HAVE NOT BEEN SHOWN HEREON.
- BARNSON TAKES NO RESPONSIBILITY FOR LOSSES, DAMAGES OR INJURIES TO ANY PERSON OR ORGANISATION THAT MAY OCCUR DUE TO THE RELIANCE ON THIS PLAN FOR THE LOCATION OF UNDERGROUND SERVICES.

KEY

- EXISTING SUBJECT CADASTRAL BOUNDARIES
- EXISTING FENCE LINE
- EXISTING GATE
- EXISTING UNDERGROUND WATER MAIN - APPROX.
- EXISTING UNDERGROUND TELECOMMUNICATIONS ASSETS - APPROX.
- EXISTING OVERHEAD ELECTRICITY CABLES

LEVEL AND DETAIL SURVEY PLAN

REDUCTION RATIO 1:150 @ A1
1:300 @ A3

SCALE 1:150(A1)
SCALE 1:300(A3)

ISSUED TO CLIENT

barnson.
DESIGN . PLAN . MANAGE

BARNSON PTY LTD

phone 1300 BARNSON (1300 227 676)
email generalenquiry@barnson.com.au
web barnson.com.au

Rev	Date	Description
A	28-09-2023	ISSUED TO CLIENT

Project
LEVEL AND DETAIL SURVEY OVER LOTS 6 & 7 IN DP 17774
Site Address
65-67 COLUMBUS STREET
IVANHOE NSW 2878
Client
DESIM PTY LTD

Drawing Title
LEVEL AND DETAIL SURVEY PLAN

Survey RB
Drawn JS
Check RB

Original Sheet Size A1
Revision A

Certification

Project No 41903
Drawing No L01

ATTACHMENT C Site and soil assessment for on site effluent management system

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Site and Soil Assessment for On-site Effluent Management System

Client: Desim Pty Ltd
Site Address: 65-67 Columbus Street
Ivanhoe, NSW 2878

29 November 2023

Our Reference : 41903-ER01_A

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DISCLAIMER

This report has been prepared solely for Desim Pty Ltd in accordance with the scope provided by the client and for the purpose(s) as outlined throughout this report.

Installation must be by a licensed plumber and Barnson will not be liable for the incorrect installation and/or construction of the system. Installation and construction of the system must hold true to the design recommendations presented in this report. Installation should be in accordance with the prescriptions within AS 1547:2012.

Unless otherwise stated in this report, Barnson has not verified the accuracy or completeness of the data retrieved from online databases and guidance documents. The recommendations for the proposed system as presented in this report are based on historical data obtained for the area. Barnson will not be liable in relation to incorrect recommendations should any information provided by the client be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed.

The accuracy of the advice provided in this report may be limited by unobserved variations in ground conditions across the site in areas between and beyond test locations and by any restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints. These factors may lead to the possibility that actual ground conditions and materials behaviour observed at the test locations may differ from those which may be encountered elsewhere on the site. If the sub-surface conditions are found to differ from those described in this report, we should be informed immediately to evaluate whether recommendations should be reviewed and amended if necessary.

Project:	Lot 6-7 DP17774, 65-67 Columbus Street, Ivanhoe NSW 2878
Client:	Desim Pty Ltd
Project Number:	41903
Report Reference:	41903-ER01_A
Date:	20/11/2023

Prepared by:	Reviewed by:
	
Jeremy Wiatkowski **AdvDip Laboratory Operations** Senior Laboratory Technician	**Nardus Potgieter** **MSc(Chem) BSc(Hons)(Env.Tech.)** Senior Environmental Scientist

1.0 SYSTEM OVERVIEW

The following table provides a summary of the information for a sustainable onsite effluent management system proposed at Lot 6-7 DP17774, 65-67 Columbus Street, Ivanhoe NSW 2878. The sections of this report that follow, provide site specific details justifying the recommendations.

Table 1 : System Overview

Site Assessor	Jeremy Wiatkowski
Client	Desim Pty Ltd
Site Location	"Lot 6-7 DP17774", 65-67 Columbus Street, Ivanhoe NSW
No. of Bedrooms	Lot 6 – 2 x 2 Bedroom Dwellings – 4 bedrooms total Lot 7 – 2 x 2 Bedroom Dwellings – 4 bedrooms total
Water Source	Town water
Estimated Daily Flow per lot (L/day)	600L/Day based on 4 people at 150L/person/day per lot ***One person per bedroom***
Tank Recommendation	1 x Aerated Wastewater Treatment System (AWTS) ***One system per lot***
Tank Capacity	As per section 6.3 the minimum size tank required is >3500L
Sub Soil Assessment Class	Field assessment and subsequent laboratory tests have classed the subsoil as category 6, as shown in section 3.5.
Sub Soil Recommended Hydraulic Loading mm/day (DIR/DLR)	ETA/ETS Bed/trench systems in category 6 soils have a design-loading rate of 5mm/day as per AS1547:2012 Table 5.2 & L1. (Refer to Table 7)
Recommended Effluent Application Type	**Due to the category 6 soil (Medium-Heavy Clays) it is recommended to dispose of AWTS secondary treated effluent onsite to an evapotranspiration (ETS) bed.**
Effluent Design Criteria	***As per section 7.0 the minimum application area was determined by calculating the requirements of hydraulic loading. As shown 2 evapotranspiration beds of 15m long x 4m wide is required to dispose of the proposed hydraulic load.***
Additional Notes	During construction gypsum to be applied at 1 kg/m² to the base of the excavated bed/trench to prevent the clay dispersing. The bed/trench shall be closed in, as soon as possible to protect the gypsum from raindrop impact.

2.0 INTRODUCTION

2.1 Overview

Barnson Pty Ltd on behalf of Desim Pty Ltd has prepared this report for submission to Central Darling Shire Council. This report provides direction for sustainable on-site effluent management for two 2 bedroom residences, proposed on each lot at Lot 6-7 DP17774, 65-67 Columbus Street, Ivanhoe NSW (refer **Figure 1).**

2.2 Key References

The following key references were utilised as part of this assessment:

- AS/NZS 1547:2012. *On-site Domestic Wastewater Management;*
- NSW Government 1998. *On site Sewerage Management for Single Households* (The Silver Book/OSMSH);
- NSW Government 2000. *The Easy Septic Tank Guide.* Developed by Social Change Media for the NSW Department of Local Government;
- NSW Health, 2001. 'Septic Tank and Collection Well Accreditation Guidelines";
- Central Darling Local Environmental Plan 2012;
- Sydney Catchment Management Authority, 2019. *Designing and Installing On-Site Wastewater Systems;*

2.3 Onsite Effluent Management System

The onsite effluent management system proposed for each Lot consists of a AWTS with secondary treated effluent disposed into evapotranspiration beds. **Figure 1 & 2** illustrates the site location. **Figure 3** illustrates the proposed site layout supplied by the client. **Figure 4** illustrates the proposed buffer, setback areas and proposed application area.

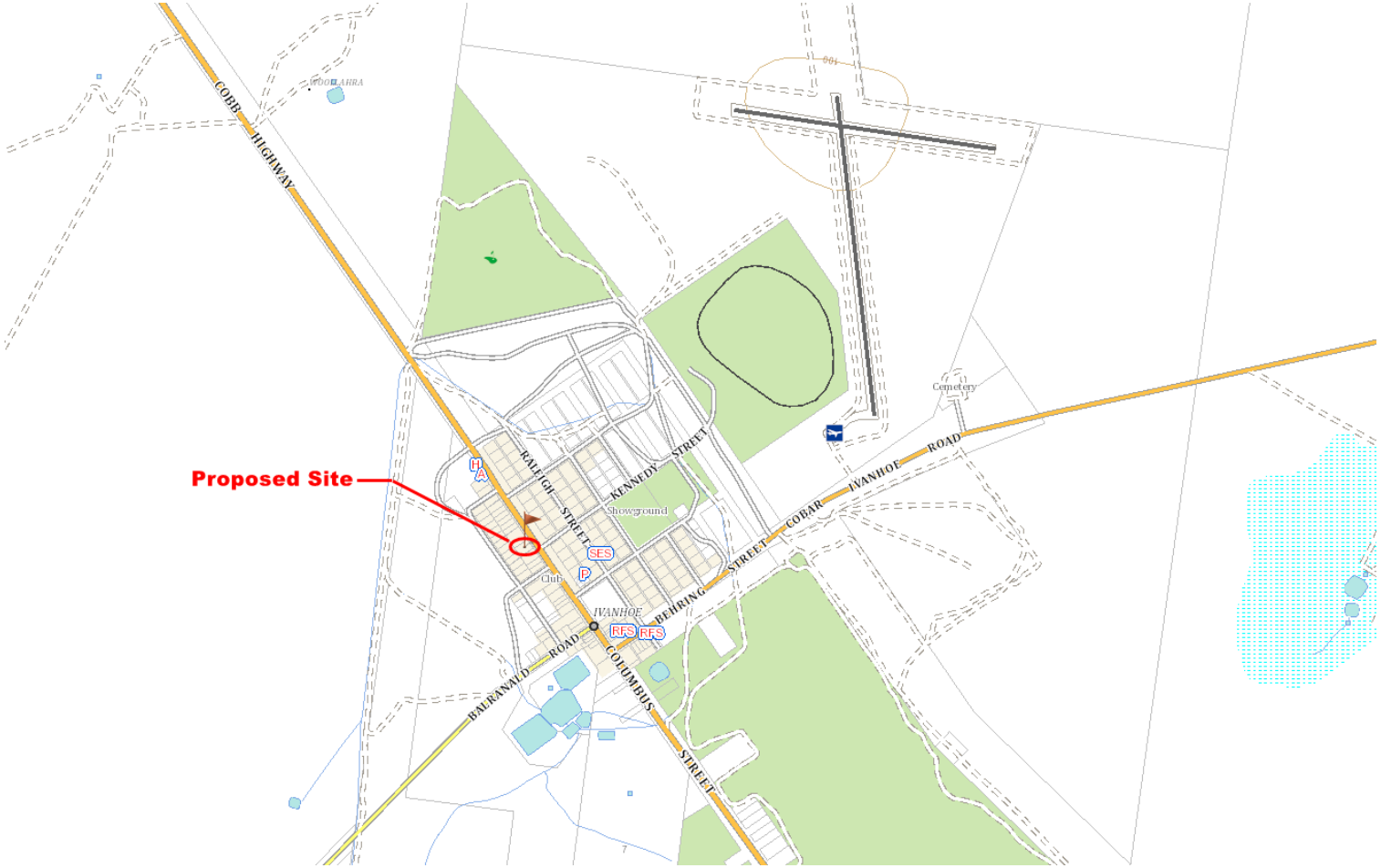

Figure 1 – Site Location Plan

Figure 2 – Buffer and Setback Plan

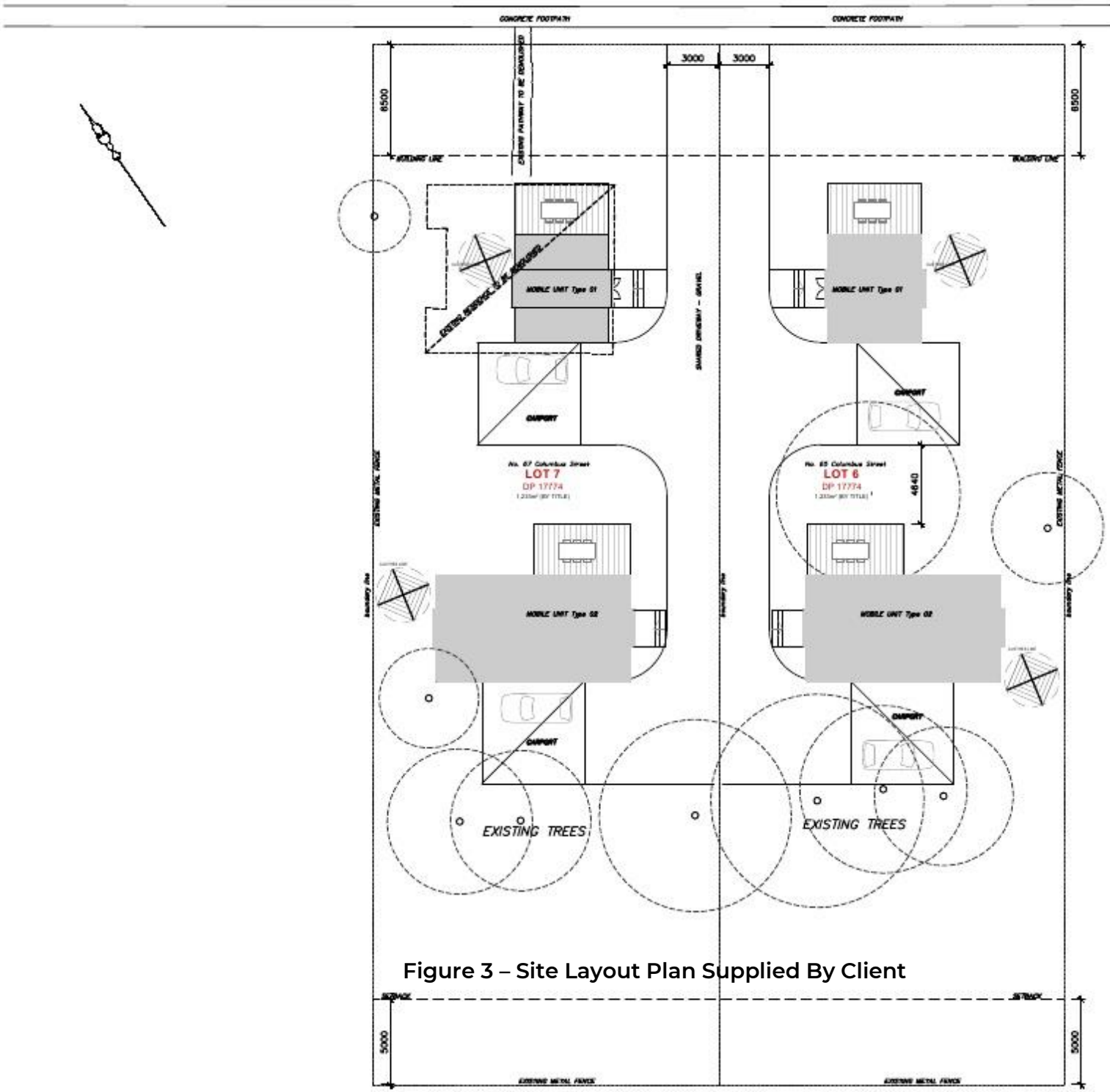

Figure 3 – Site Layout Plan Supplied By Client

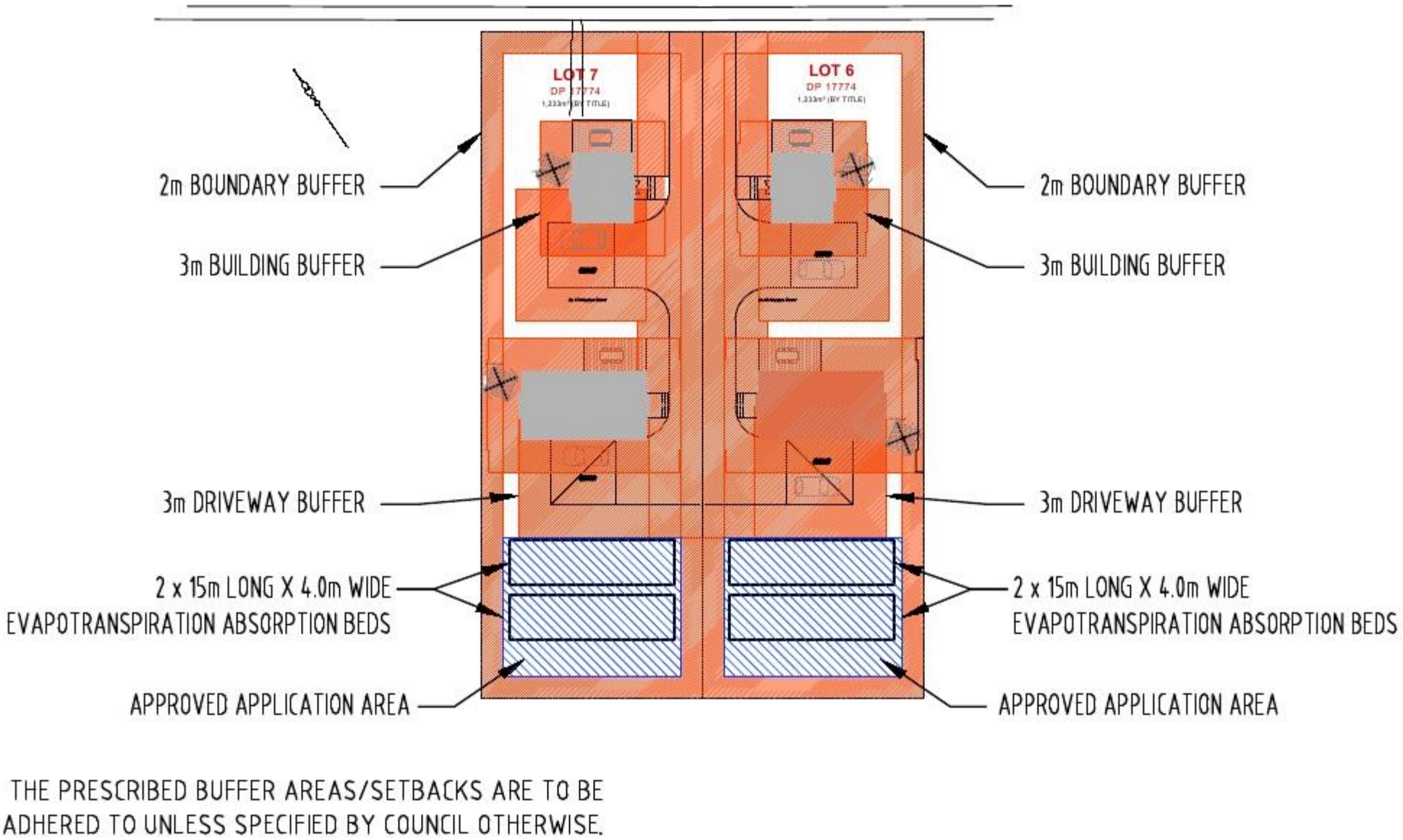

Figure 4 – Buffer and Setback Plan

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BARNSON PTY LTD
phone 1300 BARNSON (1300 227 676)
email generalenquiry@barnson.com.au
web barnson.com.au

Project
ONSITE SEWAGE DISPOSAL
Client
DESIM PTY LTD
Drawing Title
PROPOSED SITE BUFFERS

Site Address
65-67 COLUMBUS STREET
IVANHOE NSW

Design JW
Drawn JW
Check NP
Original Size A4
Revision A

Certification

Project No 41903
Drawing No GD01

3.0 SITE AND SOIL EVALUATION

3.1 Site Evaluators Details

The following table provides an overview of the evaluator's particulars.

Table 2: Details

Name / Role	Jeremy Wiatkowski
Role/ Qualifications	Geotechnical Technician
Company	Barnson Pty Ltd
Company Address	1/36 Darling Street Dubbo NSW 2830
Contact Details	1300 BARNSON
Date of Assessment	5/10/2023

3.2 Site Information

The following table provides an overview of the site information.

Table 3: Site Particulars

Address/Locality	65-67 Columbus Street, Ivanhoe NSW Lot 6-7 DP17774
Local Government Area	Central Darling Shire Council
Block Configuration	Lot 6 – 1233m² Lot 7 – 1233m²
Intended Water Supply	Town water supplied
Intended Power Supply	Supplied
Local Experience	Care needs to be taken to minimise runoff and erosion. Systems commonly malfunction due to lack of ongoing maintenance. The system is to be inspected and maintained regularly in accordance with manufacturer details, Council requirements, and prescriptions identified in this report.

3.3 Desktop Assessment

The following information was obtained via desktop review of the site.

Table 4: Desktop Assessment Details

Climate Overview[1]	Annual Average Rainfall for Ivanhoe is 307.2mm. Warm summers with large evaporative deficit, cool winters with small evaporative deficit. The mean summer monthly rainfall (January) is 29.9mm. The mean winter rainfall (July) is 23mm.
Underlying Geology[2]	*"Flat to gently undulating plains of red and brown clayey sand, loam and lateritic soils".*
Groundwater Review	No water bores were found within 500m of the proposed site, as illustrated in **Figure 5.** No flood planning or groundwater vulnerable maps were available of the proposed site.

[1] Bureau of Meteorology online Climate Data website

[2] Ivanhoe 1:250000

3.4 Groundwater Review

Although no groundwater information was available, no water bores were identified as occurring within the general area of the allotment. Information relating to historic groundwater report details on water bearing zones and standing water levels is provided in the table below.

Table 5: Groundwater Review

Groundwater Bore Reference	Total Depth (m)	Water Bearing Zones (m)	Standing Water Level (m)	Yield (L/s)	Salinity Yield
N/a	N/a	N/a	N/a	N/a	N/a

3.5 Surface Water Review

The proposed site is assumend to have poor drainage due to the minimal slope.

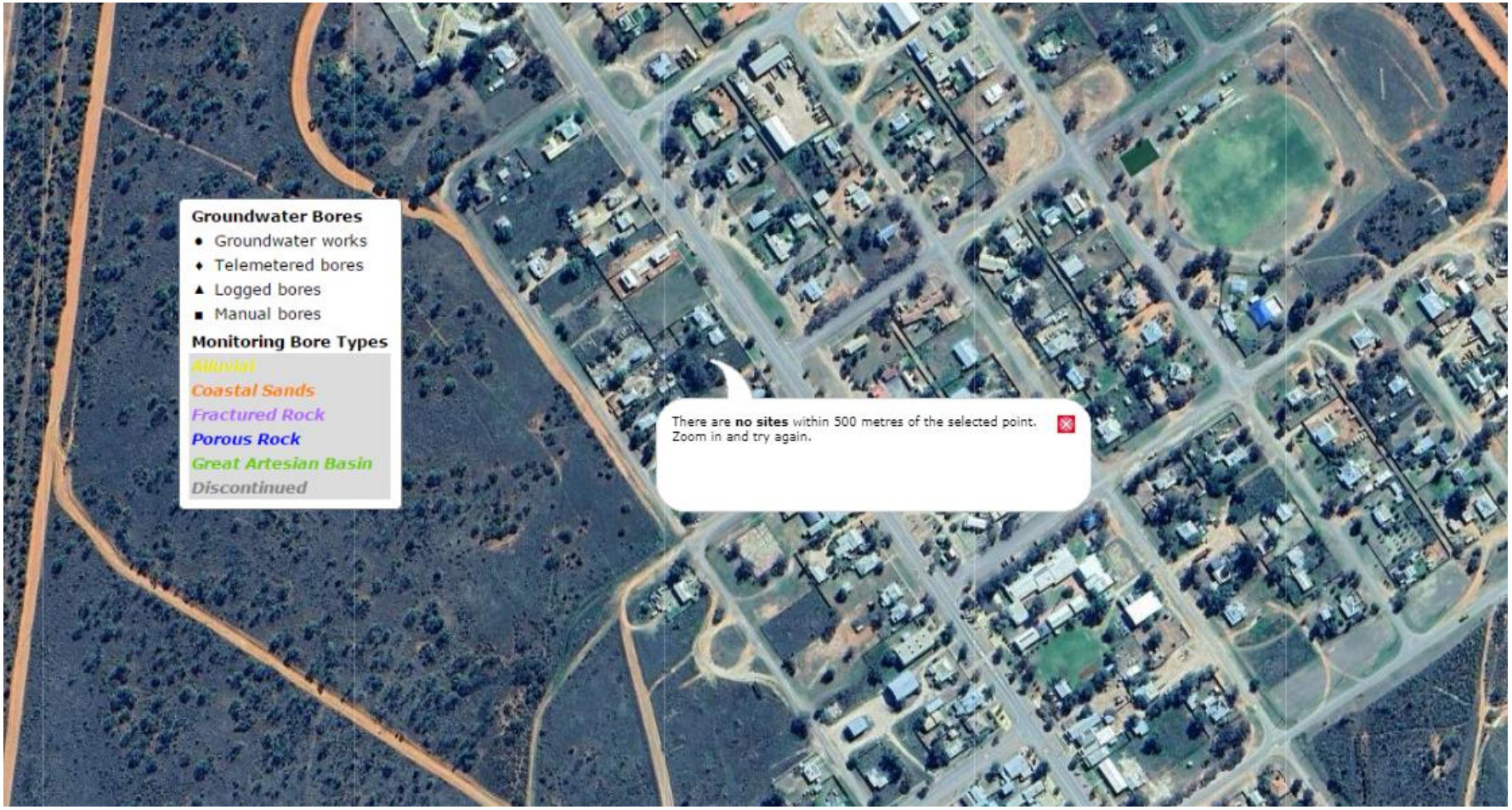

Figure 5 – Groundwater Bore Locations

3.6 Field Assessment Information

A field inspection was conducted on 5/10/2023. The following table provides detail on the site assessment as well as the field and laboratory results.

Table 6: Site Assessment Details

Water Balance Attached		See ***Appendix A***
Exposure		Good exposure.
Slope		The site is relatively flat
Run-On		None
Seepage		None
Erosion Potential		Low due to vegetation cover.
Site Drainage		The proposed site is assumend to have poor drainage due to the minimal slope
Fill		None encountered
Surface rock/Outcrops		None encountered
Is there sufficient land area for:	Application system, including buffers	Yes
	Reserve application system	Yes

3.7 Soil Assessment

A soil sample was collected and returned to Barnson Pty Ltd for analysis on 5/10/2023. The sample was collected at a depth of 800mm during the site inspection as per AS1289.1.2.1.6.5.3. Laboratory report with results are provided at Appendix B. Field assessment parameters were also obtained. The following table provides detail on both field and laboratory assessment results.

Table 7: Soil Assessment Details

Depth to bedrock or hardpan via field assessment		>1.5m
Depth to high soil water table via field assessment		>1.5m
Soil Analysis	pH – subsoil $CaCl_2$ (lab), subsoil	8
	Emerson Test Result –subsoils (Lab)	6
	Liquid Limit, Plastic Limit, Plasticity Index, Linear Shrinkage. (%)	LL = 38 PL = 13 PI = 25 LS = 14.5 See Borelog in **Appendix B**
	Estimated Soil Category–topsoil, subsoil A	3,6
	Structure massive, weak, high, moderate, strong (Field)	Strongly Structured
	Soil Profile description	See Borelog in Appendix B
	Sub soil Permeability (from table 5.2 of AS 1547:2012)	0.6-0.5(k_{sat}) (m/d) 2.5-20.8 (mm/hr) (Infiltration is Slow)
	Recommended Hydraulic Loading for disposal system (from Table 5.2 & L1 of AS 1547:2012)	5mm per day (For effluent disposal evapotranspiration beds)

4.0 SITE AND SOIL LIMITATION ASSESSMENT

The following two limitation tables are a standardised guide to the site and soil characteristics which may limit the suitability of the site for effluent disposal and which require attention through specific management practises. The tables have been reproduced from the NSW Government endorsed '*On-Site Sewerage Management for Single Households*' (1998), Tables 8 and 9. The highlighted categories represent site and soil conditions of the land covered in this report.

Table 8: Site Limitation Assessment

Site Feature	Relevant System	Minor Limitation	Moderate Limitation	Major Limitation	Restrictive Feature
Flood Potential	All land application systems	> 1 in 20 years		Frequent below 1 in 20 years	Transport in wastewater off site
	All treatment application systems	Components above 1 in 100 years		Components below 1 in 100 years	Transport in wastewater off site system failure
Exposure	All land application systems	High sun and wind exposure		Low sun and wind exposure	Poor evaporation transpiration
Slope %	Surface Irrigation	0-6	6-12	>12	Runoff, erosion potential
	Sub-surface irrigation	0-10	10-20	>20	Runoff, erosion potential
	Absorption	0-10	10-20	>20	Runoff, erosion potential
Landform	All systems	Hillcrests, convex side slopes and plains	Concave side slopes and foot slopes	Drainage plains and incised channels	Groundwater pollution hazard, resurfacing hazard
Run-on and upslope seepage	All land Application Areas	None-low	Moderate	High, diversion not practical	Transport of wastewater off site
Erosion potential	All land application systems	No sign of erosion potential		Indications of erosion e.g. rils, mass failure	Soil degradation and off-site impact
Site drainage	All land application systems	No visible signs of surface dampness		Visible signs of surface dampness, such as moisture-tolerant veg	Groundwater pollution hazard, resurfacing hazard
Fill	All systems	No fill	Fill present		Subsidence
Land area	All systems	Area available		Area not available	Health and pollution risk
Rock and rock outcrop	All land application systems	<10%	10-20%	>20%	Limits system performance
Geology	All land application systems	None		Major geological discontinuities, fractured or highly porous regolith	Groundwater pollution hazard

Table 9: Soil Limitation Assessment

Soil feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Depth to bedrock or hardpan (m)	Surface and sub-surface irrigation	> 1.0	0.5-1.0	< 0.5	Restricts plant growth
	Absorption	> 1.5	1.0-1.5	< 1.0	Groundwater pollution hazard
Depth to seasonal water table (m)	Surface and sub-surface irrigation	> 1.0	0.5-1.0	< 0.5	Groundwater pollution hazard
	Absorption	> 1.5	1.0-1.5	< 1.0	Groundwater pollution hazard
Permeability Category	Surface and sub-surface irrigation	2b, 3 and 4	2a, 5	1 and 6	Excessive runoff and waterlogging
	Absorption	3, 4		1, 2, 5 and 6	Percolation
Coarse fragments %	All systems	0-20	20-45	>40	Restricts plant growth, affects trench installation
Bulk density (g/cc) SL L, CL C	All land application systems	 < 1.8 < 1.6 < 1.4		 > 1.8 > 1.6 >1.4	restricts plant growth, indicator of permeability
pH	All land application systems	> 6.0	4.5-6.0	-	Reduces plant growth
Electrical conductivity (dS/m)	All land application systems	<4	4-8	>8	Restricts plant growth
Sodicity (ESP)	Irrigation 0-40cm; absorption 0-1.2mtr	0-5	5-10	> 10	Potential for structural degradation
CEC mequiv/100g	Irrigation systems	> 15	5-15	< 5	Nutrient leaching
P sorption kg/ha	All land application systems	> 6000	2000-6000	< 2000	Capacity to immobilise P
Modified Emerson Aggregate Test – (dispersiveness)	All land application systems	Class 3, 4	Class 2	Class 1	Potential for Structural degradation.

5.0 SYSTEM REQUIREMENTS

5.1 Central Darling Shire Council Setback Requirements

Central Darling Council does not currently have an 'On-Site Sewage Management Plan', and therefore the distances provided in the 'On-Site Sewerage Management for Single Households' (1998) should be adhered to, unless otherwise directed by Council.

5.1.1. All Land Application Systems

- 100m to permanent surface waters (e.g. river, streams, lakes, etc.);
- 250m to any domestic groundwater well;
- 40m to other waters (e.g. farm dams, intermittent waterways and drainage channels, etc.)

5.1.2. Absorption Systems

- 12m if area up-grade and 6m if area down gradient of property boundaries;
- 6m if area is up-gradient and 3m if area is down gradient of swimming pools, driveways and building.

Other site setback requirement as per AS/NZS 1547:2012 are provided in **Appendix C.**

Actual siting of the effluent application area is the responsibility of the licenced plumber. The prescribed buffer areas/setbacks are to be adhered to unless specified by council otherwise.

5.2 AS 1547:2012 Setbacks (Domestic Wastewater Management)

AS 1514:2012 identifies the following horizontal setbacks for domestic sites:

- Property Boundary –1.5-50m.
- Buildings/houses 2-6m
- Surface Waters – 15-100m
- Bores/Wells – 15-50m

5.3 Recommendations/Considerations – Buffer Distances

Given the identified site constraints, the proposed development and system requirements, the following point is noted:

Building & Driveway Setbacks– the proposed building and driveway setbacks for the application is 3.0m (onsite and neighbouring buildings).

Boundary Setbacks – the proposed boundary setbacks for the application is 2.0m.

Although the proposal does not adhere to the distances specified, it does conform to the site setbacks specified in Table R1 of AS 1547:2012. In accordance with AS 1547:2012, property boundary buffers as low as 1.5m is allowed based on treatment type, method of disposal, and the site and soil characteristics.

The factors considered in the standard (Table R2), for which property boundary buffers are applied as mitigative measure, include:

- the microbial quality of the effluent (A, Table R2),
- the slope of the site (D, Table R2), and
- the selected method of effluent application (J, Table R2).

With regard to the **microbial quality** of the effluent, the proposed AWTS will produce an effluent of very low microbial content, while the proposed absorption bed effluent disposal will ensure absorption and immobilisation of the treated effluent, eliminating the risk of exposure to the effluent.

The slope of the subject site is estimated at less than 1%. According to Table R2 of AS/NZS1547:2012, the lower value in the range of setbacks may be used for slopes up to 10%, provided that the method of effluent application is sub-surface.

The selected method of effluent application, absorption bed, will ensure absorption and immobilisation of the treated effluent preventing overland flow of effluent, off-site transfer and the risk of soil erosion.

Barnson is of the opinion that the recommended wastewater treatment system effectively addresses all the sensitive features relating to the property boundary setback distance allowing for relaxation of requirements to permit application of a shorter setback distances.

Central Darling Shire Council will have to consider the proposed buffer distances and provide approval for non-adherence to 'On-Site Sewerage Management for Single Households' (1998).. **See Appendix C**

5.4 Design Allowances – AS/NZS1547:2012 Table H1

In accordance with AS/NZS1547:2012 Table H1, the recommended design flow allowance for use in Australia, using on site town water supply is 150L/person/day. Given the proposed residence is 4 bedrooms in total, the number of persons potentially occupying the residence assumed for the calculation of the design flow is 4 (1 person per bedroom).

6.0 SEPTIC TANK SELECTION AND CALCULATION

6.1 Silver Book/ NSW Health Guidelines

The '*On-Site Sewerage Management for Single Households'* (1998) guideline is based on the NSW Health guideline for septic tank capacity. Therefore, the calculation is the same.

Secondary effluent treatment will be provided by a NSW Health accredited septic tank. The NSW Health *'Septic Tank and Collection Well Accreditation Guidelines'* (2016), set a sludge allowance of 1550L irrespective of the number of persons or which the septic tank is to be designed. It should be noted that in accordance with this guideline, a septic tank designed for a minimum of 5 persons needs to be de-sludge approximately every 4 years.

The general formula to calculate the minimum septic tank capacity in litres is:

$$S + (DF\ x\ N) = C$$

$$Sludge + (Daily\ Flow\ X\ No.of\ Persons) = Capacity\ of\ the\ tank$$

Residence - When DF = 150L/per person/per day and N =4, therefore DF x N =**600L**

$$1550L + 600L = 2150L$$

Table 2 in the NSW Health Guidelines provides a minimum of 2300L tank capacity.

6.2 AS/NZS 1547:2012 Requirements

A more conservative approach is outlined in AS/NZS1547:2012, Appendix J. A more conservative figure of 200L per person for all waste tanks is provided, giving a daily flow volume of 800L for the residence. Therefore, a minimum capacity tank of >**3500L** is required for a residence with a design flow of up to 1000L. This conservative rate is to ensure that the unit has capacity to cope with peak discharge rates or for temporary or unusual overloads and includes no allowance for food waste disposal units. This tank design capacity also allows for the storage of sludge and scum at a rate of 80L/person/year. It should be noted that the higher cost of installing a larger septic tank may be offset by a reduced pump out frequency. Too frequent pump out removes microorganisms needed for degradation of wastewater solids. The longer pump out interval has beneficial implications for conservation of resources in that the volume of seepage requiring treatment and disposal can be reduced significantly.

6.3 System Recommendations

The following table provides details on the system selection.

Table 10: System Selection Details

Consideration of connection to centralised sewerage system	**Distance to sewer**	>1km
	Potential for future connection?	None planned
	Potential for reticulated water?	None planned
Expected Wastewater volume (litres/day)	**Residence** – 2 x 2-bedroom residence on each lot, potential maximum occupancy of 4 people per lot. Typical wastewater design flow is 150L/person per day in accordance with Table H3 of AS/NZS1547:2012 for households with full water reduction facilities, supplied by town water supply. Therefore, 4 people at 150L per person per day gives a total load of 600L/day	
Type of Treatment system best suited	Aerated wastewater treatment systems (AWTS) with capacity of >3500L or more as per NSW Health accredited system – https://www.health.nsw.gov.au/environment/domesticwastewater/Pages/awts.aspx with secondary treated effluent to be distributed to an Evapotranspiration Absorption Bed	

Water conservation measures should be adapted to the greatest extent possible in the proposed residence, particularly in relation to the high water use activities of showering, clothes washing and toilet flushing. AAA rated plumbing appliances and fittings should be used. Measures including use of front loading washing machines, low volume shower roses and dual flush toilets can reduce water usage by 30-40%. Detergents low in phosphorous and sodium should be used as much as possible. Following these measures will ensure the greatest lifespan for this effluent treatment and disposal system.

7.0 EFFLUENT MANAGEMENT

Barnson Pty Ltd has analysed the proposed on-site waste management system in accordance with the NSW Government endorsed *'Silver Book'* (1998) and the ANZ Standard 1547:2012 On-site Domestic Wastewater Management', with additional advice sought from the Sydney Catchment Management Authority '*Designing and installing On-site Wastewater Systems'* 2019 guideline. For this site, given the climate and soil constraints, absorption is considered the most appropriate effluent management device.

7.1 Hydraulic Loading Calculation

Given the proposed residence will be connected by town water supply, the daily flow (Q) for the system is calculated as 600L/per day.

The required bed area shall be determined from the following relationship:

$$Length\ of\ Absorption\ Bed\ = (Q)\ /\ (DLR\ x\ W)$$

Proposed Residence

Where Q = 600L, DLR =5 mm/day (Table L1 AS 1547:2012 –Conservative Rate),

W (Width) = 4m

$$Length\ of\ Bed = \left(\frac{600}{5\ x\ 4m}\right)$$

$$= 30m$$

Therefore, from the above calculation, 2 x 15m long, 4m wide evapotranspiration absorption beds per lot will be required for the proposed 2 x 2 bedroom residence per lot.

7.2 Design Recommendations

Common failures of beds/trenches are often caused by poor installation practices. In addition to specifications outlined in AS/NZS 1547:2012, the following points should also be considered in the bed/trench design/construction which to meet the *minimum* dimensions in the table below:

Building	*Tank*	*Evapotranspiration Absorption Bed Size*
Lot 6 ***2 x 2 Bedrooms***	***Aerated Wastewater Treatment System (AWTS)***	***2 x Evapotranspiration Absorption Beds x 15.0m Long x 4.0m Wide***
Lot 7 ***2 x 2 Bedrooms***	***Aerated Wastewater Treatment System (AWTS)***	***2 x Evapotranspiration Absorption Beds x 15.0m Long x 4.0m Wide***

- Beds/trenches are to be built along the contour to ensure even distribution and avoid any section being over loaded;
- Avoid cutting beds into weakened ground;
- Construction is to take place during fine weather. If it rains beds are to be completely covered to protect them from rain damage;
- Where the beds/trenches are dug by an excavator in clay soils, the bed walls are to be scarified to remove any smearing caused by the excavator bucket;
- During construction gypsum to be applied at 1 kg/m² to the base of the trench or bed to prevent the clay dispersing. The trench shall be closed in, as soon as possible to protect the gypsum from raindrop impact.
- All distribution pipes and arches should be laid in accordance with the manufactures instructions;
- If two beds or more are utilised, ensure effluent is distributed evenly via a splitter box or sequencing valve or other appropriate method;
- All distribution pipes and arches should be laid in accordance with the manufactures instructions;
- Consideration can be given to using a pressure dosed system, which would allow for a better, more even distribution of effluent along the trench, and prolong trench life;
- Inspection ports shall be provided for the beds/trenches system. The inspection port shall be installed so as to facilitate monitoring of the effluent level in each trench;
- Trenches/Beds to be pressure dosed using pumps or dosing siphons;
- The top of the absorption trench area should be turfed or grass planted to establish vegetation cover promptly after construction. This ensures the best uptake of effluent by evapotranspiration. Ensure that larger deep-rooting plants are not planted close to trenches to reduce the chance of root intrusion and clogging of the trenches
- The beds/trenches should be in an enclosed area, with and no exposed to vehicle movement or stock that can cause compaction and premature trench failure;

- The beds/trenches are to be constructed along the contour via laser levelling to ensure the base is exactly level;
- A diversion berm/bank/drain should be built upslope of the beds. This will reduce run on. A design sketch is provided at **Appendix D.**
- ETA beds are constructed with a domed upper surface to shed rainfall. The steeper the slope the more rainfall that will be shed.
- The bed must be located where it will be well exposed to ensure maximum evapotranspiration
- Vegetation cover must be well maintained to ensure strong growth for maximum uptake by transpiration. The surrounding landscape and vegetation must also be maintained to minimise shading and maximise exposure.
- Ensure that deep rooting trees or shrubs are not planted close to the beds to reduce the chance of roots intruding and clogging the beds.

8.0 RECOMMENDATIONS

As per the '*On-Site Sewerage Management for Single Households'* (1998) publication, stakeholders should be aware that all on site systems and components have a finite life and at some point will require replacement. Septic tanks and AWTS' generally require replacement every 25 years, whereas effluent disposal systems can have an expected life between 5-15 years. The owner is encouraged to obtain a copy of the NSW Government "The Easy Septic Guide" (2000) available from - https://www.olg.nsw.gov.au/wp-content/uploads/Easy-septic-guide.pdf

As stated in AS1547-2012 section 5.5.3.4, a reserve application area of similar size to the current design 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.

The option provided in this report is a secondary treatment septic fed into evapotranspiration absorption beds. This is to be designed to accept the discharge from the wastewater treatment unit and it convey it securely and evenly to the land application area. The aim is to ensure uniform distribution of the effluent over the design area to help achieve effective aerobic/anaerobic decomposition within the soil. Typical design sketches for a bed/trench system as per AS 1547:2012 and *Design and Installation of On Site Wastewater Treatment (*2019) are provided at ***Appendix D*.**

Installation instructions shall be provided by the manufacturer or designer. Barnson will not be liable for the incorrect installation and/or construction of the system unless when inspected by Barnson the installation and construction of the system holds true to the design featured in this report. Installation should be in accordance with the prescriptions within AS 1547:2012.

Barnson has not verified the accuracy or completeness of this data, except otherwise stated in this report. The recommendations for the proposed system as suggested in this report are based on historical data obtained for the area. Barnson will not be liable in relation to incorrect recommendations should any information provided by the client be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed.

The accuracy of geotechnical engineering advice provided in this report may be limited by unobserved variations in ground conditions across the site in areas between and beyond test locations and by any restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints.

These factors may lead to the possibility that actual ground conditions and materials behaviour observed at the test locations may differ from those which may be encountered elsewhere on the site.

If the sub-surface conditions are found to differ from those described in this report, we should be informed immediately to evaluate whether recommendations should be reviewed and amended if necessary.

Please do not hesitate to contact the undersigned if you have enquires regarding this report.

Yours Faithfully

Jeremy Wiatkowski

Laboratory Technician

Reviewed By

Nardus Potgieter

MSc(Chem) BSc(Hons)(Env.Tech.)

Senior Environmental Scientist

barnson.

APPENDIX A

Water Balance

Barnson Job No	41903-ER01_A	
Location :	Ivanhoe	

Design Wastewater Flow	Q	l/day	600
Design Loading Rate	R	mm/day	5

Climate Zone	Hillston	*As per Soil Landscapes of Dubbo 1:250 000*
		Dropbox

1	2	3	4	5	6	7	8	9	
Month	Pan evap E (mm)	Evapo Transpiration Et (ET=0.75E)mm	Rainfall R (mm)	Retained Rainfall Rr (Rr=0.75R) mm	DLR per Month (mm)	Disposal Rate (3-5+6) mm	uent applied per mo (L)	Size of Area (8/7) m²	Days In Month
Jan	272.8	204.6	31.5	23.625	155	335.975	18600	55.361262	31
Feb	226.8	170.1	27.2	20.4	145	294.7	17400	59.04309467	29
Mar	186	139.5	33.4	25.05	155	269.45	18600	69.02950455	31
Apr	114	85.5	27.8	20.85	150	214.65	18000	83.85744235	30
May	68.2	51.15	32.1	24.075	155	182.075	18600	102.1557051	31
Jun	39	29.25	35.2	26.4	150	152.85	18000	117.7625123	30
Jul	46.5	34.875	30.5	22.875	155	167	18600	111.3772455	31
Aug	65.1	48.825	30.9	23.175	155	180.65	18600	102.9615278	31
Sep	108	81	28.9	21.675	150	209.325	18000	85.99068434	30
Oct	161.2	120.9	36.5	27.375	155	248.525	18600	74.84156523	31
Nov	210	157.5	30.3	22.725	150	284.775	18000	63.20779563	30
Dec	266.6	199.95	30.2	22.65	155	332.3	18600	55.97351791	31
							Mean area	81.8m²	

Month	First trial area	Application rate	Disposal rate	mm	Increase in Depth of Stored Effluent	th of Effluent for Mo	Increase in Depth of Effluent	Computed	Reset if Et<0	Equiv Storage
Dec	110m²	169.0909091	332.3	-163.2090909	-544.030303	0	-544.030303	-544.030303	0	0
Jan		169.0909091	335.975	-166.8840909	-556.280303	0	-556.280303	-556.280303	0	0
feb		158.1818182	294.7	-136.5181818	-455.0606061	0	-455.0606061	-455.0606061	0	0
Mar		169.0909091	269.45	-100.3590909	-334.530303	0	-334.530303	-334.530303	0	0
Apr		163.6363636	214.65	-51.01363636	-170.0454545	0	-170.0454545	-170.0454545	0	0
May		169.0909091	182.075	-12.98409091	-43.28030303	0	-43.28030303	-43.28030303	0	0
Jun		163.6363636	152.85	10.78636364	35.95454545	0	35.95454545	35.95454545	35.95454545	3955
Jul		169.0909091	167	2.090909091	6.96969697	35.95454545	42.92424242	42.92424242	42.92424242	4721.666667
Aug		169.0909091	180.65	-11.55909091	-38.53030303	42.92424242	4.393939394	4.393939394	4.393939394	483.3333333
Sep		163.6363636	209.325	-45.68863636	-152.2954545	4.393939394	-147.9015152	-147.9015152	0	0
Oct		169.0909091	248.525	-79.43409091	-264.780303	0	-264.780303	-264.780303	0	0
Nov		163.6363636	284.775	-121.1386364	-403.7954545	0	-403.7954545	-403.7954545	0	0
Dec		169.0909091	332.3	-163.2090909	-544.030303	0	-544.030303	-544.030303	0	0
Jan		169.0909091	335.975	-166.8840909	-556.280303	0	-556.280303	-556.280303	0	0
Feb		158.1818182	294.7	-136.5181818	-455.0606061	0	-455.0606061	-455.0606061	0	0
Mar		169.0909091	269.45	-100.3590909	-334.530303	0	-334.530303	-334.530303	0	0
Apr		163.6363636	214.65	-51.01363636	-170.0454545	0	-170.0454545	-170.0454545	0	0
May		169.0909091	182.075	-12.98409091	-43.28030303	0	-43.28030303	-43.28030303	0	0

Estimated area of effluent drainfield	110m²
Maximum depth of stored effluent (must not exceed 350mm)	42.92mm
Bed/Trench dimensions	4000mm
Length of bed/trench required	27.5m
<20m lengths of bed/trench	1.375

Trench Depth	450

barnson.

APPENDIX B

Borehole Logs & Laboratory Results

BOREHOLE NUMBER 1

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

CLIENT Desim Pty Ltd
PROJECT NAME Site Classification
PROJECT NUMBER 41903
PROJECT LOCATION 65-67 Columbus Street, Ivanhoe NSW

DATE STARTED 5/10/23 **COMPLETED** 5/10/23 **R.L. SURFACE** ___ **LONGTITUDE** ---
DRILLING CONTRACTOR Barnson **SLOPE** 90° **LATITUDE** ---
EQUIPMENT 1750 Drill Rig **HOLE LOCATION** Borehole 1
HOLE SIZE 90mm **LOGGED BY** NR **CHECKED BY** NR
NOTES ___

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: red	0	TOPSOIL
		0.3		CL	Silty CLAY: red: slightly moist: very stiff to hard: medium plasticity	7, 7, 8, 9, 10, 9, 13, 19, 32	ALLUVIAL
	Disturbed Sample LS = 12.5%	0.5					
		1.0					
		1.1		CL	Silty Sandy CLAY: red-brown: slightly moist: hard: medium to high plasticity		ALLUVIAL
		1.5					
	Disturbed Sample LS = 14.0%	2.0					
		2.5					
		3.0					

Dynamic Cone Penetrometer Blows / 100mm: 0 4 8 12 16 20 24 28 32

Borehole 1 terminated at 3m

BOREHOLE / TEST PIT WITH DCP 41903-G01A-G03A.GPJ GINT STD AUSTRALIA.GDT 26/10/23

BOREHOLE NUMBER 2

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

CLIENT Desim Pty Ltd **PROJECT NAME** Site Classification

PROJECT NUMBER 41903 **PROJECT LOCATION** 65-67 Columbus Street, Ivanhoe NSW

DATE STARTED 5/10/23 **COMPLETED** 5/10/23 **R.L. SURFACE** _____ **LONGTITUDE** ---

DRILLING CONTRACTOR Barnson **SLOPE** 90° **LATITUDE** ---

EQUIPMENT 1750 Drill Rig **HOLE LOCATION** Borehole 2

HOLE SIZE 90mm **LOGGED BY** NR **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0.3			Sandy SILT: red	TOPSOIL
		0.5		CL	Silty CLAY: red: slightly moist: very stiff to hard: medium plasticity	ALLUVIAL
		1.0				
		1.1		CL	Silty Sandy CLAY: red-brown: slightly moist: hard: medium to high plasticity	ALLUVIAL
		1.5				
		2.0				
		2.5				
		3.0				

Dynamic Cone Penetrometer Blows / 100mm

0 4 8 12 16 20 24 28 32

0 7 7 8 9 10 9 13 19 32

Borehole 2 terminated at 3m

BOREHOLE / TEST PIT WITH DCP 41903-G01A-G03A.GPJ GINT STD AUSTRALIA.GDT 26/10/23

BOREHOLE NUMBER 3

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

CLIENT Desim Pty Ltd **PROJECT NAME** Site Classification

PROJECT NUMBER 41903 **PROJECT LOCATION** 65-67 Columbus Street, Ivanhoe NSW

DATE STARTED 5/10/23 **COMPLETED** 5/10/23 **R.L. SURFACE** _____ **LONGTITUDE** ---

DRILLING CONTRACTOR Barnson **SLOPE** 90° **LATITUDE** ---

EQUIPMENT 1750 Drill Rig **HOLE LOCATION** Borehole 3

HOLE SIZE 90mm **LOGGED BY** NR **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: red	0 4 8 12 16 20 24 28 32	TOPSOIL
		0.3		CL	Silty CLAY: red: slightly moist: very stiff to hard: medium plasticity	7 7 8 9 10 9 13 19 32	ALLUVIAL
		1.1		CL	Silty Sandy CLAY: red-brown: slightly moist: hard: medium to high plasticity		ALLUVIAL
		3.0			Borehole 3 terminated at 3m		

BOREHOLE / TEST PIT WITH DCP 41903-G01A-G03A.GPJ GINT STD AUSTRALIA.GDT 26/10/23

BOREHOLE NUMBER 1

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

CLIENT Desim Pty Ltd **PROJECT NAME** Septic Design

PROJECT NUMBER 41903 **PROJECT LOCATION** 65-67 Columbus Street, Ivanhoe NSW

DATE STARTED 5/10/23 **COMPLETED** 5/10/23 **R.L. SURFACE** ___ **LONGTITUDE** ---

DRILLING CONTRACTOR Barnson **SLOPE** 90° **LATITUDE** ---

EQUIPMENT 1750 Drill Rig **HOLE LOCATION** Borehole 4

HOLE SIZE 90mm **LOGGED BY** NR **CHECKED BY** NR

NOTES

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: red	0 4 8 12 16 20 24 28 32	TOPSOIL
		0.2		CL	Sandy CLAY: red: slightly moist: very stiff to hard: medium to high plasticity		ALLUVIAL
	Disturbed Sample LS = 14.5% PI = 25%	0.5					
		0.9		CL	Silty Sandy CLAY: red-brown: slightly moist: hard: medium plasticity		ALLUVIAL
		1.0					
		1.5					

Borehole 1 terminated at 1.5m

Material Test Report

Barnson Pty Ltd
Dubbo Laboratory
16 L Yarrandale Road Dubbo NSW 2830
Phone: 1300 BARNSON
Email: jeremy@barnson.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Jeremy Wiatkowski
Geotechnical Technician
NATA Accredited Laboratory Number: 9605

Report Number: **41903-1**
Issue Number: 1
Date Issued: 26/10/2023
Client: Desim Pty Ltd
100 Harris Street, Pyrmont NSW 2009
Contact: Dejan Simovic
Project Number: 41903
Project Name: Site Classification & Septic Design
Project Location: 65-67 Columbus Street, Ivanhoe NSW
Work Request: 9031
Sample Number: D23-9031A
Date Sampled: 05/10/2023
Dates Tested: 05/10/2023 - 25/10/2023
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location: **Borehole 1, Depth: 800mm**
Material: Red Silty CLAY

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.5**		
Cracking Crumbling Curling	Cracking & Crumbling		

Material Test Report

Barnson Pty Ltd
Dubbo Laboratory
16 L Yarrandale Road Dubbo NSW 2830
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Approved Signatory: Jeremy Wiatkowski
Geotechnical Technician
NATA Accredited Laboratory Number: 9605

Report Number:	**41903-1**
Issue Number:	1
Date Issued:	26/10/2023
Client:	Desim Pty Ltd
	100 Harris Street, Pyrmont NSW 2009
Contact:	Dejan Simovic
Project Number:	41903
Project Name:	Site Classification & Septic Design
Project Location:	65-67 Columbus Street, Ivanhoe NSW
Work Request:	9031
Sample Number:	D23-9031B
Date Sampled:	05/10/2023
Dates Tested:	05/10/2023 - 25/10/2023
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location:	**Borehole 1, Depth: 2.0m**
Material:	Red-Brown Silty Sandy CLAY

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**14.0**		
Cracking Crumbling Curling	Cracking & Curling		

Material Test Report

Barnson Pty Ltd
Dubbo Laboratory
16 L Yarrandale Road Dubbo NSW 2830
Phone: 1300 BARNSON
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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Jeremy Wiatkowski
Geotechnical Technician
NATA Accredited Laboratory Number: 9605

Report Number:	**41903-1**
Issue Number:	1
Date Issued:	26/10/2023
Client:	Desim Pty Ltd
	100 Harris Street, Pyrmont NSW 2009
Contact:	Dejan Simovic
Project Number:	41903
Project Name:	Site Classification & Septic Design
Project Location:	65-67 Columbus Street, Ivanhoe NSW
Work Request:	9031
Sample Number:	D23-9031C
Date Sampled:	05/10/2023
Dates Tested:	05/10/2023 - 25/10/2023
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location:	**Borehole 4, Depth: 800mm**
Material:	Red Sandy CLAY

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	38		
Plastic Limit (%)	13		
Plasticity Index (%)	**25**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**14.5**		
Cracking Crumbling Curling	Cracking & Curling		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	Red Sandy CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	22		

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APPENDIX C

Site Setback Requirements

TABLE R1
GUIDELINES FOR HORIZONTAL AND VERTICAL SETBACK DISTANCES
(to be used in conjunction with Table R2)

Site feature	**Setback distance range** (m) (See Note 1)	**Site constraint items of specific concern** (from Table R2) (see Note 1)
	Horizontal setback distance *(m)*	
Property boundary	1.5 – 50 (see Note 2)	A, D, J
Buildings/houses	2.0 – > 6 (see Note 3)	A, D, J
Surface water (see Note 4)	15 – 100	A, B, D, E, F, G, J
Bore, well (see Notes 5 and 6)	15 – 50	A, C, H, J
Recreational areas (Children's play areas, swimming pools and so on) (see Note 7)	3 – 15 (see Notes 8 and 9)	A, E, J
In-ground water tank	4 – 15 (see Note 10)	A, E, J
Retaining wall and Embankments, escarpments, cuttings (see Note 11)	3.0 m or 45° angle from toe of wall (whichever is greatest)	D, G, H
	Vertical setback distance *(m)*	
Groundwater (see Notes 5, 6, and 12)	0.6 – > 1.5	A, C, F, H, I, J
Hardpan or bedrock	0.5 – ≥ 1.5	A, C, J

NOTES:

1 The overall setback distance should be commensurate with the level of risk to public health and the environment. For example, the maximum setback distance should be adopted where site/system features are on the high end of the constraint scale. The setback distance should be based on an evaluation of the constraint items and corresponding sensitive features in Table R2 and how these interact to provide a pathway or barrier for wastewater movement.

2 Subject to local regulatory rules and design by a suitably qualified and experienced person, the separation of a drip line system from an upslope boundary, for slopes greater than 5%, may be reduced to 0.5 m.

TABLE R1
GUIDELINES FOR HORIZONTAL AND VERTICAL SETBACK DISTANCES
(to be used in conjunction with Table R2) (continued)

3	Setback distances of less than 3 m from houses are appropriate only where a drip irrigation land application system is being used with low design irrigation rates, where shallow subsurface systems are being used with equivalent low areal loading rates, where the risk of reducing the bearing capacity of the foundation or damaging the structure is low, or where an effective barrier (designed by a suitably qualified and experienced person) can be installed. This may require consent from the regulatory authority.
4	Setback distance from surface water is defined as the areal edge of the land application system to the edge of the water. Where land application areas are planned in a water supply catchment, advice on adequate buffer distances should be sought from the relevant water authority and a hydrogeologist. Surface water, in this case, refers to any fresh water or geothermal water in a river, lake, stream, or wetland that may be permanently or intermittently flowing. Surface water also includes water in the coastal marine area and water in man-made drains, channels, and dams unless these are to specifically divert surface water away from the land application area. Surface water excludes any water in a pipe or tank.
5	Highly permeable stony soils and gravel aquifers potentially allow microorganisms to be readily transported up to hundreds of metres down the gradient of an on-site system (see R3, Table 1 in Pang et al. 2005). Maximum setback distances are recommended where site constraints are identified at the high scale for items A, C, and H. For reading and guidance on setback distances in highly permeable soils and coarse-grained aquifers see R3. As microbial removal is not linear with distance, data extrapolation of experiments should not be relied upon unless the data has been verified in the field. Advice on adequate buffer distances should be sought from the relevant water authority and a hydrogeologist.
6	Setback distances from water supply bores should be reviewed on a case-by-case basis. Distances can depend on many factors including soil type, rainfall, depth and casing of bore, direction of groundwater flow, type of microorganisms, existing quality of receiving waters, and resource value of waters.
7	Where effluent is applied to the surface by covered drip or spray irrigation, the maximum value is recommended.
8	In the case of subsurface application of primary treated effluent by LPED irrigation, the upper value is recommended.
9	In the case of surface spray, the setback distances are based on a spray plume with a diameter not exceeding 2 m or a plume height not exceeding 0.5 m above finished surface level. The potential for aerosols being carried by the wind also needs to be taken into account.
10	It is recommended that land application of primary treated effluent be down gradient of in-ground water tanks.
11	When determining minimum distances from retaining walls, embankments, or cut slopes, the type of land application system, soil types, and soil layering should also be taken into account to avoid wastewater collecting in the subsoil drains or seepage through cuts and embankments. Where these situations occur setback clearances may need to be increased. In areas where slope stability is of concern, advice from a suitably qualified and experienced person may be required.
12	Groundwater setback distance (depth) assumes unsaturated flow and is defined as the vertical distance from the base of the land application systems to the highest seasonal water table level. To minimise potential for adverse impacts on groundwater quality, minimum setback distances should ensure unsaturated, aerobic conditions in the soil. These minimum depths will vary depending on the scale of site constraints identified in Table R2. Where groundwater setback is insufficient, the ground level can be raised by importing suitable topsoil and improving effluent treatment. The regulatory authority should make the final decision in this instance. (See also the guidance on soil depth and groundwater clearance in Tables K1 and K2.)

TABLE R2
SITE CONSTRAINT SCALE FOR DEVELOPMENT OF SETBACK DISTANCES

(used as a guide in determining appropriate setback distances from ranges given in Table R1)

Item	Site/system feature	**Constraint scale** (see Note 1) **LOWER** ⟷ **HIGHER** **Examples of constraint factors** (see Note 2)		Sensitive features
A	Microbial quality of effluent (see Note 3)	Effluent quality consistently producing ≤ 10 cfu/100 mL *E. coli* (secondary treated effluent with disinfection)	Effluent quality consistently producing ≥ 10^6 cfu/100 mL *E. coli* (for example, primary treated effluent)	Groundwater and surface pollution hazard, public health hazard
B	Surface water (see Note 4)	Category 1 to 3 soils (see Note 5) no surface water down gradient within > 100 m, low rainfall area	Category 4 to 6 soils, permanent surface water <50 m down gradient, high rainfall area, high resource/environmental value (see Note 6)	Surface water pollution hazard for low permeable soils, low lying or poorly draining areas
C	Groundwater	Category 5 and 6 soils, low resource/environmental value	Category 1 and 2 soils, gravel aquifers, high resource/environmental value	Groundwater pollution hazard
D	Slope	0 – 6% (surface effluent application) 0 – 10% (subsurface effluent application)	> 10% (surface effluent application), > 30% subsurface effluent application	Off-site export of effluent, erosion
E	Position of land application area in landscape (see Note 6).	Downgradient of surface water, property boundary, recreational area	Upgradient of surface water, property boundary, recreational area	Surface water pollution hazard, off-site export of effluent
F	Drainage	Category 1 and 2 soils, gently sloping area	Category 6 soils, sites with visible seepage, moisture tolerant vegetation, low lying area	Groundwater pollution hazard
G	Flood potential	Above 1 in 20 year flood contour	Below 1 in 20 year flood contour	Off-site export of effluent, system failure, mechanical faults
H	Geology and soils	Category 3 and 4 soils, low porous regolith, deep, uniform soils	Category 1 and 6 soils, fractured rock, gravel aquifers, highly porous regolith	Groundwater pollution hazard for porous regolith and permeable soils
I	Landform	Hill crests, convex side slopes, and plains	Drainage plains and incise channels	Groundwater pollution hazard, resurfacing hazard
J	Application method	Drip irrigation or subsurface application of effluent	Surface/above ground application of effluent	Off-site export of effluent, surface water pollution

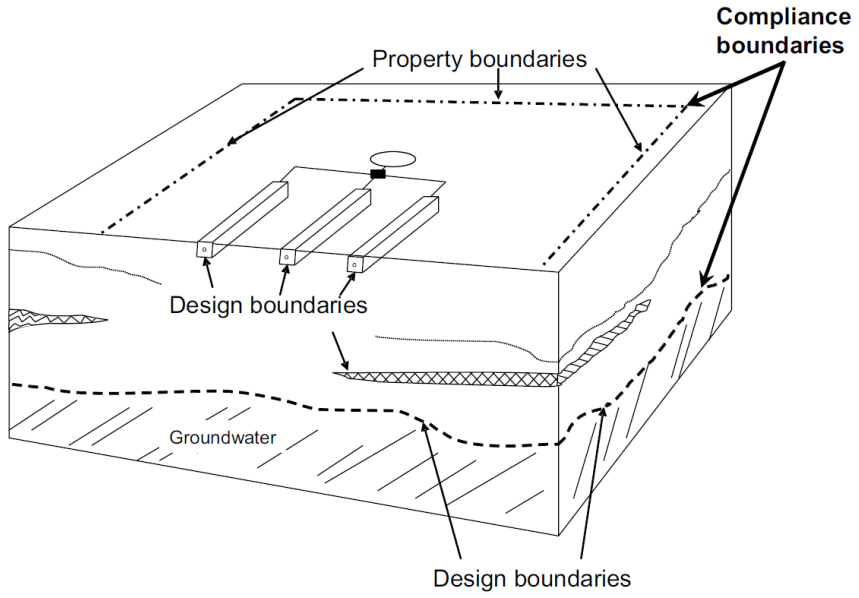
NOTES:

1 Scale shows the level of constraint to siting an on-site system due to the constraints identified by SSE evaluator or regulatory authority. See Figures R1 and R2 for examples of on-site system design boundaries and possible site constraints.

2 Examples of typical siting constraint factors that may be identified either by SSE evaluator or regulatory authority. Site constraints are not limited to this table. Other site constraints may be identified and taken into consideration when determining setback distances.

TABLE R2
SITE CONSTRAINT SCALE FOR DEVELOPMENT OF SETBACK DISTANCES
(used as a guide in determining appropriate setback distances from ranges given in Table R1) (continued)

3	The level of microbial removal for any on-site treatment system needs to be determined and it should be assumed that unless disinfection is reliably used then the microbial concentrations will be similar to primary treatment. Low risk microbial quality value is based on the values given in ARC (2004), ANZECC and ARMCANZ (2000), and EPA Victoria *(Guidelines for environmental management: Use of reclaimed water* 2003).
4	Surface water, in this case, refers to any fresh water or geothermal water in a river, lake, stream, or wetland that may be permanently or intermittently flowing. Surface water also includes water in the coastal marine area and water in man-made drains, channels, and dams unless these are to specifically divert surface water away from the land application area. Surface water excludes any water in a pipe or tank.
5	The soil categories 1 to 6 are described in Table 5.1. Surface water or groundwater that has high resource value may include potable (human or animal) water supplies, bores, wells, and water used for recreational purposes. Surface water or groundwater of high environmental value include undisturbed or slightly disturbed aquatic ecosystems as described in ANZECC and ARMCANZ (2000).
6	The regulatory authority may reduce or increase setback distances at their discretion based on the distances of the land application up or downgradient of sensitive receptors.



(Adapted from USEPA 2002)

FIGURE R1 EXAMPLE OF DESIGN AND COMPLIANCE BOUNDARIES FOR APPLICATION OF SETBACK DISTANCES FOR A SOIL ABSORPTION SYSTEM

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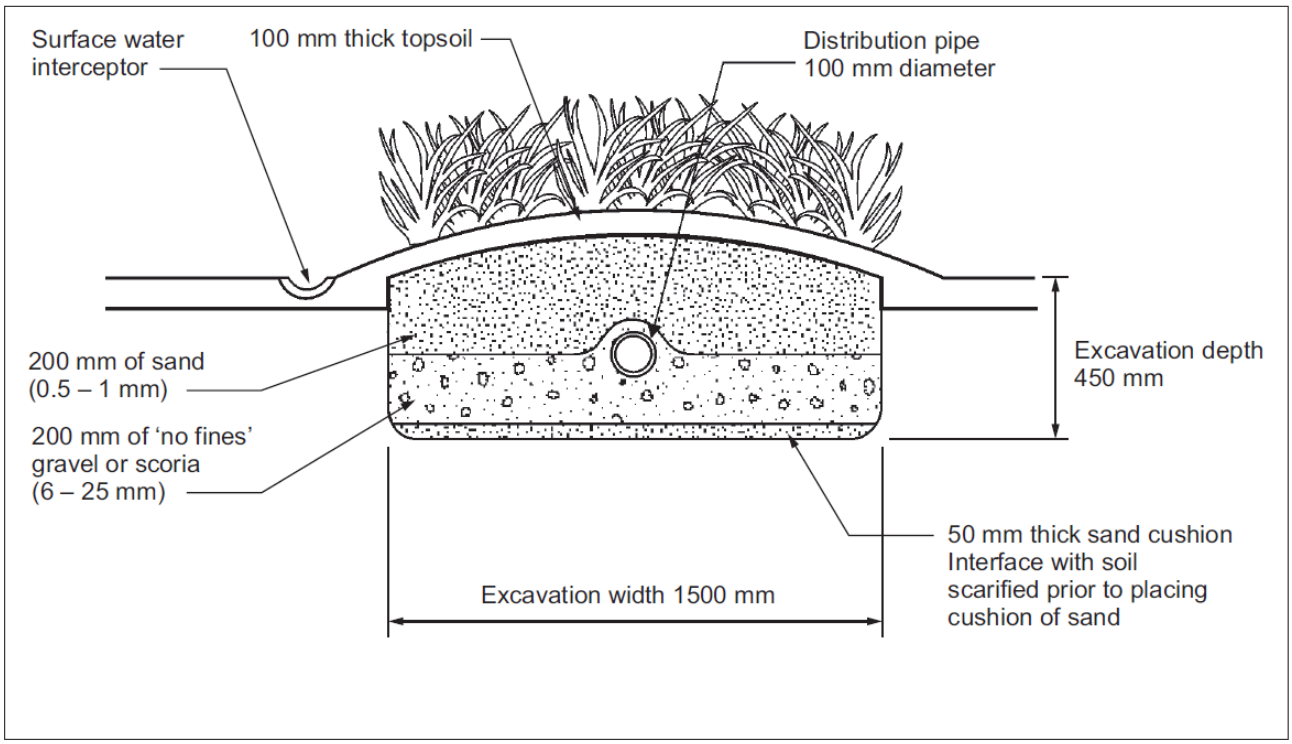
APPENDIX D

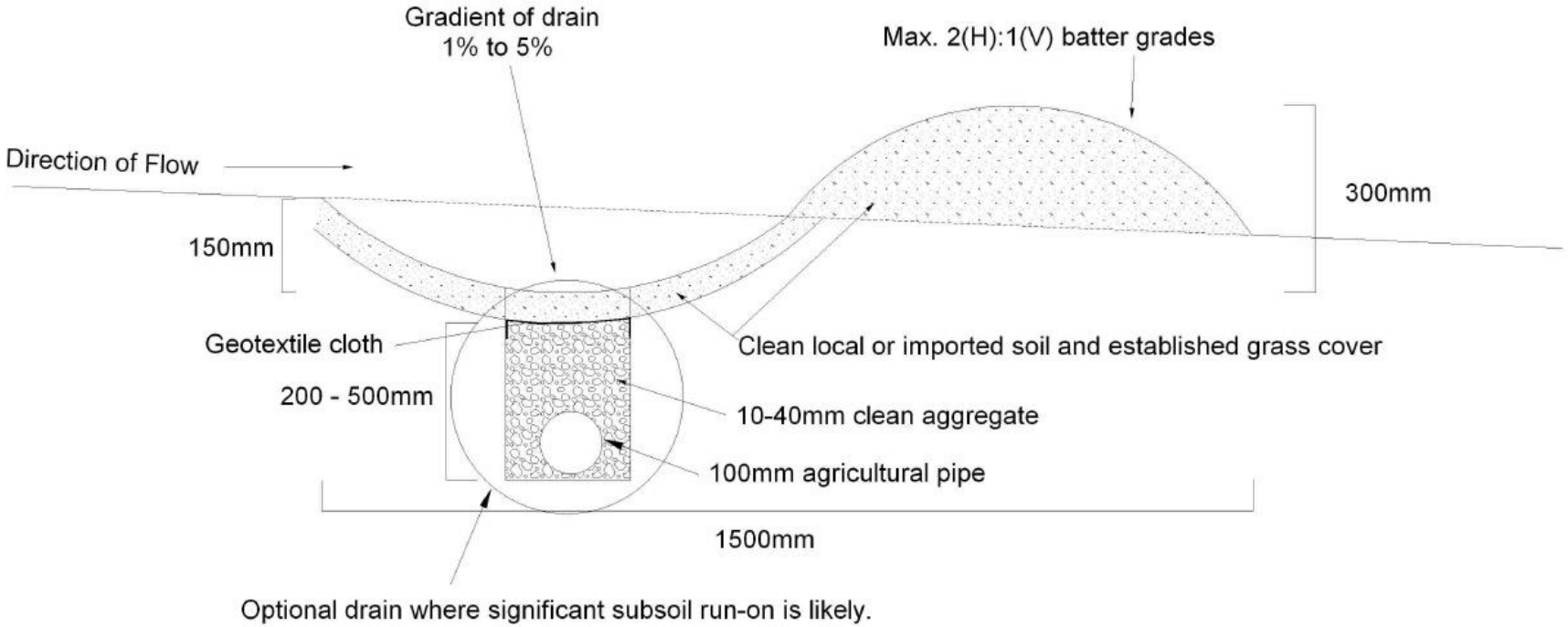
Evapotranspiration Bed Concept Plans



NOTE: An LPED line can be used to dose load the ETA/ETS bed.

FIGURE L6 ETA/ETS BED DETAILS

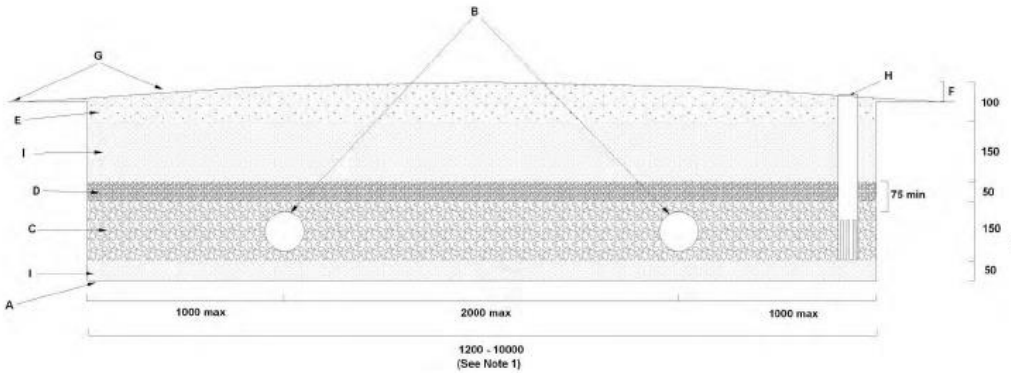
Cross Section: Upslope Diversion Drain



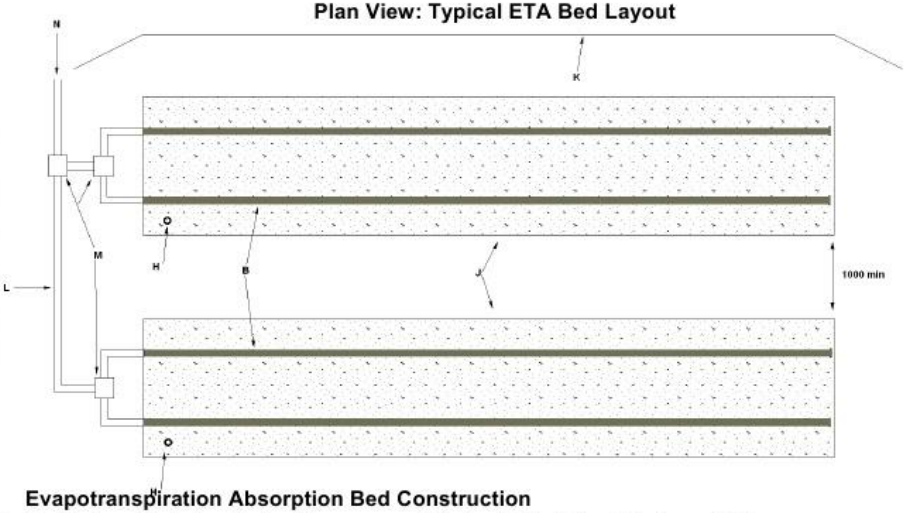
Standard Drawing 11A – Upslope Diversion Drain

(not to scale)

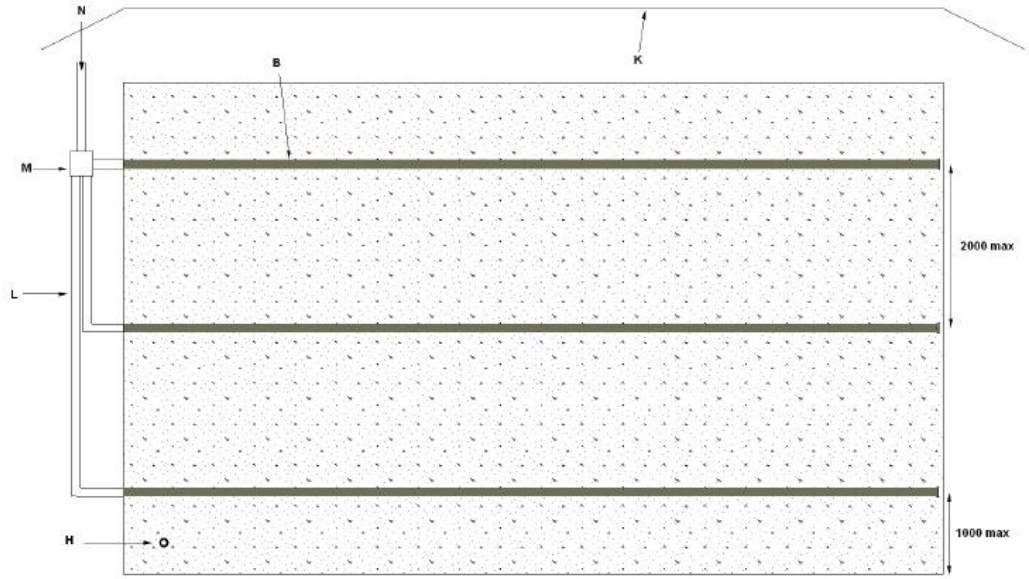
Cross Section: Evapotranspiration Absorption (ETA) Bed



Plan View: Typical ETA Bed Layout



Plan View: Typical Large ETA Bed Layout (applicable only if pressure-dosed and a flat site <5% slope)



Evapotranspiration Absorption Bed Construction

A The base of the bed must be level to ensure even distribution of effluent. It must also be scarified to overcome any smearing during excavation. Base levels should be checked with a dumpy / laser level.

B 100mm slotted PVC pipe.

C 20-40mm distribution aggregate.

D 5-10mm aggregate.

E Clean local or imported topsoil (sandy loam to loam).

F Allowance for settling after backfilling.

G Grass must be established across the construction area as soon as possible. Trench / bed surface should be level or slightly mounded.

H Inspection port on downhill side of the bed. Made from 50mm PVC pipe with perforations in the aggregate level of the bed.

I Fine sand (0.1mm).

J Bed dimensions are an example only. The basal area of the land application area must be determined according to the procedures set out in AS/NZS 1547:2012 and this Manual. The location and orientation of the area should be based on a site and soil assessment by a suitably qualified person. The system may comprise a single trench / bed or multiple smaller trenches / beds. It is essential that effluent is distributed evenly to all units on a daily basis.

K Upslope stormwater diversion drain (see Standard Drawing No.11A for design detail). Subsoil drainage may be necessary on particular sites.

L 100 mm PVC gravity dosing pipe.

M Gravity splitter box to distribute effluent evenly between two to four separate trenches / beds. Should also be used to evenly dose multiple pipework within a single trench / bed.

N Gravity, siphon or pump fed effluent from treatment system.

Note

1 More than two distribution pipes will be required in beds wider than 4,000mm. Care should be taken with beds wider than 4,000mm to ensure a level base.

2 WaterNSW notes that drilling holes within PVC pipe makes them non-compliant with the AS/NZS 3500, as it impacts the structural integrity of the pipe.

Standard Drawing 11B – Evapotranspiration Absorption Bed

(not to scale)

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APPENDIX E

List of Plates

Plate 1 – Overview of proposed site

Plate 2 – Overview of proposed site

ATTACHMENT D
Residential Site Investigation Report

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DESIGN . PLAN . MANAGE

Residential Site Investigation Report

Client: Desim Pty Ltd

Site Address: 65-67 Columbus Street
Ivanhoe, NSW 2878

7 November 2023
Our Reference: 41903-GR01_A

DISCLAIMER

This report has been prepared solely for Desim Pty Ltd in accordance with the scope provided by the client and for the purpose(s) as outlined throughout this report. Barnson Pty Ltd accepts no liability or responsibility for or in respect of any use or reliance upon this report and its supporting material by anyone other than the client.

The accuracy of the advice provided in this report may be limited by unobserved variations in ground conditions across the site in areas between and beyond test locations and by any restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints. These factors may lead to the possibility that actual ground conditions and materials behaviour observed at the test locations may differ from those which may be encountered elsewhere on the site. If the sub-surface conditions are found to differ from those described in this report, we should be informed immediately to evaluate whether recommendations should be reviewed and amended if necessary.

Project Name:	65-67 Columbus Street, Ivanhoe NSW 2878
Client:	Desim Pty Ltd
Project Number:	41903
Report Reference:	41903-GR01_A
Date:	7.11.2023
Revision	Revision A

Prepared by:	Reviewed by:
	
Gareth Williams Laboratory Technician	**Luke Morris** B.E. MIEAust CPEng (NPER) Director

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Appendices

1. INTRODUCTION

The following is a report on the geotechnical assessment of a residential site in accordance with AS2870-2011.

The purpose of the investigation is to provide guidance as to the expected foundation condition so that a suitable foundation design can be prepared for the proposed residential dwelling.

1.1. Terminology

The methods used in this report to describe the soil profiles, including visual classification of material types encountered, are in accordance with Australian standard AS1726-2017 “Geotechnical Site Investigations”.

1.2. Limitations

The geotechnical section of Barnson Pty Ltd has conducted this investigation and prepared this report in response to specific instructions from the client to whom this report is addressed. This report is intended for the sole use of the client, and only for the purpose which it is prepared. Any third party who relies on the report or any representation contained in it does so at their own risk.

1.3. Geotechnical Testing

Representative samples from the site were subjected to the following range of tests in accordance with relevant method of Australian Standard AS1289:

- Linear Shrinkage
- PH

NATA endorsed reports are attached in ***Appendix C***.

2. GENERAL DESCRIPTION OF SITE

The site is situated in a residential area of Ivanhoe NSW.

The site consists of moderate grass and weed cover with mature trees scattered over the site.

The site is relatively flat. The block has existing buildings and vacant blocks in the vicinity.

Any trees noted to be within the building zone, should be removed and the excavation remaining should be backfilled with natural material and reinstated in layers to a minimum of 95% Standard Maximum Dry Density

Plate 1 – West facing view

3. SITE HISTORY

A review of Google Earth imagery of the site indicates that the site is in similar condition as to when an image was taken in 2002. The site is therefore assumed to be natural ground with no recent tree removal or fill placed. Images exist back to 1985, yet the image is not clear enough to determine what was on the site. See 2002 aerial image below:

Plate 2 – Aerial Image 2002, Courtesy Google Earth.

4. METHOD OF INVESTIGATION

On the 5th of October 2023, a site investigation was carried out at 65-67 Columbus Street, Ivanhoe NSW.

A drill rig with a flight auger and tungsten tip was used to excavate 3 test holes. The supervising soil technician logged the soil profiles, which were recorded in the bore logs. Disturbed samples were taken from the depths shown in the bore logs. The bore logs are attached in ***Appendix B***.

The disturbed samples were returned to the Laboratory where Linear Shrinkage testing was conducted on the samples to correlate the material's Shrink Swell Index in accordance with AS2870-2011. The results of the Linear Shrinkage tests are attached in ***Appendix C.***

Dynamic Cone Penetrometer (DCP) testing was also performed on the site to evaluate the strength and consistency of the material present. The results of the Dynamic Cone Penetrometer tests are attached in ***Appendix B***.

5. SUB-SURFACE CONDITIONS

From the bore logs attached it can be seen that the soil encountered to the test end point was as follows:

5.1. Topsoil

A 0.3m thick layer of topsoil was encountered at the borehole locations. The topsoil consisted of sandy silt.

5.2. Sub-Soil

Alluvial soils were encountered throughout the boreholes. These comprised of slightly moist clayey silt to 1.1m and then slightly moist silty sandy clay to 3.0m.

5.3. Regional Geology

Reference to the Ivanhoe, New South Wales 1:250,000 Geological Series Sheet SI/55-01 indicates the surrounding area consists of "*Flat to gently undulating plains of red and brown clayey sand, loam and lateritic soils". Rock was not encountered during this investigation.*

5.4. Sub-Surface Bearing Capacity

- The allowable bearing capacity at depths ranging from 0.3m-0.5m is considered to be 100kPa.
- The allowable bearing capacity at depths ranging from 0.5m-3.0m is considered to be 100-350kPa.

All the above soil strengths are applicable to the sites at the time of the investigation. These bearing capacities should not be used for design purposes, they are provided to give an indication of soil strength only.

Elevation of moisture content will cause a marked decrease in bearing capacity with soil types listed.

5.5. Soil Exposure Classification

Acidic ground conditions can be caused by dissolved “aggressive” carbon dioxide, pure and very soft waters, organic and mineral acids and bacterial activity.

pH testing was conducted on the site samples to determine if any acidic conditions were present in the soils encountered.

Table 1: pH Testing Results

Borehole No.	Sample Depth (m)	pH (w)	Exposure Classification
1	0.8	8.6	A1

These results show the exposure classification as per Table 5.2 AS2870-2011. Groundwater was not encountered during this investigation.

5.6. Seasonal Surface Movement

From the laboratory test results, as shown attached, an estimated ground surface movement (Ys) was calculated in accordance with AS2870-2011 (using a change in suction at the soil surface $\Delta\mu$ = 1.5pF and a depth of design suction change, Hs = 4.0m) being:

Ys = 65-70mm

It is our opinion that a **Site Classification of 'P'** or "Problem Site" should be adopted for the site in its present condition, due to:

- The site has trees. Reference is made to Appendix 'H' of AS2870-2011, which gives guidance on the design of footings on reactive clay soils with the effect of trees. The footing design engineer will need to calculate the tree induced differential centre heave mound height (y_m) based on the tree height and distance of the proposed buildings from the tree or group of trees. This value should be used to design a suitable footing design in accordance with section 4 of the code.
- A building is to be removed from the site; reference is made to AS2870 Clause 1.3.3 (a) Abnormal moisture conditions.
- The site has an existing septic tanks or trench near the proposed building location. If the septic tank is in the zone of influence of the proposed building, the tank should be removed and the excavation filled with controlled fill prior the construction of the new dwelling. Its effect on site classification should be assessed as per clause 2.5.3 of AS2870-2011 based on the type of fill, its depth and the compaction records.

The site reactivity is advised to be Classification 'H2-D'.

6. RECOMMENDATIONS

6.1. Building Foundation

The recommended basic design philosophy for dealing with these soils is to cater for seasonal movements by appropriate foundation and structural design as per AS2870-2011. Therefore the foundations provided should be designed with guidance from AS2870-2011 for the site classification provided.

6.2. Foundations General

The possibility of other abnormal and localised moisture changes must be minimised by adherence to general design and site management practises as recommended in the attached CSIRO information service sheet, “Guide to Homeowners on Foundation Maintenance and Footing Performance”.

These recommendations assume that the footings will be founded in the natural soil or controlled fill, and that no topsoil or poor and uncompacted fill occurs beneath the footing beams or slab.

Finally, it must be emphasised that the recommended design approach accepts that minor aesthetic cracking may occur. The design philosophy is thus a compromise between economy and performance.

7. CONCLUSION

The testing methods adopted are indicative of the site's sub-surface conditions to the depths excavated and to specific sampling and/or testing locations in this investigation, and only at the time the work was carried out.

The accuracy of geotechnical engineering advice provided in this report may be limited by unobserved variations in ground conditions across the site in areas between and beyond test locations and by any restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints.

These factors may lead to the possibility that actual ground conditions and materials behaviour observed at the test locations may differ from those which may be encountered elsewhere on the site.

If the sub-surface conditions are found to differ from those described in this report, we should be informed immediately to evaluate whether recommendations should be reviewed and amended if necessary.

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APPENDIX A

General Notes

GEOTECHNICAL INVESTIGATION GENERAL NOTES

This report contains the results of a geotechnical investigation conducted for a specific purpose and client. The results should not be used by other parties, or for other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the client.

TEST HOLE LOGGING

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where the test information is available (field and/or laboratory results). The borehole logs include both factual data and inferred information. Reference should be made to the relevant sheets for the explanation of logging procedures (Soil and Rock Descriptions, Core Log Sheet Notes etc).

GROUNDWATER

Unless otherwise indicated, the water levels presented on the borehole logs are the levels of free water or seepage in the bore hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeability's (i.e. depending on response time of the measuring instrument). Further, variations of this level could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities. Confirmation of groundwater levels, phreatic surfaces or piezometric pressures can only be made by appropriate instrumentation techniques and monitoring programmes.

INTERPRETATION OF RESULTS

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete borehole area. Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

CHANGE IN CONDITIONS

Local variations or anomalies in the generalised ground conditions do occur in the natural environment, particularly between discrete borehole locations. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural forces.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to this firm for appropriate assessment and comment.

GEOTECHNICAL VERIFICATION

Verification of the geotechnical assumptions and/or model is an integral part of the design process – investigation, construction verification and performance monitoring. Variability is a feature of the natural environment and, in many instances, verification of soil or rock quality, or foundation levels are required. There may be a requirement to extend foundation depths to modify a foundation system or to conduct monitoring as a result of this natural variability. Allowance for verification by geotechnical personnel accordingly should be recognised and programmed during construction.

FOUNDATIONS

Where referred to in the report, the soil or rock quality, or the recommendation depth of any foundation (piles, caissons footings etc.) is an engineering estimate. The estimate is influenced and perhaps limited, by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The material quality and/or foundation depth remains, however, an estimate and therefore liable to variation. Foundation drawings, designs and specifications should provide for variations in the final depth, depending upon the ground conditions at each point of support, and allow for geotechnical verification.

REPRODUCTION OF REPORTS

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions should include at least all of the relevant test hole and test data, together with the appropriate standard description sheets and remarks made in the written report of a factual or descriptive nature.

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APPENDIX B

Borehole Logs

BOREHOLE NUMBER 1

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

CLIENT Desim Pty Ltd **PROJECT NAME** Site Classification

PROJECT NUMBER 41903 **PROJECT LOCATION** 65-67 Columbus Street, Ivanhoe NSW

DATE STARTED 5/10/23 **COMPLETED** 5/10/23 **R.L. SURFACE** --- **LONGTITUDE** ---

DRILLING CONTRACTOR Barnson **SLOPE** 90° **LATITUDE** ---

EQUIPMENT 1750 Drill Rig **HOLE LOCATION** Borehole 1

HOLE SIZE 90mm **LOGGED BY** NR **CHECKED BY** NR

NOTES

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: red	0 4 8 12 16 20 24 28 32	TOPSOIL
		0.3		CL	Silty CLAY: red: slightly moist: very stiff to hard: medium plasticity	7 7 8 9 10 9 13 19 32	ALLUVIAL
	Disturbed Sample LS = 12.5%	0.5					
		1.0					
		1.1		CL	Silty Sandy CLAY: red-brown: slightly moist: hard: medium to high plasticity		ALLUVIAL
		1.5					
	Disturbed Sample LS = 14.0%	2.0					
		2.5					
		3.0					

Borehole 1 terminated at 3m

BOREHOLE NUMBER 2

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

CLIENT Desim Pty Ltd **PROJECT NAME** Site Classification

PROJECT NUMBER 41903 **PROJECT LOCATION** 65-67 Columbus Street, Ivanhoe NSW

DATE STARTED 5/10/23 **COMPLETED** 5/10/23 **R.L. SURFACE** _____ **LONGTITUDE** ---

DRILLING CONTRACTOR Barnson **SLOPE** 90° **LATITUDE** ---

EQUIPMENT 1750 Drill Rig **HOLE LOCATION** Borehole 2

HOLE SIZE 90mm **LOGGED BY** NR **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0.3			Sandy SILT: red	TOPSOIL
		0.5		CL	Silty CLAY: red: slightly moist: very stiff to hard: medium plasticity	ALLUVIAL
		1.0				
		1.1		CL	Silty Sandy CLAY: red-brown: slightly moist: hard: medium to high plasticity	ALLUVIAL
		1.5				
		2.0				
		2.5				
		3.0				

Dynamic Cone Penetrometer Blows / 100mm

0 4 8 12 16 20 24 28 32

0 7 7 8 9 10 9 13 19 32

Borehole 2 terminated at 3m

BOREHOLE / TEST PIT WITH DCP 41903-G01A-G03A.GPJ GINT STD AUSTRALIA.GDT 26/10/23

BOREHOLE NUMBER 3

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

CLIENT Desim Pty Ltd **PROJECT NAME** Site Classification

PROJECT NUMBER 41903 **PROJECT LOCATION** 65-67 Columbus Street, Ivanhoe NSW

DATE STARTED 5/10/23 **COMPLETED** 5/10/23 **R.L. SURFACE** _____ **LONGTITUDE** ---

DRILLING CONTRACTOR Barnson **SLOPE** 90° **LATITUDE** ---

EQUIPMENT 1750 Drill Rig **HOLE LOCATION** Borehole 3

HOLE SIZE 90mm **LOGGED BY** NR **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: red	0 4 8 12 16 20 24 28 32	TOPSOIL
		0.3		CL	Silty CLAY: red: slightly moist: very stiff to hard: medium plasticity	7 7 8 9 10 9 13 19 32	ALLUVIAL
		1.1		CL	Silty Sandy CLAY: red-brown: slightly moist: hard: medium to high plasticity		ALLUVIAL
		3.0			Borehole 3 terminated at 3m		

BOREHOLE / TEST PIT WITH DCP 41903-G01A-G03A.GPJ GINT STD AUSTRALIA.GDT 26/10/23

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APPENDIX C

NATA Laboratory Reports

Material Test Report

Barnson Pty Ltd
Dubbo Laboratory
16 L Yarrandale Road Dubbo NSW 2830
Phone: 1300 BARNSON
Email: jeremy@barnson.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Jeremy Wiatkowski
Geotechnical Technician
NATA Accredited Laboratory Number: 9605

Report Number:	**41903-1**
Issue Number:	1
Date Issued:	26/10/2023
Client:	Desim Pty Ltd
	100 Harris Street, Pyrmont NSW 2009
Contact:	Dejan Simovic
Project Number:	41903
Project Name:	Site Classification & Septic Design
Project Location:	65-67 Columbus Street, Ivanhoe NSW
Work Request:	9031
Sample Number:	D23-9031A
Date Sampled:	05/10/2023
Dates Tested:	05/10/2023 - 25/10/2023
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location:	**Borehole 1, Depth: 800mm**
Material:	Red Silty CLAY

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.5**		
Cracking Crumbling Curling	Cracking & Crumbling		

Material Test Report

Barnson Pty Ltd
Dubbo Laboratory
16 L Yarrandale Road Dubbo NSW 2830
Phone: 1300 BARNSON
Email: jeremy@barnson.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Jeremy Wiatkowski
Geotechnical Technician
NATA Accredited Laboratory Number: 9605

Report Number:	**41903-1**
Issue Number:	1
Date Issued:	26/10/2023
Client:	Desim Pty Ltd
	100 Harris Street, Pyrmont NSW 2009
Contact:	Dejan Simovic
Project Number:	41903
Project Name:	Site Classification & Septic Design
Project Location:	65-67 Columbus Street, Ivanhoe NSW
Work Request:	9031
Sample Number:	D23-9031B
Date Sampled:	05/10/2023
Dates Tested:	05/10/2023 - 25/10/2023
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Sample Location:	**Borehole 1, Depth: 2.0m**
Material:	Red-Brown Silty Sandy CLAY

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**14.0**		
Cracking Crumbling Curling	Cracking & Curling		

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APPENDIX D

CSIRO Guide

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

CSIRO

BTF 18
replaces
Information
Sheet 10/91

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

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

Soil Types

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

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

Causes of Movement

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

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

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

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

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

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

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

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

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

GENERAL DEFINITIONS OF SITE CLASSES

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

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

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

Unevenness of Movement

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

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

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

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

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

Effects of Uneven Soil Movement on Structures

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

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

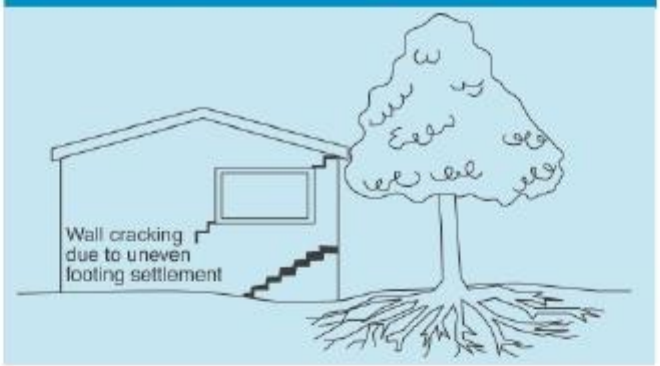
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

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

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

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

Trees can cause shrinkage and damage



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

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

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

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

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

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

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

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

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

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

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

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

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

Water Service and Drainage

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

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

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

Seriousness of Cracking

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

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

Prevention/ Cure

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

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

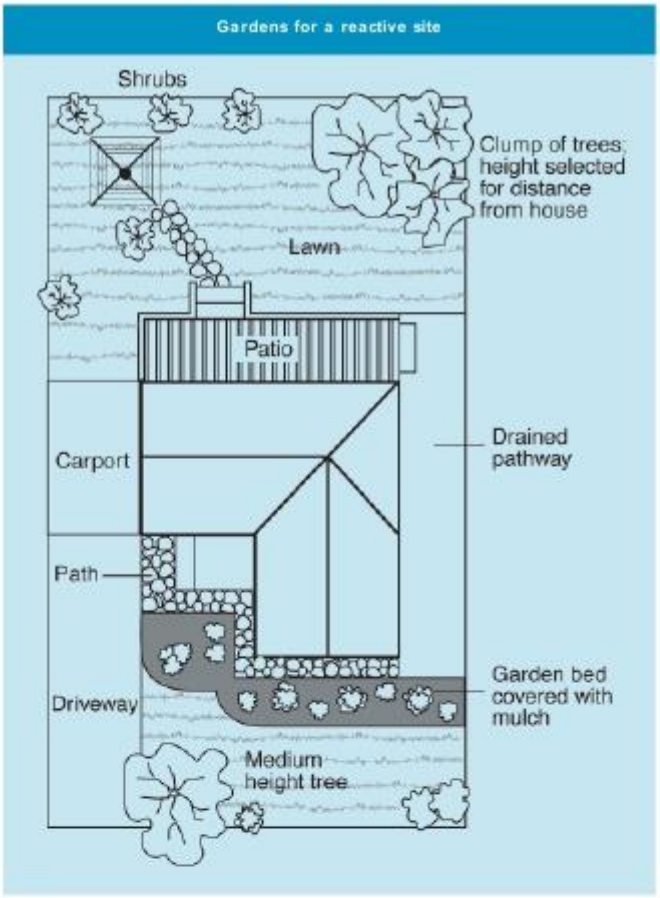
It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

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

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

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

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



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

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

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

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

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

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

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

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

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

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

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

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

Remediation

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

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

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

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ATTACHMENT E
Structural Letter of compliance

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Greycat Consulting Pty Ltd
ABN 70 673 340 504
303 65 Walker St
North Sydney NSW

19th December 2023
Desim Pty Ptd

Attention: Dejan Simovic

Dear Dejan,

Re 67 Columbus Ivanhoe – Foundation design

The proposed development comprises the installation of a single storey lightweight modular residence as documented on drawings AR 011 B, AR 101 B and AR102 C produced by Desim Pty Ltd

We have reviewed the geotechnical report produced by Barnsons (Ref 41903-GR01_A) and confirm that suitable foundation system for the proposed building will be either

1. Single pad foundations sized to be supported on clay of bearing capacity of 100 kPa and also to resist wind forces as determined using AS1170.2 or

2. A raft slab designed in accordance with AS2870 – 2011 for a clad frame for a site classification of H2 -D .

External slabs for the carport and driveways are to be designed for to bear on natural ground or engineered fill with an allowable bearing capacity of 100 kPa

Yours faithfully,
Greycat Consulting Pty Ltd

John Williams

BE(Hons) MIEAust CPeng NER

Director

DESIM PTY LTD

Design, **E**ngineering, **S**ustainability, **I**nnovation, **M**anagement

We Care. Beyond Duty.

67 Columbus Street, Ivanhoe 2878 – Cost estimate report

Item	Unit	Cost/Unit	Quantity	Cost
Preparation				
Excavation/Preparation: Light/Nil Vegetation	250m2	$1,000.00	1	**$1,000.00**
Demolition				
Demolition: Weatherboard/Brick Veneer House	each	$20,000.00	1	**$20,000.00**
Dwelling				
Dwelling: Manufactured Home m2 1000$	m2	$1,000.00	101	**$101,000.00**
Patios, balcony, verandah, decks				
Roofed Deck/Balcony/Verandah	m2	$350.00	33	**$11,550.00**
Carport, garages				
Concrete slab on ground m2 300$	m2	$300.00	72	**$21,600.00**
Other				
Driveway: Gravel m2 20$	m2	$20.00	200	**$4,000.00**
On-Site Sewer: Convential Septic Tank and trenches	each	$5,000.00	2	**$10,000.00**
				$169,150.00

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Pyrmont NSW 2009
info@desim.com.au

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Nominated Architect - Dejan Simovic,
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