strata
geoscience and environmental

Limited Scope Reconnaissance Land Capability Assessment and Onsite Wastewater System Concept Design for

Proposed 64-Lot Subdivision
Maffra Briagolong Road
Maffra

June 2024

Report Details

Table 1: Site, Client, Author and Report Details	
Address	Maffra-Briagolong Road Maffra
Nature of Proposed Development	Proposed 64 Lot Subdivision
Client	
Author	
Report Number	SR04901
Report Date	19/06/2024

Table 2: Copies Recipient	
1 PDF	, Project Manager, Beveridge Williams
1 PDF	Strata Geoscience and Environmental Project File

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Executive Summary

contracted Strata Geoscience and Environmental Pty Ltd to conduct a Reconnaissance Land Capability Assessment and Onsite Wastewater System Concept Design at a proposed subdivision on Maffra-Briagolong Road Maffra.

The investigation consisted of desktop and field reconnaissance, laboratory testing, risk analysis, modelling and reporting.

Desktop and field investigation, combined with risk modelling found that the site has constraints associated with:

- Aspect
- Erosion
- Climate
- Vegetation Cover
- Soil Texture
- Emmerson
- Sodicity
- Soil Drainage

Given these findings, the following concept design recommendations are made:

- Treatment of all effluent generated onsite to a minimum of secondary levels
- Land application via subsurface irrigation scaled via water and nutrient balancing.
- Appropriate setbacks from all site boundaries, surface waters and bores.

Furthermore, all installed treatment plants should have a regular servicing contract in place between a qualified servicing agent and the property owner to further limit risk.

1. Introduction, Guidelines and Standards Referenced

Strata Geoscience and Environmental Pty Ltd was commissioned to perform a limited scope Land Capability Assessment for:

Table 3: Site and Client Details	
Client/Agent	
Site Address	Maffra-Briagolong Road Maffra (see Site Plan)
Nature of Development	Proposed 64 lot Subdivision

The investigation was conducted based upon specific development plans supplied by the client (Figure 2) and with reference to the following documents:

1. EPA Victoria (2016) Code of Practice for Onsite Wastewater Management
2. Australian Standard AS1547-2012 Onsite Wastewater Management

The investigation also follows the principles outlined in:

1. 2006 MAV & DSE Model LCA Report
2. EPA Publication 746.4 Guidelines for Land Capability Assessment
3. MAV DEPI & EPA 2014 Land Capability Assessment Framework
4. AS1726-1993 Geotechnical Site Investigations.

2. Description of the Development

Table 4: Site Description	
Site Address	Maffra-Briagolong Road Maffra
Owner/Developer/Agent	
Address	As above
Council Area	Wellington
Zoning	RLZ
Min Proposed Allotment Size	6000 m^2 approx.
Anticipated Wastewater Load	Up to 1080 L/D (See Section 6)
Availability of Sewer	Unsewered and likely to be unsewered in mid term

3. Site Plans and Key Site Features

A range of soil and landscape features were assessed for their potential to impact upon land application area siting and level of wastewater treatment required over the site. Figures 1-2 give locality and proposed site plans respectively whilst Table 5 summarises key features as in relation to effluent management over the site.

Figure 1 Locality Plan, Site Survey Plan (if available), Surface Water and Groundwater Bore Feature Plan

PROPERTY REPORT

VICTORIA State Government | Environment, Land, Water and Planning

From www.planning.vic.gov.au at 16 August 2022 10:01 AM

PROPERTY DETAILS

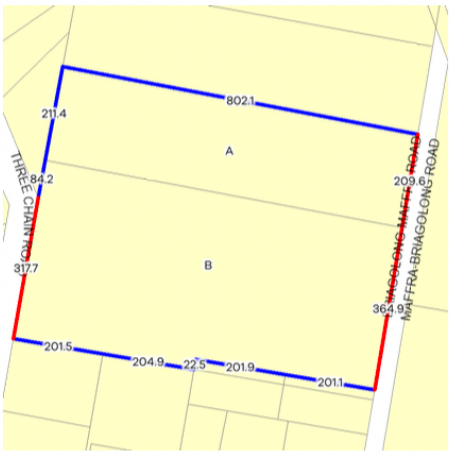
Address:	**MAFFRA-BRIAGOLONG ROAD MAFFRA 3860**
Lot and Plan Number:	**This property has 2 parcels. See table below**
Standard Parcel Identifier (SPI):	**See table below**
Local Government Area (Council):	**WELLINGTON** www.wellington.vic.gov.au
Council Property Number:	**361360**
Directory Reference:	**Vicroads 82 H8**

This property is in a designated bushfire prone area.
Special bushfire construction requirements apply. Planning provisions may apply.

Further information about the building control system and building in bushfire prone areas can be found on the Victorian Building Authority website https://www.vba.vic.gov.au

SITE DIMENSIONS

All dimensions and areas are approximate. They may not agree with those shown on a title or plan.



Area: 478967 sq. m (47.90 ha)
Perimeter: 2822 m
For this property:
— Site boundaries
— Road frontages

Dimensions for individual parcels require a separate search, but dimensions for individual units are generally not available.

Calculating the area from the dimensions shown may give a different value to the area shown above

For more accurate dimensions get copy of plan at Title and Property Certificates

PARCEL DETAILS

The letter in the first column identifies the parcel in the diagram above

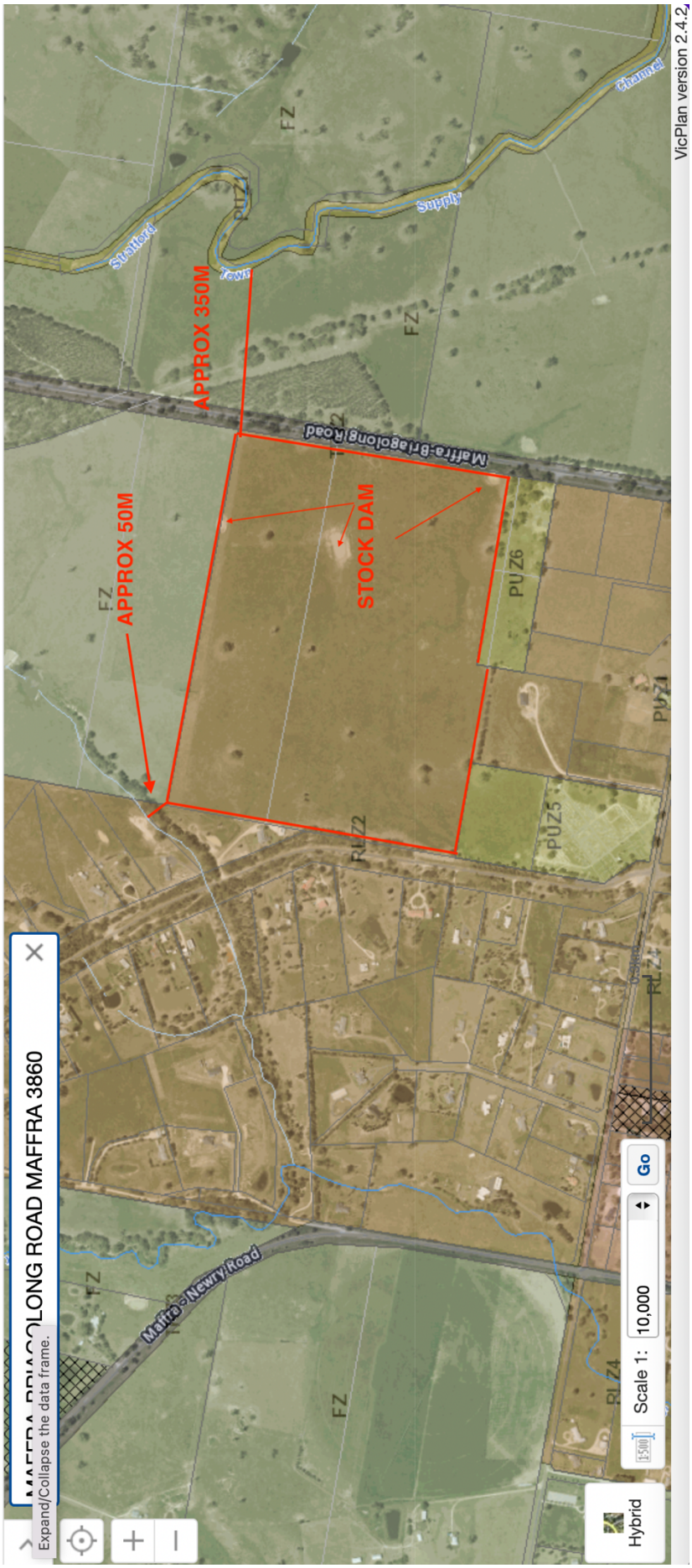
	Lot/Plan or Crown Description	SPI
A	Lot 1 TP533434	1\TP533434
B	Lot 2 TP533434	2\TP533434

UTILITIES

Rural Water Corporation:	**Southern Rural Water**
Urban Water Corporation:	**Gippsland Water**
Melbourne Water:	**Outside drainage boundary**
Power Distributor:	**AUSNET**

STATE ELECTORATES

Legislative Council:	**EASTERN VICTORIA**
Legislative Assembly:	**GIPPSLAND EAST**


APPROX 350M
APPROX 50M
STOCK DAM
Maffra-Briagolong Road
Maffra-Newry Road
FZ
PUZ1
PUZ2
PUZ4
PUZ5
PUZ6
RLZ2
RLZ4
Supply
Channel
Scale 1: 10,000
Go
Hybrid
Expand/Collapse the data frame.
VicPlan version 2.4.2

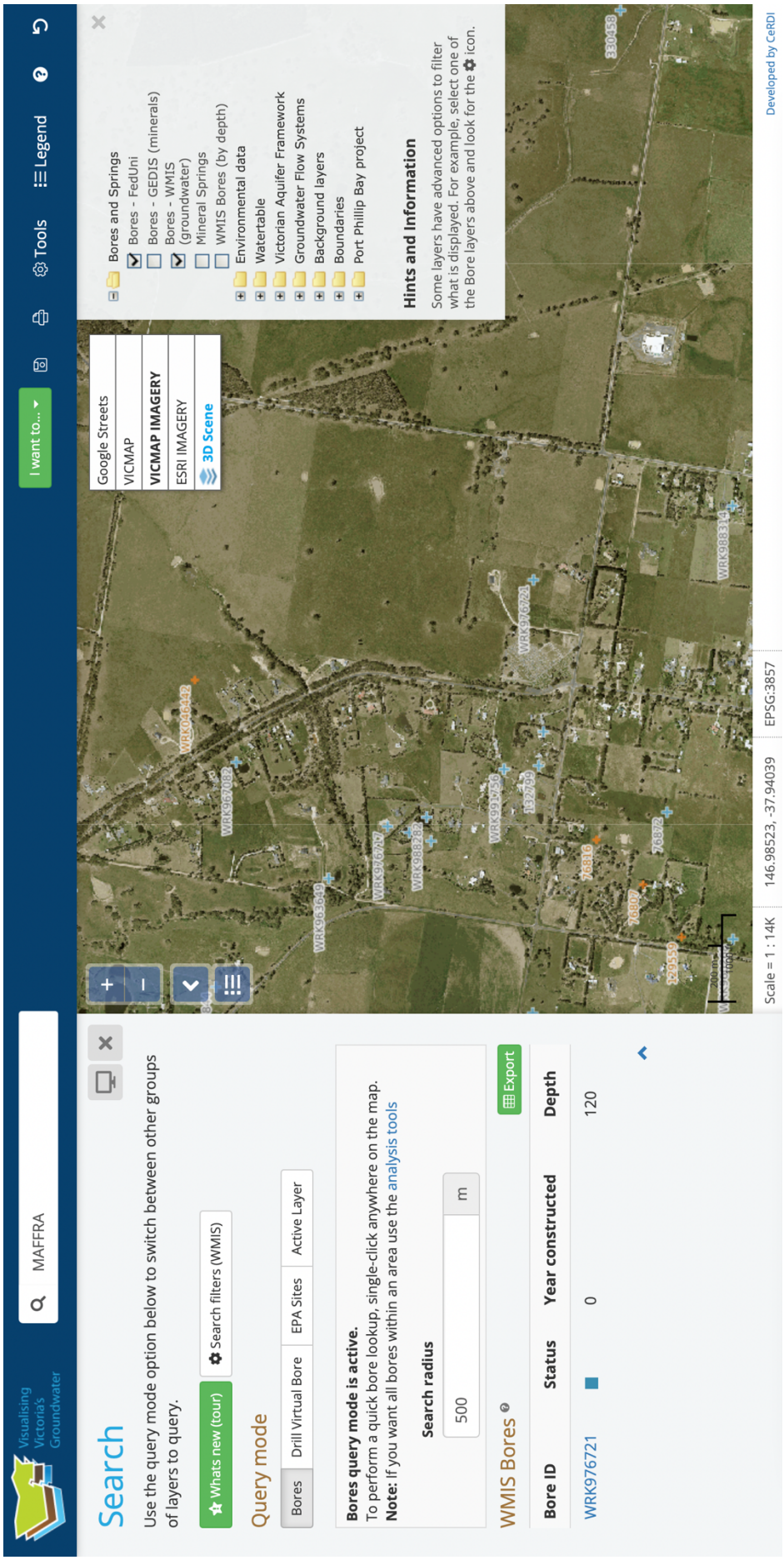

Visualising Victoria's Groundwater
MAFFRA
I want to...
Tools
Legend
Search
Use the query mode option below to switch between other groups of layers to query.
Whats new (tour)
Search filters (WMIS)
Query mode
Bores
Drill Virtual Bore
EPA Sites
Active Layer
Bores query mode is active.
To perform a quick bore lookup, single-click anywhere on the map.
Note: If you want all bores within an area use the analysis tools
Search radius
500
m
WMIS Bores
Export
Bore ID
Status
Year constructed
Depth
WRK976721
0
120
Google Streets
VICMAP
VICMAP IMAGERY
ESRI IMAGERY
3D Scene
Bores and Springs
Bores - FedUni
Bores - GEDIS (minerals)
Bores - WMIS (groundwater)
Mineral Springs
WMIS Bores (by depth)
Environmental data
Watertable
Victorian Aquifer Framework
Groundwater Flow Systems
Background layers
Boundaries
Port Phillip Bay project
Hints and Information
Some layers have advanced options to filter what is displayed. For example, select one of the Bore layers above and look for the icon.
Scale = 1 : 14K
146.98523, -37.94039
EPSG:3857
Developed by CeRDI

Figure 2 Proposed Subdivision Plan

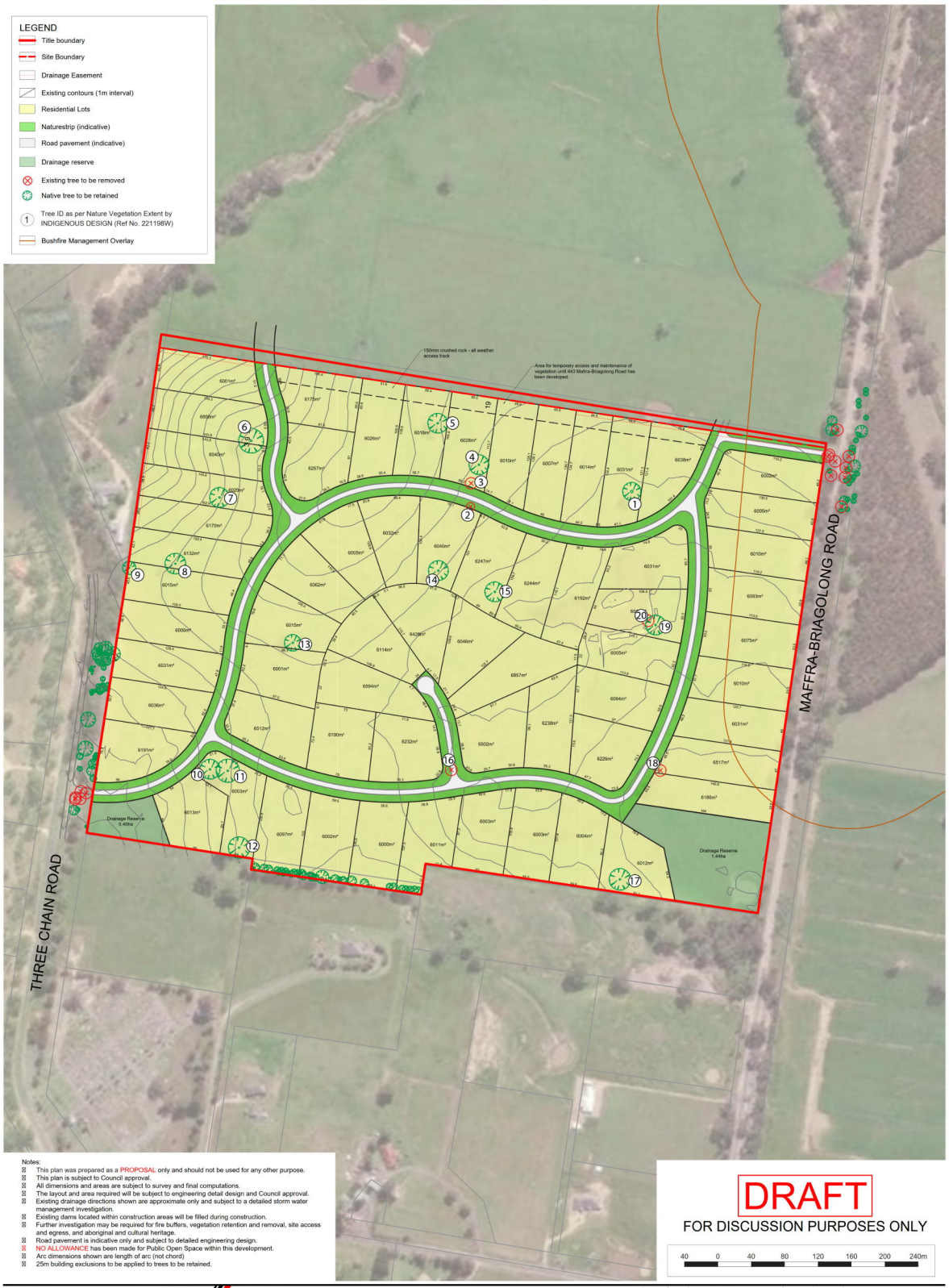


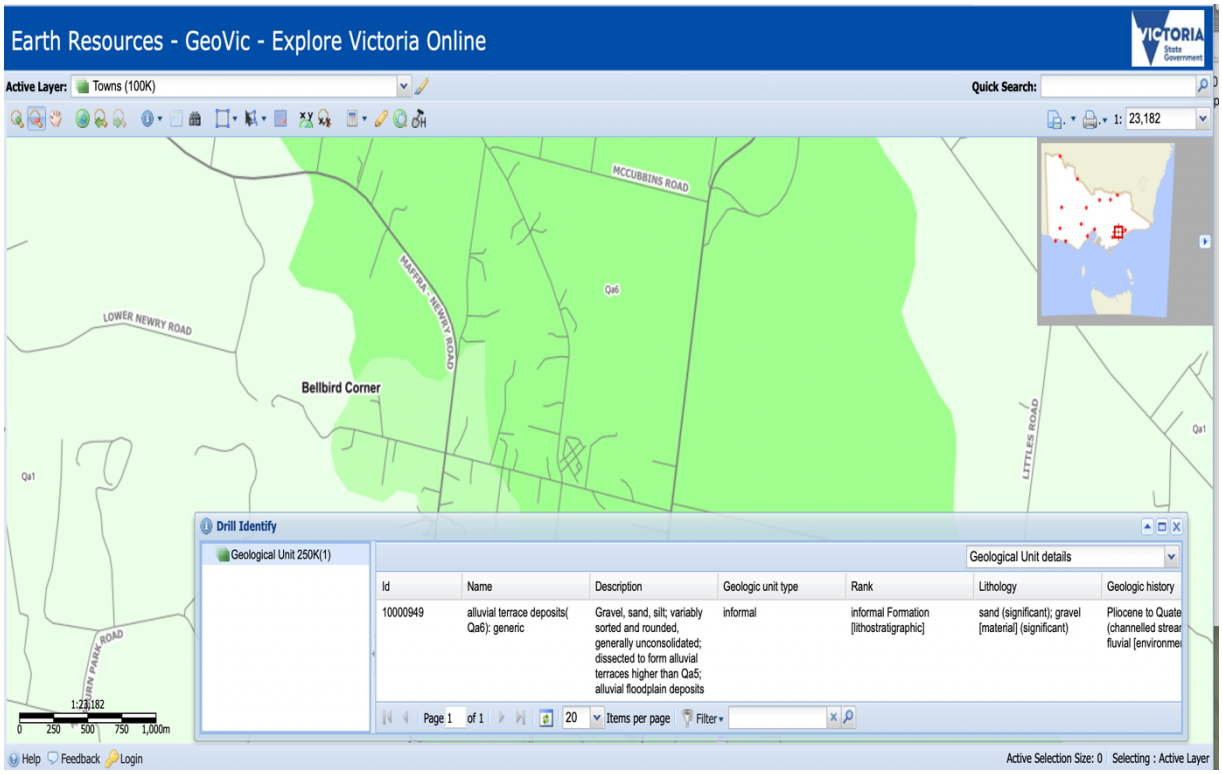
Table 5 Site Features	
Climate	The nearest weather station with **long term** data is the Maffra Station with a mean annual rainfall of 520 mm (BOM 2022). Climate Data from BOM presented in Appendix 2. The region has a near Mediterranean climate with maximum temperatures and minimum rainfall in the summer.
Exposure	The site is relatively shielded with exposure to winds which predominate from the NW/SW directions
Vegetation	Sparse with some mature trees
Landform	Undulating slopes
Slope, Slope Stability and Aspect	Minor slope, no identified stability issues, variable aspects
Fill	No fill evident in proposed land application areas
Rocks and Rock Outcrops	None observed.
Erosion Potential	No evidence of erosion, soils possibly subject to dispersion and surface rill or sheet erosion. Recommend irrigation systems into constructed ornamental garden beds.
Nearest Surface Water	Dams onsite. Off-site surface waters as noted on page 8. 30m separation form any surface water achievable on each proposed lot.
Flood Potential	Unknown
Stormwater Run-on and Upslope Seepage	Stormwater to be directed away from proposed effluent envelopes. No seepage observed.
Groundwater	**No registered bores onsite. One registered bore off site to the south approximately 100m away.** (See VVG Portal results page 9). Risk to groundwater from subsurface irrigation into topsoils of secondary effluent considered low if recommended buffer distances maintained. Based on the Department of Natural Resources and Environment Groundwater Resources Victoria Map groundwater is likely to be >10m below ground surface and have a salinity range of 501-1000 mg/L TDS. The following beneficial uses are indicated SEPP (Waters): • Maintenance of ecosystems • Stock watering • Industrial water use • Primary contact recreation • Buildings and structures
Site Surface Drainage and Subsurface Drainage	The site receives minimal run on and does not show signs of springs or other areas of ephemeral subsurface water retention.
Recommended Buffer Distances	Given the significant land area, all buffer distances as stipulated in EPA (2016) are achievable. Please refer to Note 4 Table 5 of EPA 2016.
Available Land Application Area	There is surplus space to land application area requirements (including reserves).

4. Soil Assessment and Constraints

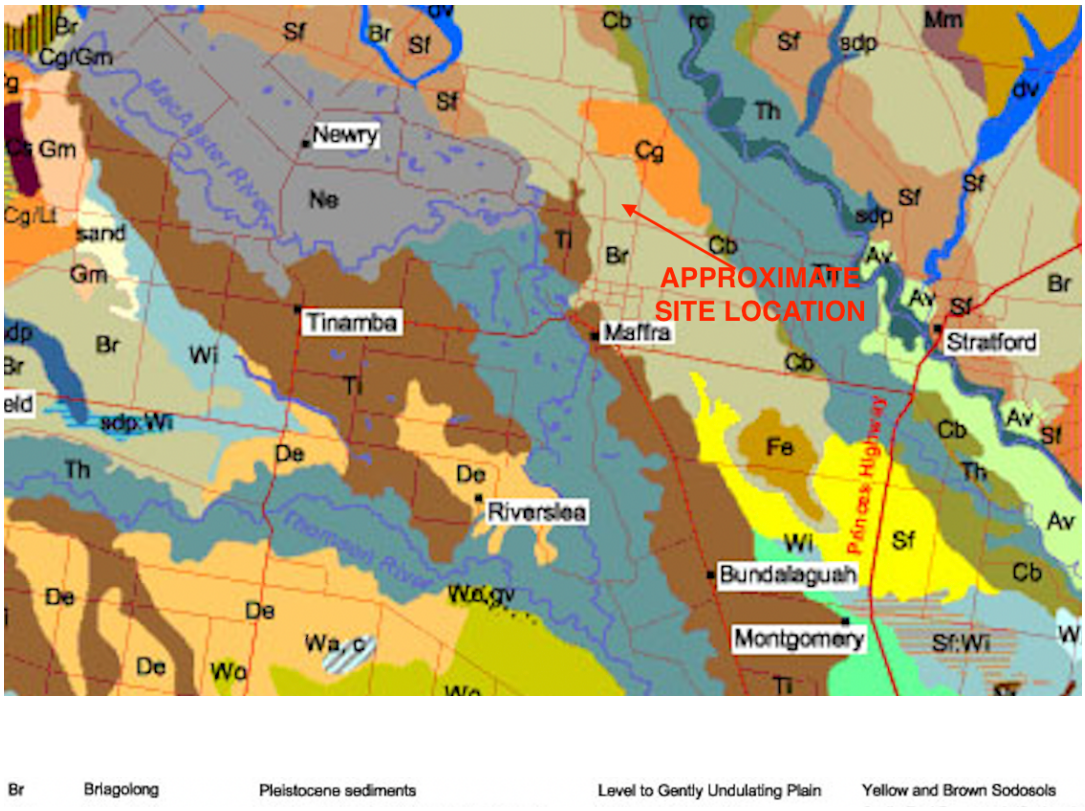
Soils have been assessed for their suitability for onsite wastewater management through both desktop review and intrusive field investigation.

4.1 Site Geology

Referring to Geoscience Australia 1:250000 geological mapping series, the site is underlain by Quaternary alluvial terrace deposits.



Referring to the Major Agricultural Soils of the Maffra Region mapping of Sargeant and Imhof (2000) the site is underlain by Briagolong soil class.



4.2 Field Investigation

Field investigation consisted of drilling soil bores using a vehicle mounted 100mm solid flight auger to 2.0m or refusal with retrieval of disturbed soil samples for logging, sampling and laboratory testing.

Bore logs and field permeability data/soil test results (where relevant) are presented in Appendix 1. Laboratory results are presented in Appendix 3. As a general comment soils appeared relative uniform over the site with one soil mapping unit consistent with the soil and geological mapping noted above.

With reference to the classification system of Isbell (2002) soils are classified as Brown **Sodosols** being clays soils with high sodium contents. Soils will exhibit duplex profiles with lighter SAND (SC/SM/SP) SILTS (ML) or Gravels (GM) grading to CLAYS (CL/CH) at variable depths from the existing ground surface. Subsoils clays will exhibit a moderate structure and will show the existence of vertical macropores throughout drier periods, significantly increasing their unsaturated hydraulic conductivities. Subsoils will likely show

slow to moderate cation exchange complex for the absorption of nutrients, may contain dispersive phases and a slightly acidic pH trend.

Table 4 Typical Soil Characteristics	
Soil Depth (m)	1.0-2m+
Depth to Water Table (m)	2.0m+
Coarse Fragments (%)	0-5%
Colloid Stability	Emmerson class and exchangable sodium percentage results indicate sodic soil phases present.
Soil Nutrient Attenuation	Good – clay phases will have moderate Cation Exchange Capacity.
Soil Field Permeability and Concept Design Loading Rates	Field permeability variable, recommend DIR of 3mm/d given clays encountered in bores.
Basement Permeability	Basement rock likely >5m – permeability therefore not relevant

	Topsoils	Subsoils
Description	Silty SAND (SM)/Clayey SAND(SC)	CLAY (CH)
Soil Category (AS1547-2011)	2	5
DIR (mm/d)/DLR (L/D)	4.5	3
pH	5.8	5.5
EMMERSON	7-8	1-3

Table 5 Summary of Key Soil Chemical Parameters							
	Units	BH1	BH2	BH3	BH 4	BH5	Indicative Desirable Levels*1
Conductivity	uS/cm	38	580	46	30	11	<300
Exchangeable Ca	meq/100g	2	0.4	3	3.8	11	>1
Exchangeable Na	meq/100g	2.1	0.1	0.8	3.1	0.2	<1
Exchangeable Mg	meq/100g	6.2	0.4	2.7	11	0.9	>1.6
Exchangeable K	meq/100g	0.2	0.2	0.2	0.2	0.2	>0.5
Field pH	units	5.4	5.4	5.1	5.6	4.6	5.5-7.5
CEC	meq/100g	11	1	6.7	18	2.1	Sum>15
Exchangable Sodium Percentage (ESP%) *2	%	20	3.5	12	17	6.8	<5
Emmerson Class	units	1	3b	2	2	3b	7-8

Table 5 (cont) Summary of Key Soil Chemical Parameters							
	Units	BH6	BH7	BH8	BH 9	BH10	Indicative Desirable Levels*1
Conductivity	uS/cm	74	24	21	21	22	<300
Exchangeable Ca	meq/100g	1	3	1.5	1.6	2.5	>1
Exchangeable Na	meq/100g	0.2	0.9	1.1	0.9	1.3	<1
Exchangeable Mg	meq/100g	0.9	6.5	1.1	0.5	5.3	>1.6
Exchangeable K	meq/100g	1.3	0.1	0.1	0.1	1.4	>0.5
Field pH	units	5.3	5.4	5.4	5.9	4.9	5.5-7.5
CEC	meq/100g	12	3	1.7	2.4	10	Sum>15
Exchangable Sodium Percentage (ESP%) *2	%	10	8.7	13	6.7	8.8	<5
Emmerson Class	units	2	8	2	3b	2	7-8

Table 5 (cont) Summary of Key Soil Chemical Parameters							
	Units	BH11	BH12				Indicative Desirable Levels*1
Conductivity	uS/cm	56	15				<300
Exchangeable Ca	meq/100g	1.5	2.2				>1
Exchangeable Na	meq/100g	0.3	0.3				<1
Exchangeable Mg	meq/100g	0.5	0.5				>1.6
Exchangeable K	meq/100g	0.1	0.1				>0.5
Field pH	units	5.4	5.4				5.5-7.5
CEC	meq/100g	2.5	3.1				Sum>15
Exchangable Sodium Percentage (ESP%) *2	%	12	8.4				<5
Emmerson Class	units	1	5				7-8

* 1 Note Green shading indicates desirable levels for plant growth without soil amendment, Yellow indicates suboptimal.}

*2 Northcote (1972)

5. Land Capability Assessment Matrix

5.1 Assessment Matrix

Referring to MAV & DSE (2006), EPA Victoria Publication 746.1 Land Capability Assessment for Onsite Domestic Wastewater Management and MAV DEPI & EPA 2014 Land Capability Assessment Framework, a qualitative LCA assessment table has been produced for the site.

Table 6: Risk Assessment of Site Characteristics (MAV, DEPI, EPA 2014)				
Characteristic	**Level of Constraint**			**Assessed Level of Constraint for Site and Mitigation if required**
	Nil or Minor	**Moderate**	**Major**	
Aspect (affects solar radiation received)	North / North-East / North-West	East / West / South-East / South-West	South	Minor-Moderate
Climate (difference between annual rainfall and pan evaporation)	Excess of evaporation over rainfall in the wettest months	Rainfall approximates to evaporation	Excess of rainfall over evaporation in the wettest months	Moderate
Erosion [1] (or potential for erosion)	Nil or minor	Moderate	Severe	Moderate
Exposure to sun and wind	Full sun and/or high wind or minimal shading	Dappled light	Limited patches of light and little wind to heavily shaded all day	Minor
Fill [2] (imported)	No fill or minimal fill, or fill is good quality topsoil	Moderate coverage and fill is good quality	Extensive poor quality fill and variable quality fill	Minor
Flood frequency (ARI) [3]	Less than 1 in 100 years	Between 100 and 20 years	More than 1 in 20 years	Minor
Groundwater bores [4]	No bores onsite or on neighbouring properties	Setback distance from bore complies with requirements in EPA Code of Practice 891.4 (as amended)	Setback distance from bore does not comply with requirements in EPA Code of Practice 891.4 (as amended)	Minor

Characteristic	Level of Constraint			Assessed Level of Constraint for Site and Mitigation if required
	Nil or Minor	**Moderate**	**Major**	
Land area available for LAA	Exceeds LAA and duplicate LAA and buffer distance requirements	Meets LAA and duplicate LAA and buffer distance requirements	Insufficient area for LAA	Minor
Landslip (or landslip potential) [5]	Nil	Minor to moderate	High or Severe	Minor
Rock outcrops (% of surface)	<10%	10-20%	>20%	Minor
Slope Form (affects water shedding ability)	Convex or divergent side-slopes	Straight side-slopes	Concave or convergent side-slopes	Minor
Slope gradient [6] **(%)**				
(a) for absorption trenches and beds	<6%	6-15%	>15%	Minor
(b) for surface irrigation	<6%	6-10%	>10%	Minor
(c) for subsurface irrigation	<10%	10-30%	>30%	Minor
Soil Drainage [7] **(qualitative)**	No visible signs or likelihood of dampness, even in wet season	Some signs or likelihood of dampness	Wet soil, moisture-loving plants, standing water in pit; water ponding on surface, soil pit fills	Moderate

Characteristic	Level of Constraint			Assessed Level of Constraint for Site and Mitigation if required
	Nil or Minor	**Moderate**	**Major**	
Stormwater run-on	Low likelihood of stormwater run-on		High likelihood of inundation by stormwater run-on	Minor
Surface waters - setback distance (m) [9]	Setback distance complies with requirements in EPA Code of Practice 891.4 (as amended)		Setback distance does not comply with requirements in EPA Code of Practice 891.4 (as amended)	Minor – 30m setback for primary irrigation field
Vegetation coverage over the site	Plentiful vegetation with healthy growth and good potential for nutrient uptake	Limited variety of vegetation	Sparse vegetation or no vegetation	Moderate

Characteristic	Level of Constraint					Assessed Level of Constraint for Site and Mitigation if required
	Nil or Minor		**Moderate**	**Major**		
Soil Drainage [8] **(Field Handbook definitions)**	Rapidly drained. Water removed from soil rapidly in relation to supply, excess water flows downward rapidly. No horizon remains wet for more than a few hours after addition	Well drained. Water removed from the soil readily, excess flows downward. Some horizons may remain wet for several days after addition	Moderately well drained. Water removed somewhat slowly in relation to supply, some horizons may remain wet for a week or more after addition	Imperfectly drained. Water removed very slowly in relation to supply, seasonal ponding, all horizons wet for periods of several months, some mottling	Poorly/Very poorly drained. Water remains at or near the surface for most of the year, strong gleying. All horizons wet for several months	Major

Table 7: Risk Assessment of Soil Characteristics				
Characteristic	**Level of Constraint**			**Assessed Level of Constraint for Site and Mitigation if required**
	Nil or Minor	**Moderate**	**Major**	
Electrical Conductivity (ECe) (dS/m) as a measure of soil salinity [1]	<0.8	0.8 – 2	>2	Minor
Emerson Aggregate Class (consider in context of sodicity)	4, 5, 6, 8	7	1, 2, 3	Major
Gleying [2] **(see Munsell Soil Colour Chart)**	Nil	Some evidence of greenish grey / black or bluish grey / black soil colours	Predominant greenish grey / black, bluish grey / black colours	Minor
Mottling (see Munsell Soil Colour Chart)	Very well to well-drained soils generally have uniform brownish or reddish colour	Moderately well to imperfectly drained soils have grey and/or yellow brown mottles and in the mottled areas occur higher in the profile the less well-drained the soil	Poorly drained soils have predominant grey colours with yellow brown or reddish brown mottles located along root channels, large pores and cracks	Minor
pH [3] **(favoured range for plants)**	5.5 - 8 is the optimum range for a wide range of plants; 4.5 - 5.5 suitable for many acid-loving plants		<4.5, >8	Minor

Characteristic	Level of Constraint			Assessed Level of Constraint for Site and Mitigation if required
	Nil or Minor	**Moderate**	**Major**	
Rock Fragments (size & volume %)	0 – 10%	10 – 20 %	>20%	Minor
Sodicity [4] (ESP %)	<6%	6 – 8%	>8%	Major
Soil Depth to Rock or other impermeable layer (m) [5]	>1.5 m	1.5 – 1 m	<1 m	Minor
Soil Structure (pedality)	Highly or Moderately structured	Weakly-structured	Structureless, Massive or hardpan	Minor
Soil Texture, [6] Indicative Permeability	Cat. 2b, 3a, 3b, 4a	Cat. 4A, 4c, 5a	Cat. 1, 2a, 5b, 5c, 6	Moderate
Watertable Depth (m) below the base of the LAA	>2 m	2 – 1.5 m	<1.5 m	Minor

Legend:

Nil or Minor: If all constraints are minor, conventional/standard designs are generally satisfactory.
Moderate: For each moderate constraint an appropriate design modification over and above that of a standard design, should be outlined.
Major: Any major constraint might prove an impediment to successful on-site wastewater management, or alternatively will require in-depth investigation and incorporation of sophisticated mitigation measures in the design to permit compliant onsite wastewater management.

5.2 LCA Conclusions

Qualitative LCA modelling has identified the following site constraints/risks:

- Aspect
- Erosion
- Climate
- Vegetation Cover
- Soil Texture
- Emmerson
- Sodicity
- Soil Drainage

5.3 Risk Mitigation and Design Implications

The identified constraints may be risk mitigated by:

- Treat to minimum secondary levels
- Install subsurface irrigation into constructed ornamental garden beds scaled to the water balance model
- Confirm minimum setback distances to all sensitive environmental receivers

Please refer to See Section 6 and Appendices for further specific system recommendations.

6. Proposed Onsite Wastewater System Design

6.1 General System Recommendations

Given the results of the LCA, the following recommendations are made for a suitable wastewater treatment system:

- Secondary treatment of effluent with subsurface disposal via water/nutrient balanced irrigation is a suitable method for onsite wastewater system disposal.

6.2 Onsite Wastewater Flow and Land Application Area Modelling

For modelling purposes, it is proposed that a **five bedroom** equivalent dwelling with standard water saving fixtures will be constructed with a loading rate of **180L/EP/day** and a total daily loading of **1080 L/day** being applicable.

Therefore, the calculated effluent flows and required disposal area for is as follows:

6.2.1 Water Balance and Land Application Area Modelling

Please refer to Appendix 2 for the water balance modelling based upon VLCAF (2013). The nominated area method is used to calculate the area required to balance all inputs and outputs, without the need for wet weather storage. As a result of these calculations, at least **456 m^2** of area is required to achieve zero wet weather storage.

6.2.2 Nutrient Balance and Land Application Area Modelling

Please refer to Appendix 2 for the nutrient balance modelling (Nitrogen and Phosphorus) based upon VLCAF (2013). The methodology aims to ensure that the LAA is of sufficient size to ensure all nutrients from the applied effluent are assimilated by soils and vegetation. As a result of these calculations, at least **358 m^2** of area is required to achieve sustainable assimilation of N and P over the nominated system design life.

BASED UPON THE ABOVE MODELLING THE MINIMUM MODELLED LAA REQUIREMENT IS 456 m^2 FOR SECONDARY TREATED EFFLUENT BASED UPON THE WATER BALANCE MODEL.

6.2.3 Alternative Land Application Area Modelling

Given that the water balance model produces the most conservative LAA, it has been used to calculate the subsurface irrigation area for a range of loadings based upon the "Number of bedrooms plus 1" model at 180L/person/day. Results are detailed in Table 8 below:

Table 8 LAA Requirement for Various Dwelling Sizes

Number of Bedrooms	Theoretical Loading (L/day)	Required LAA (m^2 of Irrigation)
4	900	380
5	1080	456
6	1260	531
7	1440	607

6.3 System Concept Design

6.3.1 Treatment System

Given the above modelling the following treatment system would be appropriate:

- Minimum 4 star WELS rated dual flush toilets (3/4.5L) or approved dry composting toilets
- Min DN100 gravity fed sewer pipe
- Min 1500L/day (Treatment Capacity) Approved Packaged Treatment Plant capable of secondary treatment

6.3.2 Land Application Areas

The land application areas could consist of:

- Min 456 m^2 of subsurface irrigation dosed into constructed ornamental gardens as detailed in Appendix 3.
- Irrigation should be zoned into maximum 250m^2 zones and dose loaded via a pressure dosed sequencing valve.

6.3.3 Provision of Adequate Setback Distances and Relevance of Reserve Provision

Given the minimum land application areas modelled above combined with the

current development plan, setback distances complying with the minimum requirements of EPA Vic (2016) are achievable (see Figure 2 and Appendix 3).

It is noteworthy that Section 3.10.2 of EPA (2016) stipulates that a reserve area is not required for a surface or sub-surface pressure-compensating irrigation system where the size of the system has been calculated and designed using the latest version of the Model LCA Report and the recommended Design Irrigation Rates in Tables 3 and 9.

6.4 System Risk Management

Risk identification and reduction measures compliant with AS1547 – 2012 Clause A3.2 is presented below:

Table 9 System Risk Management		
Risk	**Factors that Increase Risk Likelihood**	**Design Risk Reduction Measures**
Hydraulic Overloading of System	• Under scaled system • Prolonged overuse • Leaking taps • Shock Loading • Excessive solid disposal	• Scale to peak potential loading using water balance modelling • Use Conservative DLR/DIR • Use water conservation practices eg water reduction fixtures • Not rated for spa installation
Biological Failure	• Overuse of household chemicals • Shock loading	• Limit detergents and bleach use where practical • System not fit for spa or sinkerator installation
Marginal Soil Conditions	• Low soil hydraulic conductivity • Dispersive soils • Poor drainage	• Use appropriate DLR/DIR after permeability testing • Treat with gypsum, manage sodium inputs • Dose effluent into constructed garden beds.
Site Constraints	• See section 5	• See recommendations Section 5

Risk	Factors that Increase Risk Likelihood	Design Risk Reduction Measures
High Rainfall/Torrential Rainfall	• Inappropriate LAA Scaling • Stormwater impacts	• Use suitable hydraulic scaling following water balance model • Stormwater Diversion around LAA if required
Clogged Filter	• Overloading • Infrequent cleaning	• Clean monthly • Regular servicing inline with manufacturers recommendations
Pipe Blockages	• Overloading • Infrequent de-sludging	• Reduce solids inflows • Service AWTS regularly • Check IO's/flush lines regularly
Sludge transport to LAA	• Infrequent de-sludging • Clogged outlet filter • High organic loading	• Regular servicing inline with manufacturers recommendations • Clean outlet filter/flush lines regularly • No sinkerator installation
Broken pipes in LAA	• Stock/vehicles	• Exclude stock/vehicles

6.5 System Management and Maintenance

The proposed system is designed to allow for system automation and as such there are negligible management requirements from owners/site managers. A detailed operations manual and maintenance log should be provided to the owners/site managers upon installation of the system. This should remain onsite and will provide details on troubleshooting, emergency service technical support, service scheduling, flow rate and effluent quality monitoring.

Emergency contacts for on call service agents should be listed next to alarm modules and in operations manual to provide support in the event of technical difficulties/breakdown

6.5.1 Servicing

The following servicing program is recommended:

- Servicing of AWTS and associated infrastructure (via a servicing contract) is proposed in line with minimum manufacturer's recommendations.
- Desludging of anaerobic/sedimentation chambers and septic tanks at a maximum frequency of three years.

6.5.2 Monitoring

Annual effluent sampling and analysis at a NATA accredited laboratory is recommended over the first two years of operation. Sampling should be conducted by suitable qualified personnel and involve chain of custody documentation.

The following parameters should be included in any analysis

- BOD
- TSS
- Thermotolerant Coliforms
- Oil and Grease
- Total Nitrogen
- Ammonia
- Total Phosphorous
- pH

6.5.3 Effluent Quality Objectives

The proposed upgraded treatment system process will perform to a minimum secondary treatment standard as prescribed by EPA (2016). Namely:

- BOD <20mg/L
- TSS<30mg/L
- CFU<30cfu/100ml

If treatment quality objectives are not met then advice MUST be sort from the servicing agent, manufacturer and designer.

6.5.4 Contingency Planning

Specific contingencies for installed systems will be included in the operations manual and include:

Table 10 Contingency Planning

Problem	Contingency
Overflow of effluent from treatment plant	• Call service agent immediately • Reduce/cease effluent loading into system (ie ensure all taps, fixtures etc are off) • Minimise building use until problem fixed • Attempt to contain pooling effluent (only if safe to do so)
Critical components of treatments Plants not working	• Structure duty standby of all critical components with auto changeover.
Treatment plant pump not working (Alarm ringing/flashing)	• Check power supply to pump • Call service agent immediately • Reduce/cease effluent loading into system (ie ensure all taps, fixtures etc are off) • Minimise building use until problem fixed

Structural failure of treatment plant tank	• Call service agent immediately • Reduce/cease effluent loading into system (ie ensure all taps, fixtures etc are off) • Minimize building use until problem fixed
Effluent overflowing in land application area	• Call service agent immediately • Reduce/cease effluent loading into system (ie ensure all taps, fixtures etc are off) • Minimise building use until problem fixed • If problem persists seek advice from designer
Water run on to land application area	• Ensure upslope diversion of any run on • Check existing diversion system and clear if required
Land application area emitting odours	• Call service agent immediately – check treatment quality of effluent at outlet to land application area • Check for physical damage to land application area • If problem persists seek advice from designer
Excessive growth of vegetation in land application area	• Check for physical damage to land application area. • Mow/slash/thin/prune/weed land application area at regular intervals. • Remove aggressive invasive weed species. • If problem persists seek advice form designer

7. Conclusions and Further Recommendations

In conclusion, the following comments and recommendations are made:

- Given the identified site and soil limitations, secondary treatment with subsurface disposal into constructed ornamental gardens is recommended.
- The maximum wastewater flow rate modelling shows that the generated flows from the proposed development is likely to be no more than 1080 L/day (for a 5 bedroom dwelling).
- Modelled flows will likely require a land application area comprising:
    - Min 456 m^2 of subsurface irrigation based upon the water balance method.
- It is likely that peak flows associated with the modelled development should be within the buffering capacity of proposed system both in terms of the system sizing as well as for effluent acceptance into the disposal area.
- Given the lot sizes and current development plan adequate setback distances can be met.
- Any earthworks and drainage installation associated with lot development may alter conditions of the site and as a result the recommendations of this report MUST be reconfirmed after these works have occurred. Failure to ensure this will void report recommendations. Stormwater diversion or interceptor drain installation may be appropriate at this time.

- **If the prescriptions of this report are followed the likely human and environmental health risks associated with effluent disposal over the site is low.**

Environmental Engineering Scientist
Strata Geoscience and Environmental Pty Ltd
E:
W: www.strataconsulting.com.au

8. References

- AS1726-1993- Geotechnical Site Investigations
- AS 1547-2012 Onsite Wastewater Disposal
- Bureau of Meteorology Website- Monthly Climate Statistics
- EPA (2016) Vic Code of Practice for Onsite Wastewater Management
- MAV & DSE 2006 (as amended) Model LCA Report
- VLCAF (2016) Victorian Land Capability Assessment Framework – Calculation of Water and Nutrient Balances
- Isbell (2002) Australian Soil Classification (Revised Edn) CSIRO Publishing
- Northcote, K.H. and Skene J.K.M., (1972) Australian soils with saline and sodic properties. *CSIRO Soil Publication* 27.

Appendix 1 Site Photos and Indicative Borelogs

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 1
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm^2)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	TOPSOIL *Sand, silt, clay, loose, slightly moist*						
200	***SILTY SAND (SM)*** *Grey/brown, slightly moist, medium dense*						
500	*Grading to* ***SILTY CLAY (CI)*** *Light brown, slightly moist to moist, firm, intermediate plasticity*						
600				*2.2*			
900				*2.3*			
1000	*Grading to* ***CLAYEY SAND (SC)*** *Light brown, slightly moist, medium dense*						
1200		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 2
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm²)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	TOPSOIL *Sand, silt, clay, loose, slightly moist*						
200	***SILTY SAND (SM)*** *Grey/brown, slightly moist, medium dense*						
500	*Grading to* ***SILTY CLAY (CI)*** *Light brown, slightly moist to moist, firm, intermediate plasticity*						
600				*2.2*			
900				*2.3*			
1000	*Grading to* ***CLAYEY SAND (SC)*** *Light brown, slightly moist, medium dense*						
1200		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 3
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm²)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Sand, silt, clay, gravel*						
300	***SILTY CLAY (CI)*** *Light brown, slightly moist, firm, intermediate plasticity*						
600				*1.9*			
1000				*1.8*			
1200	*Grading to* ***CLAYEY SAND (SC)*** *Medium dense, slightly moist to moist* *Trace of gravel*				*6*		
1500		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 4
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm²)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Sand, silt, clay, gravel*						
300	***SILTY CLAY (CI)*** *Light brown, slightly moist, firm, intermediate plasticity*						
600				*1.9*			
1000				*1.8*			
1200	*Grading to* ***CLAYEY SAND (SC)*** *Medium dense, slightly moist to moist* *Trace of gravel*				*6*		
1500		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 5
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm²)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	TOPSOIL *Sand, silt, clay, loose, slightly moist*						
200	***SILTY SAND (SM)*** *Grey/brown, slightly moist, medium dense*						
500	*Grading to* ***SILTY CLAY (CI)*** *Light brown, slightly moist to moist, firm, intermediate plasticity*						
600				*2.2*			
900				*2.3*			
1000	*Grading to* ***CLAYEY SAND (SC)*** *Light brown, slightly moist, medium dense*						
1200		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 6
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm²)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Sand, silt, clay, gravel, compact, slightly moist*						
300	***SILTY CLAY (CI)*** *Light brown, slightly moist, firm, intermediate plasticity*						
600				*2.3*			
900				*2.3*			
1000	*Grading to* ***CLAYEY SAND (SC)*** *Light brown, slightly moist, medium dense*						
1200		*GNO*			*5*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 7
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm²)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	TOPSOIL *Sand, silt, clay, loose, slightly moist*						
200	***SILTY SAND (SM)*** *Grey/brown, slightly moist, medium dense*						
500	*Grading to* ***SILTY CLAY (CI)*** *Light brown, slightly moist to moist, firm, intermediate plasticity*						
600				*2.2*			
900				*2.3*			
1000	*Grading to* ***CLAYEY SAND (SC)*** *Light brown, slightly moist, medium dense*						
1200		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 8
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm²)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	TOPSOIL *Sand, silt, clay, loose, slightly moist*						
200	***SILTY SAND (SM)*** *Grey/brown, slightly moist, medium dense*						
500	*Grading to* ***SILTY CLAY (CI)*** *Light brown, slightly moist to moist, firm, intermediate plasticity*						
600				*2.2*			
900				*2.3*			
1000	*Grading to* ***CLAYEY SAND (SC)*** *Light brown, slightly moist, medium dense*						
1200		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 9
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm²)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	TOPSOIL *Sand, silt, clay, loose, slightly moist*						
200	***SILTY SAND (SM)*** *Grey/brown, slightly moist, medium dense*						
500	*Grading to* ***SILTY CLAY (CI)*** *Light brown, slightly moist to moist, firm, intermediate plasticity*						
600				*2.2*			
900				*2.3*			
1000	*Grading to* ***CLAYEY SAND (SC)*** *Light brown, slightly moist, medium dense*						
1200		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 10
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm²)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	TOPSOIL *Sand, silt, clay, loose, slightly moist*						
200	***SILTY SAND (SM)*** *Grey/brown, slightly moist, medium dense*						
500	*Grading to* ***SILTY CLAY (CI)*** *Light brown, slightly moist to moist, firm, intermediate plasticity*						
600				*2.2*			
900				*2.3*			
1000	*Grading to* ***CLAYEY SAND (SC)*** *Light brown, slightly moist, medium dense*						
1200		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 11
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm²)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	TOPSOIL *Sand, silt, clay, loose, slightly moist*						
200	***SILTY SAND (SM)*** *Grey/brown, slightly moist, medium dense*						
500	*Grading to* ***SILTY CLAY (CI)*** *Light brown, slightly moist to moist, firm, intermediate plasticity*						
600				*2.2*			
900				*2.3*			
1000	*Grading to* ***CLAYEY SAND (SC)*** *Light brown, slightly moist, medium dense*						
1200		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

SOIL TEST MELBOURNE

PROJECT NO.: 010669
DATE: 12/4/22
HOLE LOCATION: *Per Sketch*

HOLE NO.: 12
METHOD: Mechanical Push Tube
WEATHER CONDITIONS: Fine

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	POCKET PENETROMETER (1kg per 1cm^2)	DYNAMIC CONE PENETROMETER (Blows per 100mm)	EXISTING FOOTING (mm)	DEPTH (mm)
	TOPSOIL *Sand, silt, clay, loose, slightly moist*						
200	***SILTY SAND (SM)*** *Grey/brown, slightly moist, medium dense*						
500	*Grading to* ***SILTY CLAY (CI)*** *Light brown, slightly moist to moist, firm, intermediate plasticity*						
600				*2.2*			
900				*2.3*			
1000	*Grading to* ***CLAYEY SAND (SC)*** *Light brown, slightly moist, medium dense*						
1200		*GNO*			*6*		
2000	***END OF BOREHOLE***						

ABBREVIATIONS PER APPENDIX

Permeability Results

To see the Instructions on the right hand side of this page, make sure that 75% is entered in the Zoom box in the right hand corner of the Standard toolbar. (This note will not be printed)

Constant head permeameter

Project MAFFRA **Location** BH01/BH03

Site description

Tested by SN **Date**

Test hole geometry

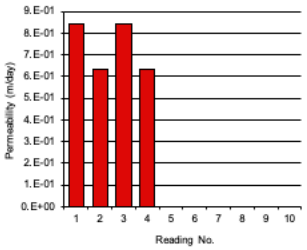
	Test 1	Test 2
Hole depth (m)	0.4	0.3
Depth (m) of water in hole	0.3	0.2
Hole diameter (mm)	38	38
Depth (m) to imperm. layer	0.6	0.6

TEST 1

Depth interval (m) tested 0.1 to 0.4 Soil type tested

Test duration (mins)

Reading No.	Water infiltrated (L)	Time to infiltrate (min)	Infiltrat. rate (L/min)	Perme-ability (m/day)
1	0.4	5	8.0E-02	8.4E-01
2	0.3	5	6.0E-02	6.3E-01
3	0.4	5	8.0E-02	8.4E-01
4	0.3	5	6.0E-02	6.3E-01

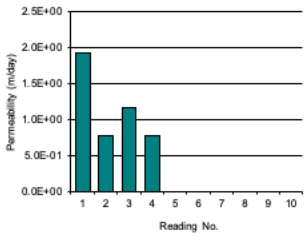


TEST 2

Depth interval (m) tested 0.1 to 0.3 Soil type tested

Test duration (mins)

Reading No.	Water infiltrated (L)	Time to infiltrate (min)	Infiltrat. rate (L/min)	Perme-ability (m/day)
1	0.5	5	1.0E-01	1.9E+00
2	0.2	5	4.0E-02	7.7E-01
3	0.3	5	6.0E-02	1.2E+00
4	0.2	5	4.0E-02	7.7E-01



Note: Permeability $K = 4.4Q(\sinh^{-1}(H/2r)-[(r/H)^2+0.25]^{0.5}+(r/H))/2\pi H^2$ where Q = infiltration rate, H = depth of water in test hole, r = hole radius and pi = 3.1416. H should be in the range 5r to 10r. See Australian/New Zealand Standard 1547: 2000 *On-site domestic-wastewater management*. Appendix 4.1F. The Standard's equation has a typographical error, which has been corrected here.

If an impermeable layer is at depth S no more than 2H below the base of the test hole, use $K = 3Q\ln(H/r)/\pi H(2H+3S)$.

See Talsma, T. and Hallam, P. (1980): Hydraulic Conductivity Measurement of Forest Catchments. *Australian Journal of Soil Research* 30, pp 139-148.

Scientific Notation

Infiltration rates and permeabilities often range over several orders of magnitude. Using standard number notation, there is not enough room in the cells to cope with the possible range of values, and significant figures. Scientific notation is used to get around the problem.

Any number can be expressed as a power of 10, in the form NEX where N (positive or negative) is a number with one or more digits, E means 10, and X (2 digit; positive or negative) is the power to which 10 is raised. If you are unfamiliar with this method, try entering a few numbers in the yellow box below to see how it works. A few examples:

1E+02 = 100
1.5E+02 = 150
2.3E+01 = 23
1E0+1 = 10
1E+00 = 1 (ie 1 x 10 raised to the power 0 = 1)
1E-01 = 0.1
1E-02 = 0.01
1E-03 = 0.001

Enter any number **0.63**

This is the same number in scientific notation **6.3E-01**

(The number has been rounded to one decimal place)

Permeability Results

To see the Instructions on the right hand side of this page, make sure that 75% is entered in the Zoom box in the right hand corner of the Standard toolbar. (This note will not be printed)

Constant head permeameter

Project MAFFRA **Location** BH05/BH08

Site description

Tested by SN **Date**

Test hole geometry

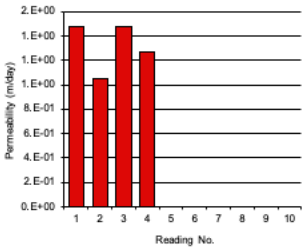
	Test 1	Test 2
Hole depth (m)	0.5	0.5
Depth (m) of water in hole	0.3	0.2
Hole diameter (mm)	38	38
Depth (m) to imperm. layer	0.6	0.6

TEST 1

Depth interval (m) tested 0.2 to 0.5 Soil type tested

Test duration (mins)

Reading No.	Water infiltrated (L)	Time to infiltrate (min)	Infiltrat. rate (L/min)	Perme-ability (m/day)
1	0.7	5	1.4E-01	1.5E+00
2	0.5	5	1.0E-01	1.1E+00
3	0.7	5	1.4E-01	1.5E+00
4	0.6	5	1.2E-01	1.3E+00

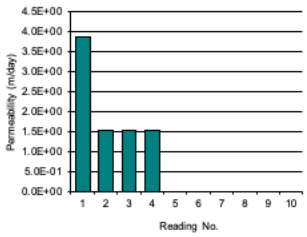


TEST 2

Depth interval (m) tested 0.3 to 0.5 Soil type tested

Test duration (mins)

Reading No.	Water infiltrated (L)	Time to infiltrate (min)	Infiltrat. rate (L/min)	Perme-ability (m/day)
1	1	5	2.0E-01	3.9E+00
2	0.4	5	8.0E-02	1.5E+00
3	0.4	5	8.0E-02	1.5E+00
4	0.4	5	8.0E-02	1.5E+00



Note: Permeability $K = 4.4Q(\sinh^{-1}(H/2r)-\{(r/H)^2+0.25\}^{0.5}+(r/H))/2\pi H^2$ where Q = infiltration rate, H = depth of water in test hole, r = hole radius and pi = 3.1416. H should be in the range 5r to 10r. See Australian/New Zealand Standard 1547: 2000 *On-site domestic-wastewater management*. Appendix 4.1F. The Standard's equation has a typographical error, which has been corrected here.

If an impermeable layer is at depth S no more than 2H below the base of the test hole, use $K = 3Q\ln(H/r)/\pi H(2H+3S)$.

See Talsma, T. and Hallam, P. (1980): Hydraulic Conductivity Measurement of Forest Catchments. *Australian Journal of Soil Research* 30, pp 139-148.

Scientific Notation

Infiltration rates and permeabilities often range over several orders of magnitude. Using standard number notation, there is not enough room in the cells to cope with the possible range of values, and significant figures. Scientific notation is used to get around the problem.

Any number can be expressed as a power of 10, in the form NEX where N (positive or negative) is a number with one or more digits, E means 10, and X (2 digit; positive or negative) is the power to which 10 is raised. If you are unfamiliar with this method, try entering a few numbers in the yellow box below to see how it works. A few examples:

1E+02 = 100
1.5E+02 = 150
2.3E+01 = 23
1E0+1 = 10
1E+00 = 1 (ie 1 x 10 raised to the power 0 = 1)
1E-01 = 0.1
1E-02 = 0.01
1E-03 = 0.001

Enter any number **1.1**

This is the same number in scientific notation **1.1E+00**

(The number has been rounded to one decimal place)

Permeability Results

To see the instructions on the right hand side of this page, make sure that 75% entered in the Zoom box in the right hand corner of the Standard toolbar. (T note will not be printed)

Constant head permeameter

Project MAFFRA **Location** BH10/BH12

Site description

Tested by SN **Date**

Test hole geometry

	Test 1	Test 2
Hole depth (m)	0.5	0.5
Depth (m) of water in hole	0.3	0.3
Hole diameter (mm)	38	38
Depth (m) to imperm. layer	0.5	0.5

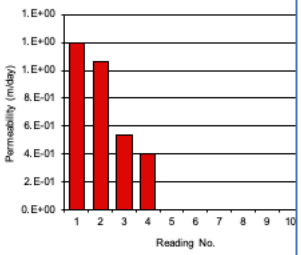
TEST 1

Depth interval (m) tested 0.2 to 0.5

Test duration (mins)

Soil type tested

Reading No.	Water infiltrated (L)	Time to infiltrate (min)	Infiltrat. rate (L/min)	Perme-ability (m/day)
1	0.9	5	1.8E-01	1.2E+00
2	0.8	5	1.6E-01	1.1E+00
3	0.4	5	8.0E-02	5.3E-01
4	0.3	5	6.0E-02	4.0E-01



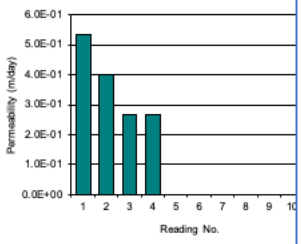
TEST 2

Depth interval (m) tested 0.2 to 0.5

Test duration (mins)

Soil type tested

Reading No.	Water infiltrated (L)	Time to infiltrate (min)	Infiltrat. rate (L/min)	Perme-ability (m/day)
1	0.4	5	8.0E-02	5.3E-01
2	0.3	5	6.0E-02	4.0E-01
3	0.2	5	4.0E-02	2.7E-01
4	0.2	5	4.0E-02	2.7E-01



Note: Permeability $K = 4.4Q(\sinh^{-1}(H/2r)-[(r/H)^2+0.25]^{0.5}+(r/H))/2\pi H^2$ where Q = infiltration rate, H = depth of water in test hole, r = hole radius and pi = 3.1416. H should be in the range 5r to 10r. See Australian/New Zealand Standard 1547: 2000 *On-site domestic-wastewater management*. Appendix 4.1F. The Standard's equation has a typographical error, which has been corrected here. If an impermeable layer is at depth S no more than 2H below the base of the test hole, use $K = 3Q\ln(H/r)/\pi H(2H+3S)$.

See Talsma, T. and Hallam, P. (1980): Hydraulic Conductivity Measurement of Forest Catchments. *Australian Journal of Soil Research* 30, pp 139-148.

Scientific Notation

Infiltration rates and permeabilities often range over several orders of magnitude. Using standard number notation, there is not enough room in the cells to cope with the possible range of values, and significant figures. Scientific notation is used to get around the problem.

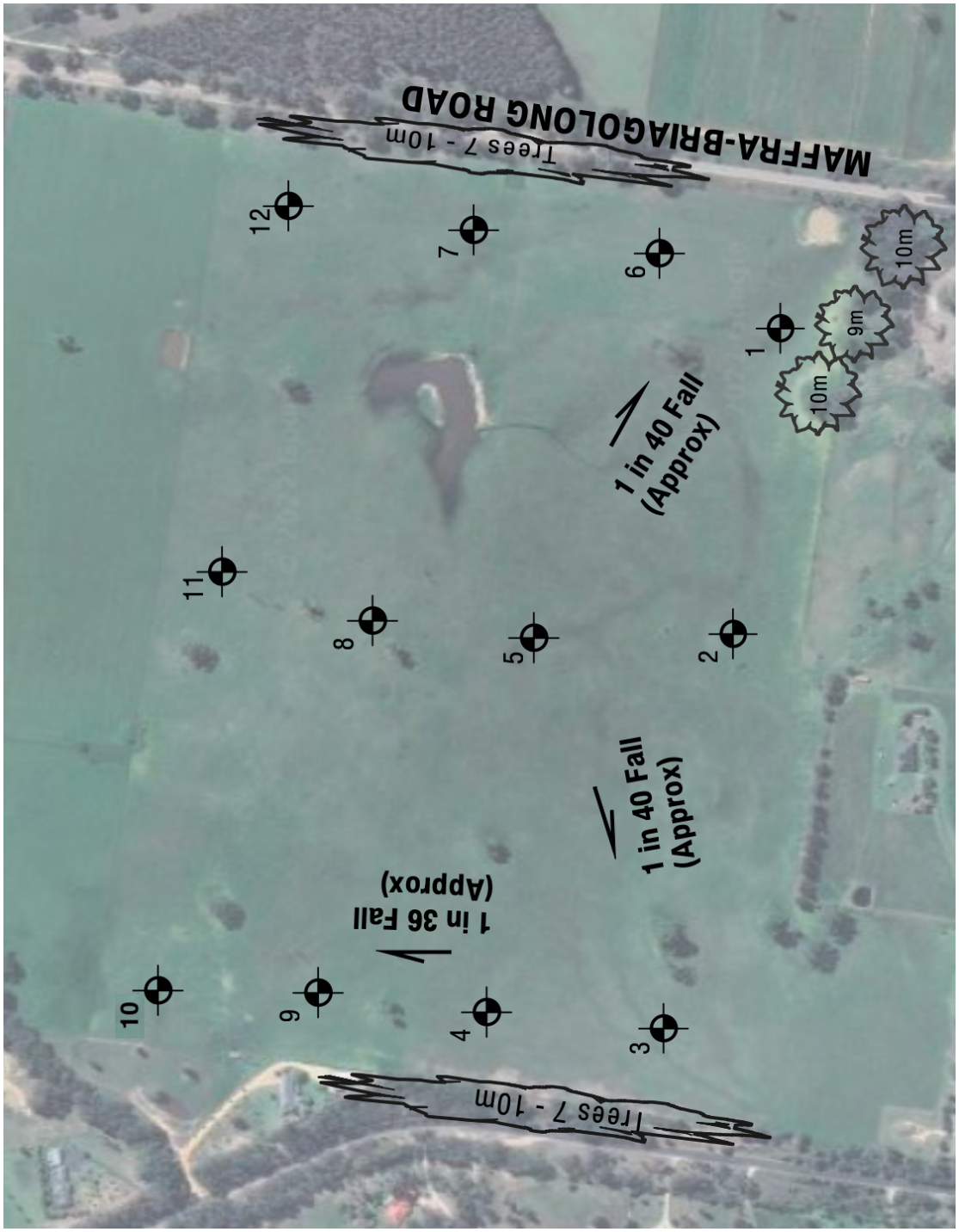
Any number can be expressed as a power of 10, in the form NEX where N (positive or negative) is a number with one or more digits, E means 10, and X (2 digit; positive or negative) is the power to which 10 is raised. If you are unfamiliar with this method, try entering a few numbers in the yellow box below to see how it works. A few examples:

1E+02 = 100
1.5E+02 = 150
2.3E+01 = 23
1E0+1 = 10
1E+00 = 1 (ie 1 x 10 raised to the power 0 = 1)
1E-01 = 0.1
1E-02 = 0.01
1E-03 = 0.001

Enter any number **0.27**

This is the same number in scientific notation **2.7E-01**

(The number has been rounded to one decimal place)


MAFFRA-BRIAGOLONG ROAD
Trees 7 - 10m
12
7
6
10m
9m
1
10m
1 in 40 Fall
(Approx)
11
8
5
2
1 in 40 Fall
(Approx)
1 in 36 Fall
(Approx)
10
9
4
3
Trees 7 - 10m

Appendix 2 Climate Data, Water and Nutrient Balance Calculations (after VLCAF 2016)

Irrigation area sizing using Nominated Area Water Balance & Storage Calculations

Site Address:	Maffra-Briagolong Road Maffra			
Date:	####		**Assessor:**	

INPUT DATA

Design Wastewater Flow	Q	1,080	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2013)
Design Irrigation Rate	DIR	3.0	mm/day	Based on soil texture class/permeability and derived from Table 9 in the EPA Code of Practice (2013)
Nominated Land Application Area	L	456	m^2	[1]
Crop Factor	C	0.6-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type[2]
Rainfall Runoff Factor	RF	1	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data		Maffra		BoM Station and number
Mean Monthly Pan Evaporation Data		East Sale Airport		BoM Station and number

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365
Rainfall	R		mm/month	46.5	49.6	38.8	43.4	34.5	44	35.4	34.8	40.6	48.8	68.7	46.4	531.5
Evaporation	E		mm/month	201.5	162.4	136.4	84	52.7	42	46.5	68.2	93	124	153	186	1349.7
Crop Factor	C		unitless	0.80	0.80	0.70	0.70	0.60	0.60	0.60	0.60	0.70	0.80	0.80	0.80	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	161	130	95	59	32	25	28	41	65	99	122	149	1006.54
Percolation	B	DIRxD	mm/month	93.0	84	93.0	90.0	93.0	90.0	93.0	93.0	90.0	93.0	90.0	93.0	1095.0
Outputs		ET+B	mm/month	254.2	213.92	188.5	148.8	124.6	115.2	120.9	133.9	155.1	192.2	212.4	241.8	2101.5
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	46.5	49.6	38.8	43.4	34.5	44	35.4	34.8	40.6	48.8	68.7	46.4	531.5
Applied Effluent	W	(QxD)/L	mm/month	73.4	66.3	73.4	71.1	73.4	71.1	73.4	73.4	71.1	73.4	71.1	73.4	864.5
Inputs		RR+W	mm/month	119.9	115.9	112.2	114.5	107.9	115.1	108.8	108.2	111.7	122.2	139.8	119.8	1396.0
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-134.3	-98.0	-76.3	-34.3	-16.7	-0.1	-12.1	-25.7	-43.4	-70.0	-72.6	-122.0	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	161	184	224	307	372	455	392	338	283	233	225	171	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 456.0 m^2

Nutrient Balance

Site Address:

SUMMARY - LAND APPLICATION AREA REQUIRED BASED ON MOST LIMITING NUTRIENT BALANCE 358 m^2

INPUT DATA[1]

Wastewater Loading			Nutrient Crop Uptake					
Hydraulic Load	1080	L/day	Crop N Uptake	220	kg/ha/yr	which equals	60.27	$mg/m^2/day$
Effluent N Concentration	25	mg/L	Crop P Uptake	50	kg/ha/yr	which equals	13.70	$mg/m^2/day$
% N Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal	**Phosphorus Sorption**					
Total N Loss to Soil	5400	mg/day	P-sorption result	240	mg/kg	which equals	3360	kg/ha
Remaining N Load after soil loss	21600	mg/day	Soil Bulk Density	1400	kg/m^3			
Effluent P Concentration	8	mg/L	Depth of Soil	1	m			
Design Life of System	25	yrs	% of Predicted P-sorp.[2]	0.5	Decimal			

NUTRIENT BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer			Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)		
Nitrogen	358	m^2	Nominated LAA Size	561	m^2
Phosphorus	269	m^2	Predicted N Export from LAA	-4.46	kg/year
			Predicted P Export from LAA	-3.42	kg/year
			Phosphorus Longevity for LAA	270	years
			Minimum Buffer Required for excess nutrient	0	m^2

PHOSPHORUS BALANCE
Using the nominated LAA Size

Nominated LAA Size	561	m^2				
Daily P Load	0.009	kg/day	→ Phosphorus generated over life of system		78.840	kg
Daily P Uptake	0.008	kg/day	→ Phosphorus vegetative uptake for life of system		0.125	kg/m^2
Measured P-sorption capacity	0.336	kg/m^2				
Assumed P-sorption capacity	0.168	kg/m^2	→ Phosphorus adsorbed over 50 years		0.168	kg/m^2
Site P-sorption capacity	94.248	kg	→ Desired Annual P Application Rate		6.575	kg/year
				which equals	0.018	kg/day
P-load to be sorbed	0.349	kg/year				

Relevant Climate Data

Monthly Rainfall (millimetres)

MAFFRA

Station Number: 085297 · State: VIC · Opened: 1993 · Status: Open · Latitude: 37.97°S · Longitude: 146.99°E · Elevation: 35 m

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1993										54.8	41.2	63.0	
1994	33.6	198.8	39.8	27.8	22.8	35.2	13.4	11.4	43.0	58.2	84.8	35.6	604.4
1995	74.3	26.0	15.6	42.6	57.8	45.4	39.8	20.4	52.4	175.6	139.6	51.8	741.3
1996	55.4	61.4	31.4	60.2	28.2	33.6	64.4	40.1	44.0	19.2	76.0	22.0	535.9
1997	42.8	8.4	33.4	5.0	37.0	60.8	18.2	19.0	56.4	19.0	45.4	36.8	382.2
1998	27.2	37.6	12.8	11.4	9.2	104.2	11.6	28.8	42.2	70.6	108.6	66.4	530.6
1999	72.2	36.4	101.6	18.0	32.6	9.4	19.0	38.2	24.1	52.1	12.0		
2000	40.4	30.4		36.2	93.8	13.8		33.2	89.2		76.0	2.6	
2001		17.8	36.8	75.4	29.8	33.2	66.2		31.0	88.6		80.4	
2002	39.0	73.4	35.2	124.6		34.6	9.0	6.2	18.4	24.2	53.8		
2003			25.4	32.4	12.8	41.0	34.6				37.2	71.4	
2004	49.2	36.4	2.8	119.8	31.6	32.6	33.4	34.6	45.2	25.8	65.6	43.0	520.0
2005	40.8	60.8		21.4	7.4	17.4	73.0	23.4	32.6	21.8	84.4	49.8	
2006	44.6	18.2	15.4	42.6	55.8	9.2	40.0	51.0	30.4		20.2		
2007	9.2			37.2	43.4	170.4	58.8	24.5		31.4	136.6	53.4	
2008	67.8	81.6	5.0	13.6	24.0	10.8	27.2	34.0	17.4	8.4	110.8	49.0	449.6
2009	0.0	26.0	29.6	37.8	7.4	13.6	21.8	36.8	58.2	29.0	68.6	34.8	363.6
2010	25.2	100.4	36.3	*18.6*	40.8	30.4	5.6	56.0	19.4	68.0	88.2	77.2	*566.1*
2011	39.8	84.4	92.8	43.6	37.9	20.1	59.8	58.2	63.5	82.2	130.8	46.0	759.1
2012	21.4	89.2	114.6	17.2	69.2	98.6	18.0	42.5	38.0	30.6	57.0		
2015				124.8	20.7	46.1	27.2	77.0	19.1	28.6	39.6	31.2	
2016	115.8	2.4	63.0	20.4	34.7	87.2	89.6	18.1	73.1	54.6	43.4	23.0	625.3
2017	13.9	28.8	59.3	35.2	14.9	11.6	16.7	47.6	29.4	59.0	22.6	112.8	451.8
2018	51.0	19.6	15.0	4.8	26.2	16.6	33.1	18.5	25.8	43.8	75.2	39.6	369.2
2019	20.4	29.2	*17.4*	12.7	*45.0*	29.2	28.8	*28.9*	40.4	18.7	*31.5*	23.6	*325.8*
2020	117.3	97.3	*23.0*	*89.6*	23.7	*19.4*	*72.6*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*442.9*
2021	*0.0*	0.0	*0.0*	*0.0*	*59.8*	*131.1*	12.6	*58.2*	*95.8*	*108.2*	*136.1*	*54.0*	*655.8*
2022	*114.6*	*26.5*	*86.0*	*100.0*	*30.6*	*33.3*	*26.2*	*62.8*	*24.8*				

Quality control: 12.3 Done & acceptable, *12.3* Not completed or unknown

Monthly Rainfall (millimetres)

MAFFRA

Station Number: 085297 · State: VIC · Opened: 1993 · Status: Open · Latitude: 37.97°S · Longitude: 146.99°E · Elevation: 35 m

Statistics for this station calculated over all years of data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	46.5	49.6	38.8	43.4	34.5	44.0	35.4	34.8	40.6	48.8	68.7	46.4	520.2
Lowest	0.0	0.0	0.0	0.0	7.4	9.2	5.6	0.0	0.0	0.0	0.0	0.0	325.8
5th percentile	1.4	3.3	3.0	4.9	7.8	9.8	9.6	7.2	17.6	9.9	14.1	4.5	354.2
10th percentile	10.6	11.2	6.6	8.8	11.0	11.3	12.1	14.1	18.7	18.8	21.4	22.2	366.4
Median	40.6	33.4	31.4	35.2	31.1	33.2	28.0	34.0	38.0	37.6	67.1	46.0	525.3
90th percentile	102.5	94.9	91.4	107.9	58.8	100.8	69.4	58.2	69.3	86.7	133.4	76.0	698.6
95th percentile	115.6	99.9	100.7	123.2	66.8	123.0	72.9	61.9	86.0	105.3	136.5	80.1	745.8
Highest	117.3	198.8	114.6	124.8	93.8	170.4	89.6	77.0	95.8	175.6	139.6	112.8	759.1

1) Calculation of statistics

Summary statistics, other than the Highest and Lowest values, are only calculated if there are at least 20 years of data available.

2) Gaps and missing data

Gaps may be caused by a damaged instrument, a temporary change to the site operation, or due to the absence or illness of an observer.

3) Further information

http://www.bom.gov.au/climate/cdo/about/about-rain-data.shtml.

Mean total evaporation (mm)

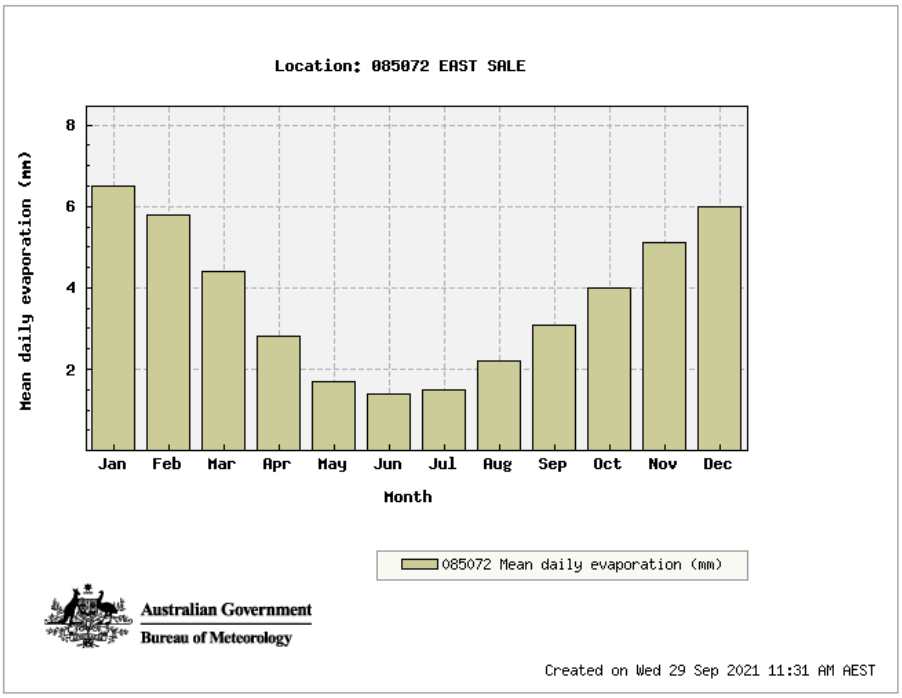
Site details

Site name: EAST SALE
Site number: 085072
Commenced: 1943
Latitude: 38.12 °S
Longitude: 147.13 °E
Elevation: 4 m
Operational status: Still Open

Yearly data | 30 year statistics | Comparison site | First statistic | Second statistic

Note: Only one option can be redrawn at a time

Include data for the year: 2015 Redraw



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean daily evaporation (mm) for years 1971 to 2015	6.5	5.8	4.4	2.8	1.7	1.4	1.5	2.2	3.1	4.0	5.1	6.0	3.7	44

12.3 = Not quality controlled

Appendix 3 Laboratory Results

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Certificate of Analysis

Strata Geoscience and Environmental P/L
17 Little Arthur Street
North Hobart
TAS 7000

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention:

Report	**922769-S**
Project name	MAFFRA-BRAIGOLONG ROAD MAFFRA
Received Date	Sep 13, 2022

Client Sample ID			**BH01**	**BH02**	**BH03**	**BH04**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M22-Se0025965**	**M22-Se0025966**	**M22-Se0025967**	**M22-Se0025968**
Date Sampled			**Jun 19, 2022**	**Jun 19, 2022**	**Jun 19, 2022**	**Jun 19, 2022**
Test/Reference	LOR	Unit				
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	38	580	46	30
Exchangeable Sodium Percentage (ESP)	0.1	%	20	3.5	12	17
Magnesium (exchangeable)	0.1	meq/100g	6.2	0.4	2.7	11
Potassium (exchangeable)	0.1	meq/100g	0.2	0.2	0.2	0.2
Sodium (exchangeable)	0.1	meq/100g	2.1	< 0.1	0.8	3.1
% Moisture	1	%	21	8.3	11	23
Emerson Class Number	1	units	see attached	see attached	see attached	see attached
Cation Exchange Capacity						
Calcium (exchangeable)	0.1	meq/100g	2.0	0.4	3.0	3.8
Cation Exchange Capacity	0.05	meq/100g	11	1.0	6.7	18

Client Sample ID			**BH05**	**BH06**	**BH07**	**BH08**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M22-Se0025969**	**M22-Se0025970**	**M22-Se0025971**	**M22-Se0025972**
Date Sampled			**Jun 19, 2022**	**Jun 19, 2022**	**Jun 19, 2022**	**Jun 19, 2022**
Test/Reference	LOR	Unit				
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	11	74	24	21
Exchangeable Sodium Percentage (ESP)	0.1	%	6.8	10	8.7	13
Magnesium (exchangeable)	0.1	meq/100g	0.9	6.5	1.1	0.5
Potassium (exchangeable)	0.1	meq/100g	0.1	1.3	0.1	0.1
Sodium (exchangeable)	0.1	meq/100g	0.2	1.2	0.3	0.2
% Moisture	1	%	8.5	15	3.9	7.5
Emerson Class Number	1	units	see attached	see attached	see attached	see attached
Cation Exchange Capacity						
Calcium (exchangeable)	0.1	meq/100g	1.0	3.0	1.5	0.9
Cation Exchange Capacity	0.05	meq/100g	2.1	12	3.0	1.7

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Client Sample ID			BH09	BH10	BH11	BH12
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M22-Se0025973	M22-Se0025974	M22-Se0025975	M22-Se0025976
Date Sampled			Jun 19, 2022	Jun 19, 2022	Jun 19, 2022	Jun 19, 2022
Test/Reference	LOR	Unit				
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	21	22	56	15
Exchangeable Sodium Percentage (ESP)	0.1	%	6.7	8.8	12	8.4
Magnesium (exchangeable)	0.1	meq/100g	0.5	5.3	0.5	0.5
Potassium (exchangeable)	0.1	meq/100g	< 0.1	1.4	0.1	0.1
Sodium (exchangeable)	0.1	meq/100g	0.2	0.9	0.3	0.3
% Moisture	1	%	3.8	16	4.0	17
Emerson Class Number	1	units	see attached	see attached	see attached	see attached
Cation Exchange Capacity						
Calcium (exchangeable)	0.1	meq/100g	1.6	2.5	1.5	2.2
Cation Exchange Capacity	0.05	meq/100g	2.4	10	2.5	3.1

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Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Conductivity (1:5 aqueous extract at 25 °C as rec.)	Melbourne	Sep 15, 2022	7 Days
- Method: LTM-INO-4030 Conductivity			
Magnesium (exchangeable)	Melbourne	Sep 15, 2022	180 Days
- Method: LTM-MET-3060 Cation Exchange Capacity and ESP			
Potassium (exchangeable)	Melbourne	Sep 15, 2022	180 Days
- Method: LTM-MET-3060 Cation Exchange Capacity and ESP			
Sodium (exchangeable)	Melbourne	Sep 15, 2022	180 Days
- Method: LTM-MET-3060 Cation Exchange Capacity and ESP			
Cation Exchange Capacity	Melbourne	Sep 15, 2022	28 Days
- Method: LTM-MET-3060 Cation Exchange Capacity by bases & Exchangeable Sodium Percentage			
Exchangeable Sodium Percentage (ESP)	Melbourne	Sep 15, 2022	28 Days
- Method: LTM-MET-3060 - Cation Exchange Capacity (CEC) & Exchangeable Sodium Percentage (ESP)			
% Moisture	Melbourne	Sep 13, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			

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web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road Dandenong South VIC 3175 Tel: +61 3 8564 5000 NATA# 1261 Site# 1254	19/8 Lewalan Street Grovedale VIC 3216 Tel: +61 3 8564 5000 NATA# 1261 Site# 1254	179 Magowar Road Girraween NSW 2145 Tel: +61 2 9900 8400 NATA# 1261 Site# 18217	Unit 1,2 Dacre Street Mitchell ACT 2911 Tel: +61 2 6113 8091	1/21 Smallwood Place Murarrie QLD 4172 Tel: +61 7 3902 4600 NATA# 1261 Site# 20794	4/52 Industrial Drive Mayfield East NSW 2304 PO Box 60 Wickham 2293 Tel: +61 2 4968 8448 NATA# 1261 Site# 25079

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Perth
46-48 Banksia Road Welshpool WA 6106 Tel: +61 8 6253 4444 NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Auckland	Christchurch
35 O'Rorke Road Penrose, Auckland 1061 Tel: +64 9 526 45 51 IANZ# 1327	43 Detroit Drive Rolleston, Christchurch 7675 Tel: 0800 856 450 IANZ# 1290

Company Name: Strata Geoscience and Environmental P/L
Address: 17 Little Arthur Street
North Hobart
TAS 7000

Project Name: MAFFRA-BRAIGOLONG ROAD MAFFRA

Order No.:
Report #: 922769
Phone:
Fax:

Received: Sep 13, 2022 8:00 AM
Due: Sep 20, 2022
Priority: 5 Day
Contact Name:

Eurofins Analytical Services Manager :

Sample Detail						Emerson Class Number	Eurofins Suite B20	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254							X	X
External Laboratory						X		
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**			
1	BH01	Jun 19, 2022		Soil	M22-Se0025965	X	X	X
2	BH02	Jun 19, 2022		Soil	M22-Se0025966	X	X	X
3	BH03	Jun 19, 2022		Soil	M22-Se0025967	X	X	X
4	BH04	Jun 19, 2022		Soil	M22-Se0025968	X	X	X
5	BH05	Jun 19, 2022		Soil	M22-Se0025969	X	X	X
6	BH06	Jun 19, 2022		Soil	M22-Se0025970	X	X	X
7	BH07	Jun 19, 2022		Soil	M22-Se0025971	X	X	X
8	BH08	Jun 19, 2022		Soil	M22-Se0025972	X	X	X
9	BH09	Jun 19, 2022		Soil	M22-Se0025973	X	X	X
10	BH10	Jun 19, 2022		Soil	M22-Se0025974	X	X	X
11	BH11	Jun 19, 2022		Soil	M22-Se0025975	X	X	X
12	BH12	Jun 19, 2022		Soil	M22-Se0025976	X	X	X
Test Counts						12	12	12

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Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**µg/L:** micrograms per litre
ppm: parts per million	**ppb:** parts per billion	**%:** Percentage
org/100 mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100 mL:** Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

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Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Conductivity (1:5 aqueous extract at 25 °C as rec.)	uS/cm	< 10			10	Pass	
Exchangeable Sodium Percentage (ESP)	%	< 0.1			0.1	Pass	
Magnesium (exchangeable)	meq/100g	< 0.1			0.1	Pass	
Potassium (exchangeable)	meq/100g	< 0.1			0.1	Pass	
Sodium (exchangeable)	meq/100g	< 0.1			0.1	Pass	
Method Blank							
Cation Exchange Capacity							
Calcium (exchangeable)	meq/100g	< 0.1			0.1	Pass	
Cation Exchange Capacity	meq/100g	< 0.05			0.05	Pass	
LCS - % Recovery							
Conductivity (1:5 aqueous extract at 25 °C as rec.)	%	107			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	K22-Se0015150	NCP	uS/cm	590	430	32	30%	Fail	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	M22-Se0025968	CP	%	23	23	<1	30%	Pass	

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Comments

Analysis of Emerson Class has been completed by East West, NATA Accreditation Number 12360, report reference EWReport 221661-1

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	No
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	Yes

Authorised by:

Analytical Services Manager
Senior Analyst-Sample Properties
Senior Analyst-Inorganic
Senior Analyst-Metal
Senior Analyst-Inorganic

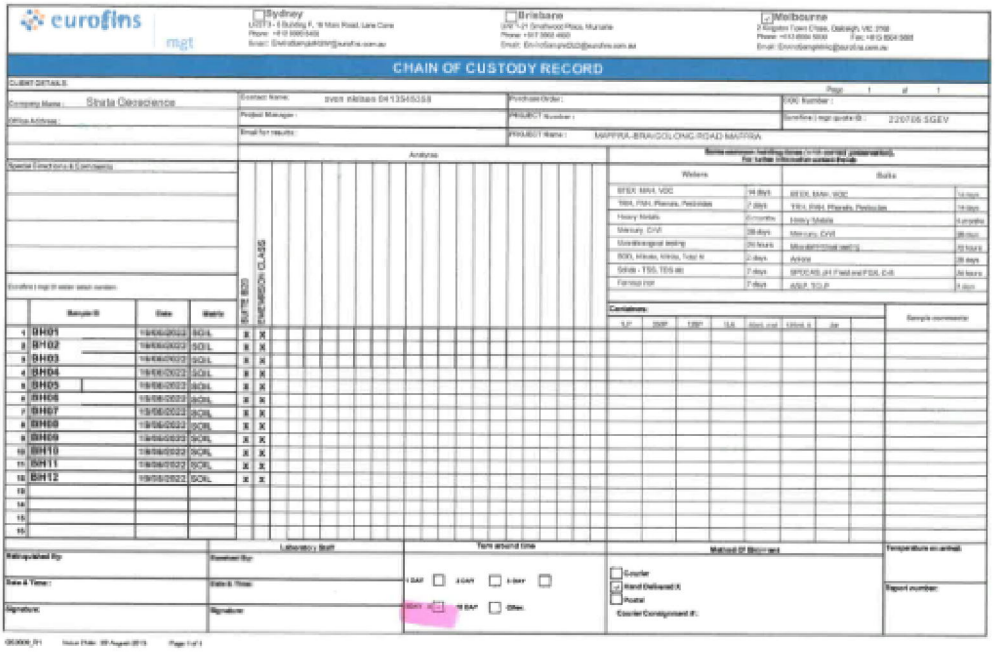
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.



eurofins mgt

☐ Sydney ☐ Brisbane ☑ Melbourne

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Company Name: Strata Geoscience

Contact Name: sven nielsen 0413545358

Project Manager:

Email for results:

Purchase Order:

PROJECT Number:

PROJECT Name: MAFFRA-BRIAGOLONG ROAD MAFFRA

COC Number:

Eurofins | mgt quote ID: 220705 SGEV

Analysis

	Sample ID	Date	Matrix	SUITE B03	EMERSON CLASS
1	BH01	13/09/2022	SOIL	X	X
2	BH02	13/09/2022	SOIL	X	X
3	BH03	13/09/2022	SOIL	X	X
4	BH04	13/09/2022	SOIL	X	X
5	BH05	13/09/2022	SOIL	X	X
6	BH06	13/09/2022	SOIL	X	X
7	BH07	13/09/2022	SOIL	X	X
8	BH08	13/09/2022	SOIL	X	X
9	BH09	13/09/2022	SOIL	X	X
10	BH10	13/09/2022	SOIL	X	X
11	BH11	13/09/2022	SOIL	X	X
12	BH12	13/09/2022	SOIL	X	X
13					
14					
15					
16					

Waters: BTEX, MAH, VOC (14 days); TRH, PAH, Phenols, Pesticides (7 days); Heavy Metals (6 months); Mercury, CVI (28 days); Microbiological testing (24 hours); BOD, Nitrate, Nitrite, Total N (2 days); Solids - TSS, TDS etc (7 days); Faecal coli (7 days)

Solids: BTEX, MAH, VOC (14 days); TRH, PAH, Phenols, Pesticides (14 days); Heavy Metals (6 months); Mercury, CVI (28 days); Microbiological testing (24 hours); Arsenic (28 days); SPOCAS, pH Field and FSA, C-S (24 hours); ASLP, TCLP (7 days)

Containers

Sample comments

Relinquished By:

Date & Time:

Signature:

Laboratory Staff

Received By:

Date & Time:

Signature:

Turn around time: ☐ 1 DAY ☐ 2 DAY ☐ 3 DAY ☐ 5 DAY ☐ Other

Method Of Shipment: ☐ Courier ☑ Hand Delivered ☐ Postal

Courier Consignment #:

Temperature on arrival:

Report number:

DATE: 13/09/22
TIME: 8.00 Am
COURIER: DO
TEMPERATURE 9.1°C
TEMP TO CHILL: YES (NO)

922769

Blanch
13/9/2022

eastwest
geo ag enviro

82 Plain Street Tamworth NSW 2340
e admin@eastwestonline.com.au
t 02 6762 1733
f 02 6765 9109
abn 82 125 442 382

eastwestonline.com.au

ANALYSIS REPORT SOIL

PROJECT NO: EW221661		**Date of Issue:**	**23/09/2022**
Customer:	EUROFINS Melbourne	Report No:	1
Address:	6 Monterey Road, DANGENONG SOUTH VIC 3175 DANDENONG SOUTH VIC 3175	Date Received:	16/09/2022
		Matrix:	Soil
Attention:		Location:	922769
Phone:	03-8564 5000	Sampler ID:	Client
Fax:		Date of Sampling:	19/06/2022
Email:		Sample Condition:	Acceptable

Comments:
3b = moderate to slight dispersion of the remould.

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

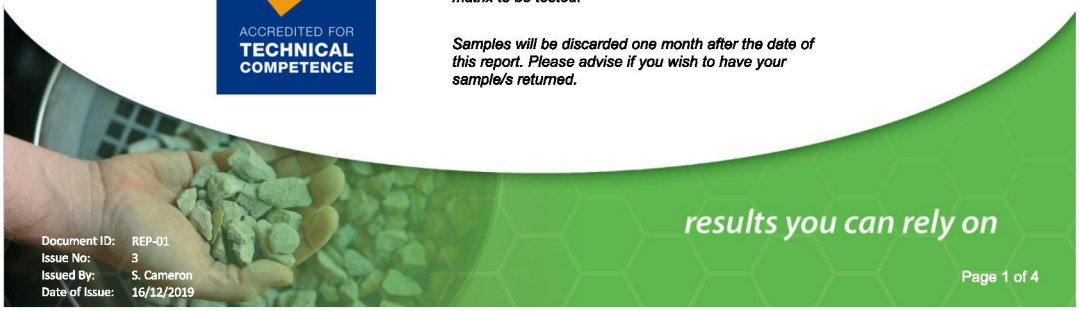
Signed:

Laboratory Operations Manager

NATA Accredited Laboratory 12360
Accredited for compliance with ISO/IEC 17025 - Testing

This analysis relates to the sample submitted and it is the client's responsibility to make certain the sample is representative of the matrix to be tested.

Samples will be discarded one month after the date of this report. Please advise if you wish to have your sample/s returned.



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ANALYSIS REPORT

PROJECT NO: EW221661 **Location: 922769**

				CLIENT SAMPLE ID	22-SE0025965	22-SE0025966	22-SE0025967	22-SE0025968
				DEPTH	BH01	BH02	BH03	BH0
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**221661-1**	**221661-2**	**221661-3**	**221661-4**
Emerson Aggregate Test	Class	PMS-21	Number	na	1	3b	2	2

eastwestonline.com.au

ANALYSIS REPORT

PROJECT NO: EW221661 **Location: 922769**

					CLIENT SAMPLE ID	22-SE0025969	22-SE0025970	22-SE0025971	22-SE0025972
					DEPTH	BH05	BH06	BH07	BH08
Test Parameter	Method Description	Method Reference	Units	LOR		221661-5	221661-6	221661-7	221661-8
Emerson Aggregate Test	Class	PMS-21	Number	na		3b	2	8	2

eastwestonline.com.au

ANALYSIS REPORT

PROJECT NO: EW221661 **Location: 922769**

				CLIENT SAMPLE ID	22-SE0025973	22-SE0025974	22-SE0025975	22-SE0025976
				DEPTH	BH09	BH10	BH11	BH12
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**221661-9**	**221661-10**	**221661-11**	**221661-12**
Emerson Aggregate Test	Class	PMS-21	Number	na	3b	2	1	5

This Analysis Report shall not be reproduced except in full without the written approval of the laboratory.
Soils are air dried at 40°C and ground <2mm.
NB: LOR is the Lowest Obtainable Reading.

DOCUMENT END

Appendix 4 Wastewater System Concept Design
Proposed Irrigation Concept Design

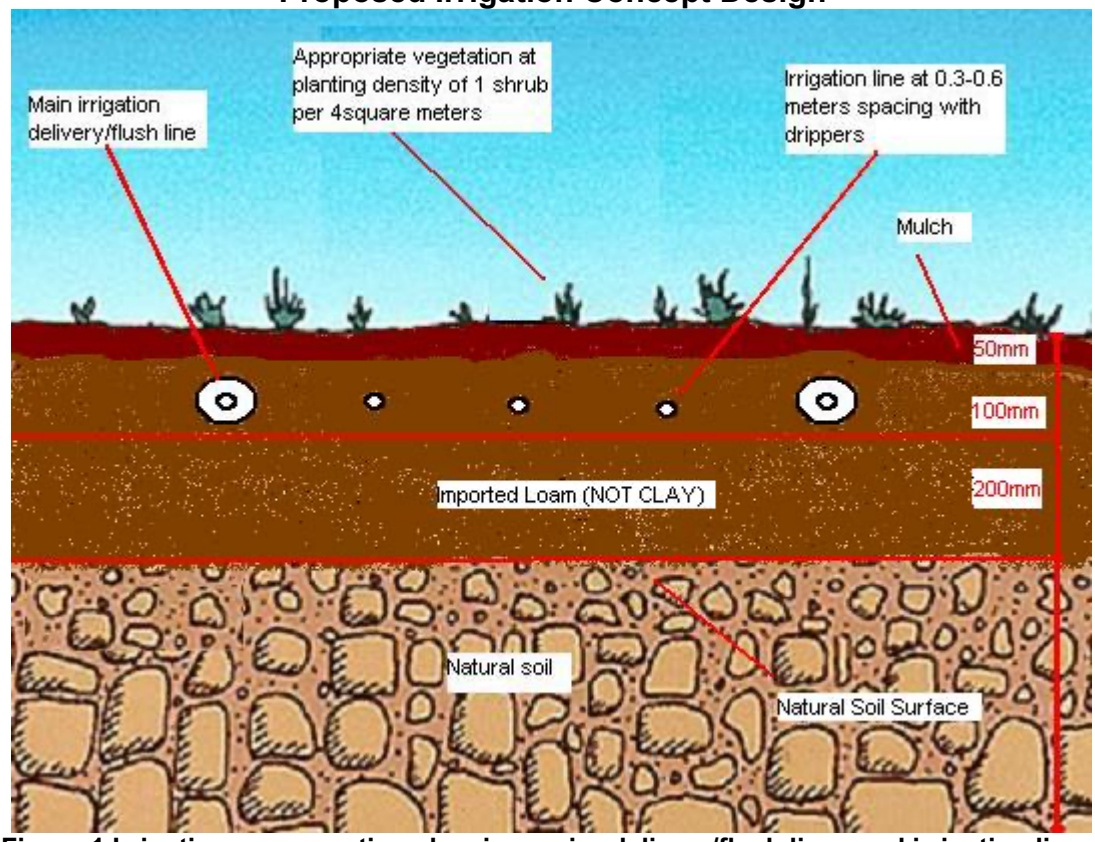

Figure 1 Irrigation cross section showing major delivery/flush lines and irrigation lines.

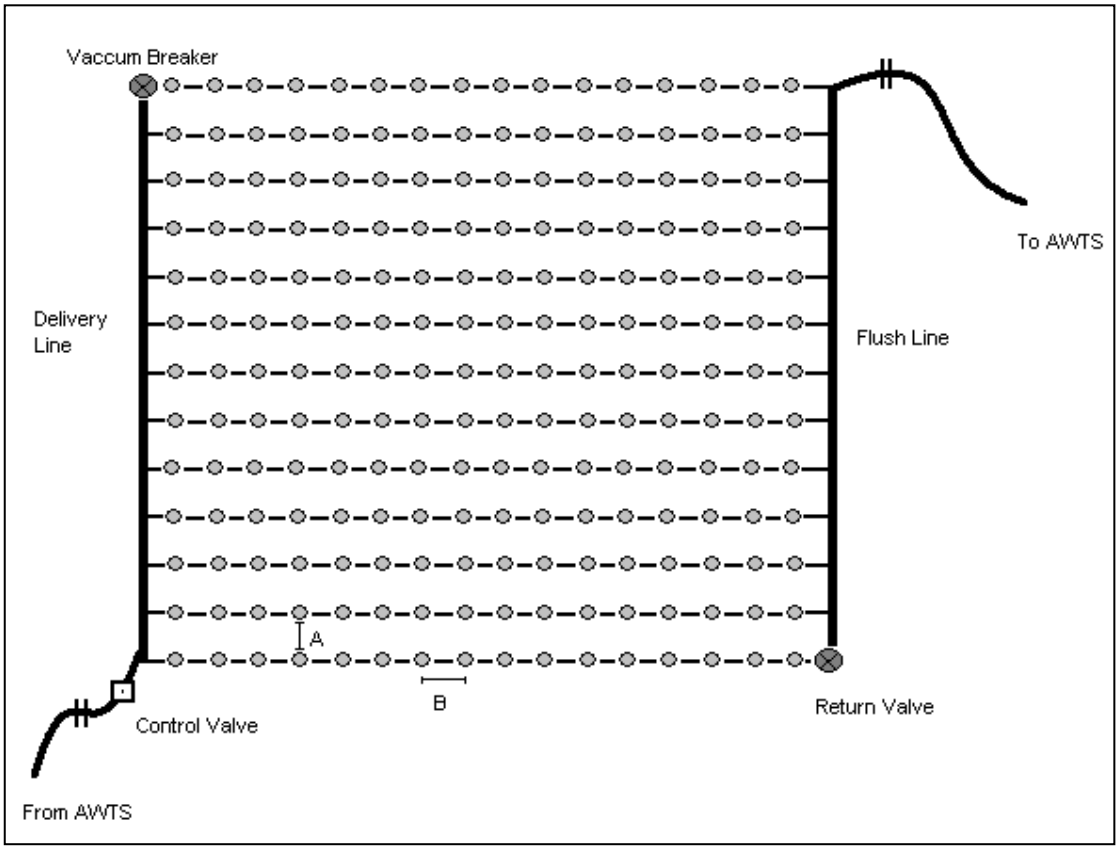

Figure 2 Irrigation Plan View

Site De-vegetation and Soil Renovation Processes

1. Soils may be disturbed by site de-vegetation and removal of large trees. Soil may also be compacted by vehicular traffic or livestock. The following steps should be taken to renovate the soil profile before irrigation is installed:
    a. Mechanically till, harrow or plough and level the residual soil surface. Ensure that all areas where vehicles or livestock have compacted the soil are deeply ripped or tilled to ensure adequate soil permeability. Ensure that the ground surface is levelled along natural slope contours and that all major rocks, gravels, road surfacing and large roots are removed.
    b. Gypsum should be incorporated at the rate of 1kg/5m^2
    c. Imported topsoil (not clay) should be applied as shown in Fig 1 above. Do not compact this layer, and avoid travelling over with large machinery.
    d. Irrigation should be laid as per the specifications below (point 2-18) and covered with further topsoil as per Fig 1 above.
    e. Selected vegetation should be planted at a density of approx. 1 plant per 4m^2.
    f. Mulch should be placed over the site as shown in Figure 1 above.

Land Application Area Design and Construction Notes

2. Delivery/flush line diameter = 25 -30 mm
3. Irrigation line diameter = 12-16mm
4. Irrigation line spacing (A) =300 mm for Sands, Sandy Loams and Loams to 600mm for Clay Loams, Light Clays and Heavy Clays (see the wastewater flow modelling section of this report for soil classification).
5. Dripper/Sprinkler spacing (B) as per manufacturers specifications.
6. A vacuum breaker should be installed at the highest point of the irrigation area (or in the case of multiple irrigation lots at each lot). This breaker should be protected and marked).
7. A flush line should be installed at the lowest point of the irrigation area incorporating a return valve for back flushing of the system back into the treatment chamber.
8. Irrigation areas greater than 400 m^2 should be split into a maximum 250 m^2 cells with effluent flows switched between irrigation lots with an automatic valve system.
9. All lateral lines MUST be installed parallel to the contours of the land. All minimum setbacks MUST be adhered to.
10. An inline filter must be inserted into the delivery line.
11. The first 100mm of the natural soil below the ground surface should be mechanically tilled to aid soil permeability.
12. Gypsum should be incorporated at the rate of 1kg/5m^2 into soils.
13. Imported topsoil (not clay) should be applied as shown above.
14. Selected vegetation should be planted at a density of approx. 1 plant per 4m^2.
15. A minimum 50mm of heavy mulch should be imported to cover the ground surface.
16. Where practical a 50% reserve area should be identified on the site to allow movement or expansion of the irrigation area if required.
17. In areas of moderate to steep slopes (>10%) then upslope cut off drainage should be installed to minimise shallow ground water recharge of the irrigation area from upslope.
18. All livestock and Vehicles MUST be excluded from irrigation area.

Appendix 4 Extract from EPAV 2016

Code of practice – onsite wastewater management

Table 4: Minimum daily wastewater flow rates and organic loading rates [1, 10]

Source	Design hydraulic flow rates for all water supplies [2, 4, 5] (L/person.day)	Organic material loading design rates (g BOD/person.day) [7]
Households with extra wastewater producing facilities [6]	220	60
Households with standard water fixtures	180	60
Households with full water-reduction fixtures [3]	150	60
Motels/hotels/guesthouse		
- per bar attendant	1000	120
- bar meals per diner	10	10
- per resident guest and staff with in-house laundry	150	80
- per resident guest and staff with out-sourced laundry	100	80
Restaurants (per potential diner) [9]		
- premises <50 seats	40	50
- premises >50 seats	30	40
- tearooms, cafés per seat	10	10
- conference facilities per seat	25	30
- function centre per seat	30	35
- take-away food shop per customer	10	40
Public areas (with toilet, but no showers and no café) [8]		
- public toilets	6	3
- theatres, art galleries, museum	3	2
- meeting halls with kitchenette	10	5
Premises with showers and toilets		
- golf clubs, gyms, pools etc. (per person)	50	10
Hospitals - per bed	350	150
Shops/shopping centres		
- per employee	15	10
- public access	5	3
School – child care	20	20
- per day pupil and staff	20	20
- resident staff and boarders	150	80
Factories, offices, day training centres, medical centres	20	15
Camping grounds		
- fully serviced	150	60
- recreation areas with showers and toilets	100	40

1. Based on EPA Code of Practice for Small Wastewater Treatment Plants, Publication 500 (1997).
2. When calculating the flow rate for an existing commercial premise, use this table or metered water usage data from the premise's actual or pro-rata indoor use.
3. WELS-rated water-reduction fixtures and fittings - minimum 4 Stars for dual-flush toilets, shower-flow restrictors, aerator taps, flow/pressure control valves and minimum 3 Stars for all appliances (e.g. water-conserving automatic clothes washing machines).
4. These flow rates take into consideration the likelihood of a reliable water supply being currently provided to a premises or in the future (e.g. from groundwater, surface water or reticulated water supply, or a tankered water supply).
5. Where Council is satisfied a household or premises is unlikely to be provided with a reliable water supply (e.g. a rural farming property where groundwater or surface water is unavailable or used only for stock) the design flow rates for Onsite Roof Water Tank Supply listed in the most current version of AS/NZS 1547 may be used.
6. Extra water producing fixtures include, but are not limited to, spa baths.
7. Based on Crites & Tchobanoglous (1998) and EPA Publication 500 (1997).
8. For premises such as public areas, factories or offices that have showers and toilets, use the flow rates for 'Premises with showers and toilets' in the calculations.
9. Number of seats multiplied by the number of seatings i.e., may include multiple seatings for breakfast, morning and afternoon teas, lunch and/or dinner.
10. The organic loading rate must be considered as well as the hydraulic flow rate when selecting the most suitable treatment system.

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Code of practice – onsite wastewater management

Table 5: Setback distances for primary and secondary treatment plants and effluent disposal/irrigation areas in sewered and unsewered areas (where applicable) [1, 2, 6, 10,]

Landscape feature or structure	Setback distances (m)		
	Primary sewage and greywater systems	Secondary sewage and greywater systems	Advanced secondary greywater systems [3]
Building			
Wastewater field up-slope of building [7]	6	3	3
Wastewater field down-slope of building	3	1.5	1.5
Wastewater up-slope of cutting/escarpment [12]	15	15	15
Allotment boundary			
Wastewater field up-slope of adjacent lot	6	3	1
Wastewater field down-slope of adjacent lot	3	1.5	0.5
Services			
Water supply pipe	3	1.5	1.5
Wastewater up-slope of potable supply channel	300	150	150
Wastewater field down-slope of potable supply channel	20	10	10
Gas supply pipe	3	1.5	1.5
In-ground water tank [14]	15	7.5	3
Stormwater drain	6	3	2
Recreational areas			
Children's grassed playground [15]	6	3 [16]	2 [16]
In-ground swimming pool	6	3 [16]	2 [16]
Surface waters (up-slope of:)			
Dam, lake or reservoir (potable water supply) [8, 13]	300	300 [4]	150
Waterways (potable water supply) [9, 13]	100	100 [4, 5, 17]	50
Waterways, wetlands (continuous or ephemeral, non-potable); estuaries, ocean beach at high-tide mark; dams, reservoirs or lakes (stock and domestic, non-potable) [8, 9]	60	30	30
Groundwater bores			
Category 1 and 2a soils	NA [11]	50 [19,]	20
Category 2b to 6 soils	20	20	20
Watertable			
Vertical depth from base of trench to the highest seasonal water table [18]	1.5	1.5	1.5
Vertical depth from irrigation pipes to the highest seasonal water table [18]	NA	1.5	1.5

1. Distances must be measured horizontally from the external wall of the treatment system and the boundary of the disposal/irrigation area, except for the 'Watertable' category which is measured vertically through the soil profile. For surface waters, the measuring point shall be from the 'bank-full level'.
2. Primary water-based sewerage systems must only be installed in unsewered areas; secondary sewerage systems must only be installed and managed in sewered areas by Water Corporations; secondary greywater systems can be installed in sewered and unsewered areas (see Section 3.12.3).
3. Advanced secondary greywater systems treating effluent to ≤10/10/10 standard.
4. The setback distance in a Special Water Supply Catchment area may be reduced by up to a maximum of 50% conditional on the following requirements (otherwise the setback distances for primary treatment systems apply):
   - effluent is secondary treated to 20/30 standard as a minimum
   - a maintenance and service contract, with a service technician accredited by the manufacturer, is in place to ensure the system is regularly serviced in accordance with Council Septic Tank Permit conditions and
   - Council is satisfied the reduction in set-back distance is necessary to permit the appropriate development of the site and that risks to public health and the environment are minimised.

Code of practice – onsite wastewater management

Appendix A:

Table 9: Soil Categories and Recommended Maximum Design Loading/Irrigation Rates (DLR/DIR) for Land Application Systems [1, 2, 5]

Soil texture	Soil structure	Soil category	Indicative permeability (Ksat) (m/d)	Design Loading Rates and Design Irrigation Rates (DLR / DIR) (mm/day)					
				Absorption trenches/beds and Wick Trench & Bed Systems 6 for primary effluent (see Table L1 in AS/NZS 1547: 2012)	(ETA) Evapo-transpiration absorption beds and trenches (see Table L1 in AS/NZS 1547: 2012)	Secondary treated effluent applied to Wick Trench & Bed System [4]	Sub-surface and surface irrigation (see Table M1 in AS/NZS 1547: 2012)	LPED (see Table M1 in AS/NZS 1547: 2012)	Mounds (basal area) (see Table N1 in AS/NZS 1547: 2012)
Gravels and sands	Structureless (massive)	1	>3.0	NA [3]	NA [3]	25	5 [6] (see Note 2 in Table M1)	NA [3]	24
Sandy loams	Weakly structured	2a	>3.0						24
	Massive	2b	1.4 – 3.0	15	15	30		4	24
Loams	High / moderate structured	3a	1.5 – 3.0	15	15	30	4 (see Note 1 in Table M1)	3.5	24
	Weakly structured or massive	3b	0.5 – 1.5	10	10	30			16
Clay loams	High / moderate structured	4a	0.5 – 1.5	10	12	30	3.5 (see Note 1 in Table M1)	3	16
	Weakly structured	4b	0.12 – 0.5	6	8	20			8
	Massive	4c	0.06 – 0.12	4	5	10			5 (see Note to Table N1)
Light clays	Strongly structured	5a	0.12 – 0.5	5	8	12	3 (see Note 1 in Table M1)	2.5 (see Note 4 in Table M1)	8
	Moderately structured	5b	0.06 – 0.12	(see Notes 2 and 3 in Table L1)	5 (see Notes 2, 3 & 5 in Table L1)	10			5 (see Note to Table N1)
	Weakly structured or massive	5c	<0.06			8			
Medium to heavy clays	Strongly structured	6a	0.06 – 0.5			5 (see Notes 2 and 3 in Table L1)	2 (see Note 2 in Table M1)	NA	
	Moderately structured	6b	<0.06						
	Weakly structured or massive	6c	<0.06						

1. Adapted from Australian Standard AS/NZS 1547: 2012 – On-site domestic wastewater management.
2. The DIR and DLR are recommended maximum application rates for treated effluent. A water balance may indicate that a reduced application rate is required for a specific site.
3. The exception is where the soil does not have a high perched or high seasonal (winter) watertable (see AS/NZS 1547).
4. See Appendix E for design, installation and maintenance details.
5. Lower application rates may be required for reduced soil permeability in sodic and dispersive soils, soils with a perched or seasonally high watertable or soils with a limiting layer.
6. The application rate may be increased in sandy soils with a high watertable where an advanced secondary treatment system with disinfection replaces a primary treatment system on an existing lot that is too small to accommodate the maximum DIR for category 1 to 2b soils.

Appendix 5 Professional Indemnity Insurance Certificate of Currency

tasman underwriting

LLOYD'S

Tasman Underwriting Pty Ltd is a Corporate Authorised Representative of Austagencies Pty Ltd ABN 76 006 090 464 AFSL 244584

Level 13, 141 Walker Street, North Sydney NSW 2060
PO Box 1813 North Sydney NSW 2059 Telephone: (02) 9930 9542

CERTIFICATE OF CURRENCY

Policy Number:	TU/PI/20210064
Type:	Professional Indemnity Insurance
Insured:	Strata Geoscience and Environmental Pty Ltd; Sven Nielsent t/as Strata Geoscience & Environmental; Nielsen Family Trust
Profession:	Consulting Geotechnical, Environmental & Plumbing Engineers
Limit of Indemnity:	$2,000,000
Period of Insurance:	From: 4.00pm 26 May 2022 To: 4.00pm 26 May 2023
Retroactive Date:	5 May 2010 (excluding any known Claims/circumstances)
Insurers:	100% Certain Underwriters at Lloyd's, London per Tasman Underwriting Pty Limited, Sydney.

Please refer to the policy document and any endorsements for the full terms and conditions of this insurance.

Signed:

Dated: In Sydney this Thursday, 5 May 2022

This Certificate has been issued in our capacity as agents for Certain Underwriters at Lloyd's, London. It does not reflect in detail the policy terms or conditions and merely provides a very brief summary of the insurance that is, to the best of our knowledge, in existence at the date we have issued this Certificate. If you wish to obtain details of the policy terms, conditions, restrictions, exclusions or warranties, you must refer to the policy document.

In issuing this Certificate, we do not guarantee that the insurance outlined will continue to remain in force for the Period of Insurance as the policy may be cancelled or altered by either party to the contract at any time in accordance with the terms and conditions of the policy or in accordance with the terms of The Insurance Contracts Act 1984. We accept no responsibility or liability to advise any party who may be relying on this Certificate of any such alteration to, or cancellation, of the policy.

Appendix 6 Terms and Conditions

Scope of Work
These Terms and Conditions apply to any services provided to you ("the Client") by Strata Geoscience and Environmental Pty Ltd ("Strata"). By continuing to instruct Strata to act after receiving the Terms and Conditions or by using this report and its findings for design and/or permit application processes and not objecting to any of the Terms and Conditions the Client agrees to be bound by these Terms and Conditions, and any other terms and conditions supplied by Strata from time to time at Strata's sole and absolute discretion. The scope of the services provided to the Client by Strata is limited to the services and specified purpose agreed between Strata and the Client and set out in the correspondence to which this document is enclosed or annexed ("the Services"). Strata does not purport to advise beyond the Services.

Third Parties
The Services are supplied to the Client for the sole benefit of the Client and must not be relied upon by any person or entity other than the Client. Strata is not responsible or liable to any third party. All parties other than the Client are advised to seek their own advice before proceeding with any course of action.

Provision of Information
The Client is responsible for the provision of all legal, survey and other particulars concerning the site on which Strata is providing the Services, including particulars of existing structures and services and features for the site and for adjoining sites and structures. The Client is also responsible for the provision of specialised services not provided by Strata. If Strata obtains these particulars or specialised services on the instruction of the Client, Strata does so as agent of the Client and at the Client's expense. Strata is not obliged to confirm the accuracy and completeness of information supplied by the Client or any third party service provider. The Client is responsible for the accuracy and completeness of all particulars or services provided by the Client or obtained on the Client's behalf. Strata is not liable, and accepts no responsibility, for any claim, demand, charge, loss, damage, injury or expense whatsoever suffered by the Client or any other person or entity resulting from the failure of the Client or third party to provide accurate and complete information. In the event additional information becomes available to the Client, the Client must inform Strata in writing of that information as soon as possible. Further advice will be provided at the Client's cost. Any report is prepared on the assumption that the instructions and information supplied to Strata has been provided in good faith and is all of the information relevant to the provision of the Services by Strata. Strata is not liable, and accepts no responsibility, for any claim, demand, charge, loss, damage, injury or expense whatsoever if Strata has been supplied with insufficient, incorrect, incomplete, false or misleading information.

Integrity
While all reasonable care is taken reporting to the Client, Strata does not warrant that the information contained in any report is free from errors or omissions. Strata is not liable, and accepts no responsibility, for any claim, demand, charge, loss, damage, injury or expense whatsoever resulting from errors in a report. Any report should be read in its entirety, inclusive of any summary and annexures.. Strata does not accept any responsibility where part of any report is relied upon without reference to the full report. Latter versions of any report invalidate any recommendations, assumptions, or designs contained in former reports. Strata is not liable, and accepts no responsibility, for any claim, demand, charge, loss, damage, injury or expense whatsoever based upon the use of older versions of any report.

Project Specific Criteria
Any report provided by Strata will be prepared on the basis of unique project development plans which apply only to the site that is being investigated. Reports provided by Strata do not apply to any project other than that originally specified by the Client to Strata. The Report must not be used or relied upon if any changes to the project are made. The Client should engage Strata to further advise on the effect of any change to the project. Further advice will be provided at the Client's cost. Strata is not liable, and accepts no responsibility, for any claim, demand, charge, loss, damage, injury or expense whatsoever where any change to the project is made without obtaining a further written report from Strata. Changes to the project may include, but are not limited to, changes to the investigated site or neighbouring sites, for instance, variation of the location of proposed building envelopes/footprints, changes to building design which may impact upon sewage treatment plant system design, specification and performance.

Interpretation

Strata is not responsible for the interpretation of site data or report findings by other parties, including parties involved in the design and construction process. The Client must seek advice from Strata about the interpretation of the site data or report.

Design/Report Recommendations

Where sewage treatment plant and/or application system designs are provided by Strata, reasonable effort will be made to minimise environmental, public health and commercial risks associated with the disposal of effluent within site boundaries with respect to relevant Australian guidelines and industry best practise at the time of investigation. Strata is not liable, and accepts no responsibility, for any claim, demand, charge, loss, damage, injury or expense whatsoever resulting from:

(i) changes to either the project or site conditions that affect the onsite wastewater land application system's ability to safely dispose of modelled wastewater flows; or
(ii) changes to original use of site infrastructure or changes from original modelled loadings as a result of change of use or incorrect loading information supplied by the client: or
(iii) seepage, pollution or contamination or the cost of removing, nullifying or clearing up seepage, polluting or contaminating substances; or
(iv) poor system performance where septic tanks have not been de-sludged at maximum intervals of 3 years or sewage treatment plants have not been serviced in compliance with the manufacturers recommendations; or
(v) system /component failure of any recommended system/component; or

(vi) poor contractor construction/installation practice; or
(vii) Inferior product/component selection by installing contractor ; or
(viii) any treatment plant , treatment plant component or land application area breakdown of any kind; or
(ix) failure of the client to commission both interim and final inspections by the designer throughout the system construction; or
(x) the selection of inappropriate plants for irrigation areas or any increased cost associated with upkeep of recommended plants or their replacement; or
(xi) damage to any infrastructure by seepage/effluent including but not limited to foundations, walls, driveways and pavements; or
(xii) land instability, soil erosion or dispersion caused by seepage/effluent or the installation of sewage plant infrastructure; or
(xiii) Excavation difficulties given hard rock, watertables, collapsing soils or other difficult conditions; or
(xiv) Dammages to underground services via excavation or system installation; or
(xv) design changes requested by the Permit Authority;or
(xvi) time delays associated with any of the above, or to strata or any of its representatives being able to mobilise to site for any reason.

Furthermore Strata does not guarantee land application area esign life beyond 2 years from installation. Strata does not warrant EPA sand filter designs.

Strata does not consider site contamination, unless the Client specifically instructs Strata to consider the site contamination in writing. If a request is made by the Client to consider site contamination, Strata will provide additional terms and conditions that will apply to the engagement.

Copyright and Use of Documents
Copyright in all drawings, reports, specifications, calculations and other documents provided by Strata or its employees in connection with the Services remain vested in Strata. The Client has a licence to use the documents for the purpose of completing the project. However, the Client must not otherwise use the documents, make copies of the documents or amend the documents unless express approval in writing is given in advance by Strata. The Client must not publish or allow to be published, in whole or in part, any document provided by Strata or the name or professional affiliations of Strata, without first obtaining the written consent of Strata as to the form and context in which it is to appear.

If, during the course of providing the Services, Strata develops, discovers or first reduces to practice a concept, product or process which is capable of being patented then such concept, product or process is and remains the property of Strata and:

(i) the Client must not use, infringe or otherwise appropriate the same other than for the purpose of the project without first obtaining the written consent of Strata; and

(ii) the Client is entitled to a royalty free licence to use the same during the life of the works comprising the project.

Digital Copies of Report
If any report is provided to the Client in an electronic copy except directly from Strata, the Client should verify the report contents with Strata to ensure they have not been altered in any way from the original provide by Strata.