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

Proposed 85-Lot Subdivision Friends, Hoopers, Williams & Willung Roads Rosedale

October 2021

Report Details

Table 1: Site, Client, Author and Report Details	
Address	Friends, Hoopers, Williams & Willung Roads Rosedale
Nature of Proposed Development	Proposed 85 Lot Subdivision
Client	Beveridge Williams
Author	[redacted]
Report Number	SR04345
Report Date	14/10/2021

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

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Executive Summary

Beveridge Williams contracted Strata Geoscience and Environmental Pty Ltd to conduct a Reconnaissance Land Capability Assessment and Onsite Wastewater System Design at Friends, Hoopers, Williams & Willung Roads Rosedale.

The investigation consisted of desktop and field reconnaissance, preliminary risk analysis, modelling and reporting. It is noteworthy that's the proposed subdivision exists across multiple titles and at the time of this investigation access was only available to 23 Hoopers Road, 91 Friends Road and Lot 1 Willung Road (see site investigation results in Appendix. Further reconnaissance on the remaining land associated with the proposed development will be required once access is available and as a results the modelling and recommendations must be treated as preliminary to be ratified at a later date subject to further investigation.

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

- Erosion
- Exposure
- Soil Texture
- Emmerson
- Soil Drainage
- Climate
- Vegetation Cover
- Groundwater Bores
- Fill

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	Beveridge Williams
Site Address	Friends, Hoopers, Williams & Willung Roads Rosedale (see Site Plan)
Nature of Development	Proposed 85 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	Friends, Hoopers, Williams & Willung Roads Rosedale
Owner/Developer/Agent	Beveridge Williams
Address	As above
Council Area	Wellington
Zoning	RLZ/PUZ6/RDZ2
Min Proposed Allotment Size	7069 m^2 approx.
Domestic Water Supply	Reticulated
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


FZ
FZ
FZ
LDRZ
PUZ1
PUZ6
RDZ2
RLZ1
Williams Road
Hoopers Road
Tennelle Court
Wright Court
Belle View Court
Boyd Court
Ashton Court
0.3km
rosedale
Scale 1: 10,000
Go
Hybrid


VicPlan version 2.3.1
Search for Address or Parcel (e.g. 42\PP3357)
Scale 1: 10,000
Go
Hybrid
Total: 177.02 m
177.02 m
Total: 279.24 m
279.24 m
Williams Road
Hoopers Road
Tenneille Court
Wright Court
Belle View Court
Boyd Court
Ashton Court
Feely Court
Bunyip
Budges Lane
IN1Z
LDRZ
RDZ2
PUZ1
PUZ6
PUZ5
FZ

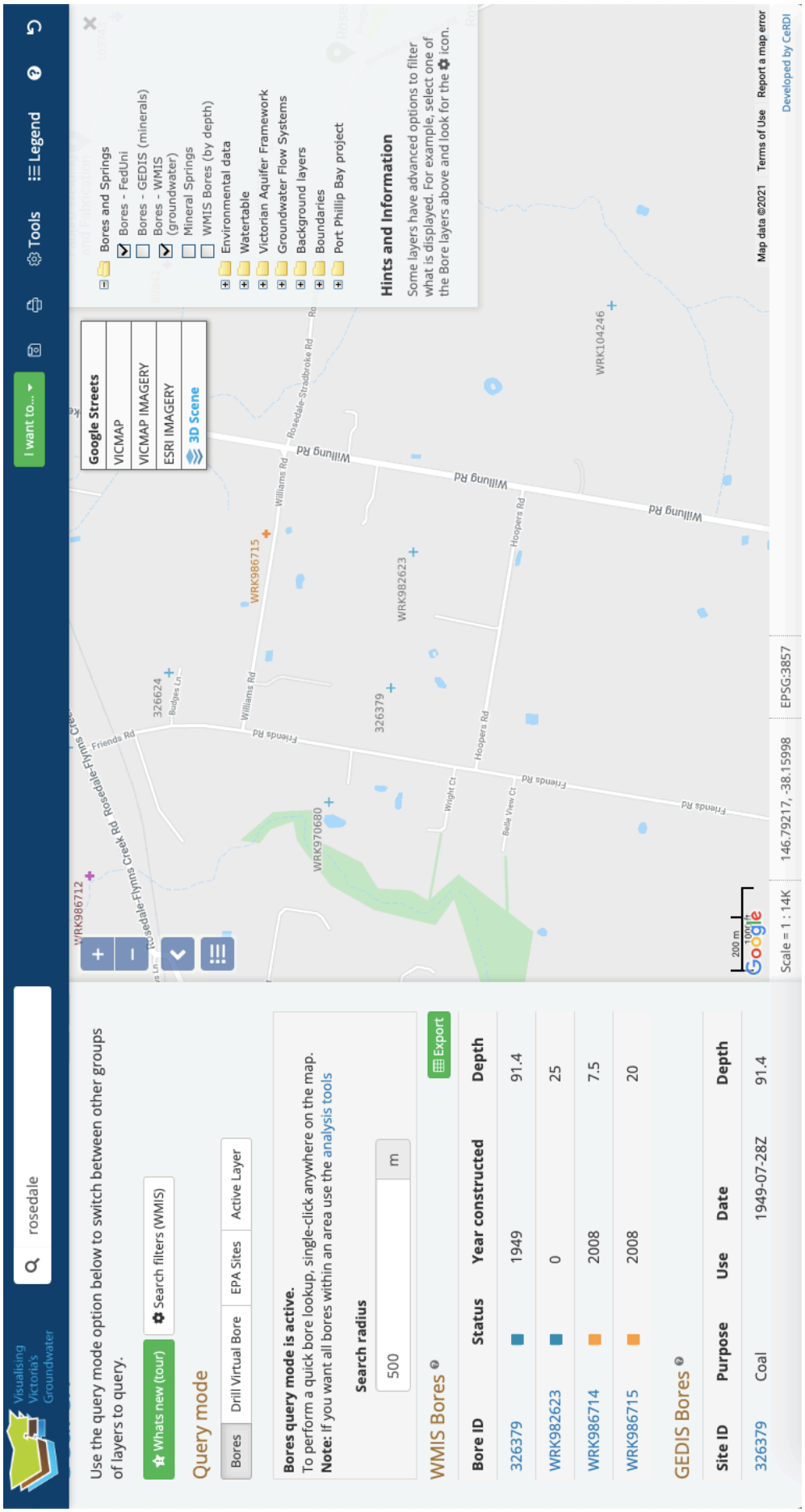

Visualising Victoria's Groundwater
rosedale
I want to...
Tools
Legend
Use the query mode option below to switch between other groups of layers to query.
Whats new (tour)
Search filters (WMIS)
Query mode
Bores
Drill Virtual Bore
EPA Sites
Active Layer
Bores query mode is active.
To perform a quick bore lookup, single-click anywhere on the map.
Note: If you want all bores within an area use the analysis tools
Search radius
500
m
Export
WMIS Bores
Bore ID
Status
Year constructed
Depth
326379
1949
91.4
WRK982623
0
25
WRK986714
2008
7.5
WRK986715
2008
20
GEDIS Bores
Site ID
Purpose
Use
Date
Depth
326379
Coal
1949-07-28Z
91.4
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.
Willung Rd
Friends Rd
Williams Rd
Hoopers Rd
Rosedale-Flynns Creek Rd
Rosedale-Straidbroke Rd
Budyes Ln
Wright Ct
Belle View Ct
WRK986712
WRK986715
WRK982623
WRK970680
WRK104246
326624
326379
Map data ©2021
Terms of Use
Report a map error
Developed by CeRDI
Scale = 1 : 14K
146.79217, -38.15998
EPSG:3857
200 m
100 ft
Google

Figure 2 Proposed Subdivision Plan

Table 5 Site Features	
Climate	The nearest weather station with **long term** data is the Traralgon EPA Station with a mean annual rainfall of 618.2 mm (BOM 2021). 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	Multiple dams onsite
Flood Potential	Unknown
Stormwater Run-on and Upslope Seepage	Stormwater to be directed away from proposed effluent envelopes. No seepage observed.
Groundwater	Two registered bore on proposed development area and one immediately to the north over Williams Road. (See VVG Portal results) 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 deposits.

4.2 Field Investigation

Field investigation consisted of drilling two soil bores using a 25mm soil probe to 1.5m or refusal with retrieval of undisturbed soil cores for logging, sampling and testing for pH, EC, CEC, Emmerson Class.

Bore logs and soil permeability data/soil test results (where relevant) are presented in Appendix 1.

With reference to the classification system of Isbell (2002) soils are classified as Brown **Dermosols** being structured clays soils. Soils will exhibit duplex profiles with lighter SILTY SAND (SM)/Clayey SAND (SC) 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 show moderate to high 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)	1.5m+
Depth to Water Table (m)	2.5m+
Coarse Fragments (%)	0-5%
Colloid Stability	Possibly dispersive soil phases present.
Soil Nutrient Attenuation	Good – clay phases will have high Cation Exchange Capacity.
Soil Permeability and Concept Design Loading Rates	DIR of 3mm/d appropriate DLR of 8-12 mm/d appropriate
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
EC	0.9	4.1
EMMERSON	8	7

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
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	Moderate
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)	Moderate

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	Minor

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	Moderate
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%	Minor
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:

- Erosion
- Exposure
- Soil Texture
- Emmerson
- Soil Drainage
- Climate
- Vegetation Cover
- Groundwater Bores
- Fill

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 **518 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 518 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	432
5	1080	518
6	1260	604
7	1440	691

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 518m^2 of subsurface irrigation dosed into constructed ornamental gardens as detailed in Appendix 3.
- Irrigation should be zoned into maximum 200m^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.
- Modelled flows will likely require a land application area comprising:
    - Min 518 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.**

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

Appendix 1 Site Photos and Indicative Borelogs

SOIL TEST MELBOURNE
Geotechnical engineering

BOREHOLOG INFORMATION

PROJECT NO.: 08534
DATE: 20/7/2021
HOLE LOCATION: *Per Sketch*

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

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	SHEAR VANE READING	POCKET PENETROMETER (1kg per 1cm²)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Topsoil, sand, silt, clay, loose, moist*						
200	***SILTY SAND (SM)*** *Pale brown, loose, moist*						
400	*Grading to* ***SILTY CLAY (CI)*** *Orange/brown, stiff, slightly moist, intermediate plasticity*						
600					*2.3*		
1200		*GNO*			*3.6*		
1500	***END OF BOREHOLE***				*6+*		

ABBREVIATIONS PER APPENDIX

Appendix A

SOIL TEST MELBOURNE
Geotechnical engineering

PROJECT NO.: 08534
DATE: 20/7/2021
HOLE LOCATION: *Per Sketch*

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

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	SHEAR VANE READING	POCKET PENETROMETER (1kg per 1cm²)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Topsoil, sand, silt, clay, loose, moist*						
200	***SILTY SAND (SM)*** *Pale brown, loose, moist*						
400	*Grading to* ***SILTY CLAY (CI)*** *Orange/brown, stiff, slightly moist, intermediate plasticity*						
600					*2.3*		
1200		*GNO*			*3.6*		
1500	***END OF BOREHOLE***				*6+*		

ABBREVIATIONS PER APPENDIX

Appendix A

SOIL TEST MELBOURNE
Geotechnical engineering

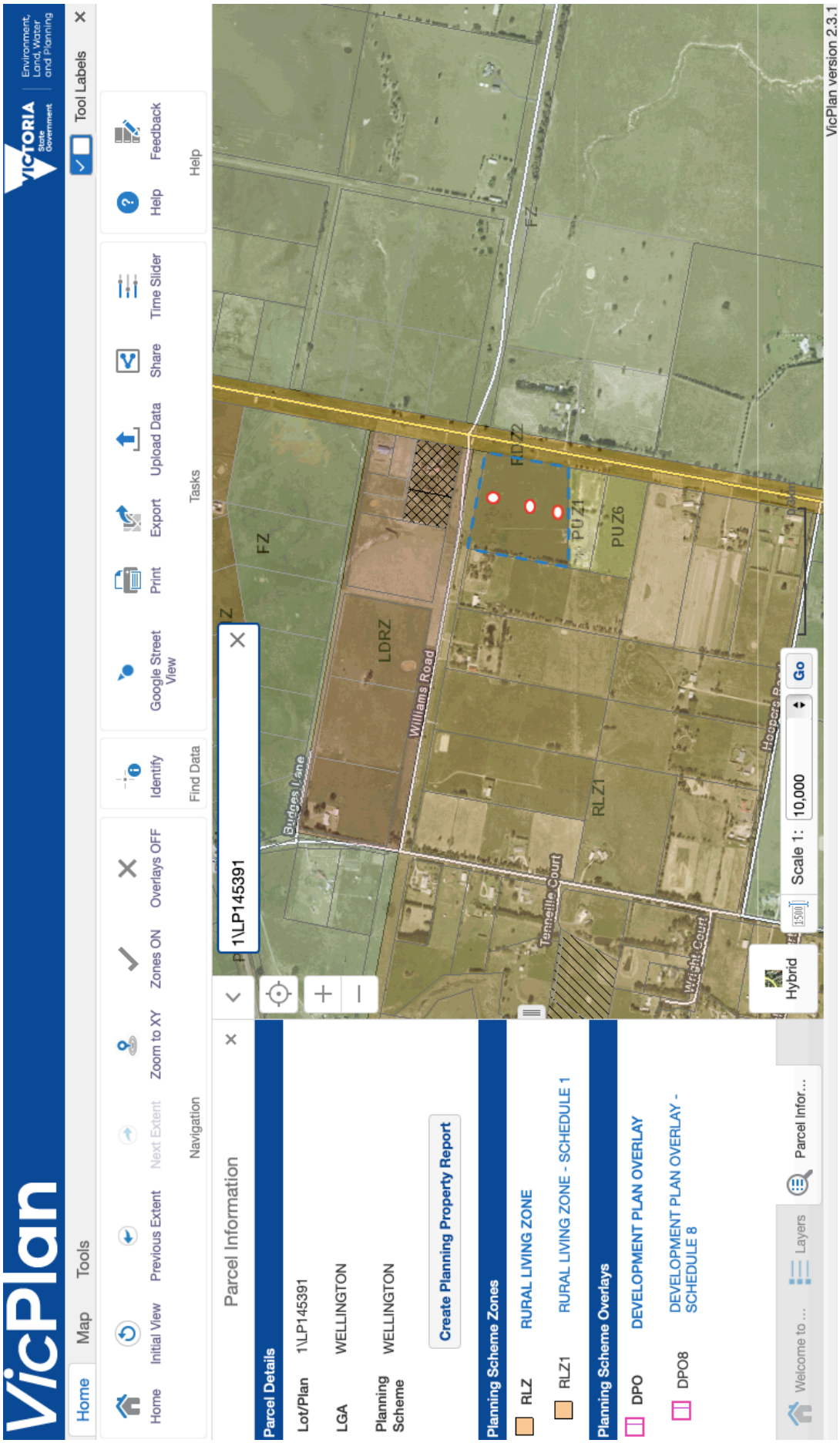
PROJECT NO.: 08534
DATE: 20/7/2021
HOLE LOCATION: *Per Sketch*

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

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	SHEAR VANE READING	POCKET PENETROMETER (1kg per 1cm²)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Topsoil, sand, silt, clay, loose, moist*						
200	***SILTY SAND (SM)*** *Pale brown, loose, moist*						
400	*Grading to* ***SILTY CLAY (CI)*** *Orange/brown, stiff, slightly moist, intermediate plasticity*						
600					*2.3*		
1200		*GNO*			*3.6*		
1500	***END OF BOREHOLE***				*6+*		

ABBREVIATIONS PER APPENDIX

Appendix A


VicPlan
Environment, Land, Water and Planning
VICTORIA State Government
Tool Labels
Home
Map
Tools
Home
Initial View
Previous Extent
Next Extent
Zoom to XY
Navigation
Zones ON
Overlays OFF
Identify
Find Data
Google Street View
Print
Export
Upload Data
Share
Time Slider
Tasks
Help
Feedback
Help
Parcel Information
1\LP145391
Parcel Details
Lot/Plan 1\LP145391
LGA WELLINGTON
Planning Scheme WELLINGTON
Create Planning Property Report
Planning Scheme Zones
RLZ RURAL LIVING ZONE
RLZ1 RURAL LIVING ZONE - SCHEDULE 1
Planning Scheme Overlays
DPO DEVELOPMENT PLAN OVERLAY
DPO8 DEVELOPMENT PLAN OVERLAY - SCHEDULE 8
Welcome to ...
Layers
Parcel Infor...
Budges Lane
Williams Road
Tenneille Court
Wright Court
Hoopers Road
FZ
LDRZ
RLZ1
RLZ2
PUZ1
PUZ6
Hybrid
Scale 1: 10,000
Go
VicPlan version 2.3.1

SOIL TEST MELBOURNE
Geotechnical engineering

BOREHOLOG INFORMATION

PROJECT NO.: 08534
DATE: 20/7/2021
HOLE LOCATION: *Per Sketch*

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

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	SHEAR VANE READING	POCKET PENETROMETER (1kg per 1cm^2)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Topsoil, sand, silt, clay, soft, loose, very moist, becoming saturated*						
200	***SILTY SAND (SM)*** *Pale brown/grey, very moist, loose*						
400	*Grading to* ***SILTY CLAY (CI)*** *Orange/brown, firm, slightly moist, intermediate plasticity*						
600					*2.2*		
1200		*GNO*			*4.1*		
1500	***END OF BOREHOLE***				*6+*		

ABBREVIATIONS PER APPENDIX

Appendix A

SOIL TEST MELBOURNE
Geotechnical engineering

PROJECT NO.: 08534
DATE: 20/7/2021
HOLE LOCATION: *Per Sketch*

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

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	SHEAR VANE READING	POCKET PENETROMETER (1kg per 1cm²)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Topsoil, sand, silt, clay, soft, loose, very moist, becoming saturated*						
200	***SILTY SAND (SM)*** *Pale brown/grey, very moist, loose*						
400	*Grading to* ***SILTY CLAY (CI)*** *Orange/brown, firm, slightly moist, intermediate plasticity*						
600					*2.1*		
1200		*GNO*			*4.3*		
1500	***END OF BOREHOLE***				*6+*		

ABBREVIATIONS PER APPENDIX

Appendix A

SOIL TEST MELBOURNE
Geotechnical engineering

PROJECT NO.: 08534
DATE: 20/7/2021
HOLE LOCATION: *Per Sketch*

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

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	SHEAR VANE READING	POCKET PENETROMETER (1kg per 1cm²)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Topsoil, sand, silt, clay, soft, loose, very moist, becoming saturated*						
200	***SILTY SAND (SM)*** *Pale brown/grey, very moist, loose*						
400	*Grading to* ***SILTY CLAY (CI)*** *Orange/brown, firm, slightly moist, intermediate plasticity*						
600					*2.2*		
1200		*GNO*			*4.4*		
1500	***END OF BOREHOLE***				*6+*		

Appendix A


Property Information
Property Details
Address 91 FRIENDS ROAD ROSEDALE 3847
LGA WELLINGTON
Planning Scheme WELLINGTON
Create Planning Property Report
Planning Scheme Zones
RLZ RURAL LIVING ZONE
RLZ1 RURAL LIVING ZONE - SCHEDULE 1
Planning Scheme Overlays
DPO DEVELOPMENT PLAN OVERLAY
DPO8 DEVELOPMENT PLAN OVERLAY - SCHEDULE 8
Welcome to ...
Layers
Property Info...
91 FRIENDS ROAD ROSEDALE 3847
Hybrid
Scale 1: 10,000
Go
VicPlan version 2.3.1
IN1Z
LDRZ
RLZ2
PUZ1
PUZ6
FZ
RLZ1
Williams Road
Hoopers Road
Budges Lane
Tenneille Court
Wright Court
Belle View Court
Boyd Court
0.3km

SOIL TEST MELBOURNE
Geotechnical engineering

BOREHOLOG INFORMATION

PROJECT NO.: 08534
DATE: 20/7/2021
HOLE LOCATION: *Per Sketch*

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

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	SHEAR VANE READING	POCKET PENETROMETER (1kg per 1cm²)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Topsoil, sand, silt, clay, soft, loose, very moist, becoming saturated*						
200	***SILTY SAND (SM)*** *Pale brown/grey, very moist, loose*						
400	*Grading to* ***SILTY CLAY (CI)*** *Orange/brown, firm, slightly moist, intermediate plasticity*						
600					*2.2*		
1200		*GNO*			*4.3*		
1500	***END OF BOREHOLE***				*6+*		

ABBREVIATIONS PER APPENDIX

Appendix A

SOIL TEST MELBOURNE
Geotechnical engineering

PROJECT NO.: 08534
DATE: 20/7/2021
HOLE LOCATION: *Per Sketch*

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

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	SHEAR VANE READING	POCKET PENETROMETER (1kg per 1cm^2)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Topsoil, sand, silt, clay, soft, loose, very moist, becoming saturated*						
200	***SILTY SAND (SM)*** *Pale brown/grey, very moist, loose*						
400	*Grading to* ***SILTY CLAY (CI)*** *Orange/brown, firm, slightly moist, intermediate plasticity*						
600					*2.2*		
1200		*GNO*			*4.3*		
1500	***END OF BOREHOLE***				*6+*		

ABBREVIATIONS PER APPENDIX

Appendix A

SOIL TEST MELBOURNE
Geotechnical engineering

PROJECT NO.: 08534
DATE: 20/7/2021
HOLE LOCATION: *Per Sketch*

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

DEPTH (mm)	SOIL & ROCK DESCRIPTION	GROUND WATER	TREE ROOTS	SHEAR VANE READING	POCKET PENETROMETER (1kg per 1cm^2)	EXISTING FOOTING (mm)	DEPTH (mm)
	FILL *Topsoil, sand, silt, clay, soft, loose, very moist, becoming saturated*						
200	***SILTY SAND (SM)*** *Pale brown/grey, very moist, loose*						
400	*Grading to* ***SILTY CLAY (CI)*** *Orange/brown, firm, slightly moist, intermediate plasticity*						
600					*2.2*		
1200		*GNO*			*4.3*		
1500	***END OF BOREHOLE***				*6+*		

ABBREVIATIONS PER APPENDIX

Appendix A

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

Irrigation area sizing using Nominated Area Water Balance & Storage Calculations

Site Address:

Date: #### **Assessor:** [redacted]

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	518	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		Traralgon EPA		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	42	43.5	41.8	49.8	45.9	52.6	52.1	62.3	53.2	55.1	60.2	54.3	612.8
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	42	43.5	41.8	49.8	45.9	52.6	52.1	62.3	53.2	55.1	60.2	54.3	612.8
Applied Effluent	W	(QxD)/L	mm/month	64.6	58.4	64.6	62.5	64.6	62.5	64.6	64.6	62.5	64.6	62.5	64.6	761.0
Inputs		RR+W	mm/month	106.6	101.9	106.4	112.3	110.5	115.1	116.7	126.9	115.7	119.7	122.7	118.9	1373.8
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	-147.6	-112.0	-82.0	-36.5	-14.1	-0.1	-4.2	-7.0	-39.4	-72.5	-89.7	-122.9	
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	158	177	228	327	425	518	487	467	318	244	213	179	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 518.0 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			

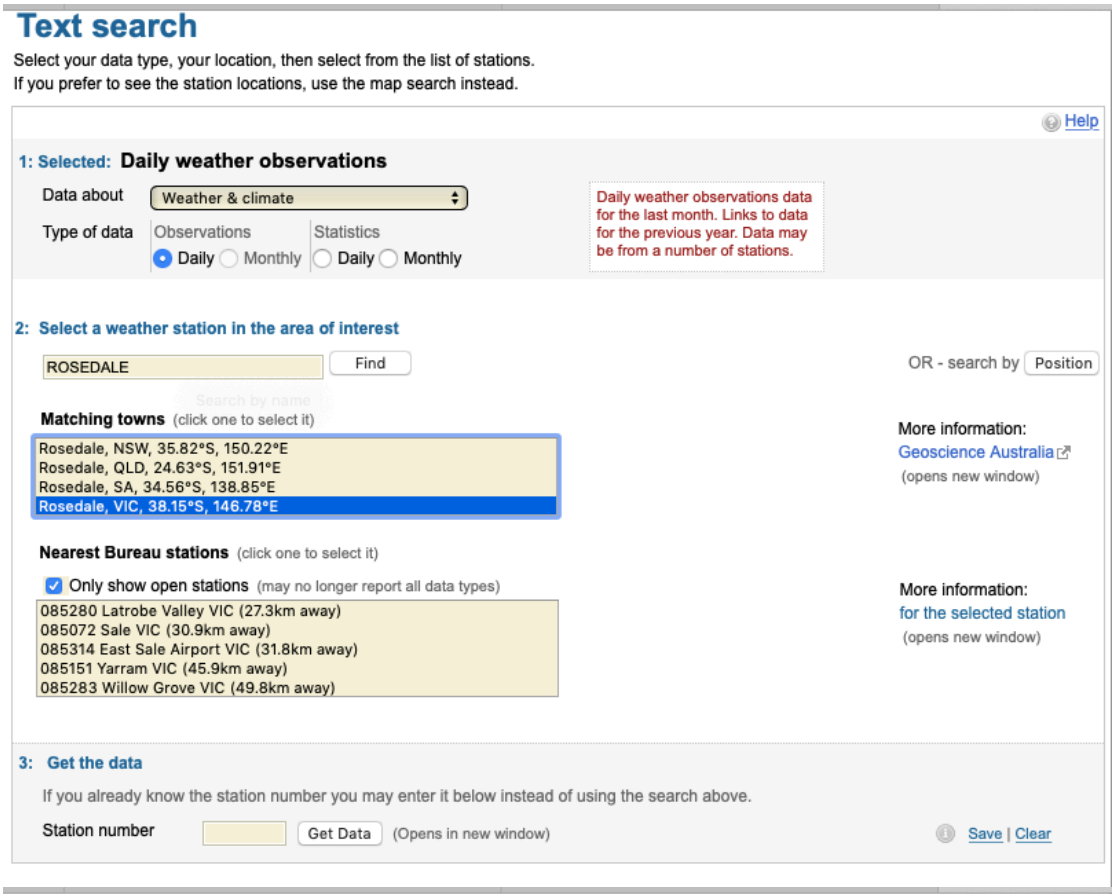
NUTRIENT BALANCE BASED ON ANNUAL CROP UPTAKE RATES

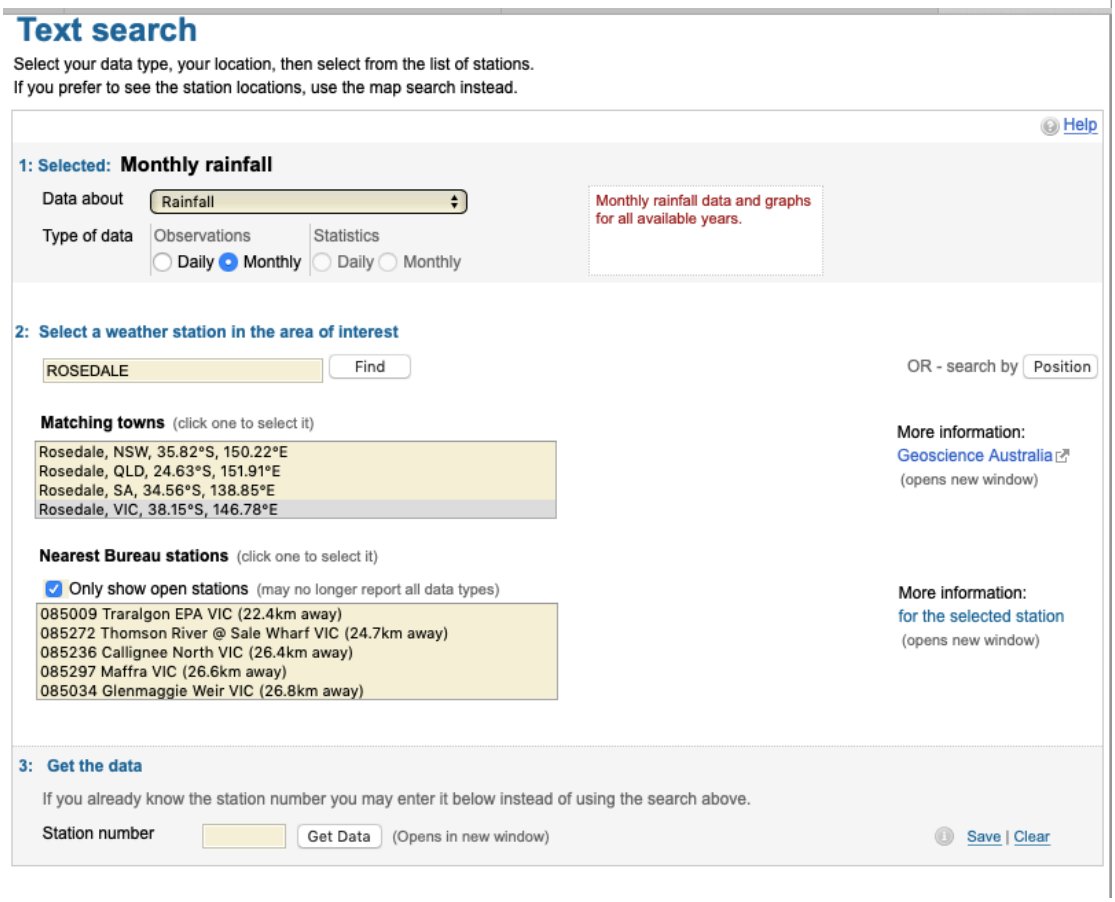
Minimum Area required with zero buffer			Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)		
Nitrogen	358	m^2	Nominated LAA Size	561	m^2
Phosphorus	269	m^2	Predicted N Export from LAA	-4.46	kg/year
			Predicted P Export from LAA	-3.42	kg/year
			Phosphorus Longevity for LAA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

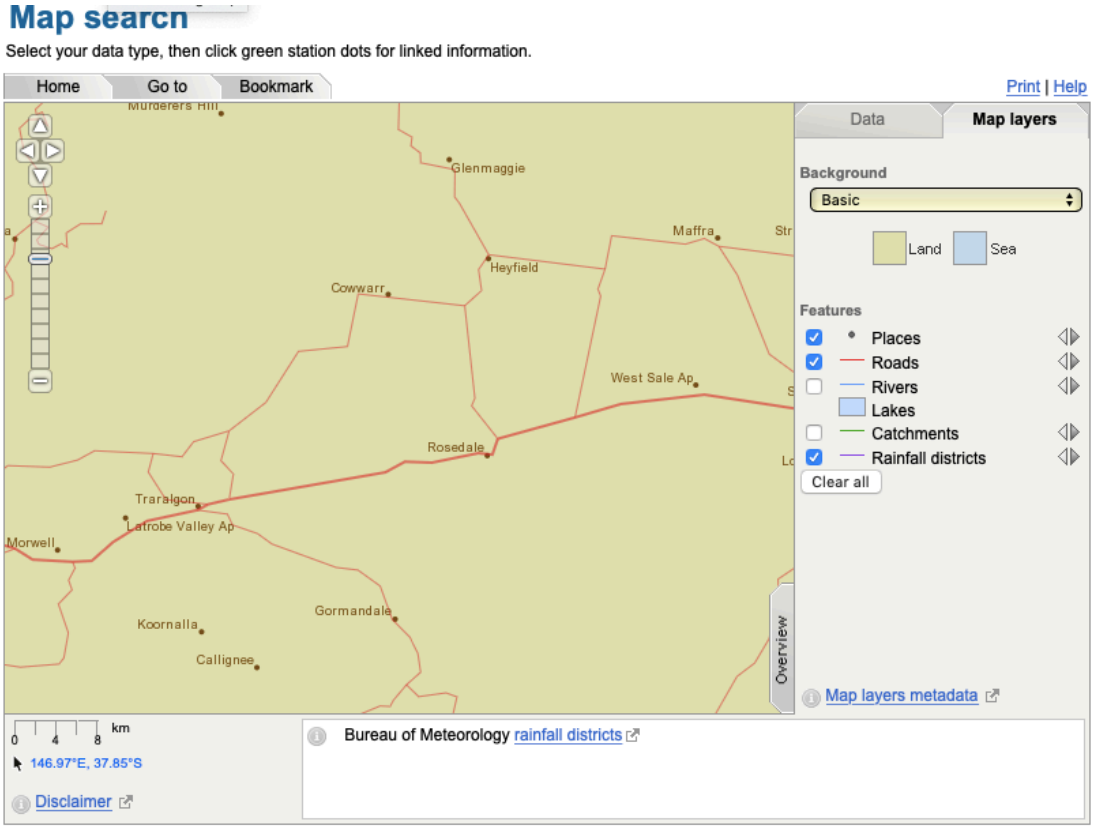
PHOSPHORUS BALANCE
Using the nominated LAA Size

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






Map search
Select your data type, then click green station dots for linked information.
Home
Go to
Bookmark
Print | Help
Data
Map layers
Background
Basic
Land
Sea
Features
Places
Roads
Rivers
Lakes
Catchments
Rainfall districts
Clear all
Map layers metadata
Glenmaggie
Maffra
Heyfield
Cowwarr
West Sale Ap
Rosedale
Traralgon
Latrobe Valley Ap
Morwell
Gormandale
Koornalla
Callignee
Overview
km
0 4 8
146.97°E, 37.85°S
Disclaimer
Bureau of Meteorology rainfall districts

Monthly Rainfall (millimetres)

TRARALGON EPA

Station Number: 085009 · State: VIC · Opened: 1999 · Status: Open · Latitude: 38.20°S · Longitude: 146.53°E · Elevation: Unknown m

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2000												*41.8*	
2001		*15.6*	*29.8*	*103.6*	*11.6*	*62.6*	*32.8*	*97.0*	*35.6*	*94.0*	*91.4*	*58.0*	
2002	*50.2*	*30.6*	*51.0*	*71.8*	*49.2*	*8.6*	*14.0*	*17.0*	*2.2*	*69.8*	*36.6*	*36.0*	*437.0*
2003	*22.8*	*12.4*	*46.2*	*44.8*	*21.8*	*58.8*	*78.0*	*61.8*	*76.4*	*92.0*	*40.0*	*47.0*	*602.0*
2004	*69.2*	*32.8*	*11.4*	*59.6*	*50.8*	*71.8*	*59.2*	*50.0*	*78.4*	*43.2*	*94.4*	*69.6*	*690.4*
2005	*44.0*	*88.6*	*18.6*	*18.0*	*11.4*	*20.6*	*66.0*	*73.4*	*71.4*	*56.6*	*48.0*	*46.6*	*563.2*
2006	*85.0*	*22.8*	*14.8*	*73.0*	*66.2*	*9.6*	*34.6*	*41.2*	*45.8*	*14.6*	*48.8*	*23.8*	*480.2*
2007	*46.4*	*69.8*	*66.2*	*44.4*	*33.2*	*84.6*	*88.6*	*45.6*	*66.6*	*41.0*	*75.6*	*79.8*	*741.8*
2008	*29.4*	*76.0*	*12.8*	*20.8*	*34.6*	*27.2*	*67.2*	*62.4*	*45.8*	*19.4*	*60.2*	*86.4*	*542.2*
2009	*4.6*	*11.4*	*27.0*	*53.2*	*23.2*	*35.8*	*51.8*	*78.4*	*60.6*	*68.0*	*56.6*	*50.6*	*521.2*
2010	*24.4*	*68.6*	*101.4*	*54.6*	*55.2*	*47.8*	*26.8*	*71.4*	*49.8*	*84.8*	*64.4*	*54.4*	*703.6*
2011	*34.8*	*105.4*	*78.2*	*82.8*	*47.0*	*35.2*	*71.2*	*51.0*	*68.8*	*49.4*	*107.4*	*48.8*	*780.0*
2012	*36.6*	*105.8*	*108.2*	*47.0*	*87.2*	*80.6*	*24.4*	*73.2*	*76.2*	*48.0*	*38.0*	*69.6*	*794.8*
2013	*2.8*	*22.8*	*16.4*	*10.2*	*35.2*	*133.4*	*37.6*	*79.6*	*57.6*	*91.2*	*51.0*	*38.0*	*575.8*
2014	*26.6*	*16.6*	*39.8*	*70.2*	*37.0*	*80.4*	*48.6*	*26.4*	*20.0*	*51.4*	*64.0*	*96.8*	*577.8*
2015	*48.2*	*56.0*	*30.0*	*43.4*	*60.2*	*36.4*	*52.8*	*86.8*	*22.8*	*18.8*	*56.6*	*23.6*	*535.6*
2016	*92.4*	*5.6*	*43.6*	*25.8*	*62.4*	*77.2*	*105.0*	*39.0*	*40.4*	*76.6*	*55.4*	*57.8*	*681.2*
2017	*18.8*	*31.0*	*30.4*	*40.4*	*41.6*	*19.6*	*47.4*	*72.0*	*88.2*	*48.0*	*18.6*	*126.2*	*582.2*
2018	*24.6*	*6.8*	*23.6*	*11.4*		*24.8*	*61.0*	*32.0*	*40.0*	*22.6*	*75.4*	*34.0*	
2019	*8.8*	*18.8*	*19.8*	*11.2*	*75.6*	*43.8*	*63.6*	*121.4*	*90.4*	*29.0*	*92.0*	*23.6*	*598.0*
2020	*95.4*	*105.0*	*29.0*	*116.8*	*68.8*	*35.2*	*32.2*	*69.4*	*26.6*	*83.8*	*29.0*	*28.8*	*720.0*
2021	*75.6*	*10.2*	*79.2*	*42.2*	*46.4*	*110.8*	*30.8*	*60.2*					

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

Monthly Rainfall (millimetres)

TRARALGON EPA

Station Number: 085009 · State: VIC · Opened: 1999 · Status: Open · Latitude: 38.20°S · Longitude: 146.53°E · Elevation: Unknown 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	42.0	43.5	41.8	49.8	45.9	52.6	52.1	62.3	53.2	55.1	60.2	54.3	618.2
Lowest	2.8	5.6	11.4	10.2	11.4	8.6	14.0	17.0	2.2	14.6	18.6	23.6	437.0
5th percentile	4.5	6.8	12.8	11.2	11.6	9.6	24.4	26.4	19.1	18.6	28.5	23.6	473.7
10th percentile	8.4	10.2	14.8	11.4	20.8	19.6	26.8	32.0	22.5	19.3	35.8	23.8	508.9
Median	35.7	30.6	30.0	44.8	46.7	43.8	51.8	62.4	53.7	50.4	56.6	48.8	590.1
90th percentile	85.7	105.0	79.2	82.8	69.5	84.6	78.0	86.8	79.4	91.3	92.2	86.4	753.3
95th percentile	92.6	105.4	101.4	103.6	76.2	110.8	88.6	97.0	88.3	92.1	95.1	96.8	782.2
Highest	95.4	105.8	108.2	116.8	87.2	133.4	105.0	121.4	90.4	94.0	107.4	126.2	794.8

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.

Product code: IDCJAC0001 reference: 78806394 Created on Wed 29 Sep 2021 10:24:13 AM AEST

Mean total evaporation (mm)

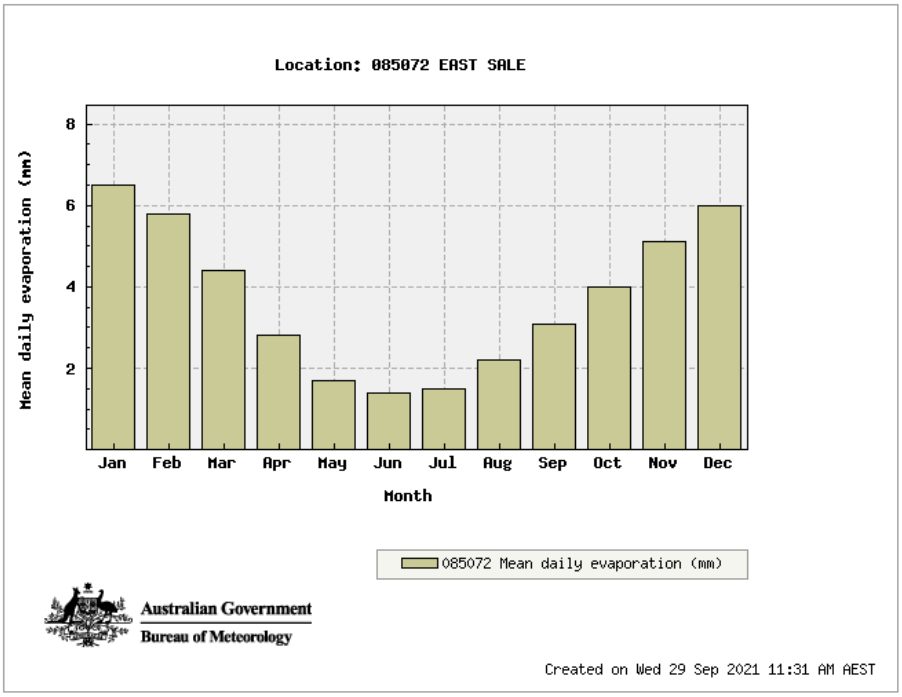
Site details

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 Wastewater System Concept Design
Proposed Irrigation Concept Design

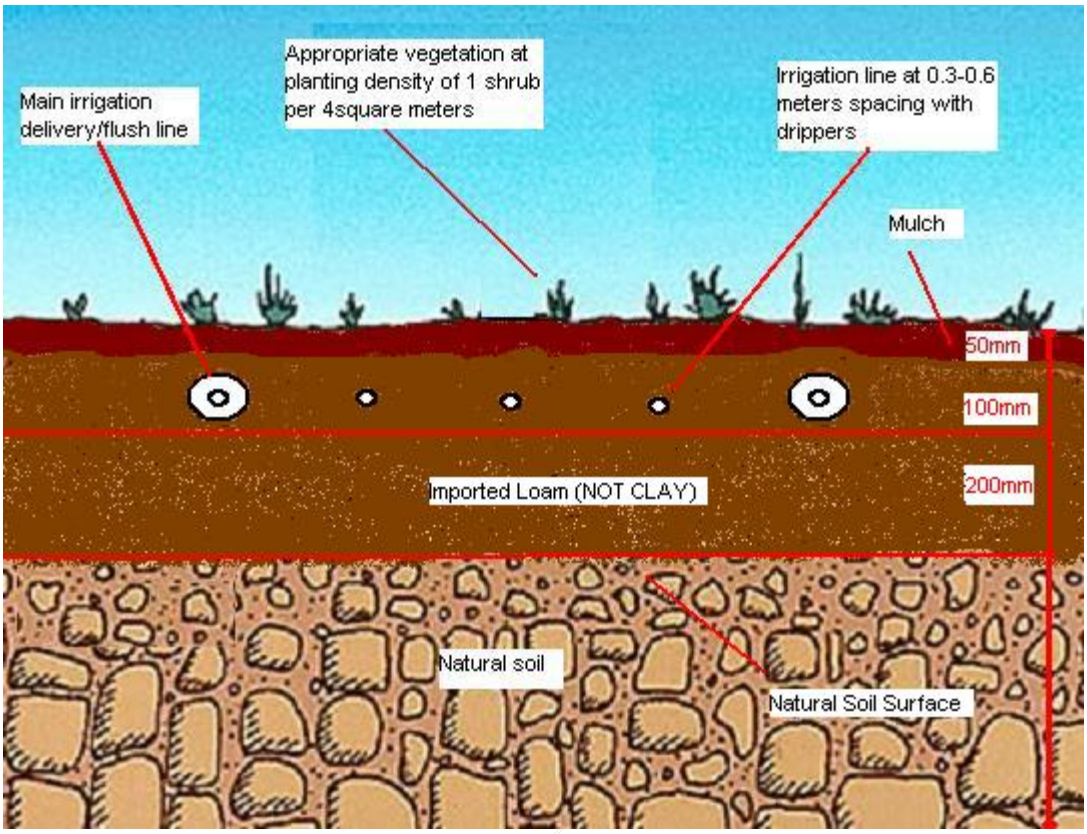


Figure 1 Irrigation cross section showing major delivery/flush lines and irrigation lines.

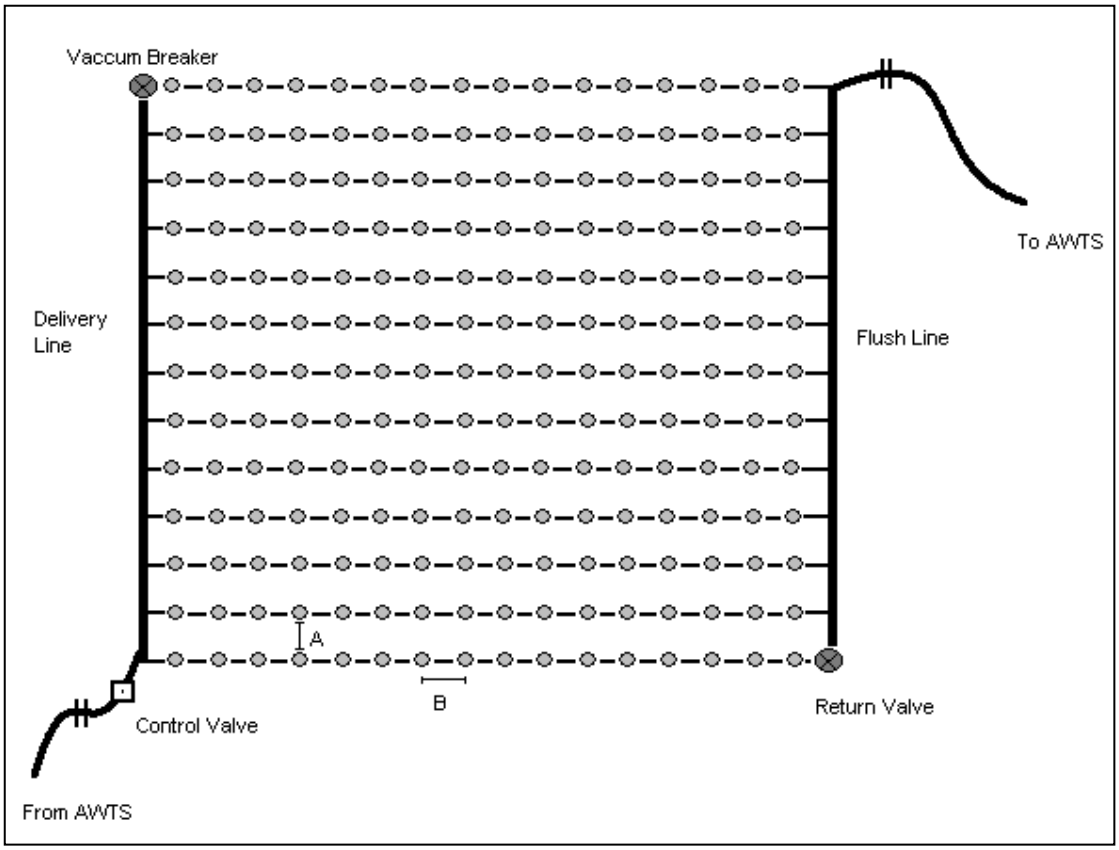


Figure 2 Irrigation Plan View

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 200 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

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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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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.

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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

Contact [redacted]
t 03 6270 0404
[redacted]

[redacted]

Certificate of Currency

Date of Issue 10 May 2021

In our capacity as Insurance Brokers to Sven Nielsen we hereby certify that the under mentioned insurance policy is current.

Policy Type	Professional Indemnity
Insured	Strata Geoscience and Environmental Pty Ltd [redacted]
Insurer	Tasman Underwriting Pty Ltd ABN: 76 006 090 464 | Lloyds Underwriters
Policy Number	TU/PI/20190269
Period of Insurance	26/05/2021 – 26/05/2022
Interest Insured	Legal Liability of Acts, Errors or Omissions committed by the Insured, in their Professional Capacity
Limits of Liability	$2,000,000 any one claim and in the aggregate
Jurisdictional Limit	Australia and New Zealand Only

Further Information
Should you have any queries, please contact us. Our details are set out in the top right side of this document.
This certificate is a summary of cover only. Please refer to the Policy Wording and Schedule for its full terms and conditions.

Important notes

- Aon does not guarantee that the insurance outlined in this Certificate will continue to remain in force for the period referred to as the Policy may be cancelled or altered by either party to the contract, at any time, in accordance with the terms of the Policy and the Insurance Contracts act 1984 (Cth).
- Aon accepts no responsibility or liability to advise any party who may be relying on this Certificate of such alteration to or cancellation of the Policy.
- This certificate does not:
  - represent an insurance contract or confer rights to the recipient; or
  - amend, extend or alter the Policy.

Office use only: AONMCAN2251 A316779/016

Aon Risk Services Australia Limited GPO Box 182, Hobart TAS 7001
ABN 17 000 434 720 AFSL 241141

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.

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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 septic trench, bed or mound design 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.

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