Land Capability Assessment

Dwelling

PC370661
1887 Thowgla Road
THOWGLA VALLEY
Report Limitations: The findings contained in this LCA result from methodologies used in accordance with normal practices and standards. The soil analysis is based on visual-tactile logging of the soil exposed at the test sites. To our knowledge, they represent a reasonable interpretation of the general condition of the site.

Under no circumstances however, can it be considered that these findings represent the actual state of the site at all points. In particular the testing may not locate any unnatural features (eg wells, mine subsidence, filled areas etc), effects of land use (eg contaminated land, waste disposal), or other features of the area (eg landslip, springs etc).

The information contained in this document has been produced by EDM Group solely for the use of the person or organisation for which it has been prepared. EDM Group undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.
CONTENTS

1. INTRODUCTION ........................................................................................................... 1
2. METHODOLOGY ........................................................................................................ 1
3. SITE ANALYSIS ......................................................................................................... 2
4. SOIL ANALYSIS ...................................................................................................... 5
5. LAND CAPABILITY ASSESSMENT ......................................................................... 6
   5.1 Site Assessment Results ...................................................................................... 8
   5.2 Buffer Distances ................................................................................................ 8
   5.3 Water Reduction Fixtures .................................................................................. 8
   5.4 Design Load / Irrigation Rates .......................................................................... 9
6. WASTEWATER MANAGEMENT OPTIONS .............................................................. 10
   6.1 Treatment and Land Application System Options .............................................. 10
   6.2 Septic Tank with Absorption Trenches or Beds ................................................ 10
   6.3 Secondary Treatment Options ......................................................................... 12
   6.4 Secondary Treatment with ETA Trenches or Beds ............................................ 14
   6.5 Secondary Treatment System & Sub-surface Irrigation ...................................... 15
   6.6 Alternative Wastewater Treatment Systems ...................................................... 17
7. CONCLUDING COMMENTS & RECOMMENDATIONS ............................................ 17
   7.1 Monitoring, Operation & Maintenance .............................................................. 18
8. REFERENCES ............................................................................................................. 19

APPENDIX 1: LAA Site Plan
APPENDIX 2: Weather & Climate Zone Information
APPENDIX 3: Indicative Water Balance (Trenches)
APPENDIX 4: Indicative Water Balance (Irrigation)
APPENDIX 5: Sand Filters
APPENDIX 6: Borehole Logs & Soil Profile
1. INTRODUCTION

This report represents the results of a land capability assessment prepared for land located at 1887 Thowgla Road, Thowgla (Figure 1). The property is an un-sewered allotment situated approximately 14.5km to the south of Corryong.

This report has been prepared to accompany a Building Application for the erection of a 2br dwelling on the subject land.

Victorian EPA publication No. 891.4 “Code of Practice – Onsite Wastewater Management” (the “Code”) requires that for all proposed un-sewered residential development; a comprehensive land assessment should be undertaken prior to the development proceeding. It also states that the overall objectives of the land assessment process include to:

- Assess the capability of the site to sustainably utilise and manage wastewater within allotment boundaries; and
- Formulate a sustainable management plan to ensure that impacts on the environment or public health do not occur or are minimised and will ensure beneficial reuse of treated water, organic matter and nutrients.

The report serves to provide an overview of indicative site and soil characteristics within the subject land to update commentary on the overall suitability of the property for the purpose of on-site wastewater management consistent with the latest EPA Guidelines. It also provides sufficient information to provide guidance on land application system selection.

2. METHODOLOGY

The original field work for the following Land Capability Assessment (LCA) was undertaken on 15 May 2019 and comprised:

- A desk top review of relevant geological, topographical, climate and soil references related to the study area. Sources for this information included published maps, the NE Victoria Land Resource Assessment (Reynald et al 2002), Australian Soil Classification (Isbell 2008) and information from the Bureau of Meteorology;
- A walk over assessment of the topographical and geological setting of the area. Factors assessed include rock outcrop, landforms, watercourses and drainage, soil surface patterns and slope configuration;
- The drilling, logging and sampling of investigation boreholes across the proposed location for a Land Application Area (LAA) to establish soil profile and groundwater conditions. A hand auger was used to drill the boreholes; and
- Data analysis and reporting.

The LCA and consequential site ratings were completed in general accordance with the guidelines outlined in the current Code. Analysis and review have also been carried out so as to be consistent with the Code as well as Standard AS/NZS 1547:2012 “On-site Domestic Wastewater Management”. The soil and site assessments and dimensions for the effluent disposal systems were calculated using this Standard.

This report has also been prepared having regard to Victorian Land Capability Assessment Framework (MAV, DEPI & EPA 2014 – 2nd Edition).
3. SITE ANALYSIS

The proposed building site is located approximately 2.5 to the south east of the intersection of Thowgla Road and Nariel Gap Road. The investigation area is situated on a lower section of the property on the eastern side of Thowgla Road. This site is above the floodplain area of Thowgla Creek on the western side of the road.

That property is situated within the Rural Living Zone which allows for a dwelling on the subject land being a parcel over 8 ha in area. A Planning Permit is triggered in this instance because the land is also affected Overlay provisions of the Towong Planning Scheme. In respect of the use of the land for a dwelling the Planning Scheme provides that in the absence of reticulated sewerage, that all wastewater from a dwelling must be treated and retained within the lot in accordance with SEPP - Waters of Victoria under the Environment Protection Act. As a consequence, this LCA seeks to address this requirement.

Following Tables 1 and 2 provide a summary of relevant site features and characteristics.

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td>Warren Gordon</td>
</tr>
<tr>
<td>Proposal</td>
<td>Dwelling house (3 BR equivalent)</td>
</tr>
<tr>
<td>Site Address</td>
<td>1887 Thowgla Road, Thowgla Valley</td>
</tr>
<tr>
<td>Property Description</td>
<td>PC370661</td>
</tr>
<tr>
<td>LGA</td>
<td>Towong Shire Council (Prop No. 159700)</td>
</tr>
<tr>
<td>Zone</td>
<td>Rural Living Zone [RLZ1]</td>
</tr>
<tr>
<td>Overlays</td>
<td>Restructure Overlay (RO11); Design &amp; Development Overlay (DD01) and Bushfire Management Overlay (BMO)</td>
</tr>
<tr>
<td>Allotment Size</td>
<td>8.03ha</td>
</tr>
<tr>
<td>Domestic Water Supply</td>
<td>Rainwater tank supply available.</td>
</tr>
<tr>
<td>Anticipated Waste Load</td>
<td>Assumed 2 bedroom dwelling with water-reduction fixtures &amp; fittings and relying on limited water supply criteria. The inferred design wastewater load is consequently 150L/person/day. Total design load = Occupancy (2+1) x 150 litres = 450 L/day. [source: Section 3.4.1 EPA Pub 891.3 (“the Code”)]</td>
</tr>
<tr>
<td>Availability of Sewer</td>
<td>Not Available. Outside of sewer district.</td>
</tr>
<tr>
<td>Climate Zone</td>
<td>66 - [note Thowgla Valley Postcode 3707 is linked to the Ballarat climate zone] (Source NatHERS – Appendix 2)</td>
</tr>
<tr>
<td>General soil description</td>
<td>Black Dermosol</td>
</tr>
<tr>
<td>Catchment</td>
<td>The subject land is located within a proclaimed water supply catchment (Lake Hume – Northern Section Catchment) and is also affected RO11 provisions. A LCA is required by the Code &amp; Towong Planning Scheme.</td>
</tr>
</tbody>
</table>

*Table 1: Site Description*
Figure 1: Site Context

[NOTE: Due to a shift with the Aerial / Cadastre layers the dwelling site is actually further to the south as indicated.]
Photo 1: Looking south westerly down to proposed development site in foreground.

Photo 2: Looking southerly across proposed LAA.

Photo 3: Looking northerly across proposed LAA.
4. SOIL ANALYSIS

The site’s soils have been assessed for their suitability for onsite wastewater management by a combination of soil survey and desktop review of published soil survey information as outlined below.

While field measurements using constant head testing, if performed properly, can give a more precise determination of saturated hydraulic conductivity or Ksat at a test site such tests can be very time consuming. They also have limitations that need to be considered when sizing and designing an effluent field layout. For instance, soil horizon topography can vary considerably over a given site, which is one reason Ksat test results can vary widely.

The cost-effectiveness of obtaining soil hydraulic properties can be significantly improved by using indirect methods such as inferring permeability from textural and structural classification as described by AS-NZS 1547-2012. Such an approach is supported within the Code and has been adopted within this report, allowing for the prediction of hydraulic properties from more easily measured procedures. By their very nature also, inferred results are inherently conservative and as a consequence they build in a level of confidence that system failure will be more unlikely.

Assessment boreholes were drilled in an area considered suitable for effluent treatment and disposal (Appendix 6). This was considered sufficient to characterise the soils of the immediate landscape to allow for an assessment of the proposal.

<table>
<thead>
<tr>
<th>SOIL FEATURES</th>
<th>TYPICAL BOREHOLE RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Landform Unit</td>
<td>Alluvial plain (type 3) - narrow upper river valleys (ALP6)</td>
</tr>
<tr>
<td>Landform Pattern</td>
<td>Alluvial plains</td>
</tr>
<tr>
<td>Landform Element</td>
<td>Alluvial plain and flats</td>
</tr>
<tr>
<td>Land Surface Shape</td>
<td>Gentle slope - Predominantly linear planer</td>
</tr>
<tr>
<td>Geology</td>
<td>Quaternary alluvium</td>
</tr>
<tr>
<td>Estimate Clay Content</td>
<td>10 - 20% (60 – 200cm) [Source <a href="http://nationalmap.gov.au">http://nationalmap.gov.au</a>]</td>
</tr>
<tr>
<td>Erosion Potential</td>
<td>As inferred from Renyald et al (2002) the expected erosion potential for this particular landform element is moderate for sheet &amp; rill and low for gully, wind and landslip erosion.</td>
</tr>
<tr>
<td>Soil Description</td>
<td>A Horizon: Very dark brown fine sandy loam with a moderate to strong fine blocky structure. Firm consistence when moist. Some river pebbles evident. Transition to B Horizon of a dark brown light sandy clay loam. Moderate blocky structure; firm consistence when moist.</td>
</tr>
<tr>
<td>Soil Depth</td>
<td>A Horizon 0 – 20cm,</td>
</tr>
<tr>
<td></td>
<td>B Horizon 20-90+cm</td>
</tr>
<tr>
<td></td>
<td>Soil depth greater than 1.0 metres</td>
</tr>
<tr>
<td>Depth to Watertable</td>
<td>Groundwater not encountered.</td>
</tr>
</tbody>
</table>
SOIL FEATURES | TYPICAL BOREHOLE RESULTS
--- | ---
Coarse Fragments (%) | <5% Some river pebbles evident across both horizons.
Inferred Soil Characteristics | As inferred from Renyald et al (2002) the B horizon soils demonstrate non-sodic, strongly acidic and very low salinity (EC) characteristics.
Subsoil Texture B Horizon | Boreholes yielded Dark brown light clay loam soils
Subsoil Structure B Horizon | Moderately structured
Soil Category | 4A
Indicative Drainage Class | Well to moderately well drained

Table 2: Soils at Land Application Area

Table Notes:
1. Adapted from Australian Standard AS/NZS 1547:2012
2: For the purposes of this LCA assessment permeability will be inferred with reference to Appendix A of the Code which describes conservative Design Loading Rates (DLR’s) for various effluent application systems according to soil type.
3: Indicative drainage classes listed are based on the assumption that drainage of water out of the soil is governed only by the indicative permeability and that external factors play no role.

5. LAND CAPABILITY ASSESSMENT

The following table has been derived for the whole site, but relying on the soil key features in the vicinity of the building envelope as outlined in Table 2.

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>DESCRIPTION</th>
<th>LEVEL OF CONSTRAINT</th>
<th>MITIGATION MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer Distances</td>
<td>All relevant buffer distances in Table 5 of the Code (2013) are achievable from the proposed effluent management area</td>
<td>Nil (Note Section 5.2 below)</td>
<td>Suitably placed Land Application Area (LAA).</td>
</tr>
<tr>
<td>Average rainfall (mm/yr)</td>
<td>Mean annual rainfall 809 mm (Source BOM Corryong Airport - BOM Site No.82169) Appendix 3</td>
<td>Minor (Rainfall between 750-1000mm)</td>
<td>Suitably sized LAA.</td>
</tr>
<tr>
<td>Pan Evaporation (mm/yr)</td>
<td>Mean daily evaporation – 1487 mm Corryong Airport - BOM Site No.82169) Appendix 3</td>
<td>Minor (evap. between 1250-1500 mm)</td>
<td>Suitably sized LAA.</td>
</tr>
<tr>
<td>Drainage</td>
<td>No visible signs of surface dampness, spring activity or hydrophilic vegetation in the proposed effluent LAA.</td>
<td>Minor – Moderately well drained soil type</td>
<td>Suitably sized LAA.</td>
</tr>
<tr>
<td>FEATURE</td>
<td>DESCRIPTION</td>
<td>LEVEL OF CONSTRAINT</td>
<td>MITIGATION MEASURES ²</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Erosion</td>
<td>No evidence of any erosion in close proximity of LAA.</td>
<td>Minor given rating for sheet &amp; rill erosion.</td>
<td>Suitably designed LAA</td>
</tr>
<tr>
<td>Exposure &amp; Aspect</td>
<td>Northerly aspect with high sun and wind exposure.</td>
<td>Nil</td>
<td>Not Needed (NN)</td>
</tr>
<tr>
<td>Flooding</td>
<td>The proposed effluent management area is located above the 1:100 year flood level.</td>
<td>Nil</td>
<td>NN</td>
</tr>
<tr>
<td>Groundwater</td>
<td>No evidence of shallow groundwater tables.</td>
<td>Nil</td>
<td>NN</td>
</tr>
<tr>
<td>Imported Fill</td>
<td>No imported fill material observed.</td>
<td>Nil</td>
<td>NN</td>
</tr>
<tr>
<td>Lot size</td>
<td>Greater than 1ha.</td>
<td>Nil</td>
<td>NN</td>
</tr>
<tr>
<td>Landform</td>
<td>Linear planar</td>
<td>Minor</td>
<td>NN</td>
</tr>
<tr>
<td>Run-on &amp; Runoff</td>
<td>Negligible stormwater run-on / run-off hazard</td>
<td>Nil</td>
<td>NN</td>
</tr>
<tr>
<td>Rock Outcrops</td>
<td>No evidence of surface rocks or outcrops observed in the area of the LAA.</td>
<td>Nil</td>
<td>NN</td>
</tr>
<tr>
<td>Slope</td>
<td>Indicative slope approx. approximately 2% from east to west.</td>
<td>Moderate</td>
<td>NN</td>
</tr>
<tr>
<td>Surface Waters</td>
<td>In excess of 60m from surface water.</td>
<td>Nil</td>
<td>NN</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Pasture grass cover across site.</td>
<td>Nil</td>
<td>NN</td>
</tr>
<tr>
<td>Land Available for LAA</td>
<td>Considering relevant site constraints and buffers distance requirements it is concluded that the site has ample suitable land for land application of treated effluent.</td>
<td>Moderate [NOTE: The overall site rating is allocated for the site rating/s assigned to the least favourable variables.]</td>
<td>There is sufficient site area available for primary treatment. (Appendix 1)</td>
</tr>
</tbody>
</table>

Table 3: Land Capability Assessment
5.1 Site Assessment Results

As indicated in Table 3 above, the chief constraints for the proposed LAA within the subject land relate to slope and soil characteristics. The land surface shape is predominantly linear planar which can be categorised as providing natural drainage with no spreading of acceleration across the site. Appendix K of AS/NZS 1547:2012 makes recommendations for such situations and identifies a range of treatment options that could be accommodated at the site.

It needs to be noted that Appendix K of AS/NZS 1547:2012 also provides guidance on system selection. It summarizes common site and soil constraints and provides guidance on land application systems that are best suited to the prevailing conditions.

5.2 Buffer Distances

Buffer distances from land application areas are required to prevent human contact, maintain public amenity and protect sensitive environments. This Land Capability Assessment has been prepared having regard to the prescribed buffers in Table 5 of the Code.

In this instance it is to be noted firstly that the subject land is situated on slightly elevated land to the east of Thowglia Creek. The default setback distance to a waterway in a Special Water Supply Catchment area, for primary treatment systems, is 100m.

While this default setback to the Creek is achievable it is also to be noted that the Code also provides for setback distances to an intermittent stream (ie drainage line or drainage depression). In such circumstances the 100m buffer may be reduced by up to a maximum of 50% (ie 50m) conditional on the following requirements:

- 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.

There are no other waterways or significant drainage depressions within proximity of the LAA. There is also no evidence of any incised bed, defined banks and/or hydrophilic plant species in the vicinity of the LAA.

Having regard to the above it is concluded that the performance objectives of all prescribed setbacks within the Code are able to be met in respect of the proposed LAA location.

5.3 Water Reduction Fixtures

The Code notes that the principles of efficient resource use should also be applied when considering the options for all onsite wastewater management. This is especially the case for dwellings on smaller lots in unsewered areas which, to contain (recycle) all wastewater onsite, must minimise the amount of wastewater generated.

To achieve such an outcome reliance on High ‘Water Efficiency Labelling Scheme’ (WELS) -rated water efficient fittings (minimum ‘3 Stars’ for appliances and minimum ‘4 Stars’ for all fittings and fixtures) is recommended including:

- water-efficient clothes washing machines (front or top loading)
- dual-flush (6.5/3.5L or less) toilets
- water-efficient shower roses
- water-efficient dishwashers
- aerated taps
- hot and cold water mixer taps (especially for the shower)
- flow restrictors
- hot water system fitted with a ‘cold water diverter’ which recirculates the initial flow of cold water until it is hot enough for a shower.

In this regard if the proposed development (ie 4 bedroom equivalent dwelling) was constructed with reliance of approved water reduction fixtures & fittings the inferred design wastewater load is consequently 150L/person/day which equates to a daily wastewater volume of 750L/day (ie no. bedrooms + 1).

5.4 Design Load / Irrigation Rates

Having regard to the above analysis and in particular the required buffers as well as the Soil Category of 5a as adapted from Australian Standard AS/NZS 1547:2012 the following table outlines the recommended design loads / irrigation rates (DLR/DIR) for Land Application Systems.

<table>
<thead>
<tr>
<th>Land Application Option</th>
<th>DLR / DIR (mm/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Treatment (Trenches / Beds)</td>
<td>10</td>
</tr>
<tr>
<td>Secondary Treatment (ETA Trenches / Beds)</td>
<td>12</td>
</tr>
<tr>
<td>Mounds</td>
<td>8</td>
</tr>
<tr>
<td>Sub-surface Irrigation</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Table 4: Land Capability Assessment

Table Notes:

1. In respect of Primary Treatment the Code provides for a 100m default buffer to a waterway within a potable water supply. Refer to Section 5.2 above.

2: Secondary-treated effluent has a quality equal to or better than 20 g/m³ BOD5 and 30 g/m³ SS and typically is the effluent discharged from processes such as AWTS, sand filters, or wetlands.

3. Evapo-Transpiration Absorption System (ETA). Suitable for areas with low permeability soils. Such systems require planting out with plants that have high uptake of water via transpiration.

4. Soil improvement should also be considered such as rotary hoeing and adding gypsum to the dedicated wastewater disposal area, with backfilling comprising good quality topsoil. Gypsum application rates will vary according to nutrients already present in the soil and a soil test to check for all nutrient requirements is highly recommended. However rates of between 2.5 t/ha - 5t/ha are often recommended for a soil conditioning effect on clay soils.

5: Subject to specialist soil advice (including soil permeability – constant head testing) and special design techniques

6: Pressure compensated drip irrigation systems need to be installed in an adequate depth of topsoil (in the order of 150 – 250 mm of in situ or imported good quality topsoil) to slow the soakage and assist with nutrient reduction.
6. WASTEWATER MANAGEMENT OPTIONS

This Land Capability Assessment has been prepared to accompany a Planning Application for a 2br dwelling on the subject land. It is intended that this LCA will provide indicative advice as to the most appropriate treatment and land application systems given the site and soil characteristics of the study site as well as relevant setback requirements.

Whilst a detailed design of a system for future development is beyond the scope of this study, the following discussion provides an overview of suitable systems, with typical sizing and design considerations, and their justification for selection. A range of site features were assessed in terms of the degree of limitation they present across the study area.

Detailed design for the system should be undertaken at the time of the subsequent Building application and submitted to Council for approval.

The EPA website provides a catalogue of approved systems that are available for use in Victoria: http://www.epa.vic.gov.au/en/your-environment/water/onsite-wastewater. The property owner has the responsibility for the final selection of the treatment system and will need to include the details of the chosen system in the Septic Tank Permit to Install application form for Council approval.

6.1 Treatment and Land Application System Options

Based on the most constraining site features, the overall land capability of the site to sustainably manage all effluent onsite is considered to be satisfactory. The following sections provide an overview of suitable onsite wastewater management options, with sizing and design considerations and justification for selection.

6.2 Septic Tank with Absorption Trenches or Beds

Given the availability of land which would be able to observe a 100m buffer distance from surface waters one option to consider on would be primary treatment with connection to conventional absorption trenches.

Conventional trenches provide the traditional means for the land application treatment of effluent from waste water treatment units. The major advantage of a trench system is that it has more sidewall space than a bed design, making it less subject to premature failure. Sidewall space is critical because effluent moves through it more effectively than through the bottom of an absorption area.

Although the trench system takes up more land than a bed design, the trenches do not have to be parallel. They can be sent in any direction, providing flexibility in design. Of relevance to the subject land it is to be noted that the flexibility makes it easier to construct the trenches in an odd-shaped lot or when obstacles limit the area.

Guidelines for the design of trench systems are outlined in Appendix L of AS/NZS 1547:2012. As noted within the Standard a reasonably accurate method for determining dimensions for the absorption fields is to use the following formula:

\[ L = \frac{Q}{DLR \times W} \]

Where:
- \( L \) = Length in metres
- \( Q \) = Design daily flow in L/day
- \( DLR \) = Design Loading Rate in mm/day
- \( W \) = Width in metres

6.2.1 Absorption Trenches

Employing Appendix A of the Code for a Category 4a soil rating, the DLR has been set at 10mm/day (conservative rate). If the daily flow (Q) is set at 450L/day and a
maximum trench width of 600mm is assumed, when inserted into the above equation, these parameters would yield an absorption system length of 75m.

With regard to a conventional system including trench lengths limited to 30m, a 1 metre buffer being retained between trenches and a 1 metre buffer around the outside of the disposal field, a system could be arranged with 3 x 25m trenches. Such a field would consequently need to be 5.8 metres wide and 27 metres long. This would yield a disposal area of 156.6m² (say 160m²).

Also having regard to the soil characteristics, the LAA could also be improved by rotary hoeing and adding gypsum to the dedicated wastewater disposal area, with backfilling comprising good quality topsoil.

6.2.2 Absorption Beds

If on the other hand the absorption field was to rely on a bed design with a maximum width of 4m when inserted into the above equation, these parameters would yield an absorption system with a total length of 11.25 (say 12m).

Relying on a 1 metre buffer around the outside of the disposal field, a system could be arranged with 1 bed with such a field consequently needing to be 6 metres wide and 14 metres long. This would yield a disposal area of 84m².

6.2.3 Water Balance Assessment

The basic function of the trench system is to return all the water from the on-site system to the hydrologic cycle through absorption. This objective requires that the daily volume of effluent from the septic tank and the rainwater infiltrating the surface of the trench (rainfall minus interception and runoff) must always be less than the actual loss of water from the trench.

An alternative approach to calculate field size therefore is to undertake a water balance assessment which takes into account rainfall and evaporation levels relevant to the district (Figure 3).

![Figure 2: Rainfall & evaporation data](image-url)

The water balance provides not only the design surface area of the trench but also the constructed depth. By manipulating the proposed width of the trench, the depth of stored effluent will either increase or decrease. For instance, a trench with maximum width of 600mm and a depth of 450 mm, the depth of stored water should not infringe within 100 mm of the surface so that at no time may the saturation be detrimental to the roots of the plants.
The closest weather station for which long term evaporation data is available is the Corryong Airport (Site number: 82169). Relying upon this data an indicative water balance has been prepared to give an indication of the required trench length.

**In this particular case, as can be demonstrated at Appendix 3 and based on the data at Figure 2, the resultant trench length for a DLR set at 10mm/day and daily flow (Q) set at 450L/day would be significantly less at 37m (say 40m) with corresponding smaller area required for disposal relying on absorption trenches (ie 92.4m² – say 95m²).**

This assessment readily supports a conclusion that the above analysis for either conventional Trenches would be at the very least conservative and that a land application system employing such an option could be readily accommodated within a field area of up to 160m² as indicated at Appendix 1.

### 6.3 Secondary Treatment Options

While there is more than ample land to accommodate a primary treatment system on the subject land, consideration could also be given to incorporating secondary treatment into the system design so as to achieve higher effluent quality, while also reducing the area required for effluent treatment.

The following sections provide an overview of suitable onsite wastewater management options, with sizing and design considerations and justification for selection.

The Code provides that management options for secondary treatment can include consideration of the following:

- AWTS (Aerated Wastewater Treatment Systems)
- Biological Filters (wet composting, vermiculture)
- Membrane Filtration
- Ozonation
- Reedbeds
- Sand Filters
- Textile Filters
- Trickling Aerobic Filters: (foam, plastic, mixture of media)

Treated effluent then must be applied to land using one of the following methods and detailed at Appendix E of AS/NZS 1547:2012:

- Absorption Trenches/Beds
- Evapo-Transpiration
- Absorption (ETA) beds
- Low Pressure Effluent Distribution (LPED)
- Mounds
- Wick Trench & Beds

Having regard to the above the following discussion is provided for consideration.

#### 6.3.1 Septic Tank & Sand Filter

The Code allows for connection of a septic tank to a sand filter system (eg ETA trench or bed system) as a relatively “low-tech” option.

Sand is a highly effective, naturally absorptive material that can treat effluent to a very high standard. Sand filters feature a contained bed of sand (either underground or above ground depending on site conditions) protected by an impervious layer around the filter which receives the effluent from the septic tank.
The action in the sand filter is not a straining process as the word ‘filter’ may suggest. Instead after wastewater has initially undergone primary treatment in the Septic Tank through the “separation” of solids & water by anaerobic bacterial action, the wastewater then undergoes secondary treatment by gravitating through the sand filter bed, where it makes intimate contact with the microbiological film which naturally develops on the surfaces of the sand grains. This microbiological action digests the organic content of the wastewater prior to passing onto an approved land application system (eg see Figure 3).

![Sand Filter cross section](image)

Note: If gravity fed trenches cannot be achieved a discharge pump needs to be installed in final chamber.

Figure 3: Typical Sand Filter cross – section (Source [www.septicsystemsaustralia.com.au](http://www.septicsystemsaustralia.com.au))

Care must be taken however in the selection of the filter sand, as fine sand tends to clog quickly and very coarse sand will not achieve satisfactory oxidation of the effluent. Providing the system has been correctly installed and is not grossly mis-used by blatant neglect etc. the process is bio-sustainable and ‘clogging’ becomes an unlikely occurrence. Such systems also provide a practical solution in catchments where space, or the drainage grade, limits the use of a bio-retention system.

Interim standards for sand filtration systems are outlined at Appendix G of Code. Some further information regarding sand filters is also provided at Appendix 5 of this report.

### 6.3.2 Aerated Wastewater Treatment System

Another option to consider is installation of an Aerated Wastewater Treatment System (AWTS). Such systems provide both primary and secondary treatment of domestic wastewater. They operate in a similar manner to a septic tank but also use aerobic treatment to promote oxidation and microbiological consumption of organic matter by bacteria through facilitated biological processes.

All AWTS systems installed in Victoria must be accredited by EPA Victoria. When selecting a system, the landowner should ensure that the particular system is suitable for the proposed use. All systems have features that can be beneficial or problematic if installed on certain sites. Things to consider when selecting a system include:

- the daily wastewater load – AWTS can have various capabilities to accommodate different sized daily wastewater loads. The system chosen must consider these daily wastewater loads and not overload the system;
• the system location – issues include distance from the house, gravity drainage, and proximity to other structures; and

• proximity to the effluent management area – this influences the pump size and where to run irrigation mains.

6.4 Secondary Treatment with ETA Trenches or Beds

The Australian Standard makes provision for connection of a Secondary Treatment system to Evapo-transpiration absorption (ETA) trench or bed systems. These systems provide a viable alternative to conventional absorption trenches and beds as they are designed to reduce the reliance on soil absorption only.

ETA land application systems operate in a similar manner to absorption trenches or beds, with effluent evaporating from the trench / bed and being absorbed through the soil. In addition, the trenches / beds are also planted over with vegetation so that the process of transpiration can further assist in the treatment of the effluent through the root zone of plants.

Evapo-transpiration can also provide an additional factor of safety for the operation of soil absorption systems, helping soils to dry and promoting the aeration and biological treatment of effluent and can be a significant output component.

As previously noted at 6.2 above, a reasonably accurate method for determining dimensions for the absorption fields is to use the formula set out in Appendix L of AS/NZS 1547:2012 as follows:

\[ L = \frac{Q}{DLR \times W} \]

Where:  
- \( L \) = Length in metres  
- \( Q \) = Design daily flow in L/day  
- \( DLR \) = Design Loading Rate in mm/day  
- \( W \) = Width in metres

6.4.1 ETA Trenches

Employing Appendix A of the Code for a Category 4a soil rating, the DLR could instead be set at 12 mm/day (maximum rate). If the daily flow (\( Q \)) is set at 450L/day and a maximum trench width of 600mm is assumed, when inserted into the above equation, these parameters would yield an absorption system length of 62.5m (say 63m).

With regard to a conventional system including trench lengths limited to 30m, a 1m spacing being retained between trenches and a 1m buffer around the outside of the disposal field, a system could be arranged with 3 x 21m trenches. Such a field would consequently need to be 4.8m wide and 23m long. This would yield a disposal area of 110.4m\(^2\) (say 115m\(^2\)).

6.4.2 ETA Beds

If on the other hand the absorption field was to rely on an ETA bed design with a maximum width of 4m when inserted into the above equation, these parameters would yield an absorption system with a total length of 9.37m (say 10m).

Relying on a 1 metre buffer around the outside of the disposal field, a system could be arranged with 1 bed with such a field consequently needing to be 6 metres wide and 12 metres long. This would yield a disposal area of 72m\(^2\).
6.4.3 Water Balance Assessment

As noted previously at Section 6.2.3 an alternative approach to calculate field size is to undertake a water balance assessment which takes into account rainfall and evaporation levels relevant to the district (Figure 2).

In this particular case, as can be demonstrated at Appendix 3 and based on the data at Figure 3, the resultant trench length for a DLR set at 12mm/day and daily flow (Q) set at 450L/day would be significantly less at 30m with corresponding smaller area required for disposal relying on ETA trenches (ie 71.4m² – say 75m²).

This assessment readily supports a conclusion that the above analysis for secondary treated effluent disposed of to either ETA Trenches or Beds would be at the very least conservative and that a land application system employing such an option could be readily accommodated within a field area of significantly less than 160m².

6.5 Secondary Treatment System & Sub-surface Irrigation

The Code makes provision for consideration to be given to disposal of secondary treatment by way of pressure-compensating sub-surface irrigation installed along the contour, which evenly distributes effluent throughout the irrigation area. Using dripline with uniformly spaced drippers/ emitters makes it possible to apply and disperse treated wastewater evenly over the entire dispersal area, causing even absorption and distribution. If required more controlled pressure can be applied when the field is divided into two or more zones and these smaller areas can then be intermittently dosed using a sequencing valve.

The advantages of such systems are that they allow:
- irrigation within irregular shaped areas.
- irrigation in areas that are not practical for trench or bed systems.
- installation of lines that do not need to be level.
- widespread distribution over the infiltration area maximising land treatment potential.
- improved control of effluent irrigation; and
- beneficial reuse of effluent for sub-irrigation of gardens.

There are also enhanced environmental benefits by placing the effluent in the root zone of plants, maximising the beneficial reuse of both the hydraulic and nutrient components of the effluent. In addition, maintenance obligations can be reduced when a subsurface irrigation system is installed and unlike a trench or bed system there is also no requirement for identification of a reserve field.

To determine the necessary size of the irrigation area it can be inferred from AS/NZS 1547:2012 that dispersal area can be calculated by applying the following formula:

\[ A = \frac{Q}{DIR} \]

Where:
- \( A \) = Irrigation area \( m^2 \)
- \( Q \) = Design daily flow \( L/day \)
- \( DIR \) = Design Irrigation Rate \( mm/day \)

In this instance \( Q \) is set at 450L/day, while the Code indicates the appropriate Design Irrigation Rate (DIR) in clay loam soils is set at a maximum of 3.5mm/day for drip irrigation. **This would yield a disposal area of 128.57m² (say 130m²)**
6.5.1 Water & Nutrient Balance Assessment

However, before installing such a system it would be recommended that a water and nutrient balance be undertaken to analyse climate and wastewater production to design an appropriately sized the irrigation system as well as to ascertain whether wet weather storage (constructed or in-soil) is also required. To have an effective effluent irrigation system, it is essential that the correct amount of effluent is applied at the right times to meet the crop requirements while ensuring increases in runoff and percolation are minimised.

Generally a water balance can be described as follows:

\[ P + \text{Effluent} = \text{Et} + \text{RO} + \text{DI} \]

Where \( P \) = Precipitation (rainfall)
\( \text{Et} \) = Evapotranspiration
\( \text{RO} \) = Runoff
\( \text{DI} \) = Deep infiltration (deep seepage)

A water balance seeks to find the minimum disposal area for a given effluent discharge rate (450 L/day in this instance). To obtain the minimum irrigation area, the maximum irrigation rate (MIR) needs to be calculated. In simple terms the MIR is the maximum amount of effluent in mm/month that can be discharged into the soil so that there is no surface run off or excess soil water logging.

Relying on the Code recommendation for indicative permeability in Category 4 soils (0.5 – 1.5 ksat) as well as available rainfall and precipitation data (Appendix 2) an indicative water balance has been prepared to give an estimate of the required irrigation area (Appendix 4). This analysis has relied upon an adjusted 9th decile rainfall to build in a level of conservatism to the results. The water balance also builds into the model an estimated peak seepage with the value set at less than 10% of the mid-range EPA Code indicative permeability.

In this particular case, it can be demonstrated that, for a DIR set at <3.5mm/day and daily flow set at 450L/day that the resultant irrigation area would be in the order of 152m².

As well as water balance modelling a preliminary nutrient balance has also been considered to check that the irrigation area is of sufficient size to ensure nutrients are assimilated by the soils and vegetation. As noted at Appendix 4 conservative Nutrient Balance Data Inputs have been relied upon including a value of 30mg/L Total Nitrogen and a Crop nutrient uptake rate of 220 kg/ha/year. It is also acknowledged that there will be a 35% loss of nitrogen that will be retained in the soil through process such as denitrification, volatilization and microbial digestion.

In this particular case, as can be demonstrated at Appendix 4 the resultant irrigation area would also be in the order of 146m² to provide a LAA requiring no nutrient buffer.

For the above analysis the larger of the two modelling approaches would be adopted as a feasible irrigation area. In this instance this water balance modelling indicates that an LAA in the order of 152m² would be more appropriate.

This assessment readily supports a conclusion that the initial calculations above for a pressure compensated subsurface irrigation system treating effluent to the 20/30 standard are at the very least conservative and that a complying system could be readily accommodated on site with laterals of installed along the contours to ensure even distribution.
6.6 Alternative Wastewater Treatment Systems

The Code makes provision for a range of treatment system brands and models systems that must be certified by an accredited conformity assessment body (CAB) as conforming to the relevant AS. This accreditation is given by JAS-ANZ (the Joint Accreditation System of Australia and New Zealand).

Relevant to study area it is noted that there are a number of alternative systems that would significantly reduce the area required on site for effluent disposal. The design of such systems including composting, vermiculture, peat bed and wetland systems is however outside the scope of this particular LCA and it would be recommended that before proceeding with such an alternative that specialist guidelines be consulted for the design and implementation of these systems.

7. CONCLUDING COMMENTS & RECOMMENDATIONS

Based on the outcomes of this assessment and having regard to the current guidelines set out in both the Code as well as AS/NZS1547:2012, a range of treatment options are available relying on different land application methods.

In deciding on a system it is to be noted that there are no significant land constraints that impact upon the location of an LAA with the selected site well clear of any drainage lines on site.

Based on the outcomes of this assessment and having regard to the current guidelines set out in both the Code as well as AS/NZS1547:2012, a range of treatment options are available relying on different land application methods.

Firstly it is noted that there is ample area on site for a septic tank and trench system offering primary treatment options. The slope of the disposal area and available location slightly downslope of the proposed building area lends support for the location of an LAA for primary treatment of up to 160m² as indicated at Appendix 1.

In respect of installation of a traditional trench system a doubling of the size of the application area is considered sufficient to provide necessary additional area for a reserve field in accordance with the EPA Code of Practice.

However to reduce the area required for disposal a viable option to consider would be a system providing for on-site secondary treatment to the 20/30 standard.

That is either a:

- conventional septic tank connected to a sand filter system or;
- an AWTS

with either option connected to:

- an evapo-transpiration / absorption (ETA) trench or bed system or alternatively:
  - a pressure compensated sub-surface irrigation system.

Based on a conservative analysis, such complying ETA trench systems could readily be accommodated within an effluent disposal area of less than 115m² or an irrigated area of 152m² based on construction of a 2 bedroom (3 br equivalent) dwelling with water saving fixtures.

Clearly these options can also be readily accommodated within the conservatively large LAA as indicated at Appendix 1. This also includes sufficient reserve field in accordance with the EPA Code of Practice.
[NOTE:

1) A conservatively larger area of 160m² has been indicated on the plan at Appendix 1 to provide some additional flexibility in siting any selected system including a pressure compensated sub-surface irrigation system.

2) Any design seeking to rely on a smaller LAA through reliance on a water balance assessment as outlined within this LCA should be undertaken in consultation with Council officers.

3) Also having regard to the soil characteristics consideration should also be given to soil improvement within the area of the LAA by rotary hoeing and adding gypsum to the dedicated wastewater disposal area, with backfilling comprising good quality topsoil.]

This notwithstanding it should be noted that any subsequent system design and installation will need to be undertaken by a suitable and competent professional contractor so as to ensure that the eventual selected system will comply with the relevant requirements of the Code and the most recent version of AS/NZS1547.

7.1 Monitoring, Operation & Maintenance

In relation to future treatment systems, the following should be considered:

- Maintenance is to be undertaken in accordance with Council’s permit conditions and supplier specifications.
- Longevity of the LAA is dependent upon the salinity tolerance of the vegetation unless households minimise high salinity and highly sodic chemicals.
- Use household cleaning products sparingly preferably using biodegradable liquid detergents
- Keep as much fat and oil as possible out of the system and regularly clean any grease traps.

With regard to selected land application areas the following are recommended:

- Regularly mow / harvest vegetation within the land application area to maximise evapotranspiration and encourage rainfall runoff.
- Bare spots within the grassed surface must be repaired because the grass transpires more water than a bare earth surface.
- During very dry periods it may be necessary to irrigate the surface with small amounts of clean water to keep the grasses in prime condition.
- Maintain the surrounds of the LAA to ensure good sun and wind exposure.
- Monitor and maintain the system.
- Minimise vehicle access to the land application area and avoid use of heavy equipment to prevent compaction.
- Do not erect structures or pathways in LAA.

The following are also recommended:

- Installation of water saving devices to reduce the effluent load.
- Endeavour to spread washing loads over the week to obtain maximum efficiency.
- Preparing ‘as constructed plans’ indicating the location of treatment systems and land application areas.
• Use of low phosphorus and low sodium (liquid) detergents to improve effluent quality and maintain soil properties.
• The operation and maintenance of the treatment and disposal system in accordance with manufacturer’s recommendations.
• Do not plant the following plants near absorption trenches because of risk of pipe blockage
  • Eucalyptus Camaldulensis - River Red Gum
  • Eucalyptus citriodora - Lemon Scented Gum
  • Fraxinus raywoodii - Claret Ash
  • Eucalyptus cladoxylyx - Sugar Gum
  • Populus nigra - Poplar
  • Salix Babylonica - Weeping Willow
• Finally it should be noted that if an AWTS is selected for the site that good maintenance is essential to ensure a constantly high level of performance. Also if a power failure occurs, water usage should be limited until power returns.

8. REFERENCES

Department of the Prime Minister and Cabinet, Department of Communications, and CSIRO (2018) NationalMap [online] URL http://nationalmap.gov.au

EPA (2003) Land Capability Assessment for Onsite Domestic Wastewater Management (March 2003) EPA Publication 746.1

EPA (2016) Code of Practice – Onsite Wastewater Management (July 2016) EPA Publication 891-4


Standards Australia / Standards New Zealand On-site Domestic Wastewater Management Standard AS/NZS 1547:2012


APPENDIX 1

LAA SITE PLAN
POSSIBLE EFFLUENT DISPOSAL AREAS
1887 THOWGLA ROAD
THOWGLA 3707

DISCLAIMER
Due regard has been given to undertake all aspects of the study in accordance with the requirements of best practice and relevant Standards. LAA calculations have been undertaken with due regard to AS/NZS 1547:2012 and whilst the findings contained in this report represent a reasonable interpretation of site conditions, it does not indicate that these findings represent the actual state of the site at all points. The complex interactions between soil, climate, topography and wastewater inputs mean that there is no one correct answer and the nominated results should be viewed in this context. The paucity of reliable evaporation data is also a constraining factor with regard to these calculations.

GENERAL NOTE:
Effluent disposal envelope to exclude all land from 6 meters upslope and 3 meters downslope of all buildings. Also all land within 3 meters of the potable water supply line to dwellings is to be excluded as well as the vehicular driveways.
Areas, dimensions and lot layout are approximate only and are subject to final survey, council approval and registration of the Plan of Subdivision at the Titles Office.
Features shown on this plan are indicative only and are not the result of survey.

EDM Group
PLANNERS SURVEYORS
& ENGINEERS
OFFICES 99 HUME ST
PO Box 317 WOODGOA 3689
Ph (02) 6057 8570
Fax (02) 6056 2392

Primary treatment area 160m²
(Water Balance = 95m²)
Backup treatment area 160m²

Irrigation area 146m²
Test bore hole location

PLANTING NOTE:
At low permeability rates, effluent within the LAA will mainly spread sideways through the biologically most active and permeable soil layers. Effluent uptake is assisted by evaporation through the root zone of vegetation planted in the top soil. Evapo-transpiration can provide an additional factor of safety for the operation of soil absorption systems, helping soils to dry and promoting the aeration and biological treatment of effluent and can be a significant output component.

Scale 1:1000

0 10 20 30 40 50m

Drawing No. 09006703_LCA_17Mar20

THIS DOCUMENT REMAINS THE PROPERTY OF EDM GROUP AND IS ONLY TO BE USED FOR ITS COMPRSSIONED PURPOSE IN ACCORDANCE WITH THE TERMS OF THAT COMPRESSION. UNAUTHORISED USE OF THIS DOCUMENT IN ANY FORM WHATSOEVER IS PROHIBITED.
APPENDIX 2

WEATHER & CLIMATE ZONE INFORMATION
Ballarat monthly climate data

Note: Thowgla Postcode 3707 is linked to Climate Zone 66 (Ballarat)
APPENDIX 3

INDICATIVE WATER BALANCE ASSESSMENT
(TRENCHES – PRIMARY & SECONDARY TREATMENT)
### TABLE G2 - Depth of stored effluent

<table>
<thead>
<tr>
<th>Month</th>
<th>First trial</th>
<th>Disposal</th>
<th>(3-4)</th>
<th>Increase</th>
<th>Starting</th>
<th>Increase</th>
<th>computed</th>
<th>reset if</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(m²)</td>
<td>(m³/ha)</td>
<td>(m)</td>
<td></td>
<td>(m)</td>
<td>(m)</td>
<td>(m)</td>
<td>(m)</td>
<td>(m)</td>
</tr>
<tr>
<td>Dec</td>
<td>48</td>
<td>291</td>
<td>-201</td>
<td>-503</td>
<td>0</td>
<td>-503</td>
<td>-503</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jan</td>
<td>291</td>
<td>395</td>
<td>-136</td>
<td>-340</td>
<td>0</td>
<td>-340</td>
<td>-340</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Feb</td>
<td>291</td>
<td>388</td>
<td>-97</td>
<td>-243</td>
<td>0</td>
<td>-243</td>
<td>-243</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mar</td>
<td>291</td>
<td>317</td>
<td>-36</td>
<td>-89</td>
<td>0</td>
<td>-89</td>
<td>-89</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Apr</td>
<td>291</td>
<td>244</td>
<td>-4</td>
<td>-9</td>
<td>0</td>
<td>-9</td>
<td>-9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>May</td>
<td>291</td>
<td>274</td>
<td>7</td>
<td>18</td>
<td>0</td>
<td>18</td>
<td>18</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jun</td>
<td>291</td>
<td>289</td>
<td>21</td>
<td>53</td>
<td>18</td>
<td>53</td>
<td>343</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aug</td>
<td>291</td>
<td>381</td>
<td>9</td>
<td>23</td>
<td>18</td>
<td>53</td>
<td>343</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sep</td>
<td>291</td>
<td>302</td>
<td>-21</td>
<td>-53</td>
<td>41</td>
<td>-53</td>
<td>789</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oct</td>
<td>291</td>
<td>381</td>
<td>-92</td>
<td>-290</td>
<td>41</td>
<td>-290</td>
<td>789</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nov</td>
<td>291</td>
<td>393</td>
<td>-112</td>
<td>-279</td>
<td>0</td>
<td>-279</td>
<td>789</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dec</td>
<td>291</td>
<td>416</td>
<td>-155</td>
<td>-388</td>
<td>0</td>
<td>-388</td>
<td>789</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jan</td>
<td>291</td>
<td>401</td>
<td>-201</td>
<td>-503</td>
<td>0</td>
<td>-503</td>
<td>789</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Feb</td>
<td>291</td>
<td>395</td>
<td>-97</td>
<td>-243</td>
<td>0</td>
<td>-243</td>
<td>789</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mar</td>
<td>291</td>
<td>317</td>
<td>-36</td>
<td>-89</td>
<td>0</td>
<td>-89</td>
<td>789</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Apr</td>
<td>291</td>
<td>244</td>
<td>-4</td>
<td>-9</td>
<td>0</td>
<td>-9</td>
<td>789</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>May</td>
<td>291</td>
<td>274</td>
<td>7</td>
<td>18</td>
<td>0</td>
<td>18</td>
<td>789</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

From calculations in tables above for optimised drainfield area, using Appendix G AS1547-1994

**Porosity in disposal area:** 30%

**Runoff Coeff:** 0.25

**Percentage runoff:**

**Variables Table**

| Summer Crop Factor | 0.80 |
| Winter Crop Factor | 0.60 |
| LTAR or DLR | 10 L/m²/day |
| Wastewater Flows | 450 L/day |

**Estimated area of effluent drainfield = 48 square metres**

**Maximum depth of stored effluent = 94 mm depth**

**Trench dimensions (mm) =**

- width = 600 mm
- depth = 450 mm
- Length of trench required = 37 metres

**NOTES:**

As a model, the best results are only ESTIMATES of performance.

A model is used to assess SENSITIVITY to changes in the variables and the effect upon application area.

Table 2 is run for 16 months to ensure system returns to ZERO at some stage.
## Corryong Airport - 82169
### ETA Trench Design (Secondary Treatment)

<table>
<thead>
<tr>
<th>Month</th>
<th>Days</th>
<th>Net Rainfall</th>
<th>Pan Evp</th>
<th>ETa</th>
<th>Rainfall</th>
<th>Retained</th>
<th>LTAR *V</th>
<th>Disposal</th>
<th>Effluent</th>
<th>Size of area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>per</td>
<td>daily pan</td>
<td>Pan Evp</td>
<td>ETa</td>
<td>+C*E0</td>
<td>P</td>
<td>Rainfall</td>
<td>rate/month</td>
<td>applied</td>
<td>per month</td>
</tr>
<tr>
<td></td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
</tbody>
</table>

| Jan  | 31  | 8.4 | 260.4 | 221 | 50 | 53.6 | 372 | 553.7 | 1950 | 25 |
| Feb  | 28  | 7.2 | 201.6 | 171 | 75 | 52.7 | 336 | 454.6 | 1200 | 28 |
| Mar  | 31  | 5.1 | 168.1 | 134 | 73 | 56.5 | 372 | 449.9 | 1950 | 31 |
| Apr  | 30  | 2.9 | 87.0  | 52 | 25 | 35.3 | 360 | 378.9 | 1350 | 36 |
| May  | 31  | 1.5 | 48.5  | 29 | 13 | 43.7 | 372 | 356.3 | 1350 | 39 |
| Jun  | 31  | 1.6 | 33.0  | 20 | 10 | 45.7 | 360 | 334.1 | 1350 | 40 |
| Jul  | 31  | 1.2 | 37.2  | 22 | 9  | 62.9 | 372 | 315.1 | 1350 | 42 |
| Aug  | 31  | 1.7 | 52.7  | 35 | 16 | 60.2 | 372 | 343.5 | 1350 | 41 |
| Sep  | 30  | 2.7 | 81.0  | 49 | 17 | 46.4 | 360 | 362.3 | 1350 | 37 |
| Oct  | 31  | 4.3 | 133.3 | 113 | 37 | 40.5 | 372 | 444.6 | 1350 | 31 |
| Nov  | 30  | 5.8 | 177.0 | 150 | 57 | 57.5 | 360 | 452.9 | 1350 | 30 |
| Dec  | 31  | 7.4 | 220.1 | 187 | 68 | 51.3 | 372 | 507.8 | 1350 | 27 |

**Totals** 1487.9 1180 789.5 592.1

### TABLE G2 - Depth of stored effluent

**First trial - choose from col.9 table above**

<table>
<thead>
<tr>
<th>Month</th>
<th>first trial</th>
<th>application</th>
<th>Disposal</th>
<th>(3)-(4)</th>
<th>Increase</th>
<th>Starting</th>
<th>Increase</th>
<th>computed</th>
<th>reset if</th>
<th>Equivalent</th>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>area</td>
<td>rate</td>
<td>rate</td>
<td>depth</td>
<td>depth</td>
<td>depth</td>
<td>Et deficit</td>
<td>storage</td>
<td>excess</td>
<td>in trench</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(m²)</td>
<td>(m³)/(d)</td>
<td>per month</td>
<td>(mm)</td>
<td>(mm)</td>
<td>(mm)</td>
<td>(mm)</td>
<td>(mm)</td>
<td>(mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td>39.5</td>
<td>353</td>
<td>554</td>
<td>-201</td>
<td>-501</td>
<td>0</td>
<td>-501</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>Feb</td>
<td>319</td>
<td>465</td>
<td>136</td>
<td>-339</td>
<td>-339</td>
<td>0</td>
<td>-339</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>353</td>
<td>450</td>
<td>-37</td>
<td>-242</td>
<td>0</td>
<td>-242</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>342</td>
<td>377</td>
<td>-35</td>
<td>-88</td>
<td>0</td>
<td>-88</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>353</td>
<td>396</td>
<td>-3</td>
<td>-8</td>
<td>0</td>
<td>-8</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>342</td>
<td>334</td>
<td>8</td>
<td>19</td>
<td>0</td>
<td>19</td>
<td>10</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jul</td>
<td>353</td>
<td>331</td>
<td>22</td>
<td>54</td>
<td>19</td>
<td>54</td>
<td>73</td>
<td>1519</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug</td>
<td>350</td>
<td>343</td>
<td>10</td>
<td>24</td>
<td>73</td>
<td>24</td>
<td>98</td>
<td>1542</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep</td>
<td>342</td>
<td>362</td>
<td>-20</td>
<td>-31</td>
<td>98</td>
<td>-51</td>
<td>46</td>
<td>733</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td>353</td>
<td>445</td>
<td>-92</td>
<td>-22</td>
<td>46</td>
<td>-22</td>
<td>181</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td>342</td>
<td>453</td>
<td>-111</td>
<td>-278</td>
<td>0</td>
<td>-278</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td>353</td>
<td>508</td>
<td>-155</td>
<td>-387</td>
<td>0</td>
<td>-387</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan</td>
<td>353</td>
<td>554</td>
<td>-301</td>
<td>-501</td>
<td>0</td>
<td>-501</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb</td>
<td>319</td>
<td>455</td>
<td>-136</td>
<td>-339</td>
<td>0</td>
<td>-339</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>363</td>
<td>450</td>
<td>-97</td>
<td>-242</td>
<td>0</td>
<td>-242</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>342</td>
<td>377</td>
<td>-35</td>
<td>-88</td>
<td>0</td>
<td>-88</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>353</td>
<td>396</td>
<td>-3</td>
<td>-8</td>
<td>0</td>
<td>-8</td>
<td>0</td>
<td>0</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From calculations in tables above for optimised drainfield area, using Appendix G AS1547:1994

**Porosity in disposal area**

<table>
<thead>
<tr>
<th>Variables Table</th>
<th>Summer Crop Factor</th>
<th>= 0.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>after as required</td>
<td>Winter Crop Factor</td>
<td>= 0.9</td>
</tr>
<tr>
<td>L Tar or DLR =</td>
<td>L/m²/day</td>
<td></td>
</tr>
<tr>
<td>Wastewater FLOWS =</td>
<td>45 L/day</td>
<td></td>
</tr>
</tbody>
</table>

**Estimated depth of effluent drainfield**

| Maximum depth of stored effluent | = 39.5 square metres |
| Trench dimensions (mm) | width = 600 mm |
| Length of trench required | = 30 metres |

**Notes:**
As a model, the best results are only ESTIMATES of performance.
A model is used to assess SENSITIVITY to changes in the variables and the effect upon application area.
Table 2 is run for 16 months to ensure system returns to ZERO at some stage.
APPENDIX 4

INDICATIVE WATER BALANCE ASSESSMENT (IRRIGATION)
### WATER/NITROGEN BALANCE (20/30 irrigation): With no wet month storage.

**Rainfall Station:** Corryong Airport (082169) / Evaporation Station: Corryong Airport (082169)

**Location:**
1887 Thowgria Road, Thowgria Valley

**Date:**
3-Mar-20

**Client:**
Warren Gordon

#### ITEM
<table>
<thead>
<tr>
<th>UNIT</th>
<th>#</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days in month:</td>
<td>A</td>
<td>31</td>
<td>29</td>
<td>31</td>
<td>30</td>
<td>31</td>
<td>30</td>
<td>31</td>
<td>31</td>
<td>30</td>
<td>31</td>
<td>30</td>
<td>31</td>
<td>365</td>
</tr>
<tr>
<td>Evaporation (Daily Mean)</td>
<td>mm</td>
<td>A1</td>
<td>8.4</td>
<td>7.2</td>
<td>5.1</td>
<td>2.9</td>
<td>1.5</td>
<td>1.1</td>
<td>1.2</td>
<td>1.2</td>
<td>1.7</td>
<td>2.7</td>
<td>4.3</td>
<td>5.9</td>
</tr>
<tr>
<td>Evaporation (Monthly Mean)</td>
<td>mm</td>
<td>A2</td>
<td>260.4</td>
<td>201.6</td>
<td>158.1</td>
<td>87.0</td>
<td>46.5</td>
<td>33.0</td>
<td>37.2</td>
<td>52.7</td>
<td>81.0</td>
<td>133.3</td>
<td>177.0</td>
<td>220.1</td>
</tr>
<tr>
<td>Rainfall (Mean)</td>
<td>mm</td>
<td>B</td>
<td>52.80</td>
<td>70.30</td>
<td>75.30</td>
<td>47.10</td>
<td>58.20</td>
<td>60.90</td>
<td>83.80</td>
<td>80.20</td>
<td>62.40</td>
<td>54.00</td>
<td>76.70</td>
<td>68.40</td>
</tr>
<tr>
<td>Rainfall (9th Decile)</td>
<td>mm</td>
<td>B1</td>
<td>58.55</td>
<td>93.72</td>
<td>103.76</td>
<td>47.10</td>
<td>69.40</td>
<td>74.83</td>
<td>120.84</td>
<td>113.61</td>
<td>77.84</td>
<td>60.96</td>
<td>106.58</td>
<td></td>
</tr>
<tr>
<td>Effective rainfall</td>
<td>mm</td>
<td>B2</td>
<td>53</td>
<td>84</td>
<td>93</td>
<td>42</td>
<td>62</td>
<td>67</td>
<td>109</td>
<td>102</td>
<td>70</td>
<td>55</td>
<td>96</td>
<td>81</td>
</tr>
<tr>
<td>Peak seepage Loss</td>
<td>mm</td>
<td>B3</td>
<td>186</td>
<td>168</td>
<td>186</td>
<td>180</td>
<td>180</td>
<td>188</td>
<td>186</td>
<td>186</td>
<td>180</td>
<td>186</td>
<td>186</td>
<td>2190</td>
</tr>
<tr>
<td>Evapotranspiration (ETo)</td>
<td>mm</td>
<td>C1</td>
<td>182</td>
<td>141</td>
<td>111</td>
<td>52</td>
<td>23</td>
<td>15</td>
<td>15</td>
<td>24</td>
<td>45</td>
<td>87</td>
<td>124</td>
<td>154</td>
</tr>
<tr>
<td>Waste Loading (C1+B3-B2)</td>
<td>mm</td>
<td>C2</td>
<td>316</td>
<td>225</td>
<td>203</td>
<td>190</td>
<td>147</td>
<td>128</td>
<td>92</td>
<td>107</td>
<td>154</td>
<td>218</td>
<td>208</td>
<td>259</td>
</tr>
<tr>
<td>Volume of Wastewater</td>
<td>L</td>
<td>E</td>
<td>13350</td>
<td>12600</td>
<td>13950</td>
<td>13500</td>
<td>13950</td>
<td>13500</td>
<td>13950</td>
<td>13500</td>
<td>13950</td>
<td>13500</td>
<td>13950</td>
<td>164250</td>
</tr>
<tr>
<td>Total Irrigation Water (E-ExG)</td>
<td>mm</td>
<td>F</td>
<td>92</td>
<td>83</td>
<td>92</td>
<td>89</td>
<td>92</td>
<td>89</td>
<td>92</td>
<td>89</td>
<td>92</td>
<td>89</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>Irrigation Area (E/C2) annual.</td>
<td>m²</td>
<td>G</td>
<td>152</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surcharge</td>
<td>mm</td>
<td>H</td>
<td>-224</td>
<td>-142</td>
<td>-112</td>
<td>-101</td>
<td>-55</td>
<td>-39</td>
<td>0</td>
<td>-16</td>
<td>-66</td>
<td>126</td>
<td>-119</td>
<td>-167</td>
</tr>
<tr>
<td>Actual seepage loss</td>
<td>mm</td>
<td>I</td>
<td>-78</td>
<td>26</td>
<td>74</td>
<td>79</td>
<td>131</td>
<td>141</td>
<td>186</td>
<td>170</td>
<td>114</td>
<td>60</td>
<td>61</td>
<td>19</td>
</tr>
<tr>
<td>Direct Crop Coefficient</td>
<td>J</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.6</td>
<td>0.5</td>
<td>0.45</td>
<td>0.4</td>
<td>0.45</td>
<td>0.55</td>
<td>0.65</td>
<td>0.7</td>
<td>0.7</td>
<td></td>
</tr>
</tbody>
</table>

1. The distribution is adjusted in proportion to the deviation of means from the minimum mean. 
2. Seepage loss (peak) equals deep seepage plus lateral flow; 6mm (=10% ksat - Indicative permeability EPA Code)

#### CROP FACTOR

<table>
<thead>
<tr>
<th>Species</th>
<th>Kg/ha/yr</th>
<th>pH</th>
<th>Species</th>
<th>Kg/ha/yr</th>
<th>pH</th>
<th>Species</th>
<th>Kg/ha/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ryegrass</td>
<td>200</td>
<td>5.6-8.5</td>
<td>Bent grass</td>
<td>170</td>
<td>5.6-6.9</td>
<td>Grapes</td>
<td>200</td>
</tr>
<tr>
<td>Eucalyptus</td>
<td>90</td>
<td>5.6-6.9</td>
<td>Couch grass</td>
<td>280</td>
<td>6.1-6.9</td>
<td>Lemons</td>
<td>90</td>
</tr>
<tr>
<td>Tall fescue</td>
<td>150-320</td>
<td>6.1-6.9</td>
<td>Buffalo (soft)</td>
<td>150-320</td>
<td>5.5-7.5</td>
<td>P radiata</td>
<td>150</td>
</tr>
<tr>
<td>Ryed/clover</td>
<td>220</td>
<td>5.6-6.9</td>
<td>Sorghum</td>
<td>90</td>
<td>5.6-6.9</td>
<td>Ppoplar</td>
<td>115</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nitrogen In Effluent</th>
<th>N</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Q</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Denitrification Rate</th>
<th>35%</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Uptake</td>
<td>220 kg/ha/yr</td>
<td>S</td>
</tr>
<tr>
<td>Mean daily seepage loss</td>
<td>2.9</td>
<td>T</td>
</tr>
<tr>
<td>Annual N load</td>
<td>3.20 kg/yr</td>
<td>U</td>
</tr>
<tr>
<td>Area for N uptake</td>
<td>146 m²</td>
<td>V</td>
</tr>
<tr>
<td>Application Rate</td>
<td>3.1 mm</td>
<td>W</td>
</tr>
</tbody>
</table>

**NOTES:**
- **Evaration:**
  - 1.0
- **Surcharge:**
  - 4.5
- **Peak seepage Loss:**
  - 6.0
- **Seepage Loss:**
  - 4.0
- **Irrigation Area:**
  - 152

---

**Base Model prepared by Paul Williams & Associates Pty Ltd as modified by EDM Group**

**Authorised for use by EDM Group**
APPENDIX 5

SAND FILTERS
FACT SHEET 3: SEPTIC TANK WITH SAND FILTER

This information will be of interest if you live on a property that is not connected to a town sewerage system and you manage your own waste water. This fact sheet focuses only on sand filters, their issues and some ideas to help manage them. To gain an understanding of the entire septic system, it is recommended that this fact sheet be read in conjunction with Fact Sheet 1: Conventional Septic Tanks (Basic Design Information) and Fact Sheet 6 Common Disposal Methods (Primary Treatment).
3.1 WHAT IS A SAND FILTER?

Sand filters are a form of secondary treatment and are most commonly installed in conjunction with conventional septic tanks (for details on conventional septic tanks refer to Fact Sheet 1: Conventional Septic Tanks: Basic Design Information). Sand filters are usually a box shape constructed out of heavy duty plastic or concrete and filled with sand material. The effluent from the septic tank is irrigated under low pressure and control dosing into a gravel filled bed on top of the sand material. This irrigated effluent then trickles through the sand material. The sand captures any remaining solid material and provides a good environment for good bugs [aerobic bacteria] to carry out extra digestion of the waste materials and reduces pollution. At the bottom of the box is another gravel drain system which then collects the treated effluent. This treated effluent is then pumped or gravity fed to underground trenches or a sub-surface irrigation system or another method approved by your local government EHO.

The main benefit of having a sand filter into your domestic wastewater treatment system is to treat the effluent coming out of the septic tank to a higher standard which will reduce negative impacts on the environment, and assist with site constraints (e.g. you are on a small block or dealing with environmental sensitivity).

3.2 WHAT ARE THE COMMON ISSUES WITH SAND FILTERS

It is important to get the sand material just right. The sand used for sand filters needs to neither too coarse nor too fine. If the material is too coarse then the wastewater passes too quickly and too fine sand slows the flow down too much increasing the likelihood of clogging.

The sand material can also become clogged by too much solid material coming from the septic tank reducing effectiveness and increasing the need for maintenance.

Sand filters can be affected by high rates of wastewater being applied in one day. These filters become less effective at removing bad bugs and other wastes from the wastewater at high wastewater loading rates.

Uncontrolled dosing and uneven distribution of wastewater across the filter surface can result in parts of the filter becoming overloaded resulting in wastewater being flushed through the filter without adequate treatment. For effective operation, the wastewater needs to be carefully dosed and evenly distributed across the surface of the sand filter.
3.3 A FEW SIMPLE STEPS TO A HEALTHY SAND FILTER:

- De-sludge your septic tank every 3-5 years depending on use. Sludge from the septic tank forms a crust on the surface of the sand filter and blocks the wastewater from moving through the filter. Consequently you may be required to periodically replace the sand in the sand filter material;

- It is possible that you will be required to have the treated effluent coming from your sand filter tested and a copy of the test results sent to your local government:

  - If the effluent is discharged off site then it needs to be tested for biochemical oxygen demand, suspended solids and the presence and levels of bad bugs 3 times a year.

  - If the effluent is discharged below the ground surface then it needs to be tested for biochemical...
oxygen demand and suspended solids annually;
- Install water saving devices to limit the flow of wastewater through the system;
- Inspect the sand filter and disposal area for odours, wet spots or surfacing sewage. If you notice any of these you will need to call a licensed plumbing practitioner;
- Pump failure or water ponding on the surface of the sand filter can be serious problems.
- If you have an older sand filter you might consider upgrading it to include a pressurised distribution system. This system will allow more even distribution of the wastewater across the surface area of the sand filter and helps it to work more effectively;
- Do not build structures like garages or sheds over the septic system or sand filter;
- Do not cover the sand filter with concrete or fixed pavers;
- Divert stormwater away from the system; and
- Keep traffic and livestock off the system.

3.5 HISTORIC SAND FILTER SYSTEMS:

If you have an ageing sand filter incorporated into your domestic wastewater system and a small allotment, it is likely that this system was designed to discharge the treated effluent to the street kerb or other offsite location. This is an outdated method of designing wastewater systems that was frequently used to manage wastewater generated from houses on small allotments.

This method of discharge is no longer permitted due to the risks to the environment and human health. However there is no need to panic just yet. If you have a system designed to discharge offsite it is unlikely that you will be required to change it unless one or more of the following circumstances arise:
- Your system fails and requires repair or replacement;
- The risk of environmental degradation or health impacts becomes too great;
- You alter your house design or any plumbing fixtures attached to the system;
- Your sand filter no longer meets the water quality standards it is required to meet;
- You have been given a formal written direction by your local government or other relevant wastewater or environmental protection agency to the upgrade the system.

Therefore, it is in your interest to maintain your wastewater management system to the highest standard possible in order to protect the natural environment, your community, your family’s health and your hip pocket.

3.6 WHO TO CONTACT:

LODDON SHIRE COUNCIL
41 High St, Wedderburn, Victoria 3518
PO Box 21, Wedderburn, Victoria 3518
Telephone: (03) 5494 1200
Facsimile: (03) 5494 3003
Email: health@loddon.vic.gov.au

PRODUCED AND FUNDED BY:

LODDON UNIVERSITY

* ALL WASTEWATER IS TO BE RETAINED ON THE PROPERTY
APPENDIX 6

BOREHOLES & SOIL PROFILE PHOTOS