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LAND CAPABILITY ASSESSMENT
FOR
ON-SITE WASTEWATER MANAGEMENT
AT
416-420 BELLARINE HIGHWAY, MOOLAP VIC 3224

REPORT No. LCA11112025 REVISION 2 MAY/2026

[redacted]

IMPORTANT NOTE

The land capability assessment report consists of this cover sheet, two written sections, three drawings and four appendices.
The report elements are not to be read or interpreted in isolation.

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ASSESSOR'S ACADEMIC & PROFESSIONAL QUALIFICATIONS

[redacted] is the principal Soil Scientist at Land Capability Assessment Victoria. He has a Masters Degree in Applied Science (General Agriculture) (awarded in 2002) and completed his studies in a two-year Postgraduate Specialist Training Programme in Soil Science (awarded in 2012).

All fieldwork and analyses are undertaken by [redacted]

ASSESSOR'S PROFESSIONAL INDEMNITY INSURANCE

Policy Number:	118U813797BPK
Period of Cover:	24/8/2025 – 24/8/2026
Geographical Coverage:	Australia
Retro-active Date:	Unlimited
Limit of Indemnity:	$2,000,000

EXECUTIVE SUMMARY

The proposed development at 416-420 Bellarine Highway, Moolap VIC is suitable for sustainable on-site effluent disposal.

The site of 2.02 hectares (approximately) is located in the Farming Zone and is not in a Special Water Supply Catchment. It is proposed to construct a 12-bedroom accommodation unit with out-sourced laundry in addition to the existing 5-bedroom (equivalent) residence.

The site is not sewered.

Our field testing which included soil profile logging and sampling, a differential level survey, laboratory testing and subsequent reporting including water and nutrient balance modelling has revealed that on-site effluent disposal is rational and sustainable.

The assessment has been made in the context of prioritising public and environmental health with a design compromise between rational wastewater reuse and sustainable wastewater disposal.

Effluent shall be treated to at least the 20/30 standard and distributed by pressure compensated subsurface irrigation utilising the processes of evapotranspiration and deep seepage.

The irrigation area has been determined for the mean wet year and satisfies the requirements of *SEPPs (Waters of Victoria)* in that the effluent irrigation system cannot have any detrimental impact on the beneficial use of surface waters or groundwater.

For the proposed development the available area is not limiting and continuous or long-term increases in effluent volume above 3300 litres/day (12-bedroom accommodation unit with out-sourced laundry and an existing 5-bedroom (equivalent) residence with mains water supply and with WELS scheme fixtures and fittings - as per *EPA Victoria - Guideline for onsite wastewater management (May 2024) Table 4-4* and *Table 4-1*) are possible.

With regard to density of development and cumulative risk the assessment has considered risk associated with subsurface flows and surface flows.

In regard to subsurface flows, it is clear that provided the on-site system is adequately designed, constructed, operated and maintained the risk to surface and ground waters is negligible. Once the effluent is placed underground, the extraordinary long travel times via ground water to surface waters ensures adequate nutrient attenuation.

In regard to surface flows, it is clear that provided the on-site system is adequately designed, constructed, operated and maintained, the risk to surface and ground waters is no greater than for a sewered development.

Proposed use requires AWTS or a septic tank with a sand filter (or any other treatment system that is capable of producing secondary standard effluent and has current AS/NZS accreditation) and pressure compensated subsurface irrigation.

The LCA recommends a conservative, scientifically based, well founded wastewater management system with inherent multiple barriers of safety.

Cumulative risk from the development is extremely low. The risk of serious or irreversible damage is extremely low.

All requirements of *SEPP (Waters of Victoria)* have been met.

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SECTION 1. SITE INVESTIGATION

1.1 INTRODUCTION

On instruction from the landowner, an investigation was undertaken to assess land capability for on-site effluent disposal for a 12-bedroom accommodation unit with out-sourced laundry and the existing 5-bedroom (equivalent) residence at 416-420 Bellarine Highway, Moolap VIC.

The site of 2.02 hectares (approximately) is in the Farming Zone and is not located in a Special Water Supply Catchment. The site is not sewered.

The assessment has been made in the context of prioritising public and environmental health with a design compromise between rational wastewater reuse and sustainable wastewater disposal.

1.2 INVESTIGATION METHOD

The site investigation was carried out in accordance with *SEPPs (Waters of Victoria) and related documents. This report is in accordance with* current *SEPPs (Waters of Victoria), EPA Victoria - Guideline for onsite wastewater management (May 2024)* and *EPA Victoria - Guideline for onsite wastewater effluent dispersal and recycling systems (May 2024).* Guidance has been sought from *AS/NZS 1547:2012*, *Guidelines for Wastewater Irrigation*, E.P.A. Publication 168, April 1991, *Wastewater Subsurface Drip Distribution*, Tennessee Valley Authority, March, 2004, *AS 2223, AS 1726, AS 1289, AS 2870* and *Australian Laboratory Handbook of Soil and Water Chemical Methods*.

Our capability assessment involved the mapping of unique land-soil unit(s) which were defined in terms of significant attributes including; climate, slope, aspect, vegetation, soil profile characteristics (including soil reaction trend, electrical conductivity and colloid stability), depth to rock, proximity to surface waters and escarpments, transient soil moisture characteristics and hydraulic conductivity.

Exploratory auger drilling was undertaken to enable profile characterization and sampling. Onsite dispersion index testing revealed significant dispersion. Hence, insitu permeability testing was not considered rational.

Water balance analysis was based on the mean wet year calculated from the mean monthly rainfall data and mean annual rainfall data for Breakwater and mean evaporation data for Durdidwarrah and was undertaken in accordance with *Guidelines for Wastewater Irrigation, E.P.A.* Publication 168, April 1991 (Part), *AS/NZS 1547:2012* and in-house methods.

The rainfall and evaporation data were obtained from the National Climate Centre, Bureau of Meteorology. The data was subsequently analysed and applied to our water balance analysis.

The results of the water balance analysis are given in Appendix B, to this report.

The results of the investigation and *in situ* and laboratory testing are given in Section 1.3, below, and in Appendix A, to this report.

1.3 CAPABILITY ASSESSMENT

We have used the attributes determined by the investigation to define one (1) land-soil unit, as follows:-

1.3.1 Land-Soil Unit A.

This land-soil unit consists of level terrain, as shown in Drawing 2 and Figure 1.

The salient land-soil attributes and constraints are summarised in Appendix C.

1.3.1.1 Climate.

The general area receives a mean annual rainfall of 511mm and a mean annual evaporation of 997mm. Mean evaporation exceeds the mean rainfall in August through April.

Rainfall and evaporation data are presented in Appendix B, to this report.

1.3.1.2 Slope and Aspect.

The natural ground surface over the proposed land application area slopes to the south at 0.5%, generally, as shown in Drawing 2 and Figure 1.

The unit is somewhat protected from the prevailing winds and is subject to partial shade from nearby trees.

1.3.1.3 Vegetation and Land Use.

The unit is vegetated with pasture grasses and different types of trees, as shown in Figure 1. The proposed effluent field is currently used as a garden.

The land application area has been designed for pasture grass (rye/clover equivalent).

1.3.1.4. Slope Stability.

For the encountered subsurface conditions, slope degree and geometry and for the proposed range of hydraulic loadings, the stability of the ground slopes within the disposal areas are unlikely to be compromised.

1.3.1.5 Subsurface Profile.

The following interpretation of the general subsurface profile assumes conditions similar to those encountered in the boreholes are typical of the investigation area.

Note: If subsurface conditions substantially different from those encountered in the investigation are encountered during soil renovation works, all work should cease, and this office notified immediately.

The unit is underlain by alluvial materials of Pleistocene Age.

The subsurface profiles consist of:

Borehole 2:

- A topsoil (A_1-horizon) layer of grey-brown, moist, medium dense loam, with a soil reaction trend of 7.6pH and electrical conductivity (EC_{SE}) of 0.30dS/m, containing a root zone, to a depth of 0.25m, overlying,
- A topsoil (A_2-horizon) layer of light grey-brown, moist, medium dense sandy loam, with a soil reaction trend of 8.0pH and electrical conductivity (EC_{SE}) of 0.10dS/m, to a depth of 0.45m, overlying,
- An alluvial soil (B_1-horizon) layer of grey-brown, moist, silty light clay of high plasticity, with a soil reaction trend of 8.3pH, electrical conductivity (EC_{SE}) of 0.81dS/m and a free swell[a] of 100%, to a depth of 0.65m, overlying,

[a] After Holtz (measures swell potential of fraction passing 450 micron sieve)

- An alluvial soil (B_2-horizon) layer of grey-brown with orange, moist, silty light clay of high plasticity, with a soil reaction trend of 8.5pH, electrical conductivity (EC_{SE}) of 2.25dS/m and a free swell of 100%, to a depth of 1.15m, overlying,

- An alluvial soil (BC-horizon) layer of grey-brown with orange, moist, silty light clay of medium plasticity, with a soil reaction trend of 8.5pH, electrical conductivity (EC_{SE}) of 4.86dS/m and free swell of 80%, to a depth of at least 1.50m.

Borehole 6:

- A topsoil (A_1-horizon) layer of dark grey-brown, moist, medium dense loam, with a soil reaction trend of 8.5pH and electrical conductivity (EC_{SE}) of 0.10dS/m, containing a root zone, to a depth of 0.15m, overlying,

- A topsoil (A_2-horizon) layer of light grey-brown, moist, medium dense loam, with a soil reaction trend of 8.3pH and electrical conductivity (EC_{SE}) of 0.10dS/m, to a depth of 0.35m, overlying,

- An alluvial soil (B_1-horizon) layer of dark grey-brown with orange, moist, silty light clay of high plasticity, with a soil reaction trend of 8.0pH, electrical conductivity (EC_{SE}) of 2.52dS/m and a free swell of 90%, to a depth of 0.65m, overlying,

- An alluvial soil (B_2-horizon) layer of dark yellow-brown, moist, silty light clay of high plasticity, with a soil reaction trend of 7.8pH, electrical conductivity (EC_{SE}) of 5.76dS/m and a free swell of 90%, to a depth of 1.10m, overlying,

- An alluvial soil (BC-horizon) layer of dark yellow-brown, moist, silty light clay of high plasticity, with a soil reaction trend of 8.3pH, electrical conductivity (EC_{SE}) of 4.95dS/m and free swell of 110%, to a depth of at least 1.50m.

Soil test results, soil profile photographs and logs of boreholes are summarised in Appendix A. For location of boreholes refer Drawing 2.

1.3.1.6 Soil Permeability.

Where the soils are dispersive and/or swelling insitu permeability testing realises inaccurate, low or nil results.

The hydraulic conductivity can be estimated by using test waters containing calcium chloride or by laboratory assessment of colloid stability and determination of ameliorant quantities (e.g. gypsum/lime requirement) and swell potential.

A conservative estimate of permeability has been deduced as follows (from soil texture, structure and swell potential tests):-

Profile analysis in accordance with AS/NZS 1547:2012 and our laboratory determined dispersion and swell potential shows the alluvial clay soils to be dispersive silty light clays (Type 6 soils) with saturated hydraulic conductivity of less than 0.06m/day.

Similar dispersive and swelling soils have responded positively (with sufficiently improved hydraulic capability) following applications of gypsum.

For the limiting moderately structured clay soils and assuming renovation by gypsum application (at the rate of 1.5kg/m^2, we have adopted an estimated and conservative design saturated hydraulic conductivity of 0.04m/day.

Peak deep seepage is conservatively estimated at 3.4mm/day. Average daily deep seepage is 2.1mm.

1.3.1.7 Basement Rock Permeability.

From the literature and from examination of rock profiles and rock mass defect character in the vicinity, the hydraulic conductivity of the basement rocks would be in excess of 0.05m/day (adopt 1m/day for buffer design).

1.3.1.8 Colloid Stability.

The results of the Emerson Crumb and Dispersion Index Tests indicate that the soil materials are dispersive. The alluvial clay soils have Emerson Classes of 1 and 2 and Dispersion Indexes of 11 to 15.

The salting potential has been assessed by inspection of the ground surface for salt tolerant and/or salt affected vegetation and the electrical conductivity has been determined for the A and B horizons using a 1:5 soil/water extract and converted to EC (saturation extract). Also reaction trend and free swell potential have been determined.

The determined electrical conductivity (EC_{SE}) ranged from 0.10dS/m to 5.76dS/m for all materials. The reaction trend ranged from 7.6pH to 8.5pH, while the free swell potential ranged between 80% and 110%.

We recommend amelioration in the form of gypsum application to create and maintain stable peds under saline irrigation.

1.3.1.9 AS1547:2012 Soil Classification.

In accordance with *AS/NZS1547:2012* the alluvial clay materials can be classified as Type 6 soils (dispersive silty light clays).

After allocating proportional vertical and lateral flows and allowing for the potential for perched water mounding, we have adopted a daily peak water balance seepage rate[b] of 3.4mm for 20/30 standard effluent. The theoretical average daily seepage rate is 2.1mm.

1.3.1.10 Surface Drainage.

Site surface is level, as shown in Drawing 2. The nearest surface waters are located at least 90m distant. There is an open stormwater drain running along the easter boundary of the site but the site is sloping away from this drain thus a 3m setback distance is adequate.

1.3.1.11 Groundwater.

No seepage was encountered in any of the boreholes. Subsurface flow direction will generally reflect natural surface flow direction (southerly direction).

There are no groundwater bores within a significant distance of the site (the closest bore is approximately in 1.15km distance).

The Visualising Victoria's Groundwater database indicates that the groundwater is within 5 metres of the surface.

Regionally, the groundwater is of moderate yield and medium quality (3500-7000mg/litre TDS) with beneficial use including most stock.

1.3.1.12 Nutrient Attenuation.

Clayey soils (as found on this site) can fix large amounts of phosphorous. Phosphate-rich effluent seeping through these soils will lose most of the phosphorous within a few metres.

The limiting nutrient for this site is nitrogen. No phosphorous balance is required.

Nitrogen, contained in organic compounds and ammonia, forms nitrate-N and small amounts of nitrite-N when processed in an aerated treatment plant. Several processes affect nitrogen levels within soil after irrigation. Alternate periods of wetting and drying with the presence of organic matter promote reduction to nitrogen gas (denitrification). Plant roots absorb nitrates at varying rates depending on the plant species (see Appendix B), however nitrate is highly mobile, readily leached, and can enter groundwater via deep seepage and surface waters via overland flow and near-surface lateral flow.

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[b] The peak water balance seepage loss rate is based on being <10% of the measured/estimated hydraulic conductivity (of the limiting horizon) plus a lateral flow component, effluent type and the effects of soil characteristics including profile thickness (flow paths and storage), shrink-swell, dispersivity, soil reaction trend and assumes renovation.

Based on the water and nutrient balance (see Appendix B), and assuming 30mg/litre N in the effluent (general case) and 20mg/litre P, a denitrification rate of 20%, with N uptake of 220 kg/ha/year for an appropriate grass cover equivalent to a rye/clover mix and sequential zoned dosing of the irrigation area, a conservative estimate can be made of the nitrogen content in the deep seepage and lateral flow.

For the general case, and without taking into account further expected denitrification below the root zone and in the groundwater (reported to be in the vicinity of 80%), denitrification in the lateral flow (external to the irrigation areas but within the curtilage of the allotment) and plant uptake in the lateral flow, the irrigation area would need to be 1314m^2 for 3300 litres/day of effluent for complete attenuation.

The hydraulic component of the water balance has shown that an irrigation area of 1650m^2 would be required to limit surface rainwater flows to episodic rain events.

For a 12-bedroom accommodation unit with out-sourced laundry and the existing 5-bedroom (equivalent) residence and to 20/30 secondary effluent standard, to satisfactorily attenuate nitrogen on-site and to accommodate the design hydraulic loading, the irrigation area should be at least 1650m^2 with an application rate of 2mm/day.

1.3.1.13 Sand filter.

A sand filter of 66m^2 would be required for a wastewater flow of 3300l/day. For the dosage rate of 50L/m^2/day in the sand filter the clay and fine silt content shall be less than 5%, the effective size shall be between 0.4 and 1.0 and the uniformity coefficient shall be less than 4.

1.4 RISK MANAGEMENT & MITIGATION

SEPP (Waters of Victoria) requires that the proposal be assessed on a risk-weighted basis and that cumulative effects be considered.

A multiple barrier approach is used in assessing this development, with components listed below:

1.4.1 Water Usage.

Current best practice allows for a (continuous) daily effluent flow of 3300 litres (a 12-bedroom accommodation unit with out-sourced laundry and the existing 5-bedroom (equivalent) residence with WELS scheme fixtures and fittings and with mains water supply) as per *EPA Victoria - Guideline for onsite wastewater management (May 2024) Table 4-4* and *Table 4-1.*

1.4.2 Secondary Treatment.

The LCA recommends AWTS or a septic tank with a sand filter (or any other treatment system that is capable of producing secondary standard effluent and has current AS/NZS accreditation) and pressure compensated subsurface irrigation. These systems generate a much higher quality of effluent than septic systems.

1.4.3 Block Size.

Many under-performing effluent fields are placed on blocks where area is limited. Limited area can lead to inadequately sized or inappropriately placed effluent fields and a lack of options should the daily effluent volumes increase.

In the subject site, size is not a constraining factor for a 12-bedroom accommodation unit and the existing 5-bedroom (equivalent) residence.

1.4.4 Management Plan.

Historically, inadequate maintenance has played a major part in the failure of onsite effluent disposal systems. There is a management plan within the LCA (see Appendix D). This plan gives guidance on the implementation of mandatory operation, maintenance and inspection procedures.

1.4.5 Sizing of Treatment Systems.

No specific treatment plant is recommended, however treatment plants must have current AS/NZS accreditation, which match effluent volumes with plant capacity.

1.4.6 Load Balancing.

Surge flows are possible due to parties, gatherings, etc. (if any). Under these conditions the systems may become overwhelmed for a period. This potential problem can be eliminated by installing a plant with a load balancing facility (or equivalent function) which enables short-term storage and sustainable flows to the distribution area over extended time. The load balancing facility also provides temporary storage should the plant fail or if there is a power outage.

1.4.7 Zoned Dosing.

The LCA stipulates that the effluent area is (automatically) irrigated sequentially by zones to promote the creation of transient aerobic and anaerobic soil conditions.

The effluent field is sized conservatively for nitrogen attenuation, using pasture grass (rye/clover eq mix), which has a nitrogen uptake of 220 kg/ha/year. Zoned dosing will increase the efficiency of the field for removing nitrogen from the soil.

Undersized effluent fields are at risk of becoming anaerobic for long periods, with the risk of microbial build-up. This leads to secretion of microbial polysaccharides, which coat soil particles and restrict the ability of the soil to adsorb nutrients and attenuate pathogens. Polysaccharides can also coat the interior of pipes and block drainage holes if drainage is slow due to the field being overloaded with effluent. This can lead to effluent surcharge from the ends of the drainage pipes, forming preferential flow paths through overlying soil and draining overland to nearby surface waters.

The alternating aerobic and anaerobic conditions created by zoned dosing prevent the build-up of microbial polysaccharides, and ensures efficient renovation of effluent.

1.4.8 Pressure Compensated Subsurface Disposal.

Conservatively sized irrigation areas with pressure compensated subsurface disposal and zoned dosing deliver effluent directly into the soil. Under saturated conditions, water flow is downwards in the direction of maximum hydraulic gradient. For a surface flow containing effluent to occur, the effluent would have to rise, *against gravity*, through at least 150mm of soil. Under unsaturated conditions, water flow is multi-directional due to capillary forces and matrix suction. The atmosphere provides a capillary break with capillary forces and matrix suction reducing to zero at the air/soil interface. Gravitational forces outweigh the capillary forces and matrix suction long before the surface is reached. Hence, any surface flow from the effluent area cannot contain any effluent, regardless of the intensity and duration of rain events. Surface flow can only consist of **rainfall** in excess of soil storage capacity and hydraulic conductivity.

Note: For a pressure compensated distribution network to function properly, lines <u>must</u> be placed parallel to contours and/or horizontal for even effluent distribution. This requirement, alone, requires a high level of quality assurance at the design and construction phases.

1.4.9 Oversized Effluent Areas.

Design effluent areas are based on conservative estimates of renovation and complete attenuation of nitrogen. After amelioration the deep seepage rate will be lower than the hydraulic conductivity of the limiting layer (<10%).

1.4.10 Reserve Areas.

Although reserve areas are not required for subsurface irrigation there is sufficient area available for extension of the irrigation area. The reserve area is a spare effluent field, which is left undeveloped, but can be commissioned in the case of increase in daily effluent production due to contingencies through the chain of ownership or should the effluent field fail.

1.4.11 Buffer Distances.

Buffer distances are set out in the *EPA Victoria - Guideline for onsite wastewater management (May 2024) Table 4-10* to allow for attenuation of pathogens and nutrients, should an effluent surcharge occur, either overland or subsurface.

All effluent areas are located at least 90m from surface waters.

The time taken for groundwater to reach the nearest surface waters can be estimated by using the Darcy equation (which states that velocity is the product of the hydraulic conductivity and the hydraulic gradient). From the literature, the regional gradient is about 0.001.

Flow times can be estimated for groundwater to flow the 90m (minimum) to the nearest surface waters at this site.

For a conservative basement hydraulic conductivity of 1m/day[c] with a hydraulic gradient of 0.001, the time taken for groundwater to flow a distance of 90m is over 240 years.

1.4.12 System Failure.

A properly designed and constructed onsite effluent system consisting of the treatment plant and the irrigation area can suffer degrees of failure.

Failure can take the form of mechanical (plant), accidental (toilet blockages, damaged irrigation lines, high BOD influent), operational (power outage, overloading) and maintenance (failure to check filters, failure to participate in maintenance programme).

1.4.12.1 Mechanical Breakdown.

Mechanical plant breakdown typically involves compressor and pump malfunction causing no aeration and high water levels, respectively. Both of these situations are alarmed (both audible and visual). The proposed plants will benefit from a service contract providing 24 hour repair cycles. If the alarms were ignored (or malfunctioned) and the household/establishment continued to produce waste until the load balancing tank and plant capacities were exceeded, a mixture of septic and raw effluent would back up to the interior of the residence and/or surcharge through the plant hatches. It is difficult to imagine how this outcome could be allowed to manifest. In addition, a plant malfunction with the residents absent could not cause an effluent surcharge because no influent would be produced during this period.

1.4.12.2 Accidents.

Toilet blockages and accidentally damaged irrigation lines could allow localised surface surcharge of treated effluent. This is why minimum buffers to surface waters have been maintained. High BOD influent (e.g. dairy or orange juice) can realise a lesser quality than 20/30 standard for some weeks. Provided the high BOD influent is not continuous, the soils will continue to satisfactorily renovate the effluent.

1.4.12.3 Operational Breakdown.

Operational failures including power outages and transient hydraulic overloading are accommodated by the load balancing facility, as described in Section 1.4.6, above.

1.4.12.4 Maintenance Breakdown.

Maintenance breakdowns such as failure to clean line filters can lead to expensive pump repairs and in extreme cases leakage (of 20/30 secondary standard effluent) from the outlet pipe. This leakage would occur in proximity to the dwelling and would be noticed and acted on.

Refusal to participate in the management programme would be acted on by the responsible authority within one maintenance cycle.

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[c] This is a conservatively high figure to demonstrate maximum possible flow rates. A conservatively low figure was used for calculation of effluent application rates (see recommendations) to demonstrate irrigation sustainability.

AWTSs and pumped systems have mechanical components which can malfunction and will age. The management plan including the maintenance and monitoring programmes are essential to ensure safe onsite effluent disposal.

A prepaid maintenance, monitoring and reporting programme involving a certified and insured entity (i.e. external audit) would ensure safe onsite effluent disposal and reduce the responsible authority's burden of responsibility.

1.4.13 Risk Summary.

With regard to density of development and cumulative risk the assessment has considered risk associated with subsurface flows and surface flows.

In regard to subsurface flows, it is clear that provided the on-site system is adequately designed, constructed, operated and maintained (see items 1.4.1 through 1.4.12.4), the risk to surface and ground waters is negligible. Once the effluent is placed underground, the extraordinary long travel times via ground water to surface waters ensures adequate nutrient attenuation.

In regard to surface flows, it is clear that provided the on-site system is adequately designed, constructed, operated and maintained (see items 1.4.1 through 1.4.12.4), the risk to surface and ground waters is no greater than for a sewered development. Indeed, it could be considered that the risk is less than for a sewered development because there can be no mains failure (because there is no mains).

The LCA recommends a conservative, scientifically based, well founded wastewater management system with inherent multiple barriers of safety.

Cumulative risk from the development is extremely low. The risk of serious or irreversible damage is extremely low.

All requirements of *SEPP (Waters of Victoria)* have been met.

Figure 1:. Land-soil unit A (proposed effluent area) viewed from southeast to northwest.

SECTION 2. RECOMMENDATIONS

2.1 APPLICATION

The following recommendations are based on the results of our assessment, and are made in accordance with *SEPPs (Waters of Victoria),* the *EPA Victoria - Guideline for onsite wastewater management (May 2024)* and *EPA Victoria - Guideline for onsite wastewater effluent dispersal and recycling systems (May 2024)*, *AS 1726*, and *AS/NZS 1547:2012*.

They are based on the estimated hydraulic conductivity of the limiting clay materials and are designed to demonstrate the viability of on-site effluent disposal for a 12-bedroom accommodation unit with out-sourced laundry and the existing 5-bedroom (equivalent) residence and a daily effluent production of up to 3300 litres and are considered to be conservative.

2.2 SUBSURFACE IRRIGATION

2.2.1 General.

Based on the results of the water balance analysis and considering the prevailing surficial and subsurface conditions including soil profile thickness[d] and slope and <u>on condition that adequate site drainage is provided</u> (as described in Section 2.4, below), on-site irrigation systems are appropriate for effluent disposal for land-soil unit A.

2.2.2 Effluent.

Effluent will be generated from a 12-bedroom accommodation unit with out-sourced laundry and the existing 5-bedroom (equivalent) residence and will include black and grey water (all wastes).

2.2.2.1 Effluent Quality.

Effluent shall be treated to a standard that meets or exceeds the water quality requirements of the 20/30 standard for BOD/SS.

Operation and maintenance shall be carried out in accordance with *AS/NZS 1547:2012* and a ”system specific” JAS/ANZ accreditation, as appropriate.

2.2.2.2 Effluent Quantity.

The daily effluent volume of 3300 litres has been calculated from *EPA Victoria - Guideline for onsite wastewater management (May 2024) Table 4-4 and Table 4-1)* and assumes a 12-bedroom accommodation unit with out-sourced laundry and the existing 5-bedroom (equivalent) residence with mains water supply and 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.

The daily effluent flow rate has been calculated as follows:

Source	Number of people	Design flow/person (litres)	Design flow (litres)	Total design flow (litres)
Existing 5-bedroom (equivalent) residence	6	150	900	900
12-bedroom accommodation unit	24	100	2400	2400
Total				**3300**

2.2.2.3 Load Balancing.

Transient hydraulic loads in excess of the expected daily load may occur (e.g. holidays, entertaining, overnight guests etc, if any). In addition, and in the case of power outages and/or mechanical breakdown, the load balancing tank can act as a temporary storage.

[d] Minimum 1400mm required for evapotranspiration-absorption trenches.

We recommend that the effluent treatment system be fitted with a load balancing facility **or equivalent function** to allow transient high hydraulic loads to be retained and distributed to the irrigation area during periods of low load.

2.2.3 Application Rates and Irrigation Areas.

An irrigation area and application rate has been determined from the results of the water and nutrient balance analyses and *AS/NZS 1547:2012, Appendix M*.

2.2.3.1 Hydraulic Loading.

To satisfy the requirement for no surface discharge in the mean wet year, effluent shall be applied at an application rate not exceeding 2mm/day.

2.2.3.2 Nutrient Loading.

The requirements of *SEPPs (Waters of Victoria)* would be satisfied with effluent applied at an application rate not exceeding 2.5mm/day.

2.2.3.3 Design Loading.

For a daily effluent flow of 3300 litres and to satisfy the requirement for no surface flows in the mean wet year and on-site attenuation of nutrients the effluent shall be applied to an area of 1650m^2 at a rate not exceeding 2mm/day.

2.2.4 General Requirements.

For subsurface irrigation, it is assumed that the design, construction, operation and maintenance are carried out in accordance with *AS/NZS1547:2012* and a “system specific” JAS/NZS accreditation, as appropriate.

The irrigation area is to be a dedicated area. To prevent stock and vehicular movements (if any) over the area, the effluent area shall be “fenced”.

2.2.5 Subsurface Distribution System.

A distribution network design similar to that shown in *AS/NZS1547:2012, Figure M1* is appropriate.

2.2.5.1 Ground Preparation and Excavations.

Preparation of the ground is to include the smoothing of the land application surface by the redistribution of topsoil to form a free draining, at least 200mm deep, loamy surface over the land application area. Pipe excavations shall only be undertaken in drier periods when soil moisture contents are relatively low and when heavy rainfall and storms are not normally expected.

2.2.5.2 Pump System and Pipe works.

Uniform delivery pressure of the effluent throughout the distribution system is essential. Percolation or drip rates shall not vary by more than 10% from the design rate over the whole of the system (i.e. pressure compensated).

The distribution pipes shall be placed coincident with slope contours. The dripper system is to provide an effective even distribution of effluent over the whole of the design area. Line spacing shall be no closer than 1000mm.

2.2.6 Sequential Zoned Irrigation.

The efficiency of irrigation effluent disposal systems can be highly variable. We recommend that as part of the daily irrigation process, the effluent area be irrigated sequentially by zones to promote the creation of transient aerobic and anaerobic soil conditions.

The inspection regime described in Section 2.2.7, below, is to be strictly adhered to.

2.2.7 Inspections and Monitoring.

We recommend that the mandatory testing and reporting as described in the *EPA Victoria - Guideline for onsite wastewater management (May 2024) Section 6*, include an annual (post spring) report on the functioning and integrity of the distribution system and on the functioning and integrity of the cut-off bunds, outfall areas and soil media.

It is expected that the frequency of inspections and monitoring will intensify as systems age.

2.2.8 Soil Renovation.

Soils are dispersive and require amelioration. To create and maintain water-stable peds (under irrigation with saline effluent), soil renovation in the form of gypsum application is required at the rate of 1.5kg/m^2. Initially, prior to the installation and operation of the effluent irrigation system gypsum is to be broadcast over the land application area at the rate of 0.5kg/m^2. Following that gypsum shall be broadcast again over the effluent area at the rate of 0.25 kg/m^2 in every two winter months and 0.25kg/m^2 in every 3 summer months until the determined gypsum application of 1.5kg/m^2 is reached.

If the determined gypsum application of 1.5kg/m^2 is not reached by the time of the installation and operation of the effluent irrigation system gypsum shall be broadcast again over the effluent area at the rate of 0.25 kg/m^2 in every winter month and 0.25kg/m^2 in every 1.5 summer months.

After reaching the determined gypsum application of 1.5kg/m^2 we recommend sampling and testing to assess the effectiveness of the gypsum application. This testing will determine future application rate and frequency of application.

Gypsum requirement assumes the gypsum contains 19% Calcium and 15% Sulphur. Gypsum is to be fine ground “Grade 1” agricultural quality and shall be reapplied every 3 years at the rate of 0.5kg/m^2.

2.2.9 Effects of Irrigation on Existing Trees.

A study[e] by Dr Nick O’Brien (Melbourne University) regarding impacts of 20/30 standard irrigation on remnant *Eucalyptus* forest at Ringwood North has shown that trees would not be adversely affected by subsurface 20/30 standard irrigation provided the distribution slots did not exceed about 150mm in depth.

2.3 RESERVE AREA

The expected design life of fifteen years may vary due to construction and maintenance vagaries and possible effluent volume increases through the chain of ownership.

There is sufficient available area for extension of the effluent area.

2.4 SITE DRAINAGE.

Our recommendations for on-site effluent disposal have allowed for incident rainfall only (not surface flow or lateral subsurface flow) and are conditional on the installation of a shallow cut-off bund, which shall be placed upslope of the disposal area.

Care shall be taken to ensure that the intercepted and diverted surface waters are discharged well away and down slope of the disposal field.

Locations of the cut-off bunds and a drain detail are shown in Drawings 2 and MP1.

The owner shall also ensure that any upslope site works do not divert and/or concentrate surface water flows onto the disposal area.

[e] Dr Nick O’Brien (Research Fellow, School of Botany, University of Melbourne, 2000: *Comment on the irrigation of remnant native vegetation with municipal effluent associated with the proposed subdivision at the rear of 111 Hall Road, North Ringwood.*

2.5 BUFFER DISTANCES

The water balance analysis has shown that potential surface (rain water) flows from the effluent area would be restricted to episodic events.

The estimated hydraulic properties of the upper soil materials and hydraulic gradient have been used to evaluate (via Darcy's Law) the buffer distances with respect to subsurface flows.

Our risk analysis and evaluation has shown that the default setback distances given in *EPA Victoria - Guideline for onsite wastewater management (May 2024) Table 4-10* are conservative and can be applied without amendment.

For a building located downslope of an effluent field, your engineer shall evaluate the integrity of building foundations with respect to the assigned buffer distance.

2.6 SUMMARY OF RECOMMENDATIONS

Our capability assessment has shown that at least one rational and sustainable on-site effluent disposal method (20/30 standard subsurface irrigation) is appropriate for the proposed development.

A management plan is presented in Appendix D, to this report.

[redacted]

APPENDIX A1

SOIL PERMEABILITY

Where the soils are dispersive insitu permeability testing realises inaccurate, low or nil results.

The hydraulic conductivity can be estimated by using test waters containing calcium chloride or by laboratory assessment of colloid stability and determination of ameliorant quantities (e.g. gypsum/lime requirement) and swell potential.

A conservative estimate of permeability has been deduced as follows (from soil texture, structure and free swell potential tests):-

Profile analysis in accordance with AS/NZS 1547:2012 and our laboratory determined dispersion and swell potential shows the alluvial soils to be dispersive silty light clays (i.e. Type 6 soils) with saturated hydraulic conductivity of less than 0.06m/day.

Similar dispersive and swelling soils have responded positively (with sufficiently improved hydraulic capability) following applications of gypsum.

The limiting moderately structured clay soils require amelioration in the form of gypsum application at the rate of 1.5kg/m^2.

Peak deep seepage is conservatively estimated at 3.4mm/day. Average daily deep seepage rate is 2.1mm.

SOIL TEST RESULTS

Project: Moolap			**Date of sampling: 21/08/24**		**Date of Lab test:**					**BH: 1**
horizon (cm)	**pH**	**$EC_{1:5}$**	**EC_{SE}**	**disp 10 min**	**disp 2 hours**	**disp total**	**Emers 2 hours**	**Emers 20 hours**	**free swell %**	**texture**
0-30				0	0	0	8	8		loam
30-60				2	3	13	2	2		silty light clay
60-130				2	4	14	1	1		silty light clay
130-150				0	1	9	2	2		clayey silt

Project: Moolap			**Date of sampling: 21/08/24**		**Date of Lab test:**					**BH: 2**
horizon (cm)	**pH**	**$EC_{1:5}$**	**EC_{SE}**	**disp 10 min**	**disp 2 hours**	**disp total**	**Emers 2 hours**	**Emers 20 hours**	**free swell %**	**texture**
0-25	7.6	0.03	0.30	0	0	0	8	8		loam
25-45	8.0	0.01	0.10	0	0	0	8	8		sandy loam
45-65	8.3	0.09	0.81	3	4	15	1	1	100	silty light clay
65-115	8.5	0.25	2.25	2	4	14	1	1	100	silty light clay
115-150	8.5	0.54	4.86	1	2	11	2	2	80	silty light clay

Project: Moolap			**Date of sampling: 21/08/24**		**Date of Lab test:**					**BH: 3**
horizon (cm)	**pH**	**$EC_{1:5}$**	**EC_{SE}**	**disp 10 min**	**disp 2 hours**	**disp total**	**Emers 2 hours**	**Emers 20 hours**	**free swell %**	**texture**
0-20				0	0	0	8	8		loam
20-30				0	0	0	8	8		sandy loam
30-55				3	4	15	1	1		silty light clay
55-100				2	4	14	1	1		silty light clay
100-155				0	1	9	2	2		silty light clay

Project: Moolap			Date of sampling: 21/08/24			Date of Lab test:			BH: 4	
horizon (cm)	pH	$EC_{1:5}$	EC_{SE}	disp 10 min	disp 2 hours	disp total	Emers 2 hours	Emers 20 hours	free swell %	texture
0-23				0	0	0	8	8		loam
23-55				2	3	13	2	2		silty light clay
55-95				2	4	14	1	1		silty light clay
95-120				1	2	11	2	2		silty light clay
120-150				0	3	11	2	2		clayey silt

Project: Moolap			Date of sampling: 21/08/24			Date of Lab test:			BH: 5	
horizon (cm)	pH	$EC_{1:5}$	EC_{SE}	disp 10 min	disp 2 hours	disp total	Emers 2 hours	Emers 20 hours	free swell %	texture
0-30				0	0	0	8	8		loam
30-60				3	3	14	2	2		silty light clay
60-100				2	3	13	2	1		silty light clay
100-120				1	2	11	2	2		silty light clay
120-145				1	2	11	2	2		clayey silt

Project: Moolap			Date of sampling: 21/08/24			Date of Lab test:			BH: 6	
horizon (cm)	pH	$EC_{1:5}$	EC_{SE}	disp 10 min	disp 2 hours	disp total	Emers 2 hours	Emers 20 hours	free swell %	texture
0-15	8.5	0.01	0.10	0	0	0	8	8		loam
15-35	8.3	0.01	0.10	0	0	0	8	8		loam
35-65	8.0	0.28	2.52	3	3	14	2	1	90	silty light clay
65-110	7.8	0.64	5.76	1	3	12	2	1	90	silty light clay
110-150	8.3	0.55	4.95	1	2	11	2	2	110	silty light clay

APPENDIX A2

SOIL PROFILE PHOTOGRAPHS

BOREHOLE 1

BOREHOLE 2

BOREHOLE 3

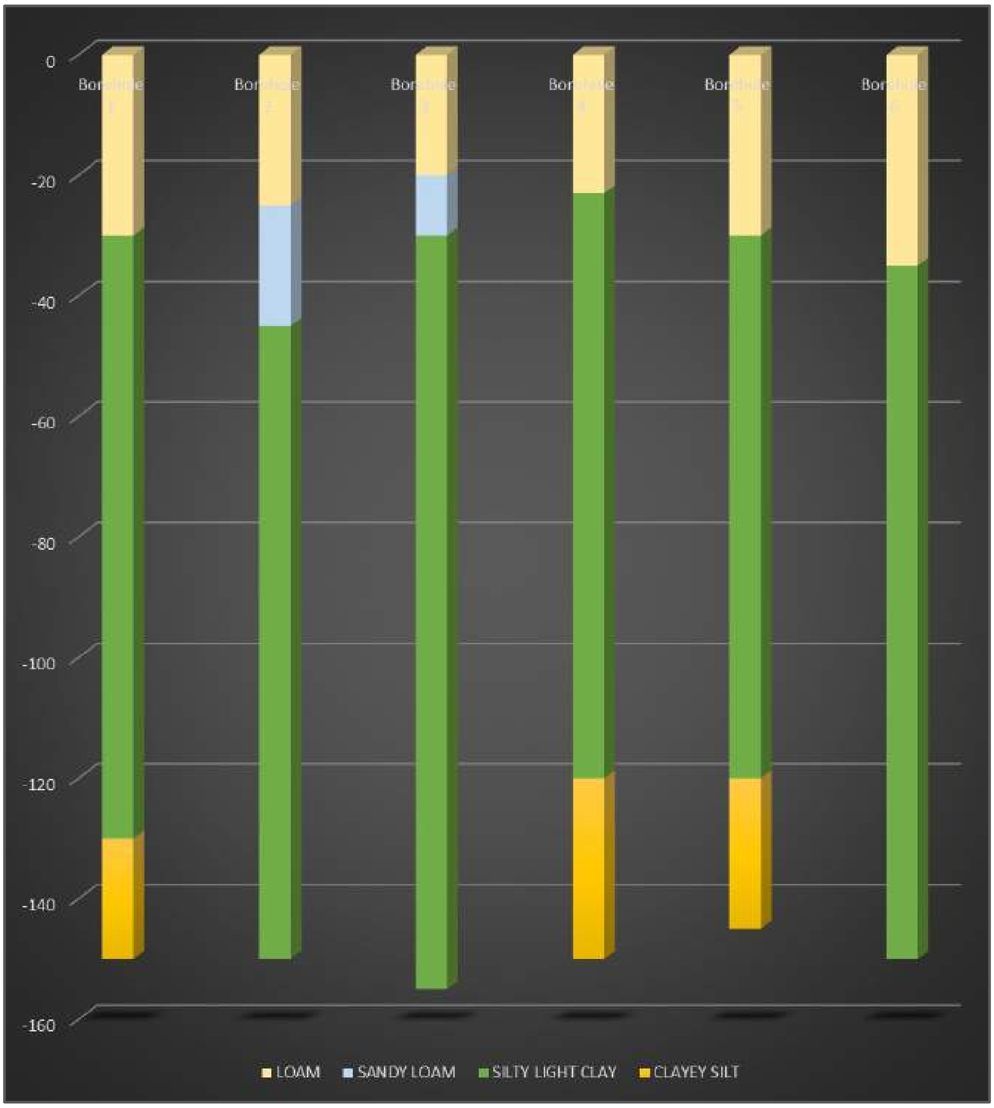
BOREHOLE 4

BOREHOLE 5

BOREHOLE 6

APPENDIX A3

LOGS OF BOREHOLES



For location of boreholes refer Drawing 2.

APPENDIX B

WATER AND NUTRIENT BALANCE

Land Capability Assessment Victoria **(Spreadsheet used with permission)**

WATER/NITROGEN BALANCE (20/30 irrigation): With no wet month storage **LCA11112025**

Rainfall Station: Breakwater/ **Evaporation Station:** Durdidwarrah

Location: Moolap

REVISION 2

Date: May, 2026

Client: [redacted]

ITEM	UNIT	#	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Days in month:		D	31	28	31	30	31	30	31	31	30	31	30	31	365
Evaporation (Mean)	mm	A	155	134	102	60	40	24	31	47	60	93	111	140	997
Rainfall (mean)	mm	B1	42	30	24	47	43	53	40	41	47	56	54	33	511
Effective rainfall	mm	B2	40	28	23	45	41	50	38	39	45	53	51	32	485
Peak seepage Loss[1]	mm	B3	105	95	105	102	105	102	105	105	102	105	102	105	1241
Evapotranspiration(IXA)	mm	C1	70	60	46	27	18	11	14	21	27	42	50	63	449
Waste Loading(C1+B3-B2)	mm	C2	135	127	128	84	83	62	82	87	84	94	101	137	1204
Net evaporation from lagoons (10(0.8A-B1xlagoon area(ha)))	L	NL	0	0	0	0	0	0	0	0	0	0	0	0	0
Volume of Wastewater	L	E	102300	92400	102300	99000	102300	99000	102300	102300	99000	102300	99000	102300	1204500
Total Irrigation Water(E-NL)/G	mm	F	62	56	62	60	62	60	62	62	60	62	60	62	730
Irrigation Area(E/C2)annual.	m^2	G													1650
Surcharge/Storage	mm	H	-73	-71	-66	-24	-21	-2	-20	-25	-24	-32	-41	-75	0
Actual seepage loss	mm	J	32	24	39	78	85	100	86	80	78	74	61	31	767
Direct Crop Coefficient:		I	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	Shade:

Rainfall Retained:	95	%	K
Lagoon Area:	0	ha	L
Wastewater(Irrigation):	3300	L	M
Seepage Loss (Peak):	3.4	mm	N
Irrig'n Area(No storage):	1650	m^2	P2
Application Rate:	2.0	mm	Q
Nitrogen in Effluent:	30	mg/L	R
Denitrification Rate:	20	%	S
Plant Uptake:	220	kg/ha/y	T
Average daily seepage:	2.1	mm	U
Annual N load:	28.91	kg/yr	V
Area for N uptake:	1314	m^2	W
Application Rate:	2.5	mm	X

1. Seepage loss (peak) equals deep seepage plus lateral flow: 3.4mm

CROP FACTOR

#	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
M	0.7	0.7	0.7	0.6	0.5	0.45	0.4	0.45	0.55	0.65	0.7	0.7	Pasture:
N	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	Shade:
P2	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	Fescue:
Q	1	1	1	1	1	1	1	1	1	1	1	1	Woodlot

NITROGEN UPTAKE:

Species:	Kg/ha.yr	pH	Species:	Kg/ha.yr	pH	Species:	Kg/ha.yr	pH
Ryegrass	200	5.6-8.5	Bent grass	170	5.6-6.9	Grapes	200	6.1-7.9
Eucalyptus	90	5.6-6.9	Couch grass	280	6.1-6.9	Lemons	90	6.1-6.9
Lucerne	220	6.1-7.9	Clover	180	6.1-6.9	C cunn'a	220	6.1-7.9
Tall fescue	150-320	6.1-6.9	Buffalo (soft)	280	6.1-6.9	P radiata	150	5.6-6.9
Rye/clover	220		Sorghum	90	5.6-6.9	Poplars	115	5.6-8.5

RAINFALL DATA

Station: Breakwater (Geelong Racecourse) **Number:** 87184 **Opened:** 2011 **Now:** Open

Lat: 38.17° S **Lon:** 144.38° E **Elevation:** 13 m

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	42.2	29.8	24.2	46.9	42.9	53.0	39.7	41.3	47.4	56.3	54.0	33.3	527.9
Lowest	2.0	0.4	3.8	4.0	15.6	8.4	18.8	3.0	6.8	2.0	14.0	8.6	423.6
5th %ile	3.4	2.6	6.9	7.4	19.2	14.0	19.2	13.2	12.4	11.9	15.3	11.7	425.4
10th %ile	8.3	4.5	9.7	9.9	21.4	18.1	20.4	18.1	17.5	16.2	21.4	15.9	426.8
Median	42.1	22.1	23.2	45.4	29.9	48.6	36.8	46.2	46.2	52.0	48.7	32.1	512.7
90th %ile	73.1	59.3	37.5	81.9	80.4	91.0	53.4	58.9	78.2	109.4	84.2	54.9	654.3
95th %ile	77.8	67.8	43.9	111.5	88.4	95.7	64.0	66.1	96.9	124.0	104.1	63.4	664.2
Highest	85.0	83.4	51.4	151.2	98.2	104.4	82.8	78.8	125.2	148.4	132.8	67.8	670.0

APPENDIX C

LAND CAPABILITY ASSESSMENT TABLE
(Non-Potable Water Supply Catchments)

LAND FEATURE	LAND CAPABILITY RISK RATING				AMELIORATIVE MEASURES & RISK REDUCTION
	LOW	MEDIUM	HIGH	LIMITING	
Available land for LAA	Exceeds LAA and duplicate LAA requirements	Meets LAA and duplicate LAA requirements	Meets LAA and partial duplicate LAA requirements	Insufficient LAA area	Limiting for trenches & beds: Full reserve area not available. Non-limiting for subsurface irrigation.
Aspect	North, north-east and north-west	East, west, south-east, south-west	South	South, full shade	Not relevant.
Exposure	Full sun and/or high wind or minimal shading	Dappled light (partial shade)	Limited light, little wind to heavily shaded all day	Perpetual shade	Partial shade from nearby trees.
Slope Form	Convex or divergent side slopes	Straight sided slopes	Concave or convergent side slopes	Locally depressed	Not relevant.
Slope gradient:					
Subsurface irrigation	<10%	10% to 30%	30% to 40%	>40%	0.5% Non-limiting for subsurface irrigation.
Site drainage: runoff/run-on	LAA backs onto crest or ridge	Moderate likelihood	High likelihood	Cut-off drain not possible	Unremarkable. Cut-off bund required up-slope.
Landslip[1]	Potential	Potential	Potential	Existing	Unremarkable.
Erosion potential	Low	Moderate	High	No practical amelioration	All runoff to be dispersed without concentrating flows. LAA stabilised with gypsum (dispersive and swelling soils).
Flood/inundation	Never		<1%AEP	>5% AEP	Unremarkable.
Distance to surface waters (m)	Buffer distance complies with Guideline requirements		Buffer distance does not comply with Guideline requirements	Reduce buffer distance not acceptable	90 metres to watercourse.
Distance to groundwater bores (m)	No bores on site or within a significant distance	Buffer distances comply with Guideline	Buffer distances do not comply with Guideline	No suitable treatment method	No bores within a significant distance (1.15km).
Vegetation	Plentiful/healthy vegetation	Moderate vegetation	Sparse or no vegetation	Propagation not possible	Existing grasses are suitable.
Depth to water table (potentiometric) (m)	>2	2 to 1.5	<1.5	Surface	Water table within 5m.
Depth to water table (seasonal perched) (m)	>1.5	<0.5	0.5 to 1.5	Surface	Perching possible.
Rainfall[2] (Mean) (mm)	<500	500-750	750-1500	>1500	511mm. Non-limiting for subsurface irrigation - Design by water balance.
Pan evaporation (mean) (mm)	>1250	1000 to 1250	750 to 1000	<750	997mm. Design by water balance.
SOIL PROFILE CHARACTERISTICS					
Structure	High or moderately structured	Weakly structured	Structureless, massive or hardpan		Maintain structure by gypsum application (dispersive and swelling soils).
Fill materials	Nil or mapped good quality topsoil	Mapped variable depth and quality materials	Variable quality and/or uncontrolled filling	Uncontrolled poor quality/unsuitable filling	No fill present.
Thickness: (m)					
Subsurface irrigation	1.5+	1.0 to 1.5	0.75-1.0	<0.75	Non-limiting for irrigation systems.
Permeability[3] (limiting horizon) (m/day)	0.15-0.3	0.03-0.15 0.3-0.6	0.01-0.03 0.6-3.0	>3.0 <0.03	Non-limiting for irrigation but requires renovation.
Permeability[4] (buffer evaluation) (m/day)	<0.3	0.3-3	3 to 5	>5.0	Evaluate flow times via Darcy's Law (assume 1m/day for alluvial clays).
Stoniness (%)	<10	10 to 20	>20		Unremarkable.
Emerson number	4, 5, 6, 8	7	2, 3	1	Non-dispersive topsoil, dispersive subsoils. Apply gypsum to improve ksat and to create and maintain stable peds.
Dispersion Index	0	1-8	8-15	>15	Non-dispersive topsoil, dispersive subsoils. Apply gypsum to improve ksat and to create and maintain stable peds.
Reaction trend (pH)	5.5 to 8	4.5 to 5.5	<4.5 >8		7.6pH and 8.5pH in topsoil. Ideal and below the ideal range for grasses.
E.C. (dS/m)	<0.8	0.8 to 2	>2	>2.0	Non-restrictive.
Sodicity (ESP) (%)	<6	6 to 8	>8	>14	Sodic. Inferred from Emerson, Dispersion Index, Free swell.
Free swell (%)	<30	30-80	80-120	>120	80%-110%. Medium- to high-swelling clay fraction.

There are limiting and high-risk factors for primary effluent trench systems (insufficient LAA, colloid stability).

There are no limiting factors for secondary effluent subsurface irrigation (after renovation with gypsum).

Evaluation of buffer distances via Darcy's Law shows EPA default buffer distances to be adequate.

Hence, in terms of the design engineering and management inputs required for sustainable on-site effluent disposal are rational and easily achieved without significant impost on the landowner.

[1] Landslip assessment based on proposed hydraulic loading, slope, profile characteristics and past and present land use.
[2] Mean monthly rainfalls used in water balance analyses.
[3] Saturated hydraulic conductivity estimated from data base and laboratory tests.
[4] Saturated hydraulic conductivity estimated from AS/NZS1547:2012 and data base.

APPENDIX D

MANAGEMENT PLAN

[redacted]

[redacted]

LCA11112025 REVISION 2 – MAY/2026

MANAGEMENT PLAN
FOR
ON-SITE EFFLUENT DISPOSAL VIA SUBSURFACE IRRIGATION
AT
416-420 BELLARINE HIGHWAY, MOOLAP VIC 3224

1. INTRODUCTION

This document identifies the significant land-soil unit constraints (as identified in LCA11112025 Revision 2) and their management and day-to-day operation and management of the on-site effluent system.

This management plan is to be read in conjunction with our land capability assessment for this land-soil unit (LCA11112025).

2. SIGNIFICANT LAND-SOIL UNIT CONSTRAINTS

2.1 Allotment Size. The day-to-day operation and management of on-site effluent systems, as described below, is not constrained by lot size or geometry.

Although all requirements of *SEPPs* have been met or exceeded through conservative design, prudence dictates that property owners assiduously follow the management programme given in Section 4, below.

2.2 Nitrogen Attenuation. To reduce nitrates to insignificant levels, the effluent should not contain more than 30mg/litre total nitrogen.

Provided the irrigation areas are at least as large as those required to satisfy the nitrogen loading, as described in LCA11112025 Sections 1.3.1.12 and 2.2.3, and that the (specified) grass is cut and (periodically) harvested, nitrogen will be attenuated on-site.

2.3 Hydraulic Conductivity. The soils of this site are dispersive silty light clays with medium- to high-swelling potential and a low hydraulic conductivity. The hydraulic conductivity is significantly influenced by soil structure, soil colloid stability and swell characteristics. Breakdown or reduction of these soil parameters over time may manifest as reduced performance of the irrigation system. The monitoring and inspection regime detailed in Section 4.7.2, below, should be adhered to.

2.4 Site Drainage. Our recommendations for on-site effluent disposal have allowed for incident rainfall only (not surface flow or lateral subsurface flow) and are conditional on the installation of a cut-off bund, which should be placed upslope of the disposal area. Care should be taken to ensure that the intercepted and diverted surface waters are discharged well away and down slope of the disposal field (see LCA11112025 Drawings 2 and MP1).

This diverted water should also be discharged in a manner to avoid scouring and/or erosion. It may be appropriate to discharge the water onto a stone/rubble dissipation area.

The owner should also ensure that any upslope land-soil unit works do not divert and/or concentrate surface water flows onto the disposal area.

2.5 Vegetation. Existing vegetation is suitable. The effluent disposal area has been sized via water and nutrient balance analyses utilising crop factors for pasture (rye/clover mix) under conditions of partial shade.

3. THE ONSITE EFFLUENT SYSTEM

The onsite effluent system consists of the influent (kitchen, laundry, bathrooms and toilets), a load balancing tank/facility (if any), the treatment plant (a device to treat the effluent to at least the secondary effluent standard (20/30)), the irrigation area including effluent distribution system (delivery pipes and drippers), prescribed irrigation area vegetation, associated infrastructure (cut-off bunds, outfall areas, fencing (if any)), a service and maintenance programme and on-going management.

4. MANAGEMENT

The owner is required to understand (and ensure that tenants and visitors understand) that sustainable operation of the onsite effluent system is not automatic. Sustainable operation requires on-going management, as outlined below.

4.1 Effluent. Effluent will be generated from a 12-bedroom accommodation unit (with out-sourced laundry) and an existing 5-bedroom (equivalent) residence, and will include black and grey water (all wastes).

4.1.2 Effluent Quality. Effluent should be treated to a standard that meets or exceeds the water quality requirements of the secondary effluent standard (20/30 standard for BOD/SS).

Operation and maintenance shall be carried out in accordance with *AS/NZS 1547:2012* and a "system specific" JAS/ANZ accreditation, as appropriate.

4.1.3 Effluent Quantity. The daily effluent volume of 3300 litres has been calculated from *EPA Victoria - Guideline for onsite wastewater management (May 2024) Table 4-4* for a 12-bedroom accommodation unit with out-sourced laundry and *Table 4-1* for the existing 5-bedroom (equivalent) residence with mains water supply and 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.

The daily effluent flow rate has been calculated as follows:

Source	Number of people	Design flow/person (litres)	Design flow (litres)	Total design flow (litres)
Existing 5-bedroom (equivalent) residence	6	150	900	900
12-bedroom accommodation unit	24	100	2400	2400
Total				**3300**

4.2 Treatment System. No specific treatment system is recommended, however the treatment system must have current AS/NZS accreditation, which match effluent volumes with plant capacity.

4.3 Irrigation Area. The irrigation area has been determined from the results of the water and nutrient balance analyses and AS/NZS 1547:*2012*, *Appendix M*. For subsurface irrigation, it is assumed that the design, construction, operation and maintenance are carried out in accordance with *AS/NZS1547:2012* and a "system specific" JAS/NZS accreditation.

4.3.1 Effluent Area Requirement. For a daily effluent flow of 3300 litres and to satisfy the requirement for no surface rainwater flow in the mean wet year and on-site attenuation of nutrients the effluent should be applied to an irrigation area of 1650m^2.

Effluent distribution is as detailed in Section 4.3.2, below.

Any landscaping and/or planting proposals require endorsement from the Greater Geelong Shire Council.

4.3.2 Distribution System. The distribution system must achieve controlled and uniform dosing over the irrigation area. A small volume of treated effluent should be dosed at predetermined time intervals throughout the day via a pressurised piping network that achieves uniform distribution over the entire irrigation area.

Uniform delivery pressure of the effluent throughout the distribution system is essential. Drip rates should not vary by more than 10% from the design rate over the whole of the system.

To minimise uneven post-dripper seepage, the distribution pipes must be placed parallel with slope contours.

Line spacing shall be not closer than 1000mm under any circumstances.

To facilitate the creation of transient aerobic and anaerobic soil conditions we recommend that as part of the daily irrigation process, the effluent area be irrigated sequentially by zones.

4.3.3. Soil Renovation: Soils are dispersive and swelling and require amelioration. To create and maintain water-stable peds (under irrigation with saline effluent), soil renovation in the form of gypsum application is required at the rate of 1.5kg/m^2. Initially, prior to the installation and operation of the effluent irrigation system gypsum is to be broadcast over the land application area at the rate of 0.5kg/m^2. Following that gypsum shall be broadcast again over the effluent area at the rate of 0.25 kg/m^2 in every two winter months and 0.25kg/m^2 in every 3 summer months until the determined gypsum application of 1.5kg/m^2 is reached.

If the determined gypsum application of 1.5kg/m^2 is not reached by the time of the installation and operation of the effluent irrigation system gypsum shall be broadcast again over the effluent area at the rate of 0.25 kg/m^2 in every winter month and 0.25kg/m^2 in every 1.5 summer months.

After reaching the determined gypsum application of 1.5kg/m^2 we recommend sampling and testing to assess the effectiveness of the gypsum application. This testing will determine future application rate and frequency of application.

Gypsum requirement assumes the gypsum contains 19% Calcium and 15% Sulphur. Gypsum is to be fine ground “Grade 1” agricultural quality and shall be reapplied every 3 years at the rate of 0.5kg/m^2.

4.3.4 Buffer Distances. The water balance analysis has shown that potential surface rainwater flows from the effluent area would be restricted to episodic events.

The estimated hydraulic properties of the upper soil materials and hydraulic gradient (equivalent to the ground slope and regional gradients) have been used to evaluate (via Darcy’s Law) the buffer distances with respect to subsurface flows.

Our analysis and evaluation have shown that the default setback distances given in *EPA Victoria - Guideline for onsite wastewater management (May 2024)*, *Table 4-10* are conservative and can be applied without amendment.

For a building located downslope of an effluent field, your engineer should evaluate the integrity of building foundations with respect to the assigned buffer distance.

Buffer distances are to be applied exclusive of the irrigation area.

4.3.5 Buffer Planting. All downslope (Title inclusive) buffers may be required to filter and renovate abnormal surface discharges. Hence, they are to be maintained with existing or equivalent groundcover vegetation.

4.3.6 Buffer Trafficking. On all allotments, buffer trafficking should be minimised to avoid damage to vegetation and/or rutting of the surface soils.

Traffic should be restricted to ‘turf’ wheeled mowing equipment and to maintenance, monitoring and inspections by pedestrians, where possible.

4.4 Vegetation. The system design for on-site disposal includes the planting and maintenance of suitable vegetation, as specified in LCA11112025 Revision 2 and/or similar documents.

Specifically, this irrigation area has been sized (in part) utilising crop factors and annual nitrogen uptake for a rye/clover eq mix.

The grass needs to be harvested (mown and periodically removed from the irrigation area).

Where a variation to recommended grass species is proposed, it must be demonstrated that the nitrogen uptake and crop factors (as specified in LCA11112025 Appendix B – water and nutrient balance) are met or exceeded.

4.5 Verification. The Council is to be satisfied that the effluent system has been constructed as designed with appropriate engineering endorsement and underwriting.

4.6 Associated Infrastructure. The following items are an integral part of the onsite effluent system.

4.6.1 Cut-off bunds. Cut-off bunds are designed to prevent surface water flows from entering the effluent area. They should be constructed and placed around the effluent area, as shown in Drawings 2 and MP1.

4.6.2 Outfall areas. All pipe outfalls should be at grade and designed to eliminate scour and erosion.

A grassed outfall would normally be adequate. However, should monitoring and inspections reveal rill or scour formation, the outfall will need to be constructed so that energy is satisfactorily dissipated.
Should this situation occur, professional advice is to be sought.

4.6.3 Fencing. The disposal area is to be a dedicated area. Adequate fencing must be provided to prevent stock, excessive pedestrian and vehicular movements (if any) over the area.

4.7 Service and Maintenance Programme. The minimum requirements for servicing and maintenance are set out in the relevant JAS/ANZ accreditation and the manufacturer's recommendations.

4.7.1 Treatment Plant. Aerated treatment plants and sand filters should be serviced at least one time per year (or as recommended in the JAS/ANZ accreditation) and the effluent should be sampled and analysed as required by the JAS/ANZ accreditation). The local authority is to ensure compliance.

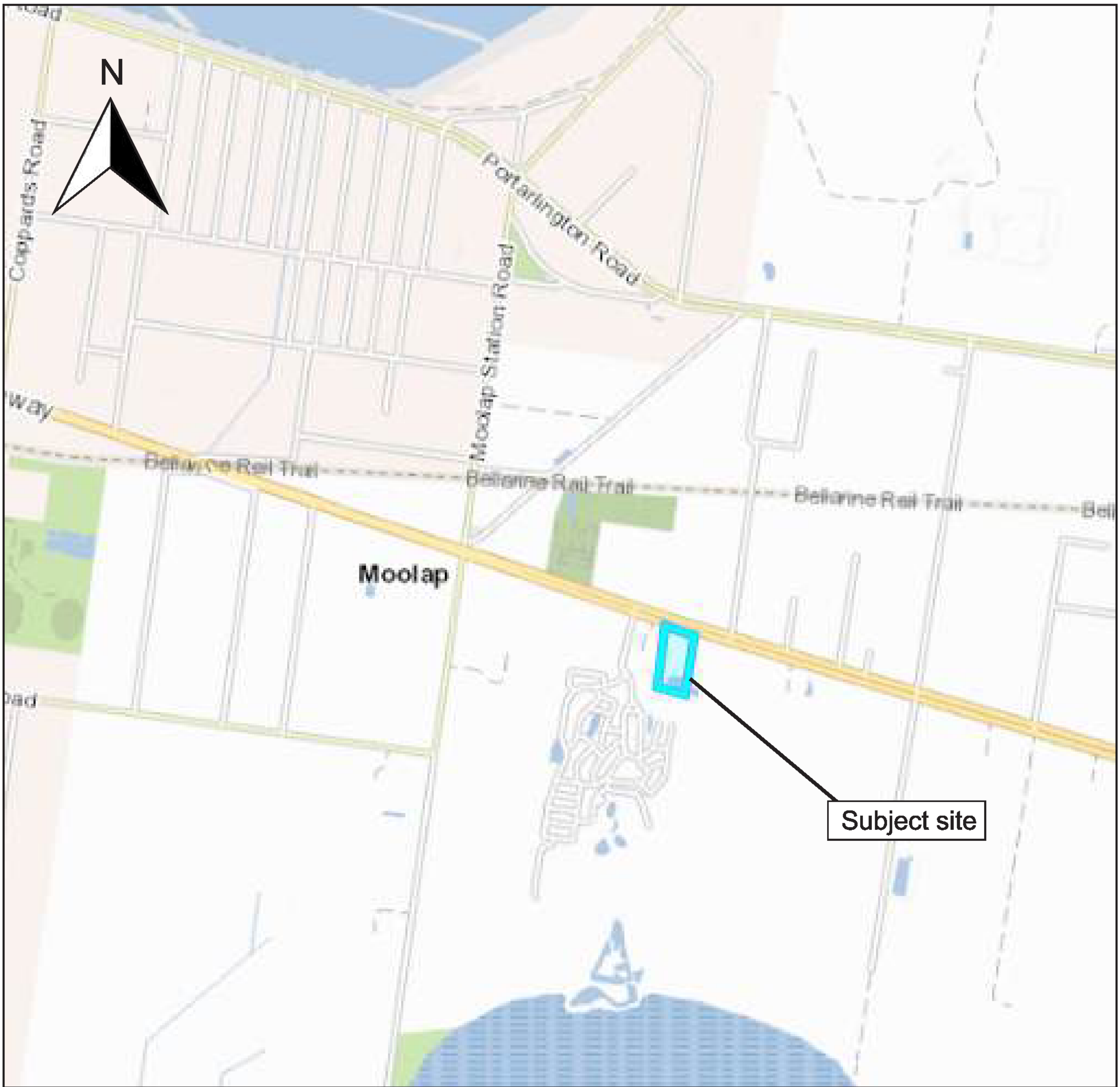
The manufacturer's recommendations are to be followed. Generally, low phosphorous and low sodium (liquid) detergents should be used. Plastics and other non-degradable items should not be placed into the tanks. Paints, hydrocarbons, poisons etc should not be disposed of in sinks or toilets. Advice from a plumber should be obtained prior to using drain cleaners, chemicals and conditioners. It is important to ensure that grease does not accumulate in the tanks or pipes. Grease and similar products should be disposed of by methods other than via the on-site effluent system.

4.7.2 Monitoring and Inspections. We recommend that the mandatory testing and reporting as described in the *EPA Victoria - Guideline for onsite wastewater management (May 2024) Section 6*, include an annual (post spring) and post periods of heavy and/or prolonged rainfall report on the functioning and integrity of the distribution system and on the functioning and integrity of the cut-off bunds, outfall areas and soil media.

The effluent areas should be regularly inspected for excessively wet areas and vegetation integrity.

The inspection regime described in LCA11112025 Revision 2, Section 2.2.7, should be strictly adhered to.

[redacted]



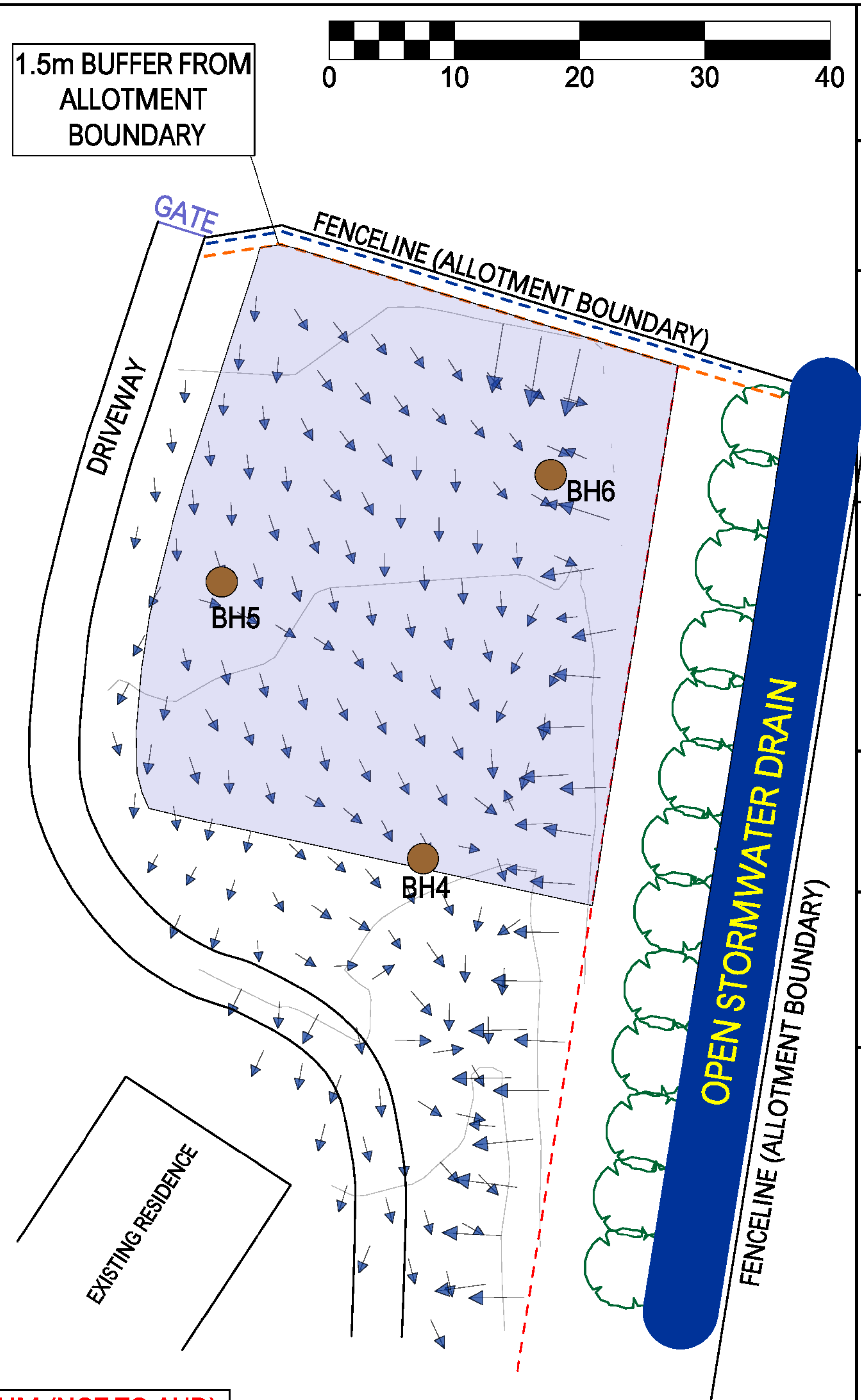
LOCATION OF SUBJECT SITE	
416-420 BELLARINE HIGHWAY, MOOLAP VIC 3224	
[redacted]	
[redacted]	Report number: LCA11112025 REV2
Date: May 2026.	Drawing number: 1

SLOPE, SURFACE AND SUBSURACE FLOW DIRECTIONS

BOREHOLE

1650m² EFFLUENT FIELD FOR 20/30 STANDARD SUBSURFACE IRRIGATION

CUT-OFF BUND
SEE DRAWING MP1



NOTE: THIS IS NOT A RE-ESTABLISHMENT SURVEY. TITLE BOUNDARIES ARE ASSUMED TO BE COINCIDENT WITH EXISTING FENCES.

CONTOUR INTERVAL: 0.1m

CONTOURS ARE TO LOCAL DATUM (NOT TO AHD)

LOCATION OF PROPOSED DEVELOPMENT SHOWING CONTOURS

416-420 BELLARINE HIGHWAY, MOOLAP VIC 3224

[redacted]

DRAWN: LAND CAPABILITY ASSESSMENT VICTORIA

DATE: MAY 2026

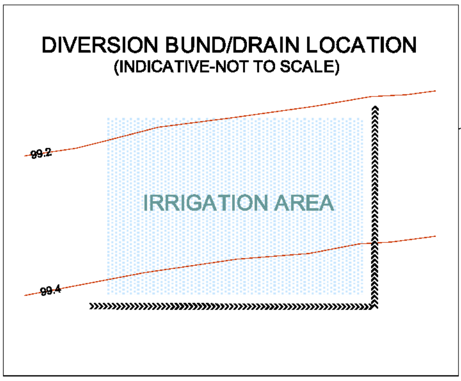
REPORT NUMBER: LCA11112025 REVISION 2

DRAWING NUMBER: 2

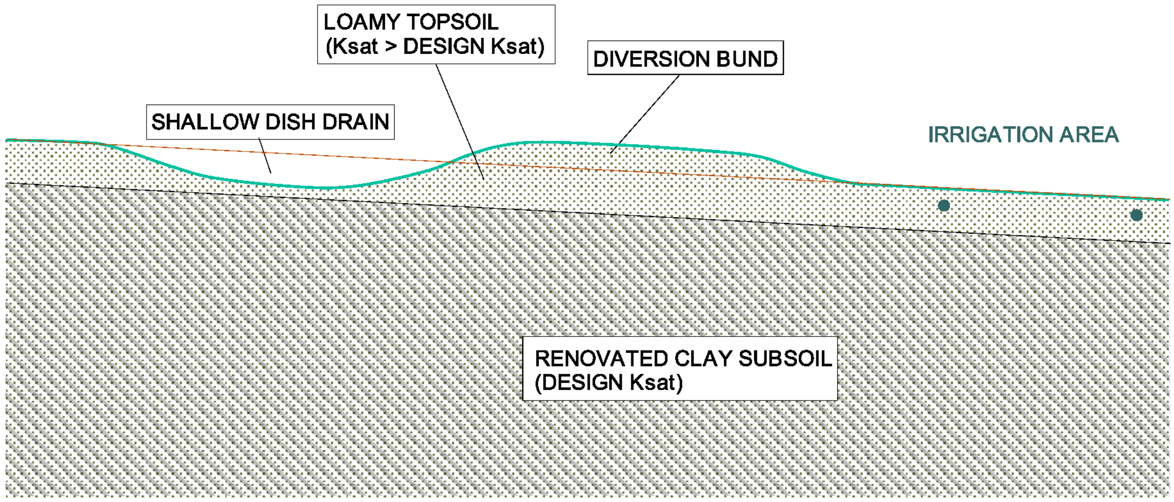
SCALE: 1:600

N

LAND CAPABILITY ASSESSMENT VICTORIA



NOTE: CUT-OFF DRAIN LOCATION IS SCHEMATIC ONLY. FINAL LOCATION TO BE DETERMINED BY DESIGN ENGINEER AS PART OF SITE DRAINAGE DESIGN.



NOTES:
1. DRAIN TO BE DESIGNED, CONSTRUCTED & MAINTAINED TO ENSURE THAT NO SURFACE FLOWS ENTER THE IRRIGATION AREA.
2. DRAIN AND TO BE LOCATED ON UPSLOPE SIDES OF IRRIGATION AREA (NO CLOSER THAN 1m FROM NEAREST SUBSURFACE DISTRIBUTION LINE).
3. DRAIN TO HAVE UNSPECIFIED FALL.
4. MINIMUM DEPTH AT LEAST 200mm.
5. DRAIN CROSS SECTIONAL AREA RELATED TO DESIGN FLOWS AS DETERMINED BY A SUITABLY QUALIFIED AND EXPERIENCED ENGINEER.
6. OFF-SITE DRAIN OUTFALL TO LEGAL POINT OF DISCHARGE SUBJECT TO LOCAL AUTHORITY REQUIREMENTS.
7. ON-SITE DRAIN OUTFALL TO INCLUDE APPROPRIATE ENERGY DISSIPATION TO AVOID EROSION.
8. ALL DRAINS AND OUTFALL AREAS SUBJECT TO POST-SPRING INSPECTION.

NOTE: DRAWING NOT TO BE USED FOR SET-OUT PURPOSES

CUT-OFF DRAIN DETAIL FOR EFFLUENT DISPOSAL FIELDS

SURFACE FLOW DIVERSION BUND & DISH DRAIN

[redacted]

Scale: 1:10 (Approximately)	Drawn: P.R.W.	Report Number: LCA11112025 REV2
Contour Interval: N/A	Date: May 2026	Drawing Number: MP1