5 Lot Subdivision
Hopkins Highway, Purnim

Location: 184 Fairy Street
ABN 72 079 362 717

Postal Address:
184 Fairy St
Warrnambool Vic 3280

[redacted]

Land Capability Assessment

Client: St Joseph's Parish
Prepared By: [redacted]
Project Number: 20-321
Date: 29/03/2021

Revision	Description	Date

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1. Introduction

SITEC Pty Ltd has been engaged to undertake a Land Capability Assessment (LCA) for a proposed 5 lot subdivision on Hopkins Hwy, Purnim. The field investigation and report have been undertaken and prepared by suitably experienced staff. SITEC Pty Ltd has appropriate professional indemnity insurance for this type of work. Our professional indemnity insurance is available on request.

This report will accompany an application submitted to the Moyne Shire Council for a proposed 5 lot subdivision which will use on-site wastewater systems. This document provides information about the site and soil conditions. It also provides a detailed LCA for the approximately 2.365 Ha area, and includes a conceptual design for a suitable onsite wastewater management system, including recommendations for monitoring and management requirements.

We provide recommendations for both the treatment system and land application area (LAA).

2. Description of the Development

Table 2 Site Description

Site Address:	1707 Hopkins Highway, Purnim VIC 3278
Owner / Developer:	St Joseph's Parish
Postal Address:	[redacted] St Joseph's Parish Warrnambool VIC 3280
Contact:	0407 800 510 – Tony Herbert
Council Area:	Moyne Shire Council
Allotment Size:	Approx. 2.365Ha
Domestic Water Supply:	The site has reticulated water supply available
Anticipated Wastewater Load:	Assume one 4-bedroom residence per lot, @ 6 people per residence maximum occupancy. Design wastewater load is 150L/person/day. This design load is sourced from AS/NZS 1547:2012.
Availability of Sewer:	The area is unsewered and unlikely to be sewered in the short to medium term future.

3. Site Key Features

Travis Greening undertook site investigations on the 31st of March 2009. A range of site features were assessed in terms of the degree of limitation they present for a range of onsite wastewater management systems.

Table 3 summarises the key features in relation to effluent management at the site.

Figure 1 provides a locality plan and indicates the location of the site of the proposed development.

Appendix A provides a site plan describing the location of the proposed development works and physical site features and location of percolation tests and soil sampling.

Figure 1 - Locality Plan

Table 3 Site Features

Feature	
Climate	The site has a temperate climate with a warm summer and cold winter. The site experiences an average annual rainfall of 732 mm (Warrnambool Airport NDB 090186 gauge) and an average of 117 rain days per year. Average annual pan evaporation is taken as 1300 mm.
Exposure	The site has a southern aspect with high sun exposure
Vegetation	Grass across both sites with large trees along the southern, eastern and northern boundaries and interspersed throughout the eastern/southern sections of the site
Slope	The proposed effluent management areas have a slight slope, with gradients between 0 to 2% to the south/south-east
Fill	Natural soil profiles were observed throughout the site. No fill was observed and no filling is proposed in the effluent management area.
Rocks and Rock Outcrop	No surface rocks or outcrop evident at the site
Erosion Potential	No evidence of sheet or rill erosion. The erosion hazard is low.
Surface Water	The site is moderately sloping allowing water to drain.
Flood Potential	The development site and area available for application of treated effluent lies above the 1:100 year flood level.
Stormwater run-on and upslope seepage	The Site experiences negligible stormwater run-on and has a minor run-off hazard. There are no visible signs of surface dampness, spring activity or hydrophilic vegetation in the preferred effluent management area.
Groundwater	There are no signs of shallow groundwater tables above 1.5m depth. There is no use of groundwater for domestic purposes within 50m of the proposed effluent management area.
Site drainage and Subsurface Drainage	The site may experience stormwater run-on and has a negligible run-off hazard.
Recommended Buffer Distances	All buffer distances recommended in Table 5 of EPA (2016) are achievable.

Soil Assessment and Constraints

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.

Published Soils Information

Reference to the geological survey of Victoria map sheet Colac SJ-54-12, indicates that the underlying site consists of Quaternary Period Basaltic Clay.

Soil & Survey Analysis

A soil survey was carried out at the site to determine suitability for application of treated effluent. The site was found to consist of dark brown soft silty sandy topsoil and sandy silt overlying dark brown firm moderately plastic clay and light brown firm moderately plastic gravelly basaltic clay overlying light brown stiff highly plastic basaltic clay. Due to the similar topsoil profile found between the boreholes it has been deemed appropriate to conduct one percolation test and adopt the results for the entire site.

The location of boreholes is shown in **Appendix A**. Full profile descriptions are provided in **Appendix D**.

Seven number test sites were established and excavated using a drill rig to the depth of 450mm.

Appendix A shows testing locations

The indicative K_{sat} value is taken as 0.38 m/day. **Appendix B** shows the percolation data.

After analysis of the soil structure and drainage characteristics the soil category has been determined to be Category 4b in accordance with Table 5.2 AS/NZS1547:2012

Land Capability Assessment Matrix

The Land Capability Matrix has been developed for the local area under investigation.

LAND *FEATURES*	LAND CAPABILITY CLASS RATING					**COMMENTS**
	1) Very good	**2)** Good	**3)** Fair	**4)** Poor	**5)** Very Poor	**Site Value**
GENERAL CHARACTERISTICS						
Site drainage/ Run off	No visible sign of dampness	Moist soil, but no standing water in soil pit		Visible signs of dampness, such as moisture-tolerant plants	Water ponding on surface	**3**
Flooding **(% AEP)**	***Never***		**< 1 in 100**	**< 1 in 30**	**< 1 in 20**	**3**
Grade %	**0 – 2**	**2 – 8**	**8 – 12**	**12 – 20**	**20 >**	**2**
Landslip	**Exempt** Not present	**Low**	**M0 – M1**	**M2**	**H** Present	**1**
Rainfall (mm/yr)	**< 450**	**450 - 650**	**650 - 750**	**750 - 1000**	**> 1000**	**3**
Pan Evap (mm/yr	**> 1500**	**1250 – 1500**	**1000 – 1250**	**< 1000**	-	**2**
Seasonal Water Table	**> 5m**	**5 – 2.5m**	**2.5 – 1.5m**	**1.5 – 1m**	**< 1m**	**3**
SOIL PROFILE CHARACTERISTICS						
Soil Structure	**Cat. 2 & 3 Soils**	**Cat. 4 Soils**		**Cat. 5 Soils**	**Cat. 1 & 6 Soils**	**2**
Profile Depth	**> 2m**	**1.5 – 2m**		**1.0 – 1.5m**	**< 1m**	**2**
Modified Emerson * test	**1** 4,6,8	**2** 5	7	**3** 2,3	**4** 1	**-**
Stoniness* (%)	**<10**			**10 - 20**	 **> 20**	**2**
Percolation* (mm/hr)	>500	300-500	**15-20** 150-300	**20-50** 75-150	50-75	**1**

QA89a **OVERALL SITE RATING** **3**

4. Land Capability Classes – generalised definitions

Rating 1

The effluent envelope is suitable for on-site disposal of septic tank discharge. The limitations or environmental hazard from long-term use are considered very slight. Standard performance measures for design, installation and management should prove satisfactory.

Rating 2

The site has been identified as generally suitable for on-site effluent disposal but there is a slight associated environmental hazard expected. One or more land limitations are present, which may not be compatible with “straight forward” conventional on-site disposal. The wastewater management program will require careful planning, adherence to specifications and adequate supervision.

Rating 3

The site has only a fair capability for on-site effluent disposal with a moderate associated environmental risk always present. Very careful site selection, preparation and specialised design will be required to address the identified land constraints. A management program should be delivered to the responsible authority with the development application and prior to earthworks commencing.

It is recommended that, in order to achieve BPEM, wastewater processing systems which can attain a higher level of treatment with basic monitoring should be considered as an alternative to standard conventional trench disposal.

Rating 4

Areas have a poor capability rating with a high associated environmental risk. Considerable difficulties are expected during siting and installation of the wastewater treatment system and during routine operation. A very high engineering input and close supervision would be needed to minimise the environmental impact.

Alternative wastewater processing systems capable of consistently producing a high-quality secondary effluent (such as aerated wastewater treatment plants) together with a close monitoring program should be seriously investigated and adopted.

Rating 5

Areas have a very poor capability and there is a severe associated environmental risk. The areas are not generally considered suitable for disposal of septic tank effluent by trench systems. The high levels of engineering input and management needed at all stages are unlikely to adequately address the identified land constraints and achieve a sustainable outcome.

It is strongly recommended that consideration be given to connecting the subdivision to a nearby sewer network. If this is not possible, a substantially larger-than-average land application area is usually the only alternative.

5. The Management Program

This LCA has been prepared to accompany a development application to Moyne Shire Council for an on-site septic system. As such, this report provides recommendations for treatment and land application systems that are appropriate to land capability. The following sections provide an overview of a suitable system, with sizing and design considerations and justification for its selection. Detailed design for the system is beyond the scope of this study, but should be undertaken at the time of building application and submitted to council.

5.1 Treatment System

Reference to the Land Capability Assessment Matrix above shows that the site has been assigned an overall site rating of 3.

Due to this rating, we strongly recommend that the treatment system provides secondary treatment to meet Environmental Protection Authority requirements for irrigation.

The system must be approved by the EPA and issued with a numbered Certificate of Approval. The local council must also issue a permit prior to the installation of the unit. To treat all waste, septic tanks must have a capacity of 3200 litres. It is recommended that an aerated wastewater treatment system (AWTS) be used to achieve the desired level of performance.

5.2 Land Application

The preferred system is pressure compensating subsurface irrigation in combination with the selected secondary treatment system. Subsurface irrigation will provide even and widespread dispersal of highly treated effluent loads within the root-zone of plants. Subsurface irrigation will provide beneficial reuse of wastewater and will also ensure that the risk of effluent being transported off the site will be negligible.

The 7 lots are required to be serviced by wastewater treatment systems (see **Appendix A** for further details). Each lot's land application area must be subdivided into at least two separate fields (minimum 225m^2 each) that can be watered alternately. An automatic indexing valve generically known as a 'roto-valve' can be used to allow alternation between the areas with each pump cycle.

5.3 Sizing the Land Application Area

To determine the necessary size of the irrigation area water and nutrient balance modelling has been undertaken in accordance with EPA Publication 168(1991) *Guidelines for Wastewater Irrigation).* The results show that the required irrigation area is 450m^2, the larger of the areas calculated by the water and nutrient balance.

Balance Calculation	Area required
Water Balance	**450m^2**
Nitrogen Balance	358m^2
Phosphorous Balance	392m^2

The calculations are summarised below, with full details in **Appendix. C**.

Water Balance

The water balance can be expressed by the following equation:

Precipitation + Effluent Applied = Evapotranspiration + Percolation

Data used in the water balance includes:

- Mean monthly rainfall, mean monthly pan evaporation (Warrnambool Airport 090172 gauge);
- Average daily effluent load - 900 L;
- Design loading rate (DLR) – 3.5 mm/day; (Imperfectly drained)
- Crop factor - 0.8; and
- Retained rainfall 80%. (some natural runoff due to slope)

The nominated area method is used to calculate the area required to balance all inputs and outputs, without the need for wet weather storage. As a result of these calculations, at least 450m^2 of area is required to achieve zero wet weather storage. A backup system of the same size (450m^2) should also be installed to prevent the design irrigation system from becoming overloaded during times of peak usage, resulting in a total area of 900m^2 per site.

Nutrient Balance

A nutrient balance has been undertaken to check that the LAA is of sufficient size to ensure nutrients are assimilated by the soils and vegetation. The model used here is based on simplistic methodology, but improves on this by incorporating more variables in the respective nutrient cycles to more accurately model actual processes. It acknowledges that a proportion of nitrogen will be retained in the soil through processes such as mineralisation (the conversion of organic nitrogen and ammonia) and volatilisation (Geary and Gardner 1996). It also accounts for crop growth rates (and hence nutrient uptake rates) for a typical pasture.

Some assumptions used in the modelling follow:

- Hydraulic loading - 900 mg/L [1];
- Nitrogen concentration in effluent - 30 mg/L [1];
- Nitrogen percentage lost to soil processes - 20%
- Phosphorus concentration in effluent - 10 mg/L [1];
- Critical nutrient loading rates - 220 kg/ha/year (60 mg/m^2/day) for nitrogen and 50 kg/ha/year (14 mg/m2/day) for phosphorus [2];
- Soil phosphorus sorption capacity - 3375 kg/ha of soil [3];
- Proportion of phosphorus sorption capacity utilised - 50%; and
- Design life of system - 50 years.

The area required for nitrogen assimilation is 358 square metres, while phosphorus requires 392 square metres.

Summary and Discussion

The preferred irrigation area is based on the larger of the water and nutrient balance calculations. An area of at least 450 square metres plus a backup area of equal size must be provided, for a total area of 900 square metres per site. It is worth noting that the modelling includes several significant factors of conservatism:

- Hydraulic load (900 l/day) - this assumes 6 people will permanently occupy a 4-bedroom residence. It is likely that the actual occupancy will be less than this;
- From the nutrient balances, in the absence of site-specific data very conservative estimates of crop nutrient uptake rates and total nitrogen lost to soil processes have been adopted.
- A backup land application area of 450m^2 has been provided in the event that the design irrigation area becomes overloaded;

5.4 Siting and Configuration of the Land Application Area

The land application area should be isolated from high pedestrian and/or vehicle traffic areas, be excluded from areas where livestock have access to and be protected from rainwater runoff/run-on by a diversion drain configured like the one designated on the site plan in **Appendix A**.

Appendix A shows an indicative envelope of land that is suitable for effluent management. The client will be allowed flexibility in selecting the final location and configuration of the septic system when applying for their on-site wastewater application through council providing it remains in accordance with the EPA Publication 891.4 (2016) *Code of practice – onsite wastewater management* & Australian Standards.

Appendix A shows an indicative area, to scale, of the minimum area required according to the water and nutrient balance.

It is recommended that the owner consult an irrigation expert familiar with wastewater irrigation equipment, to help design and install the irrigation system. The irrigation plan must ensure good, even application of effluent.

Irrigation lines should be installed along the contour where possible. When irrigation lines need to be installed down a slope then non leakage emitters must be installed to manufactures specifications. For slopes greater than 10% the DIR value should be reduced by the figure shown in Table M2 AS/NZS 1547:2012.

5.5 Irrigation System Description

Secondary treatment systems (treats all household wastes) which are commercially available are one option which complies with all requirements. Sand filters are also available assuming that they produce effluent that complies with all requirements.

The irrigation area shall be located away from vehicle crossings and vehicle access points.

No trees are to be planted inside the irrigated area. Trees are to be planted around the irrigated area.

Effluent shall not be used for irrigating fruit or vegetables.

An adequate cover of fertile and porous topsoil material will be provided and vegetation will be established when the irrigation areas have a low soil permeability.

DN25 and DN12 class 12 poly feeder pipes are to be used to distribute the effluent around the irrigation area. A minimum coverage of 250mm is needed.

All irrigation fittings and pipe work must comply with AS1477 or AS2698.2. and must be able to withstand at least 150% of the shut off head of the pump.

5.6 Buffer Distances

Buffer distances from LAAs are required to help prevent human contact, maintain public amenity and protect sensitive environments. Council generally adopts the following nominal buffers, described in EPA Publication 891.4 (2016) *Code of practice – onsite wastewater management* Table 5.

- 20 metres from potable or non-potable groundwater bores
- 60 metres from watercourses that are non potable; and
- 100 metres from watercourses in a potable water supply catchment.
- 6 metres if area up-gradient and 3 metres if area down-gradient of property boundaries, swimming pools and buildings.

All nominal buffers are achieved.

Buffer distance may be reduced by 50% if the effluent is treated through a secondary treatment system.

6 Monitoring, Operation and Maintenance

Maintenance is to be carried out in accordance with the certificate of approval and Council's permit conditions. The system proposed above will only function adequately if appropriately maintained. Residents will be required to carry out maintenance as discussed below.

To ensure the treatment system functions adequately, residents must:

- Restrict the use of germicides (such as strong detergents, disinfectants, toilet cleaners and bleaches) as they will kill the bacteria which makes the septic work.

- Inspect the system at least annually and desludge the tank at least once every three years, or as otherwise directed by the council.

- Keep a record of all maintenance (including tank pump-outs and the location of the system, tank inspection and access openings) and send copies of the maintenance reports to the local council in accordance with the septic tank permit and Certificate of Approval.

- Do not add or alter any part of your system without council approval.

- Ensure that only suitable trained persons work on the system.

- Check sludge level, pumps and alarms regularly.

- Arrange for an inspection of the system, at least annually.

- Pump out the tank in accordance with the permit conditions.

To ensure the land application system functions adequately, residents must:

- Regularly harvest (mow) vegetation within the LAA and remove this to maximise uptake of water and nutrients.

- Monitor and maintain the subsurface irrigation system following the manufacturer's recommendations, including flushing of irrigation lines.

- Regularly clean in-line filters;

- Not erect any structures over the LAA;

- Minimise vehicle access to the LAA, to prevent compaction; and

- Ensure that the LAA is kept level by filling any depressions with good quality topsoil (not clay).

Good water conservation is an important aspect in the overall management of onsite systems. It will be important for the ongoing performance of both the treatment and land application system that they are not overloaded hydraulically. AAA rated plumbing is recommended for all future water fixtures.

7. Stormwater Management

As mentioned above, stormwater run on may occur at this site. The construction and maintenance of a diversion drain will mitigate this risk – see the Site Plan in Appendix A. Roof stormwater must not be disposed in the LAA.

8. Conclusions

As a result of our investigations we recommend that a sustainable onsite wastewater management system can be built at Hopkins Highway, Purnim.

Specifically, we recommend the following:

- Installation of a septic tank with a min. 3200L capacity;
- Secondary treatment of wastewater in either an Aerated Wastewater Treatment System (AWTS), or intermittently-dosed single-pass sand filter (either system will need to be EPA approved);
- Land application of wastewater within a 450 m^2 subsurface irrigation area subdivided into at least two separate fields (225m^2). A water rotor will be used to dose load the two fields alternately;
- A backup system of the same area (450m^2) should be provided for the event of the design system becoming overloaded;
- Installation of water saving devices in the new building to reduce the effluent load for onsite disposal;
- Use of low phosphorus and low sodium (liquid) detergents to improve effluent quality and maintain soil properties;
- Operation and management of the treatment and disposal system in accordance with manufacturer's recommendations and the recommendations made in this report; and

SITE CLASSIFIER: [redacted]

SITEC PTY. LTD
Assoc. Deg Eng (Civil)

Signature: [redacted]

APPENDIX A

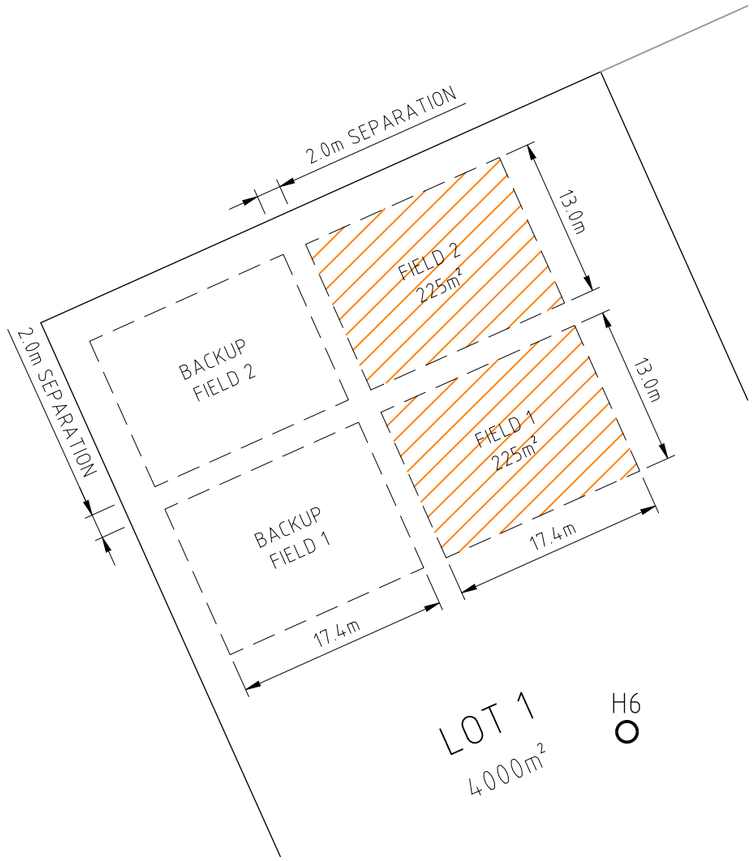
Site Plan

SITEC CONSULTING ENGINEERS
184 Fairy Street
Warrnambool Vic 3280
E: info@sitecvic.com.au P: (03) 5561 3939

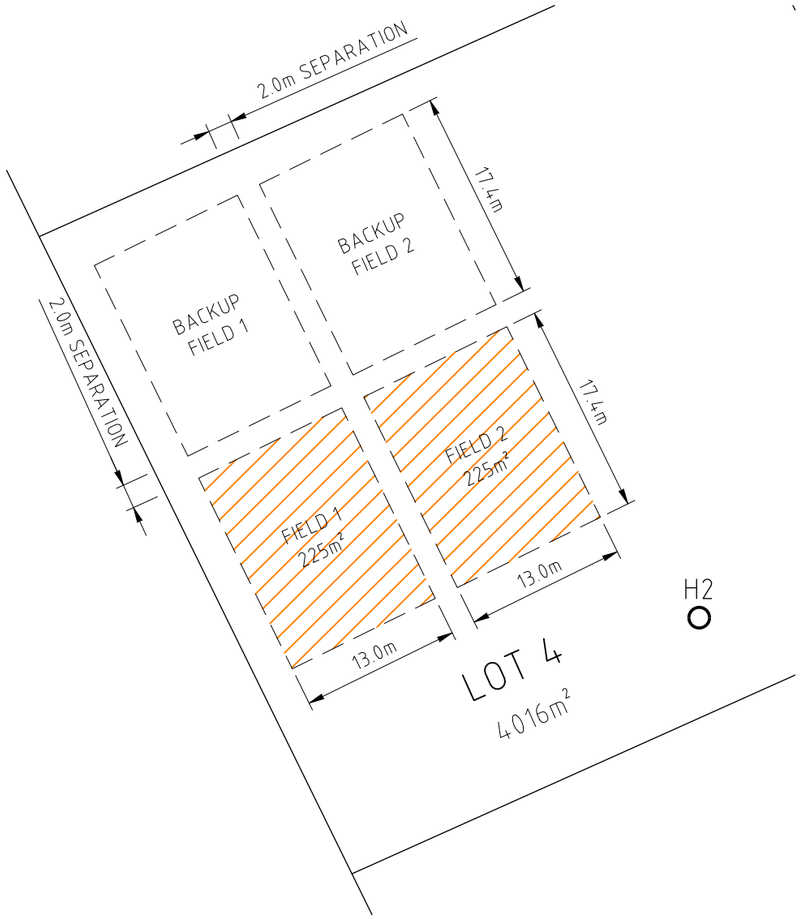
PROJECT

PROPOSED 7 LOT SUBDIVISION
HOPKINS HIGHWAY
PURNIM
LAND APPLICATION AREA

SIZE	SCALE	PROJECT No.	SHEET No.	REV
A3	1:1000	20-321	1 OF 2	-



TYPICAL LAYOUT DETAIL
SCALE 1:500



LOT 4 LAYOUT DETAIL
SCALE 1:500

LEGEND:

ASSUMED LAND APPLICATION AREA

H1 BORE HOLE LOCATION

SITEC CONSULTING ENGINEERS
184 Fairy Street
Warrnambool Vic 3280
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PROJECT

PROPOSED 7 LOT SUBDIVISION
HOPKINS HIGHWAY
PURNIM
LAYOUT DETAILS

SIZE	SCALE	PROJECT No.	SHEET No.	REV
A3	AS SHOWN	20-321	2 OF 2	-

APPENDIX B

Percolation Data

SOIL PERCOLATION TEST RECORD

Location: Hopkins Hwy, Purnim VIC 3278
Test Conducted By: SITEC
Date: 31/03/2009

Auger Radius=	5.5	cm
Ave Depth of Hole=	45	cm
Ave Depth of Water=	36.0	cm

HOLE 1	
MINUTES	DROP IN WATER LEVEL (cm)
10	11.9
20	11.8
30	11.3
40	10.6
50	10.4
60	10.1
Total Drop	**66.1**

HOLE 2	
MINUTES	DROP IN WATER LEVEL (cm)
10	12.7
20	12
30	11.9
40	11.7
50	11.3
60	11.3
Total Drop	**70.9**

HOLE 3	
MINUTES	DROP IN WATER LEVEL (cm)
10	16.6
20	16.5
30	16
40	15.7
50	15.6
60	15.6
Total Drop	**96**

HOLE 4	
MINUTES	DROP IN WATER LEVEL (cm)
10	7.9
20	7.8
30	7.4
40	7.2
50	6.4
60	6.4
Total Drop	**43.1**

HOLE 5	
MINUTES	DROP IN WATER LEVEL (cm)
10	9.1
20	8.7
30	8.7
40	8.6
50	8.2
60	8.2
Total Drop	**51.5**

HOLE 6	
MINUTES	DROP IN WATER LEVEL (cm)
10	6.4
20	6.1
30	6
40	5.9
50	5.3
60	5.3
Total Drop	**35**

HOLE 7	
MINUTES	DROP IN WATER LEVEL (cm)
10	7.1
20	6.5
30	6.2
40	5.9
50	5.8
60	5.8
Total Drop	**37.3**

Average Drop in Water Level	8.95714286	cm	
Average Rate of Loss	85.11	cm^3/min	
K_{sat}	0.026701	cm/min	
K_{sat}	**0.38**	**m/d**	**0.000004**

$$K_{sat} = \frac{4.4Q\left[0.5sinh^{-1}\left(\frac{H}{2r}\right) - \sqrt{\left\{\left(\frac{r}{H}\right)^2 + 0.25\right\}} + \frac{r}{H}\right]}{2\pi H^2}$$

As per AS/NZ 1547:2012

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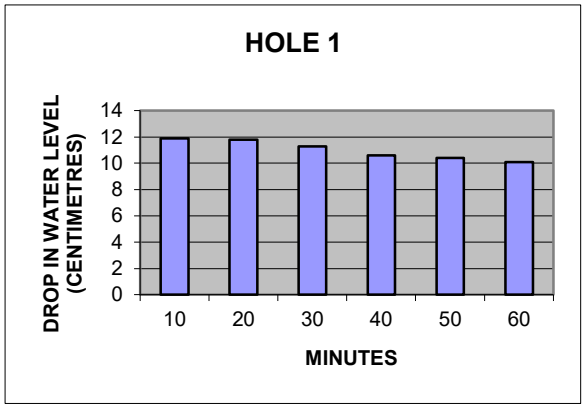

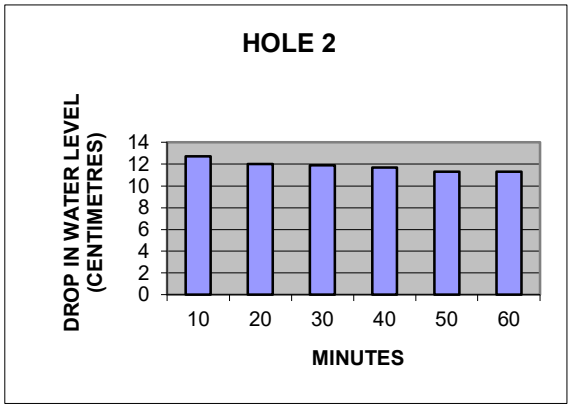

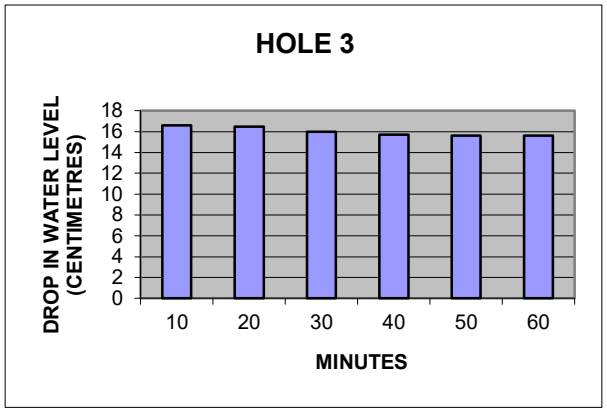

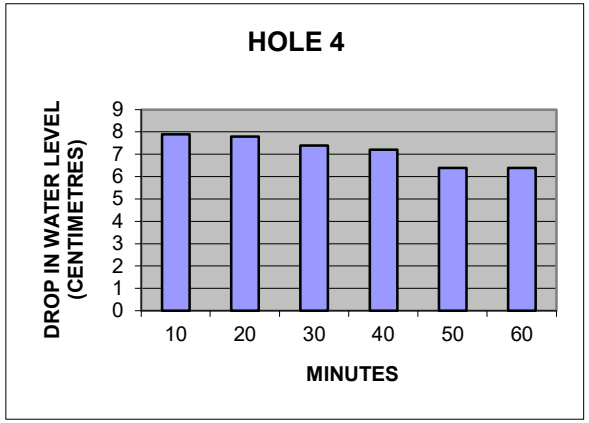

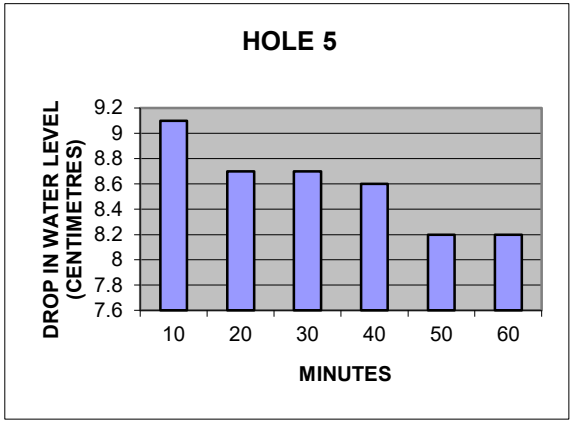

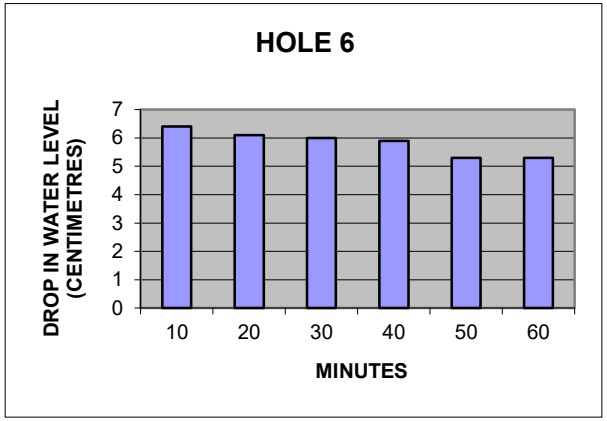

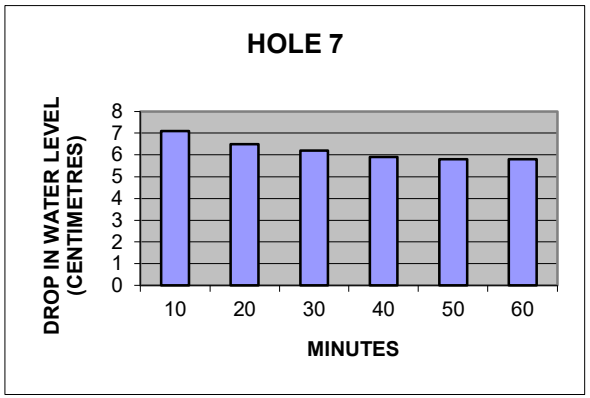

APPENDIX C

Water & Nutrient Balance

Nominated Area Water Balance & Storage Calculations

Site Address **1707 Hopkins Hwy, Purnim** **Job No: 20-321**

INPUT DATA			**NOTES**	
Design Wastewater Flow (L/day)	Q	900	Based on 4br/5 person house @ 150 L/p/day	(Table 4) EPA 891.4
Design DLR (mm/week)	DLR	24.5		(Table H2) AS/NZS 1547:2012
Daily DIR (mm/day)		3.5		Table M1 AS/NZS 1547:2012
Nominated Land Application Area (m^2)	L	450		
Crop Factor	C	0.7-0.8		
Retained Rainfall	Rf	0.8	Assume some natural runoff from site due to slope	
Rainfall Data		Warrnambool Airport NDB - 090186		
Evaporation Data		BOM Average - West Coast		

Parameter	**Symbo**	**Formula**	**Units**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Days in Month	D		Days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall - Average	R		mm/month	32.9	32.2	47.9	53.3	75.2	77.1	85.7	95	73.7	61.8	50.4	46.1	**731.3**
Evaporation - Average	E		mm/month	180	175	140	90	60	35	45	55	70	125	140	170	**1300**
Crop Factor	C			0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	
OUTPUTS																
Evaportransporation	ET		mm/month	80	65	50	35	30	30	30	30	45	75	90	85	**645**
Percolation	B		mm/month	108.5	98.0	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	**1277.5**
Outputs			mm/month	188.5	163.0	158.5	140.0	138.5	135.0	138.5	138.5	150.0	183.5	195.0	193.5	**1922.5**
INPUTS																
Retained Rainfall	RR		mm/month	26.32	25.76	38.32	42.64	60.16	61.68	68.56	76	58.96	49.44	40.32	36.88	**585.04**
Effluent Irrigation	W		mm/month	62.0	56.0	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	**730**
Inputs			mm/month	88.3	81.8	100.3	102.6	122.2	121.7	130.6	138.0	119.0	111.4	100.3	98.9	**1315.04**
STORAGE CALCULATIONS																
Storage remaining from previous month																
Storage from month	S		mm/month	-100.2	-81.2	-58.2	-37.4	-16.3	-13.3	-7.9	-0.5	-31.0	-72.1	-94.7	-94.6	(adjust until <0)

MINIMUM AREA REQUIRED FOR ZERO STORAGE (m2) = **450**

Nitrogen Balance

Site Address **Hopkins Highway, Purnim** **Job No:** **20-321**

Daily N Load

Effluent concentration N	30	mg/l	
Daily Hydraulic Load	900	l/day	
Daily Load	27000	mg/day	
Annual N Load	9855000	mg/year	

Losses

Estimate losses through denitrification, volatilzation, microbial attack

Loss	20%		
Annual N Load	7.884	Kg/year	
Allow for uptake by plants	220	kgN/Ha/yr	maintained grass
Minimum Area Required	**358**	m2	

Phosphorus Balance

Daily P Load

Effluent concentration P	10	mg/l	
Daily Hydraulic Load	900	l/day	
Daily Load	9000	mg/day	
Annual N Load	3285000	mg/year	

Losses

Determine P sorption each year for 50 years

3375/50x0.5	33.75	actual field sorption multiplier	
Allow for uptake by plants	50	kgN/Ha/yr	maintained grass
Minimum Area Required	**392**	m2	

APPENDIX D

Soil Borehole Logs

184 FAIRY STREET
WARRNAMBOOL VICTORIA 3280
Phone (03) 5561 3939

Engineering Bore Logs

Borehole No: 1
Sheet No: 1
Job No: 20-321

Client:	St Joseph's Parish	Date:	31/03/2009
Project:	Proposed 7 Lot Subdivision	Logged By:	T.Greening
Location:	1707 Hopkins Highway, Purnim		
Drill model: Truline trailer mounted	Slope 90 deg	RL Surface:	N.A
Hole Diameter: 100mm	Bearing - deg	Datum:	N.A

Material Description	Depth (mm)	Graphic Log	Water	Moisture Condition	Unified Classification	Structure, additional observations	Notes Samples Tests	Method	Support
TOPSOIL Silty Sandy topsoil, dark brown, soft, dry, some fine gravels				D		< 100 kPa			
CLAY Silty clay, dark brown, firm, moist, medium plasticity	700			M	CL	> 100 kPa			
CLAY Silty clay, light brown, firm, moist, medium plasticity, some medium gravels, with orange rock flour	1000			M	CH	> 100 kPa			
TERMINATED	1500								

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Engineering Bore Logs

Borehole No: **2**
Sheet No: 2
Job No: 20-321

Client:	St Joseph's Parish	Date:	31/03/2009
Project:	Proposed 7 Lot Subdivision	Logged By:	T.Greening
Location:	1707 Hopkins Highway, Purnim		
Drill model: Truline trailer mounted	Slope 90 deg	RL Surface:	N.A
Hole Diameter: 100mm	Bearing - deg	Datum:	N.A

Material Description	Depth (mm)	Graphic Log	Water	Moisture Condition	Unified Classification	Structure, additional observations	Notes Samples Tests	Method	Support
TOPSOIL Silty Sandy topsoil, dark brown, soft, dry, some fine gravels				D		< 100 kPa			
SILT Sandy silt, light brown, soft, dry, fine sands	600			D	ML	< 100 kPa			
CLAY Silty clay, light brown, firm, moist, medium plasticity, some medium gravels, with orange rock flour	800			M	ML	> 100 kPa			
CLAY Silty clay, light brown, high plasticity, stiff, moist	1000			M	CH	> 100 kPa			
TERMINATED	1500								

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Engineering Bore Logs

Borehole No: **3**
Sheet No: 3
Job No: 20-321

Client:	St Joseph's Parish	Date:	31/03/2009
Project:	Proposed 7 Lot Subdivision	Logged By:	T.Greening
Location:	1707 Hopkins Highway, Purnim		
Drill model: Truline trailer mounted	Slope 90 deg	RL Surface:	N.A
Hole Diameter: 100mm	Bearing - deg	Datum:	N.A

Material Description	Depth (mm)	Graphic Log	Water	Moisture Condition	Unified Classification	Structure, additional observations	Notes Samples Tests	Method	Support
TOPSOIL Silty Sandy topsoil, dark brown, soft, dry, some fine gravels				D		< 100 kPa			
SILT Sandy silt, light brown, soft, dry, fine sands	600			D	ML	< 100 kPa			
CLAY Silty clay, light brown, high plasticity, stiff, moist	900			M	CH	> 100 kPa			
TERMINATED	1500								

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Engineering Bore Logs

Borehole No: **4**
Sheet No: 4
Job No: 20-321

Client:	St Joseph's Parish	Date:	31/03/2009
Project:	Proposed 7 Lot Subdivision	Logged By:	T.Greening
Location:	1707 Hopkins Highway, Purnim		
Drill model: Truline trailer mounted	Slope 90 deg	RL Surface:	N.A
Hole Diameter: 100mm	Bearing - deg	Datum:	N.A

Material Description	Depth (mm)	Graphic Log	Water	Moisture Condition	Unified Classification	Structure, additional observations	Notes Samples Tests	Method	Support
TOPSOIL Silty Sandy topsoil, dark brown, soft, dry, some fine gravels				D		< 100 kPa			
CLAY Silty clay, dark brown, firm, moist, medium plasticity	700			M	CL	> 100 kPa			
CLAY Silty clay, light brown, high plasticity, stiff, moist	1000			M	CH	> 100 kPa			
TERMINATED	1500								

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Engineering Bore Logs

Borehole No: **5**
Sheet No: 5
Job No: 20-321

Client:	St Joseph's Parish	Date:	31/03/2009
Project:	Proposed 7 Lot Subdivision	Logged By:	T.Greening
Location:	1707 Hopkins Highway, Purnim		
Drill model: Truline trailer mounted	Slope 90 deg	RL Surface:	N.A
Hole Diameter: 100mm	Bearing - deg	Datum:	N.A

Material Description	Depth (mm)	Graphic Log	Water	Moisture Condition	Unified Classification	Structure, additional observations	Notes Samples Tests	Method	Support
TOPSOIL Silty Sandy topsoil, dark brown, soft, dry, some fine gravels				D		< 100 kPa			
CLAY Silty clay, dark brown, firm, moist, medium plasticity	800			M	CL	> 100 kPa			
CLAY Silty clay, light brown, high plasticity, stiff, moist	1000			M	CH	> 100 kPa			
TERMINATED	1500								

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Engineering Bore Logs

Borehole No: **6**
Sheet No: 6
Job No: 20-321

Client:	St Joseph's Parish	Date:	31/03/2009
Project:	Proposed 7 Lot Subdivision	Logged By:	T.Greening
Location:	1707 Hopkins Highway, Purnim		
Drill model: Truline trailer mounted	Slope 90 deg	RL Surface:	N.A
Hole Diameter: 100mm	Bearing - deg	Datum:	N.A

Material Description	Depth (mm)	Graphic Log	Water	Moisture Condition	Unified Classification	Structure, additional observations	Notes Samples Tests	Method	Support
TOPSOIL Silty Sandy topsoil, dark brown, soft, dry, some fine gravels				D		< 100 kPa			
CLAY Silty clay, dark brown, firm, moist, medium plasticity, some medium gravels, with orange rock flour	800			M	CH	> 100 kPa			
TERMINATED	1500								