Assessing A20 permit applications for onsite wastewater management systems

Training for Council Officers

Checking the Calculations

Checking the calculations

- In a typical LCA there are several calculations which need to be checked
  - Design flow rate (daily hydraulic load)
  - System sizing
    - Hydraulic equation (loading rate method)
    - Water and nutrient balance
    - Setback (buffer) distance estimation using a risk-based approach (refer to Section 6)

Design flow rate

- Refer to the Guideline for onsite wastewater management (GOWM; Section 4.2)
- Households with reticulated water and WELS fixtures and fittings 150 L/person/day
- Households with roof tank water supply and WELS fixtures and fittings 120 L/person/day
- Check, or be reasonably satisfied, that these WELS fixtures and fittings have been/will be installed

Design flow rate

- Higher rates for households with standard water fixtures
- Occupancy (persons) based on number of bedrooms + 1, i.e. 3 bedrooms = 4 persons
- Remember to consider other rooms that can be potentially converted to bedrooms
- Reconcile with potable water meter or flow meter data, if available

Non-domestic premises

- Occupancy of short term rental premises is often higher than domestic (i.e. two persons per bedroom)
- Non-domestic premises really require metered data – always require installation of a meter and reporting of water usage data
- May have to design on usage data from similar premises or refer Table 4-4 in GOWM
- Consider organic loads

Design flow rate

- What is the design flow rate for a five bedroom house with WELS fixtures and fittings on reticulated water supply?
- Five bedrooms
- Occupancy (five bedrooms + 1) = 6 persons
- 150 Litres/person/day
- 6 x 150 = 900 Litres/day

Design flow rate

- What is an appropriate design flow rate for a four bedroom Airbnb property with WELS fixtures and fittings on reticulated water supply?
- Four bedrooms
- Occupancy (four bedrooms x 2) = 8 persons
- 150 Litres/person/day
- 8 x 150 = 1,200 Litres/day

Water and nutrient balances

- MAV VLCAF water and nutrient balances available at:

https://www.mav.asn.au/what-we-do/policy-advocacy/environment-water/on-site-domestic-wastewater-management

- See large format versions following at end of Section

Victorian Land Capability Assessment Framework

Please read the attached notes before using this spreadsheet

Irrigation area sizing using Nominated Area Water Balance & Storage Calculations

Site Address:		**Lot 585 Bundalaguah Road, Maffra**		
Date:			**Assessor:**	
INPUT DATA				
Design Wastewater Flow	Q	750	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2013)
Design Irrigation Rate	DIR	3.5	mm/day	Based on soil texture class/permeability and derived from Table 9 in the EPA Code of Practice (2013)
Nominated Land Application Area	L	267	m²	
Crop Factor	C	0.6-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type[2]
Rainfall Runoff Factor	RF	1	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data		East Sale Airport (085072)		BoM Station and number
Mean Monthly Pan Evaporation Data		East Sale Airport (085072)		BoM Station and number

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365
Rainfall	R		mm/month	45.4	42.5	48.9	48.2	51.7	45.7	41.4	46	51.7	58.1	63.8	54.3	597.7
Evaporation	E		mm/month	198.4	162.4	136.4	87	52.7	42	46.5	65.1	93	124	153	186	1346.5
Crop Factor	C		unitless	0.80	0.80	0.70	0.70	0.60	0.60	0.60	0.60	0.70	0.80	0.80	0.80	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	159	130	95	61	32	25	28	39	65	99	122	149	1004.3
Percolation	B	DIRxD	mm/month	108.5	98	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	1277.2
Outputs		ET+B	mm/month	267.4	227.92	204.5	165.9	140.1	130.2	136.4	147.6	170.1	207.7	227.4	257.3	2281.6
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	45.4	42.5	48.9	48.2	51.7	45.7	41.4	46	51.7	58.1	63.8	54.3	597.7
Applied Effluent	W	(QxD)/L	mm/month	87.1	78.7	87.1	84.3	87.1	84.3	87.1	87.1	84.3	87.1	84.3	87.1	1025.3
Inputs		RR+W	mm/month	132.5	121.2	136.0	132.5	138.8	130.0	128.5	133.1	136.0	145.2	148.1	141.4	1623.0
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-134.7	-106.8	-68.0	-33.4	-1.3	-0.2	-7.9	-14.5	-34.1	-62.5	-79.3	-115.9	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	135												
		Mat.	L	0												
LAND AREA REQUIRED FOR ZERO STORAGE			m²	166	113	150	191	263	266	245	229	190	155	138	115	
MINIMUM AREA REQUIRED FOR ZERO STORAGE:				267.0	m²											

CELLS

	Please enter data in blue cells
XX	Red cells are automatically populated by the spreadsheet
XX	Data in yellow cells is calculated by the spreadsheet, DO NOT ALTER THESE CELLS

NOTES

This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

Values selected are suitable for pasture grass in Victoria

Victorian Land Capability Assessment Framework

Please read the attached notes before using this spreadsheet

Nutrient Balance

Site Address:	**Lot 585 Bundalaguah Road, Maffra**						
SUMMARY - LAND APPLICATION AREA REQUIRED BASED ON MOST LIMITING NUTRIENT BALANCE						249	m²
INPUT DATA[1]							
Wastewater Loading				**Nutrient Crop Uptake**			
Hydraulic Load	750	L/day	Crop N Uptake	220	kg/ha/yr	which equals 60.27	mg/m²/day
Effluent N Concentration	25	mg/L					
% N Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal					
Total N Loss to Soil	3750	mg/day					
Remaining N Load after soil loss	15000	mg/day					

NUTRIENT BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer			**Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)**		
Nitrogen	249	m²	Nominated LAA Size	267	m²
			Predicted N Export from LAA	-0.40	kg/year
			Minimum Buffer Required for excess nutrient	9	m²

CELLS

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NOTES

[1] Model sensitivity to input parameters will affect the accuracy of the result obtained. Where possible site specific data should be used. Otherwise data should be obtained from a reliable source such as:

- *EPA Guidelines for Effluent Irrigation*
- *Appropriate Peer Reviewed Papers*
- *Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households*
- *USEPA Onsite Systems Manual*

Water and nutrient balances

- Water and nutrient balances require the use of information (data) on:
  - Soil characteristics
  - Site characteristics
  - Vegetation type (of the irrigation area)
  - Local climate
- Important that the above data is representative of the design site

Water balance data required

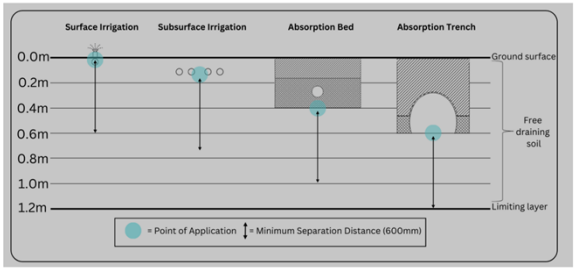
- To complete a water balance, the following input data is required:
  - Design flow rate (Q)
  - Design Irrigation Rate (DIR) for soil
  - Crop factor (C)
  - Rainfall runoff factor (RF)
  - Rainfall data (mean or median)
  - Evaporation data (mean)

Design Irrigation Rate (DIR)

- Design Irrigation Rate obtained from:
  - Table 4.9 (GOWM)
  - Table M1 (AS/NZS 1547:2012)
- DIR needs to be appropriate for soil
- Based on limiting layer within 0.6m of point of application, i.e. at depth of:
  - 0.6m for surface irrigation
  - 0.7 - 0.75m for subsurface irrigation
- Therefore, most commonly should be based on subsoil, not topsoil
- May need to adjust for slope (Table M2 AS1547)

Point of Application

Point of Application (POA) – The point at which treated effluent is applied to the soil. This is the level of the emitters in an irrigation system or the base of a bed or trench system.



Crop factor (C)

- Table 21 in GOWM suggests crop factors from EPA VIC Publication 168 (1983)

Table 21: Monthly crop factors[6]

Vegetation type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pasture	0.70	0.70	0.70	0.60	0.50	0.45	0.40	0.45	0.55	0.65	0.70	0.70
Lucerne	0.95	0.90	0.85	0.80	0.70	0.55	0.55	0.65	0.75	0.85	0.95	1.00

- These differ from those in the MAV VLCAF spreadsheet

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pasture	0.80	0.80	0.70	0.70	0.60	0.60	0.60	6.00	0.70	0.80	0.80	0.80

Victorian Land Capability Assessment Framework

Please read the attached notes before using this spreadsheet

Irrigation area sizing using Nominated Area Water Balance & Storage Calculations

Site Address:	Lot 585 Bundalaguah Road, Maffra		
Date:		**Assessor:**	

INPUT DATA

Design Wastewater Flow	Q	750	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2013)
Design Irrigation Rate	DIR	3.5	mm/day	Based on soil texture class/permeability and derived from Table 9 in the EPA Code of Practice (2013)
Nominated Land Application Area	L	288	m^2	
Crop Factor	C	0.4-0.7	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type[2]
Rainfall Runoff Factor	RF	1	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data		East Sale Airport (085072)		BoM Station and number
Mean Monthly Pan Evaporation Data		East Sale Airport (085072)		BoM Station and number

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365
Rainfall	R		mm/month	45.4	42.5	48.9	48.2	51.7	45.7	41.4	46	51.7	58.1	63.8	54.3	597.7
Evaporation	E		mm/month	198.4	182.4	136.4	87	52.7	42	46.5	65.1	93	124	153	186	1346.5
Crop Factor	C		unitless	0.70	0.70	0.70	0.60	0.50	0.45	0.45	0.45	0.55	0.65	0.70	0.70	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	139	114	95	52	26	19	19	29	51	81	107	130	862.435
Percolation	B	DiffxD	mm/month	108.5	98	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	1277.5
Outputs		ET+B	mm/month	247.4	211.68	204.5	157.2	134.9	123.0	127.1	137.8	156.2	189.1	212.1	238.7	2139.9
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	45.4	42.5	48.9	48.2	51.7	45.7	41.4	46	51.7	58.1	63.8	54.3	597.7
Applied Effluent	W	(QxD)/L	mm/month	80.7	72.9	80.7	78.1	80.7	78.1	80.7	80.7	78.1	80.7	78.1	80.7	950.5
Inputs		RR+W	mm/month	126.1	115.4	129.6	126.3	132.4	123.8	122.1	126.7	129.8	138.8	141.9	135.0	1548.2
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-121.3	-96.3	-74.4	-30.9	-2.4	-0.1	-5.0	-11.1	-26.3	-50.3	-70.2	-103.7	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm				0.00									
		Max					0									
			m	115	134	150	206	280	288	271	253	215	177	152	126	
LAND AREA REQUIRED FOR ZERO STORAGE																
MINIMUM AREA REQUIRED FOR ZERO STORAGE:							288.0	m^2								

CELLS

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NOTES

This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

Values selected are suitable for pasture grass in Victoria

Crop factor (C)

- GOWM crop factor data increases required irrigation area in MAV VLCAF spreadsheet example from 267m^2 to 288m^2
- By comparison, the same irrigation area calculated using the hydraulic equation A = Q / DIR

  A = 750 Litres/day / 3.5 mm/day (L/m^2/d) = 215m^2

Rainfall runoff factor (RF)

- Retained rainfall is the proportion of rainfall that will percolate into the soil
- The VLCAF water balance spreadsheet assumes that all rainfall will percolate into the soil, hence the default value for the rainfall runoff factor (RF) is 1.0
- Where the ground surface is inclined or mounded, some rainfall may be assumed to run off
  - Flat ground with sandy soil, RF = 1.0
  - Sloping ground with clay soil, RF = 0.75

Rainfall runoff factor (RF)

- Implications of changing RF value from 1.0 to 0.75 for same soil
- Required irrigation area:

  for RF = 1.0 is 288m²

  for RF = 0.75 is 252m²

- Although this was a locked cell in the MAV VLCAF spreadsheet, modified spreadsheets with this cell open to alteration are not uncommonly used
- Any alteration of RF needs justification

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Victorian Land Capability Assessment Framework

Please read the attached notes before using this spreadsheet

Irrigation area sizing using Nominated Area Water Balance & Storage Calculations

Site Address: Lot 585 Bundalaguah Road, Maffra

Date: **Assessor:**

INPUT DATA

Design Wastewater Flow	Q	750	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2013)
Design Irrigation Rate	DIR	3.5	mm/day	Based on soil texture class/permeability and derived from Table 9 in the EPA Code of Practice (2013)
Nominated Land Application Area	L	252	m^2	1
Crop Factor	C	0.4-0.7	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type[2]
Rainfall Runoff Factor	RF	0.75	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data	East Sale Airport (085072)			BoM Station and number
Mean Monthly Pan Evaporation Data	East Sale Airport (085072)			BoM Station and number

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	R		mm/month	45.4	42.5	48.9	48.2	51.7	45.7	41.4	46	51.7	58.1	63.8	54.3	**597.7**
Evaporation	E		mm/month	198.4	162.4	136.4	87	52.7	42	46.5	65.1	93	124	153	186	**1346.5**
Crop Factor	C		unitless	0.70	0.70	0.70	0.60	0.50	0.45	0.40	0.45	0.55	0.65	0.70	0.70	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	139	114	95	52	26	19	19	29	51	81	107	130	**862.435**
Percolation	B	DIRxD	mm/month	108.5	98	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	**1277.5**
Outputs		ET+B	mm/month	247.4	211.68	204.0	157.2	134.9	123.9	127.1	137.8	156.2	189.1	212.1	238.7	**2139.9**
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	34.05	31.875	36.675	36.15	38.775	34.275	31.05	34.5	38.775	43.575	47.85	40.725	**448.275**
Applied Effluent	W	(QxD)/L	mm/month	92.3	83.3	92.3	89.3	92.3	89.3	92.3	92.3	89.3	92.3	89.3	92.3	**1086.3**
Inputs		RR+W	mm/month	126.3	115.2	128.9	125.4	131.0	123.6	123.3	126.8	128.1	135.8	137.1	133.0	**1534.6**
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-121.1	-96.5	-75.0	-31.8	-3.8	-0.3	-3.8	-11.0	-28.1	-53.3	-75.0	-105.7	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	109	117	139	186	242	251	242	225	192	160	137	117	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 252.0 m^2

CELLS

Please enter data in blue cells

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NOTES

1 This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

2 Values selected are suitable for pasture grass in Victoria

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Rainfall data

- MAV VLCAF spreadsheet example uses mean rainfall data, but VLCAF indicates that Councils may require use of other data sets, e.g. 50th percentile (median) etc.
- EDRS Guideline (Section 4.4.2.1) recommends use of 50th percentile (median) data

Site name:	EAST SALE		Site number:	085072									
Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall													
Mean rainfall (mm)	45.1	40.6	48.7	48.5	49.6	47.3	40.2	46	49.3	58.6	63.3	55.7	592.9
Decile 5 (median) rainfall (mm)	39.4	32.2	39.6	40.1	34.6	39	31.4	42.2	47	53.3	55.6	46.8	595.6

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Rainfall data

- The median is the preferred measure of 'typical' rainfall from the meteorological point of view. An extreme rainfall event will have less effect on the median than the mean
- The use of higher percentiles is 'not recommended' (EDRS Guideline)
- Check to see if rainfall data being used is representative of Site
- Minimum 30-year recent data record important (beware closed station data)

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Rainfall data

- Median monthly rainfall data should be obtained from the closest rainfall station available on the Bureau of Meteorology (BoM) website:

http://www.bom.gov.au/climate/data/index.shtml?bookmark=200

- If local data from a Bureau of Meteorology station is not available, can use SILO:

https://www.longpaddock.qld.gov.au/silo/

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Evaporation data

- The mean daily evaporation data (if available) can also be obtained from the closest climate station available on the Bureau of Meteorology website:

http://www.bom.gov.au/climate/data/index.shtml?bookmark=200

- Mean monthly evaporation data is also available from SILO:

https://www.longpaddock.qld.gov.au/silo/

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SILO – Locality Data

- Mean and median monthly rainfall data and mean monthly evaporation data, suitable for use in and for checking water balance calculations, are tabulated and presented at the end of Section 4
- If using VLCAF spreadsheet remember to convert SILO mean monthly evaporation data to daily data by dividing by the number of days in the month

Water balances

- In some areas of Victoria, where there is heavy rainfall, e.g. Otways, Gippsland etc., or where there are number of successive months where rainfall exceeds evapotranspiration, water balances may indicate a requirement for very large irrigation areas, or may not resolve
- Reducing the DIR may help make them resolve, but generally results in very large area requirements

Water balances

- Water balances can also be used:
  - to size trenches and beds
  - determine the extent to which trenches and beds will store effluent
  - to predict when they might surcharge
- Need to know void space ratio of the media in the trench or bed
  - use 0.3 (30%) for gravel and sand filled trenches or beds
  - can use a higher value 0.5 (50%) for arch trench

Water balances

- Beware use of alternative water balances, often selected, or constructed, to achieve a desired outcome
- Commonly used to support an 'unsustainably small' irrigation area because conservative VLCAF water balance template recommends a larger irrigation area than desired or will fit on the lot
- Beware water balances using Seepage Loss (Peak) values > DIR. Need to reduce Seepage Loss (Peak) value until Mean Daily Seepage Loss = DIR

Water balances

- All applications for Rhizopods should provide a water balance
- Water balances for Rhizopod LAA systems require careful scrutiny to ascertain how frequently pump outs will be required in both the establishment phase (first year or two) and over the longer term
- Are the number of pump outs required affordable / sustainable, and are the homeowners aware of the requirement and likely to comply with it?

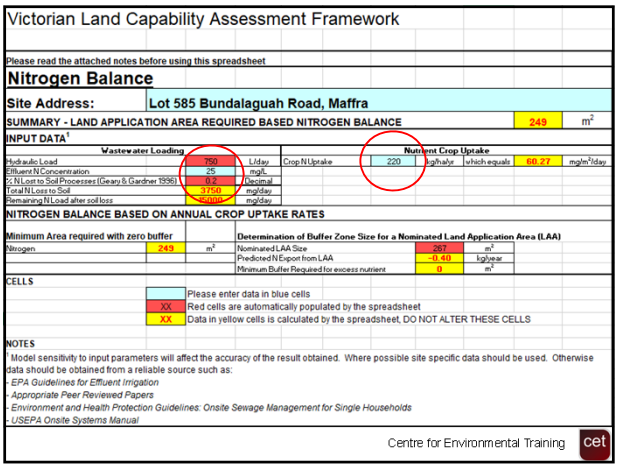
Water balances

- For larger, more complex and non-domestic designs, it may be necessary, or preferable, to use daily soil-water modelling tools such as MEDLI (v2.5)

https://science.desi.qld.gov.au/government/science-division/water-and-coastal/medli

Nutrient balances

- Nutrient balances require data on:
  - effluent nutrient concentrations
  - crop nutrient uptake
- Appropriate effluent nutrient concentrations for Secondary (AWTS) treated effluent:
  - Nitrogen: 25 mg/L (range 20-50 mg/L)
  - Phosphorus: 10 mg/L (range 10-15 mg/L)
- MAV nutrient balance does not assess phosphorus, but remember that sandy soils adsorb little phosphorus (check P-sorption value used)



Victorian Land Capability Assessment Framework

Please read the attached notes before using this spreadsheet

Nitrogen Balance

Site Address: Lot 585 Bundalaguah Road, Maffra

SUMMARY - LAND APPLICATION AREA REQUIRED BASED NITROGEN BALANCE 249 m²

INPUT DATA[1]

Wastewater Loading			Nutrient Crop Uptake				
Hydraulic Load	750	L/day	Crop N Uptake	220	kg/ha/yr	which equals	60.27	mg/m²/day
Effluent N Concentration	25	mg/L						
Cc N Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal						
Total N Loss to Soil	3750	mg/day						
Remaining N Load after soil loss	15000	mg/day						

NITROGEN BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer			Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)		
Nitrogen	249	m²	Nominated LAA Size	267	m²
			Predicted N Export from LAA	-0.40	kg/year
			Minimum Buffer Required for excess nutrient	0	m²

CELLS

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NOTES

[1] Model sensitivity to input parameters will affect the accuracy of the result obtained. Where possible site specific data should be used. Otherwise data should be obtained from a reliable source such as:

- *EPA Guidelines for Effluent Irrigation*
- *Appropriate Peer Reviewed Papers*
- *Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households*
- *USEPA Onsite Systems Manual*

Crop nutrient uptake

- Crop nutrient uptake values depend on the vegetation type
- Suitable crop nutrient uptake values for various vegetation types are listed in Table 22 of EDRS Guideline
- Typical crop uptake values adopted for nutrient balance calculations
  - Nitrogen 220-250 kg/ha/year
  - Phosphorus 20-30 kg/ha/year

Water and nutrient balances

- It is a good idea for Councils to set up a water balance and nutrient balance with data appropriate for the Local Government Area
- This can then be used to readily check data provided with applications received

Setback (buffer) distances

- Setback or buffer distances are distances of separation of OWMS from sensitive receptors, set to minimise potential environmental and public health risks
- Table 4-10 in the GOWM defines conservative minimum setback distances based on level of treatment (Primary, Secondary etc.)

Setback (buffer) distances

- Alternative setback distances may be set where appropriate protections and controls can be demonstrated
- These can be set using a risk based approach such as that presented in Appendix R of AS/NZS1547:2012