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SITE GEOTECHNICAL ASSESSMENT REPORT

On Site Waste Water Disposal - Effluent Capability Study

Proposed Subdivision of Lot 1 DP 130034 & Lot 2 DOP 750207 into 6 Allotments, 1.54ha, 1.50ha, 1.57ha, 1.87ha, 3.0ha and 5600m2 for Cobandrah Pty Ltd

Introduction

The overall block is a parcel of some 10.0 hectares which the Owners are proposing to subdivide into 6 allotments. The land is generally vacant with no significant or residential buildings and has north boundary frontage to the Pambula River, requiring a 150m buffer to the north side.

All future buildings will be on tank water supply with some possible water use reduction features to Basix. In accordance with the current BVSC On Site Waste Water Disposal Strategy and subdivision design requirements each disposal will require a design to a hydraulic loading of 8 equivalent persons or 800 litres per day, and an area of at least 1600 square metres must be set aside on the land for disposal. It is considered that the Sydney Catchment Authority methodology is appropriate in accordance with the Local Authority requirements, and the approach is generally consistent with AS1547-2012. This report is to consider the ability of the sites to dispose of waste water and to recommend suitable compliant options and systems.

Site Considerations

The new sites are irregular but somewhat rectangular allotments varying between 0.56ha and 3.0ha on an access road off the Mt Darragh Road. The overall property is presently bounded by larger rural and semi rural blocks with some larger holdings nearby. The new blocks contain no gullies or dams but front the Pambula River on the north boundary. No water bores were located on the proposed blocks or within a distance of 100 metres of the proposed disposal. Soils on site are predominantly weathered granites and shales with very isolated rock outcropping on the block. Soil depths were adequate and it would be expected that disposal areas could be achieved on site to suit requirements and the required buffers. The soil at a depth of 600mm is a gritty clay loam and for calculations the properties for a Soil Texture Group of 4 Clay Loam was used.

Groundwater was not reached on site in the proposed disposal areas, and soils did not exhibit abnormally high moisture content. The overall site grade at the optimum disposal areas is approximately 10-14%, which is suitable for all types of disposal. Due to the layout of the sites and the larger land areas there can be a number of options for the allotments.

APZ and Trees

The proposed disposal sites are generally quite clear and grassed in the proposed disposal areas, and we have placed the disposal areas on clear land, however these may extend beyond the proposed allotment APZ areas.

Flood Potential

The disposal area level was referenced to the Lands Department mapping portal which revealed that the disposal area is at approximately 30-40m AHD. Information from the survey in the area recently has indicated a 1% flood level is below that level.

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Treatment and Disposal Considerations

The sites have few constraints, however the disposal areas will be limited by the boundary and river buffers on each block. Due to the reasonable size of the allotments there is land suitable for disposal on the high to moderately graded clear land, clear of buffers. The best practice for disposal is by secondary treatment and irrigation disposal methods as all nutrients are adsorbed by the larger vegetated areas. The most economical method of irrigation is surface spray and site grades in the disposal are suitable for such disposal methods, however the sites may also be suitable for primary treatment methods.

Soils on site were coarse with some coarse gritty particles and exhibited minor plasticity and moderate P sorption capacities, with reasonable percolation. The block has some buffer constraints, but it is possible to use surface spray disposal due to the larger area and suitable grades. Nutrient data from current approval requirements was used for calculations.

References

References used were the Local Authority Code for on Site Waste Water Disposal, the Australian New Zealand Standard AS 1547 – 2012 " On Site Domestic Wastewater Management " , the SCA Guidelines and the NSW Department of Urban Affairs and Planning Environment and Health Protection Guidelines, " On Site Sewage Management for Single Households ". Modelling is carried out on custom Excel spreadsheets with local median data from BOM. Vegetation data and methodology is adopted from the SCA On Site Waste Water Design Manual.

Effluent - Secondary

A secondary treatment system tested to AS1546.3-2017 with current approval may be used on the sites. **Effluent Quality for the system for above ground or shallow sub surface drip irrigation will meet the following system performance indicators, confirmed by a manufacturer's accreditation :**

TABLE 2.1 (Abrev) AS1546.3:2017
ADVANCED SECONDARY EFFLUENT COMPLIANCE CRITERIA FOR A STS

Parameter	Advanced secondary effluent	
	90% of Samples	Maximum
BOD5	≤ 10mg/L	20 mg/L
TSS	≤ 10 mg/L	20 mg/L
E. coli *	≤ 10 cfu/100mL	30 cfu/100mL
FAC þ	Minimum 0.5 mg/L†	N/A
Turbidity ?	N/A	10 NTU

Any free residual chlorine in the effluent must be between 0.2 and 2.0mg/litre

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Effluent - Primary

A primary treatment and disposal system may also be possible on the sites. This is a septic tank, involving only primary treatment, then gravity flow to a splitter box and even flow to an absorption trench or bed disposal.

This proposed method of treatment was considered in respect of site constraints imposed by the Environment and Health Protection Guidelines – " On Site Sewage Management for Single Households ".

The Expected Effluent Quality after primary treatment only, in a septic tank, is well documented and is summarised as

- Biochemical Oxygen Demand 150 mg/litre
- Suspended Solids 100 mg/l
- Thermotolerant Faecal Coliforms 100,000 to 10,000,000 cfu per 100 ml
- Total Phosphurus TP 12 mg / litre
- Total Nitrogen TN 55 mg / litre

These effluent nutrient concentrations have been utilised in calculations for the site.

P Sorption

The soil texture group has been referenced to published data regarding the P sorption properties of the soil in mg/kg. Soil on site exhibited moderate P sorption capacity and the tests and calculations indicated a value of 5800kg per hectare (at 1m depth) and this was used for calculations. Any calculation is factored at 33% to ensure that no leaching from the disposal occurs, and to ensure at least a 50 year longevity of the disposal area.

Dispersion

Site soils at a depth of 600mm exhibited dispersive properties and tests indicated that the soils are Emerson MEAT Class 2. In accordance with the recommendations in AS1547 **gypsum should be applied to the base of any trenches or beds** at a rate of 1kg per square metre. Any trenches should be closed as soon as possible to protect the gypsum from rain drop impact.

Water Balance Assessment

Water balance spreadsheet and full calculations for absorption and irrigation are included at rear and relevant results have been utilised in this report. Calculations have been done for water balance irrigation, nutrient uptake requirements and absorption and are included in this report for information.

Wet Weather Storage Recommendations

The annual water balances are nil or negative, and the calculations have been carried out to AS1547 and the EHP Guidelines to achieve zero pondage. Groundwater contamination may be a concern on this site and accordingly disposal by irrigation or absorption can be used.

Wet weather storage is usually acceptable at a storage capacity of 3 days, or with a nil nett storage achieved in a disposal area water balance at median rainfall data. On this site, the irrigation disposal areas may provide up to 9.6m3 of storage below ground in each disposal area.

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Site Limitations

Climate	South Coast Temperate Climate suitable for on site systems with any type of treated waste water disposal for treated effluent. .
Land Area	Generally larger blocks - adequate area available between buffers Disposal on lands clear of buffers, area 160m2 set aside.
Slope and Category	Moderate, suitable with diversion berm, minor earthworks
Landform	Suitable areas in clear lands, with any type of disposal
Vegetation	Mostly grassed and distant dry sclerophyll on site, to remain clear and well grassed in disposal areas.
Exposure	Exposed to all aspects, mostly north.
Flood Potential	Low - disposal at approximately AHD 30-40m
Run on and seepage	Construction of diversion berm recommended .
Erosion	Minor, use sediment control devices
Dispersion	The soil has dispersive properties - see recommendations.
Groundwater	No evidence of groundwater in disposal site. Some water carriage may be expected to be carried on rock strata well below.
Buffer distances	Can be achieved on site to primary and secondary disposal areas. Buffers to river and boundaries can be achieved.
Rock and Outcrops	Very little surface rock with gritty clay loam soils, 5% coarse. Disposal areas grassed as at the time of inspection.
Depth to hardpan, soil	Quite deep to 1.3m + from ground level - bore hole extent
Geology	Soil suitable for on site methods - predominantly gritty clay loam soils with evidence of top layer shale stone weathering. Moderate percolation in soil on site
Wetness	Constraints maps not available for the site No areas of wetness at proposed disposal site, lower areas of wetness (gullies, low areas) avoided for disposal - no abnormal or elevated moisture level at proposed disposal location - moist soils on site.
Covenants, Sec 88	No restrictions on site known or advised by Owners
Cat ion exchange	Measured in cmol/kg, unable to hold plant nutrients if > 15. No issue on this site
Coarse Fragments %	May affect plant growth or restrict works if > 40% Soil not affected on site Gritty site soils - some rock at depth
Bulk Density	May restrict plant growth if >1.8g/cm3 Soil suitable on site

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Site and Soil Property Assessment - By Site Test and Calculation

Site area	0.56-3.0ha semi rural allotments	
Grade	Varying but 10-14% as average general grade in disposal area	
Aspect	North facing	
Climate	South Coast Temperate climate, with winter frosts	
	Minimum winter temperature 0 degrees.	
	Expected maximum summer temperature 45 degC on isolated days.	
Soil Properties	Texture Group	4 Clay Loam
	Emerson Class MEAT	2 Dispersive - See notes
	Field ph	5.8 – Very Mildly Acidic
	Bulk Density in g/cm3	1.45
	P Sorption in kg/ha/ at 100cm3	5800 Calculated
	Soil depth adopted in m	1.00
	Coarse fragments less than	5% at 600 depth
	Electrical conductivity in ds/m =	0.1 no sodicity
	Percolation test	0.3 metres per day (@600)
From AS1547	Design Loading Rate	10mm (cons) per day
	Design Loading Rate	15mm (max) per day
	Design Loading Rate	30mm per day for secondary
	Design Irrigation Rate	24.5mm per week for irrigation

Total Site Project Specifications - Subdivision on Tank Water

Daily hydraulic flow (L/day):	800
The flow estimation method chosen is by:	Person
Equivalent persons (EP):	8.0
Organic Load per person in kg per day	0.070
Peak hourly flow (L/hour):	200

Total Nutrient Disposal Application Area - Secondary Treatment

BOD5 load to disposal area (kg/day):	0.008
BOD5 load to disposal area (kg/pa):	2.92
Nitrogen loading (kg/ha/year):	99
Actual nitrogen load to application trench area (kg/year):	8.76
Phosphorus loading (kg/ha/year):	11
Actual phosphorus load to application area (kg/year):	3.5
Conservative longevity for P-storage (years) including vegetative uptake:	> 50
Irrigation Area in m2 (factored for grade)	225
Secondary Irrigation Area in m2	225
Total area affected by nutrient uptake in m2 (TP)	711
Total area affected by nutrient uptake in m2 (TN)	885

Possible Disposal 225 + 225 + 660 = 1110 < 1600m2 (OK)
Possible Disposal 225 + 225 + 660 + 660 = 1770 > 1600m2 with 2 nutrient areas.
(Future house designs to be optimised to limit nutrient uptake area)

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Total Nutrient Disposal Application Area - Primary Treatment

BOD5 load to disposal area (kg/day):	0.12
BOD5 load to disposal area (kg/pa):	43.8
Nitrogen loading (kg/ha/year):	181
Actual nitrogen load to application trench area (kg/year):	16.06
Phosphorus loading (kg/ha/year):	11
Actual phosphorus load to application area (kg/year):	3.5
Conservative longevity for P-storage (years) including vegetative uptake:	> 50
Trench Length in 600mm width Trenches	89
Secondary Trench length in 600m width Trenches	89
Total area affected by nutrient uptake in m2 (TP)	711
Total area affected by nutrient uptake in m2 (TN)	1623

Buffer Distance to Disposal Areas

NSW Health Table 5 (Page 66) recommends the following buffer distances

Disposal System	Recommended Buffer Distance to Disposal Area
All land application systems	**100 metres to permanent waters, creeks etc 250 metres to domestic water supply wells 40 metres to dams, channels, etc**
Surface spray irrigation	**6 metres if up gradient and 3 metres if down gradient of driveways and property boundaries 15 metres to dwellings 3 metres to paths and walkways 6 metres to swimming pools**
Surface drip and trickle irrigation	**6 metres if up gradient and 3 metres if down gradient of swimming pools, property boundaries, driveways and buildings**
Sub surface irrigation	**6 metres if area up-gradient and 3 metres if area down-gradient of swimming pools, property boundaries, driveways and buildings**
Absorption system	**12 metres if area up-gradient and 6 metres if area is down-gradient of property boundaries 6 metres if area up-gradient and 3 metres if area is down-gradient of swimming pools, driveways and buildings**

The appropriate NSW Health buffers and the Local Authority buffers on this site can be achieved to the secondary irrigation or absorption disposal areas for any future buildings. All required setback distances can be achieved on the sites, including buffers as required to the river and site boundaries.

The 150m buffer line has been plotted on plan by Caddey Searl and Jarman and this setback has been adopted as the buffer to the Pambula River which fronts most allotments to the north side.

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Option for Proposed Buildings - Secondary Treatment with Irrigation Disposal

Treatment System	:	Secondary Treatment Approved System Approved to AS1546.3-2017 Maintenance Contract Required
Disposal Method	:	Surface Spray or Sub Surface Irrigation 225m2
Emerson Class	:	MEAT Class 2 Soil, dispersive - see notes
Hydraulic Load	:	4 Bedroom 8 equivalent people (100 litres) & 800 litres/day
Design Irrigation Rate Soil	:	DIR 24.5mm per week for irrigation
Hydraulic Disposal	:	225 square metres irrigation (factored for grade)
Secondary Disposal	:	225 square metres irrigation (factored for grade)
Water balance	:	Satisfactory for soil type and conditions
Nitrogen TN uptake	:	885m2 of area required including hydraulic Area available downgrade of proposed disposal area
Phosphorus TP uptake	:	711m2 of area required including hydraulic Area available downgrade of proposed disposal area

1600m2 has been set aside on each allotment in accordance with the BVSC Strategy for Waste Water Disposal and is of sufficient dimensions for the above option.

Option for Proposed Buildings - Secondary Treatment with Trench Disposal

Treatment System	:	Secondary Treatment Approved System Approved to AS1546.3-2017 Maintenance Contract Required
Disposal Method	:	Absorption Trenches 600mm by 600mm cross section 44 Lineal metres of trench
Emerson Class	:	MEAT Class 2 Soil, dispersive - see notes
Hydraulic Load	:	4 Bedroom 8 equivalent people (100 litres) & 800 litres/day
Design Loading Rate Soil	:	DLR 30mm per day absorption
Hydraulic Disposal	:	Absorption Trenches 600mm by 600mm cross section 44 Lineal metres of trench
Secondary Disposal	:	Absorption Trenches 600mm by 600mm cross section 44 Lineal metres of trench
Water balance	:	Satisfactory for soil type and conditions
Nitrogen TN uptake	:	885m2 of area required including hydraulic Not required for absorption but available
Phosphorus TP uptake	:	711m2 of area required including hydraulic Not required for absorption but available

1600m2 has been set aside on each allotment in accordance with the BVSC Strategy for Waste Water Disposal and this area is of sufficient dimensions for the above option.

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Option for Proposed Buildings - Primary Treatment with Trench Disposal

Treatment System	:	Septic Tank 3000 litres (or to suit) Approved to AS1546.1-2017 No Maintenance Contract Required
Disposal Method	:	Absorption Trenches 600mm by 600mm cross section 89 Lineal metres of trench
Emerson Class	:	MEAT Class 2 Soil, dispersive - see notes
Hydraulic Load	:	4 Bedroom 8 equivalent people (100 litres) & 800 litres/day
Design Loading Rate Soil	:	DLR 15mm per day absorption
Hydraulic Disposal	:	Absorption Trenches 600mm by 600mm cross section 89 Lineal metres of trench
Secondary Disposal	:	Absorption Trenches 600mm by 600mm cross section 89 Lineal metres of trench
Water balance	:	Satisfactory for soil type and conditions
Nitrogen TN uptake	:	1623m2 of area required including hydraulic Not required for absorption but available
Phosphorus TP uptake	:	711m2 of area required including hydraulic Not required for absorption but available

1600m2 has been set aside on each allotment in accordance with the BVSC Strategy for Waste Water Disposal and this area can be of sufficient dimensions for the above option.

General Recommendations

Surface runoff from the site is unlikely except during heavy rain due to sufficient soil permeability, the grassed site slope and the various options for disposal. A stormwater diversion mound or berm should be constructed above the disposal area to divert stormwater. Effluent is to be discharged above or below ground which may increase risks in times of heavy rain, however the proposed treatment and lower grades will limit the site risks.

Site slope is moderate to high and suitable for the construction of waste water disposal areas with minor earthworks required to level the application areas.

The soil has dispersive properties, Emerson MEAT Class 2 - Gypsum should be applied to the base of any trenches or beds at the rate of 1kg per square metre to prevent and limit dispersion. This will not be applicable if surface spray disposal is used on site.

Large trees in the vicinity of the disposal area should be avoided as they may tend to shade the disposal area and reduce evapotranspiration. Smaller trees and bushes planted below the disposal area will assist with transpiration and the uptake of nutrients.

Plants that thrive in wet soils should be selected, and a local plant nursery should be contacted in this regard.

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Nutrient Balances

Nutrient balances are required for irrigation disposal systems, and it is good practice to consider the areas that may be affected by nutrient uptake in any case. The disposal sites are presently covered by grasses with only very distant dry sclerophyll trees and will become well grassed in the possible disposal areas.

As the disposal is on semi rural lands it is considered that the site appropriate dosing rates (from SCA Guidelines for Perennial Pasture) on these sites are 3.01mg per square metre for Total Phosphorus (TP) and 27.11mg per square metre for Total Nitrogen (TN).

A site plan has been prepared showing the site, the area set aside for disposal and site buffers required. All required buffers on the proposed allotments to the River and boundaries have also been plotted and avoided.

The proposed area for disposal and nutrient uptake can be clear of all buffers and there will be sufficient room for any type of disposal and any required nutrient uptake areas.

All required buffers can be achieved to the proposed disposal systems, and sufficient room can be provided clear of all buffers to ensure that all nutrients are adsorbed. The proposed on site waste water systems will have no detrimental effect on the Local water quality.

Conclusion

The recommendations for this site have been summarized in this report. In my recommendations I have considered :

- Drainage properties of soils on site and allotment size, soil properties
- Location and topography of site
- Proximity to gullies, proximity to water bodies, landforms
- Local Authority requirements and Owners requests
- Maximum possible hydraulic loads for the site

No disposal system is totally suitable for long term disposal of waste water effluent, and future modifications and maintenance may be necessary to maintain the system in a good healthy safe working condition.

Regular maintenance work may be necessary to the systems, and should be performed regularly to avoid long term problems and failure. Regular inspections are always required and should be performed by the Owners as well as the Local Authority. **Please note that a maintenance contract is required for approved on site waste water treatment systems.**

Final Considerations

It must again be noted that the on site waste water disposal design for the proposed residence has been based on the hydraulic loadings based on equivalent people from the Australian Standards.

This is an assessment of the capability of the site to safely dispose of wastewater with options for the disposal of waste water on the proposed new allotments. Some water use reduction features may be proposed and this will minimize the hydraulic loads of the proposal.

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Each proposed new allotment is capable of safely disposing 800 litres per day of waste water calculated in accordance with the Tables in AS1547-2012, the Local Authority DCP, the Sydney Catchment Authority Design Manual and the NSW Department of Health Guidelines. Each on site waste water disposal will have a neutral or slightly beneficial effect on the water quality on the allotment and the local area in general. Please note that a maintenance contract is required for approved on site waste water treatment systems.

Please note that this is a report with designs done for an application for the subdivision of lands. A future application for an actual residence on any block may be on the basis of a lesser or larger flow and will be subject to a further design

Rainfall Data

Median rainfall data for the nearest weather station at Merimbula Airport has been used for calculations.

Summary statistics for all years

Move mouse over highest daily rainfall to view dates

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	66.7	84.6	91.6	63.0	55.0	66.5	46.7	44.6	43.2	65.7	77.0	65.1
Median	50.4	63.1	59.3	45.5	31.0	39.8	21.0	33.6	21.2	57.4	68.0	49.7
Highest Daily	103.6	101.0	107.6	101.0	125.0	104.8	61.0	57.0	76.0	81.0	103.6	98.4

If you do require further information please do not hesitate to contact me.

Yours sincerely

George Zuev 21 AUG 2023

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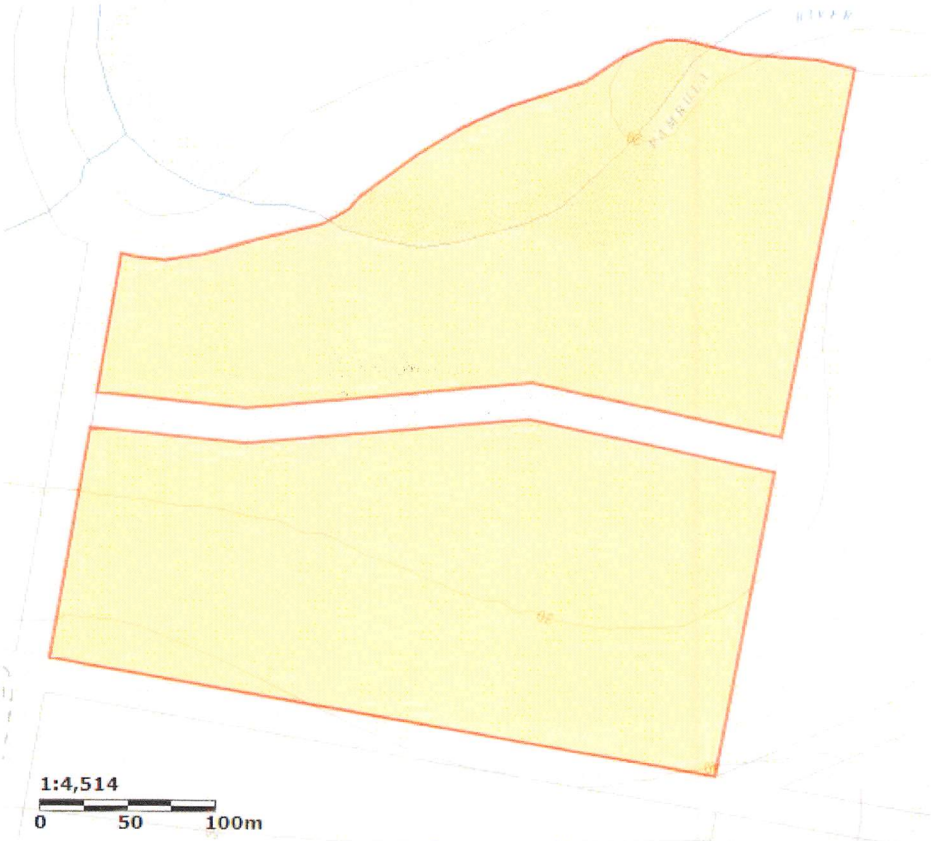
Site Aerial View (NTS)



Site Contours (NTS)

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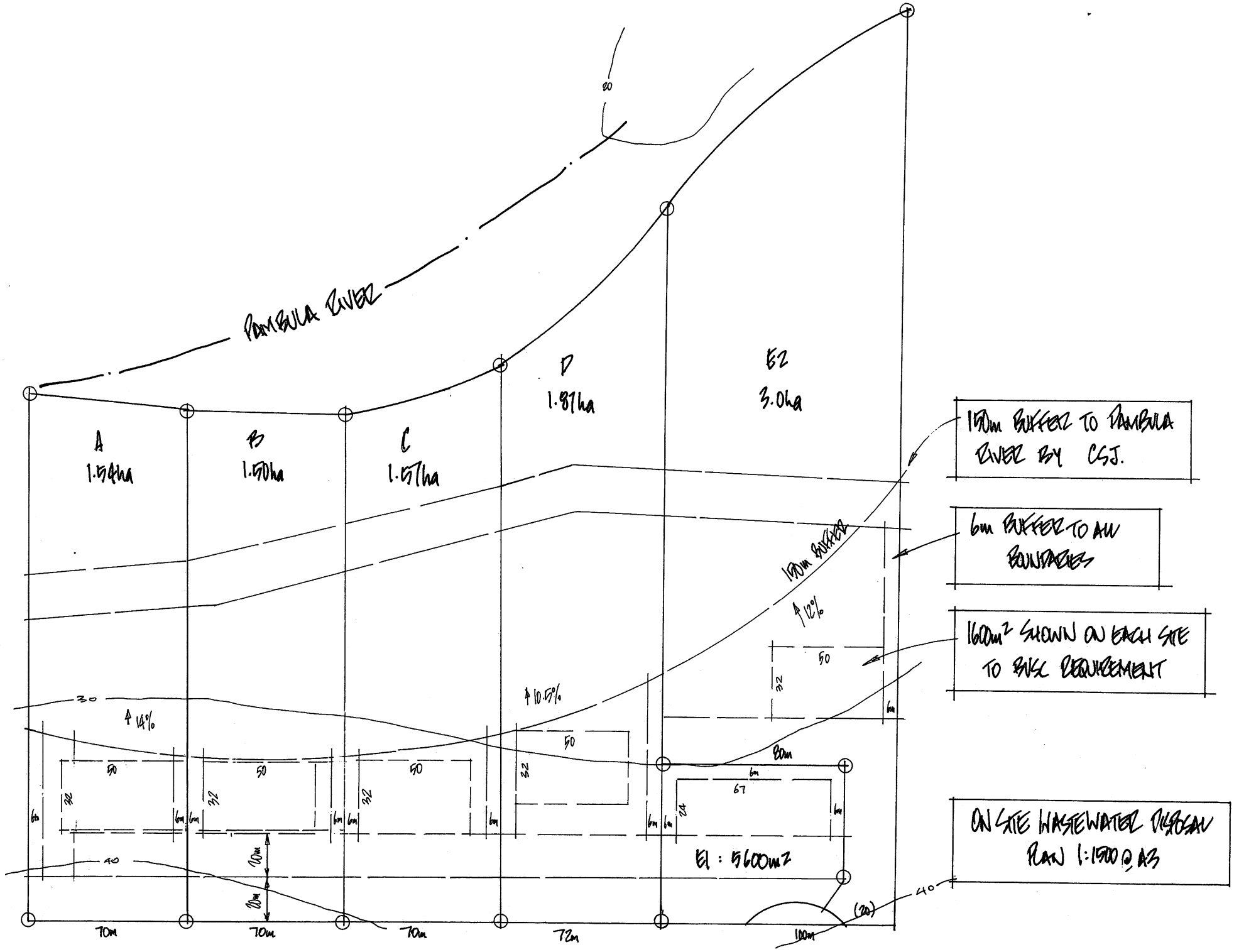
Calculation Sheets, Information and Plans


PAMBULA RIVER
A
1.54ha
B
1.50ha
C
1.57ha
D
1.87ha
E2
3.0ha
150m BUFFER TO PAMBULA RIVER BY CSJ.
6m BUFFER TO ALL BOUNDARIES
1600m² SHOWN ON EACH SITE TO BASIC REQUIREMENT
ON SITE WASTEWATER DISPOSAL PLAN 1:1500 @ A3
150m BUFFER
12%
10.5%
14%
50
32
6m
80m
67
24
E1 : 5600m²
70m
70m
70m
72m
100m
40
30
20m
10m

Full Calculation Sheet for On Site Waste Water System

Address :

Flow		
Bedrooms:	4	Residence Equivalent
Water Supply :	Tank	
Per Person litres :	100	
Total Daily Flow litres:	**800.0**	
Peak flow /hr in litres:	**200.0**	
Equivalent people :	**8.0**	

Organic load
Per person per day in kg 0.07

Soil Profile

Horizon	Start D	Stop D	Texture Group	Description
A	0	300	Topsoil	Variable Tan brown topsoil
B	300	1300	Clay Loam	Light tan orange clay loam, 5% coarse
C	1300	1300	Firm Clay	Tan orange granodiorite & clay - hard
D				

Refusal at : 1300

Sampled at : 300

Typical P Sorb Values for Soils in mg/kg
(SCA, Martens and Assoc)
Sands 50-150
Loamy sands 150-200
Sandy Loams 200-300
Clay loams 350-500
Silty Clays 400-600
Clays 500-900

Calculations

Area for Uptake Nitrogen, BOD

$A = \frac{CxQ}{L}$ Where C is conc nutrient in in mg/l
Q is wastewater flow per day in l/day
L is critical loading rate of nutrient in mg/m2/day

Area for Uptake Phoshporus

$A = \frac{P\ generated}{P\ adsorbed + P\ uptake}$ Where P gen is total P conc by vol wwater in 50 yrs, kg
P ads is p soil capacity divided by one third, kg/m2
P uptake is veg uptake 50 yrs in kg/m2

P Sorption Calculation

Soil Depth adopted in metres	1.00
Bulk Density in gm/cm3	1.45
Phosphurus Sorption in mg/kg	400
P Sorption in kg/ha	**5800**

Subdivision

Lot 1 DP 130034 Lot 5 DP 750207 Lochiel NSW

Disposal Area is Total Disposal Area for Nutrients

TN Disposal Area (effective) in m2 :	885
Disposal area (effective) in ha :	0.088528
Soil Test Data	
Percolation test K sat in m/day	0.3
pH field test :	5.8
Electrical Conductivity in ds/m :	0.1
Bulk Density in gm/cm3	1.45
Soil Texture Category Class	4
Emerson MEAT Class	2
P Sorption at kg/ha	5800
Not including vegetative uptake	

Septic Tank Output

BOD 5 in mg/l :	150
Suspended soilds in mg/l :	100
Total Nitrogen in mg/l	55
Total Phosphurus in mg/l	12

Septic Tank to Disposal Area total output per day

BOD 5 in kg :	0.12
Solids in kg :	0.08
Total nitrogen in kg :	0.044
Phosphurus in kg :	0.0096

Septic Tank to Disposal Area total output per annum

BOD 5 in kg :	43.8
Solids in kg :	29.2
Total nitrogen in kg :	16.06
Phosphorus in kg :	3.504
Nitrogen in kg/ha :	181.4111
Phosphorus in kg/ha :	10.99379
Nitrogen to disposal area kg/annum	16.06
Phosphorus to disposal area in kg/annum	0.973261
Plant absorption of P in mg per day (Lp)	3.01
P Plant absorption at above rate in kg pa	0.972615
Nett Phosporus to disposal area pa	0.000645

Critical Area for Phosphorus

Dose rate P in mg/m2 (veg)	3.01
P sorption in kg/ha =	5800
Reduction factor for P sorption	0.33
P adsorbed 50 yrs kg/m2 =	0.1914
P uptake veg in mg/m2	3.01
P veg uptake 50 yrs in kg/m2	0.054933
P generated 50 yrs in kg =	175.2
Area for P uptake in m2	711.2338

Critical Area for Nitrogen
(Veg)
Area A = C*Q/Ln
Where Q = flow rate,

&Ln = Load Rate N in mg/m2/day use =	27.11
Area for N uptake in m2 =	1623.017

Perennial Pasture

TP Nutrient Area extra over Hydraulic Area
Area in m2 = 486.2338
TN Nutrient Area extra over Hydraulic Area
Area in m2 + 660.2822

Application to Hydraulic Area (from water balance)
Hydraulic Load Disposal Area in m2 = 225
Effluent to area in mm/day = 3.56

Application to Total Nutrient Disposal Area
Total Disposal Area in m2 = 885.2822
Effluent to area in mm/day = 0.903667

On Site Wastewater System Output Default
(From AS1546.3-2017 Specification)

BOD 5 in mg/l :	10
Suspended soilds in mg/l :	10
Total Nitrogen in mg/l	30
Total Phosphurus in mg/l	12

System to Disposal Area total output per day

BOD 5 in kg :	0.008
Solids in kg :	0.008
Total nitrogen in kg :	0.024
Phosphorus in kg :	0.0096

System to Disposal Area total output per annum

BOD 5 in kg :	2.92
Solids in kg :	2.92
Total nitrogen in kg :	8.76
Phosphorus in kg :	3.504
Nitrogen in kg/ha :	98.9515
Phosphorus in kg/ha :	10.99379
Nitrogen to disposal area kg/annum	8.76
Phosphorus to disposal area in kg/annum	0.973261
Plant absorption of P in mg per day (Lp)	3.01
P Plant absorption at above rate in kg pa	0.972615
Nett Phosporus to disposal area pa	0.000645

Critical Area for Phosphorus

Dose rate P in mg/m2 (veg)	3.01
P sorption in kg/ha =	5800
Reduction factor for P sorption	0.33
P adsorbed 50 yrs kg/m2 =	0.1914
P uptake veg in mg/m2	3.01
P veg uptake 50 yrs in kg/m2	0.054933
P generated 50 yrs in kg =	175.2
Area for P uptake in m2	711.2338

Critical Area for Nitrogen
(Veg)
Area A = C*Q/Ln
Where Q = flow rate,

&Ln = Load Rate N in mg/m2/day use =	27.11
Area for N uptake in m2	885.2822

See Appendix 1 of SCA Manual, AS1547

Water Balance Calculation(Irrigation) for On Site Wastewater System

At : **Subdivision Lot 1 DP 130034, Lot 5 DP 750207 Lochiel into 6 Allotments**

No Bedrooms =	4		
Equivalent People =	8		
Water Supply =	Tank	**with reduction features**	
Flow per person =	100	**litres**	
Total Daily Flow Q =	800		
Disposal Area in m2 =	204.4	**m2**	**Slope factor in % =** 10
Percolation Test in m/day =	0.3	**metres per day**	
Soil Texture Category Class =	4	**Clay Loam**	
Design Irrigation Rate in mm/week =	24.5	**mm/week**	**Table M1 AS 1547:2012 x 7**

Slope factors	
Flat land up to 10%	0
Land 10%-20%	20%
Land 20%-30%	50%
Land 30%+	Advice

Design Hydraulic disposal Area in m2 = **224.84**

Use as appropriate for site conditions **From Metzeler Report**

Input	Notation	Calc	Unit	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec	Totals
Days	D	No	Ea	31	28	31	30	31	30	31	31	30	31	30	31	365
Rain	R	Median Data	mm/mth	50.4	63.1	59.3	45.5	31	39.8	21	33.6	21.2	57.4	68	49.7	540
Evapo	E	mm/mth	mm/mth	195.3	159.6	145.7	120	96.1	87	93	127.1	147	176.7	183	207.7	1738.2
Crop F	C	factor	factor	0.8	0.8	0.8	0.8	0.7	0.6	0.6	0.6	0.7	0.8	0.8	0.8	
T Evapo				156.24	127.68	116.56	96	67.27	52.2	55.8	76.26	102.9	141.36	146.4	166.16	1304.83
Inflows																
Inflows	R			50.4	63.1	59.3	45.5	31	39.8	21	33.6	21.2	57.4	68	49.7	540
Effluent	QD/L			121.33	109.59	121.33	117.42	121.33	117.42	121.33	121.33	117.42	121.33	117.42	121.33	
Total	**Inflows**			171.73	172.69	180.63	162.92	152.33	157.22	142.33	154.93	138.62	178.73	185.42	171.03	
Outputs																
T Evapo				156.24	127.68	116.56	96	67.27	52.2	55.8	76.26	102.9	141.36	146.4	166.16	
Percolation	DIR/7*Days			108.50	98.00	108.50	105.00	108.50	105.00	108.50	108.50	105.00	108.50	105.00	108.50	
Total	**Outflows**			264.74	225.68	225.06	201.00	175.77	157.20	164.30	184.76	207.90	249.86	251.40	274.66	
Nett	Inflow - Out			-93.0	-53.0	-44.4	-38.1	-23.4	0.0	-22.0	-29.8	-69.3	-71.1	-66.0	-103.6	

Cumulative Sum of Positive Results Only 0 **0** mm

Storage Required in System Volume in m3 = positive depth m * disposal area m2 / 100 Cubic Metres 0

Irrigation Area Sub Soil Storage in Voids

Hydraulic Disposal Area from Water Balance =	204.4		
Disposal Area in m2 =	225	m2	
Void ratio % in soil and backfill =	15	%	
Trench Backfill and Soil Depth =	0.15	metres	
Trenches at total depth =	0.3	metres	
Storage capacity trenches, voids, piping =	**6.496875**	m3 store	

Void Storage Required for Site = 2400 litres / 2.4 m3

Merimbula Airport Median Rainfall
Nowra RAN Median Evaporation

Calculations - Water Balance, Trench, Storage and Irrigation Area

At : Lochiel Subdivision
Lot 1 DP 130034 Lot 5 DP 750207

BVSC
Trench & ET Bed
2022

Bega Valley Shire Council Area - Primary Treatment

A	B		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
month	pan evap		evap tran	rain	rain retain	DLR/mth	disposal /mth	effluent applied/mth	size area	trial	application rate	disposal rate	remainder	increase in depth of effluent (n)	depth of effluent for mth (x-1)		computed depth of effluent/ month (x)
						enter in mm/day		Daily									
	E	Crop F	ET E x F	R	R_r=1.0R	DLR 15	ET-R_r+DLR	Flow 800	H/G		H/J	G	K-L	M/n		add N inc depth	
	mm/mth	factor	mm/mth	mm/mth	mm/mth	mm/mth	mm/mth	l/mth	m^2	m^2	mm/mth	mm/mth	mm/mth	mm/mth	mm	mm/mth	mm
Jan	195.3	0.8	156.2	61.2	61.2	465.0	560.0	24800.0	44.3	50.0	496.0	560.0	-64.0	-213.5	0.0	-213.5	0.0
Feb	159.6	0.8	127.7	77.0	77.0	423.8	474.4	22600.0	47.6	50.0	452.0	474.4	-22.4	-74.8	0.0	-74.8	0.0
Mar	145.7	0.8	116.6	60.8	60.8	465.0	520.8	24800.0	47.6	50.0	496.0	520.8	-24.8	-82.5	0.0	-82.5	0.0
Apr	120.0	0.8	96.0	49.0	49.0	450.0	497.0	24000.0	48.3	50.0	480.0	497.0	-17.0	-56.7	0.0	-56.7	0.0
May	96.1	0.7	67.3	32.6	32.6	465.0	499.7	24800.0	49.6	50.0	496.0	499.7	-3.7	-12.2	0.0	-12.2	0.0
Jun	87.0	0.6	52.2	42.4	42.4	450.0	459.8	24000.0	52.2	50.0	480.0	459.8	20.2	67.3	0.0	67.3	**67.3**
Jul	93.0	0.6	55.8	26.0	26.0	465.0	494.8	24800.0	50.1	50.0	496.0	494.8	1.2	4.0	67.3	4.0	**71.3**
Aug	127.1	0.6	76.3	25.9	25.9	450.0	500.4	24000.0	48.0	50.0	480.0	500.4	-20.4	-67.9	71.3	-67.9	3.5
Sep	147.0	0.7	102.9	39.6	39.6	450.0	513.3	24000.0	46.8	50.0	480.0	513.3	-33.3	-111.0	3.5	-111.0	0.0
Oct	176.7	0.8	141.4	56.1	56.1	465.0	550.3	24800.0	45.1	50.0	496.0	550.3	-54.3	-180.9	0.0	-180.9	0.0
Nov	183.0	0.8	146.4	92.8	92.8	450.0	503.6	24000.0	47.7	50.0	480.0	503.6	-23.6	-78.7	0.0	-78.7	0.0
Dec	207.7	0.8	166.2	58.6	58.6	465.0	572.6	24800.0	43.3	50.0	496.0	572.6	-76.6	-255.2	0.0	-255.2	0.0
TOTAL	1738.2		1304.8	622.0	622.0	5463.8	6146.6	291400.0	570.5								
Average	144.9		108.7	51.8	51.8	455.3	512.2	24283.3	**47.5**	Bed Area Calculation							

Merimbula Airport Median Rainfall
Nowra Median Pan Evaporation

n = 0.3 **Selected Void Ratio**
n=0.1 reedbeds
n=0.3(Bed with 20mm gravel)
n=0.37(230 to 600mm trench with 20mm gravel)

Soil Type and Properties

Clay Loam, gritty — 0.3 Percolation

Design Data

Soil Texture Class :	4	Clay Loam
Design Loading Rate DLR in mm/day	**15**	Maximum Rate
Design Loading Rate DLR in mm/day	**30**	Secondary Treatment
Design Irrigation Rate DIR in mm/week	**24.5**	In mm/week - NOTE

Hydraulic load Calculations

Hydraulic Load in ltres per day :	**800**	
Bedrooms :	2	
People :	8	Equivalent persons
Hydraulic load per person per day in litres :	100	Tank Supply

Reduction features to Basix

Other Calculations

Trench Calculation — Trench width to be in mm : 600

L = Q / DLR * W
Q = daily flow in litres
DLR = Conservative rate with limiting factors
W = trench width in metres

Trench Length to be in m = 88.88889 **Adopt = 89 m**

Wet Weather Storage in System

Trenches at adopted length in m3	**9.612**
Bed at adopted area in m3	**9**

Hydraulic Area Disposal

Calculations - Water Balance, Trench, Storage and Irrigation Area

At : Lochiel Subdivision
Lot 1 DP 130034 Lot 5 DP 750207

BVSC
Trench & ET Bed
2023

Bega Valley Shire Council Area - Secondary Treatment

A	B		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
month	pan evap		evap tran	rain	rain retain	DLR/mth	disposal /mth	effluent applied/mth	size area	trial	application rate	disposal rate	remainder	increase in depth of effluent (n)	depth of effluent for mth (x-1)		computed depth of effluent/ month (x)
						enter in mm/day		Daily									
	E	Crop F	ET E x F	R	R_r=1.0R	DLR 30	ET-R_r+DLR	Flow 800	H/G		H/J	G	K-L	M/n		add N inc depth	
	mm/mth	factor	mm/mth	mm/mth	mm/mth	mm/mth	mm/mth	l/mth	m^2	m^2	mm/mth	mm/mth	mm/mth	mm/mth	mm	mm/mth	mm
Jan	195.3	0.8	156.2	61.2	61.2	930.0	1025.0	24800.0	24.2	26.0	953.8	1025.0	-71.2	-237.3	0.0	-237.3	0.0
Feb	159.6	0.8	127.7	77.0	77.0	847.5	898.2	22600.0	25.2	26.0	869.2	898.2	-28.9	-96.5	0.0	-96.5	0.0
Mar	145.7	0.8	116.6	60.8	60.8	930.0	985.8	24800.0	25.2	26.0	953.8	985.8	-31.9	-106.4	0.0	-106.4	0.0
Apr	120.0	0.8	96.0	49.0	49.0	900.0	947.0	24000.0	25.3	26.0	923.1	947.0	-23.9	-79.7	0.0	-79.7	0.0
May	96.1	0.7	67.3	32.6	32.6	930.0	964.7	24800.0	25.7	26.0	953.8	964.7	-10.8	-36.1	0.0	-36.1	0.0
Jun	87.0	0.6	52.2	42.4	42.4	900.0	909.8	24000.0	26.4	26.0	923.1	909.8	13.3	44.3	0.0	44.3	**44.3**
Jul	93.0	0.6	55.8	26.0	26.0	930.0	959.8	24800.0	25.8	26.0	953.8	959.8	-6.0	-19.8	44.3	-19.8	**24.4**
Aug	127.1	0.6	76.3	25.9	25.9	900.0	950.4	24000.0	25.3	26.0	923.1	950.4	-27.3	-90.9	24.4	-90.9	0.0
Sep	147.0	0.7	102.9	39.6	39.6	900.0	963.3	24000.0	24.9	26.0	923.1	963.3	-40.2	-134.1	0.0	-134.1	0.0
Oct	176.7	0.8	141.4	56.1	56.1	930.0	1015.3	24800.0	24.4	26.0	953.8	1015.3	-61.4	-204.7	0.0	-204.7	0.0
Nov	183.0	0.8	146.4	92.8	92.8	900.0	953.6	24000.0	25.2	26.0	923.1	953.6	-30.5	-101.7	0.0	-101.7	0.0
Dec	207.7	0.8	166.2	58.6	58.6	930.0	1037.6	24800.0	23.9	26.0	953.8	1037.6	-83.7	-279.0	0.0	-279.0	0.0
TOTAL	1738.2		1304.8	622.0	622.0	10927.5	11610.3	291400.0	301.4								
Average	144.9		108.7	51.8	51.8	910.6	967.5	24283.3	**25.1**								

Bed Area Calculation

n = 0.3 **Selected Void Ratio**

n=0.1 reedbeds
n=0.3(Bed with 20mm gravel)
n=0.37(230 to 600mm trench with 20mm gravel)

Merimbula Airport Median Rainfall
Nowra Median Pan Evaporation

Soil Type and Properties

Clay Loam, gritty

0.3 Percolation

Design Data

Soil Texture Class :	4	Clay Loam
Design Loading Rate DLR in mm/day	30	Secondary Treatment
Design Loading Rate DLR in mm/day	15	Maximum
Design Irrigation Rate DIR in mm/week	24.5	In mm/week - NOTE

Hydraulic load Calculations

Hydraulic Load in ltres per day :	**800**	
Bedrooms :	2	
People :	8	Equivalent persons
Hydraulic load per person per day in litres :	100	Tank Supply

Reduction features to Basix

Other Calculations

Trench Calculation — Trench width to be in mm : 600

L = Q / DLR * W

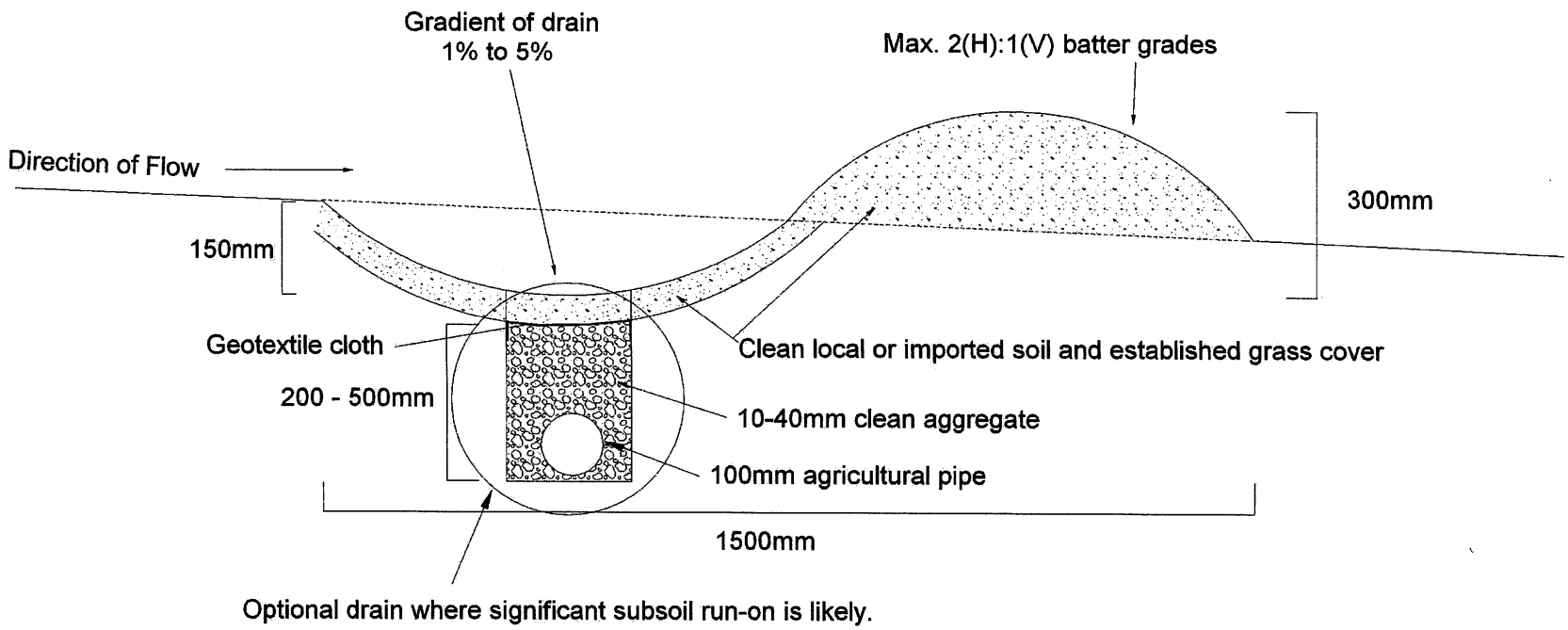
Q = daily flow in litres
DLR = Conservative rate with limiting factors
W = trench width in metres

Trench Length to be in m = 44.44444 **Adopt = 44 m**

Wet Weather Storage in System

Trenches at adopted length in m3	**4.752**
Bed at adopted area in m3	**4.68**

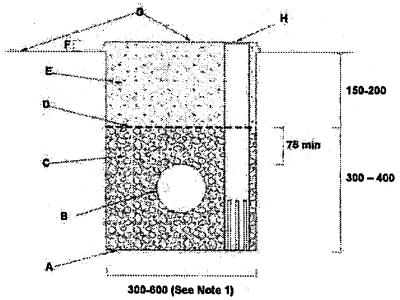
Hydraulic Area Disposal



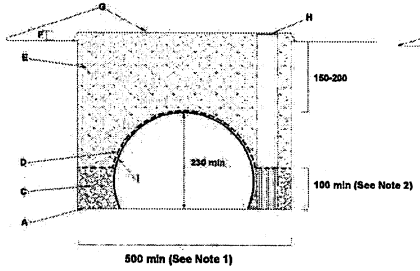
Standard Drawing 10A – Upslope Diversion Drain

(not to scale)

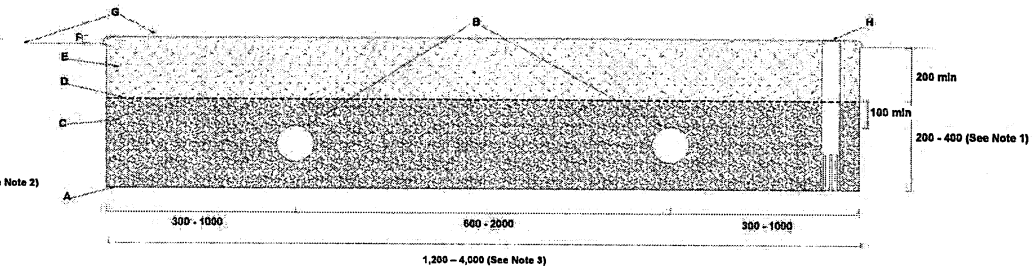
Cross Section: Piped Trench



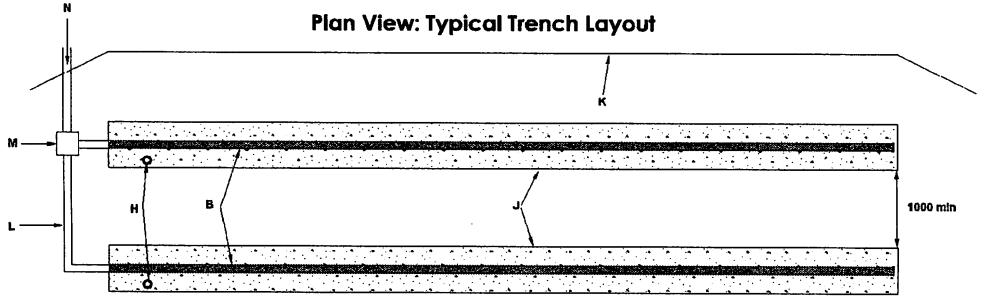
Cross Section: Arch Trench



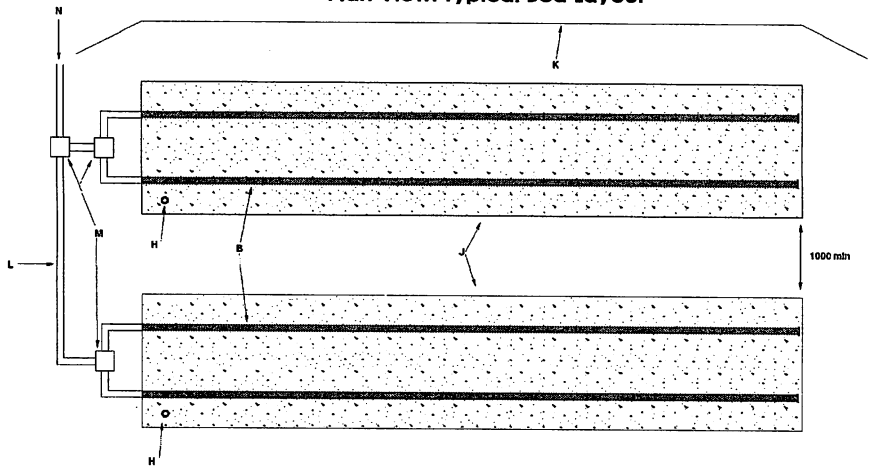
Cross Section: Conventional Piped Bed



Plan View: Typical Trench Layout



Plan View: Typical Bed Layout



Absorption Trench / Bed Construction

- **A** The base of the trench must be level to ensure even distribution of effluent. Base levels should be checked with a dumpy / laser level.
- **B** 90-100mm slotted PVC pipe.
- **C** 20-40mm distribution aggregate.
- **D** Geotextile filter cloth.
- **E** Clean local or imported topsoil (sandy loam to clay loam).
- **F** Allowance for settling after backfilling.
- **G** Grass must be established across the construction area as soon as possible. Trench / bed surface must be slightly mounded.
- **H** Inspection port on downhill side of trench / bed. Made from 50mm PVC pipe with perforations in the aggregate level of the trench / bed.
- **I** Self-supporting arch trench that complies with AS/NZS1547:2012.
- **J** Trench / bed dimensions are an example only. The basal area of the land application area must be determined according to the procedures set out in AS/NZS1547:2012 and this document. The location and orientation of the area should be based on a site and soil assessment by a suitably qualified person. The system may comprise a single trench / bed or multiple smaller trenches / beds. It is essential that effluent is distributed evenly to all units on a daily basis.
- **K** Upslope stormwater diversion drain (see Standard Drawing No.9A for design detail). Subsoil drainage may be necessary on particular sites.
- **L** 90-100mm PVC gravity dosing pipe.
- **M** Gravity splitter box to distribute effluent evenly between two to four separate trenches / beds. Should also be used to evenly dose multiple pipework within a single trench / bed.
- **N** Gravity or pump fed effluent from treatment system.

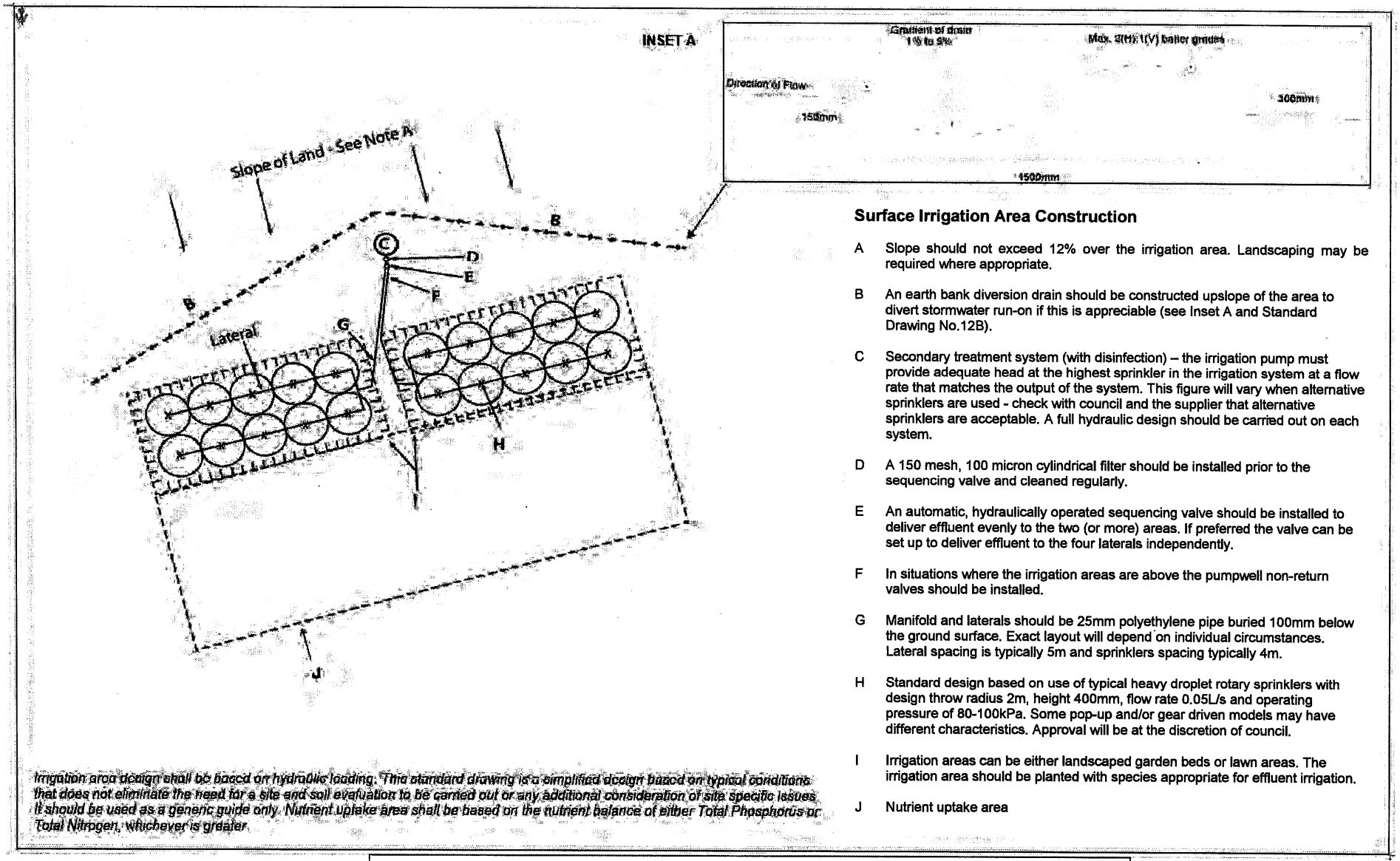
Notes

1. Trenches should be a maximum of 600mm (piped trench) or 1,000mm (arch trench) wide. Optimum width will balance storage requirements against footprint and required trench length.
2. 100mm of aggregate is the minimum depth. Depth can be increased to provide more storage if required, however, a minimum 150-200mm of topsoil must exist above the top of the arch trench material. Alternative proprietary void / support materials are available to provide a substitute for both aggregate and arch trench.
3. Consideration should be given to maintaining a level base when determining an appropriate width.

   Gravity-fed beds are generally not suitable for sites with highly permeable soils due to difficulties in maintaining even distribution. Primary-treated effluent should not be dosed; effluent should at least be secondary-treated. Pressure dosing should be used in such soils.
4. WaterNSW notes that drilling holes within PVC pipe makes them non-compliant with the AS/NZS 3500, as it impacts the structural integrity of the pipe.

Standard Drawing 10B – Absorption Trench / Bed

(not to scale)



Surface Irrigation Area Construction

A Slope should not exceed 12% over the irrigation area. Landscaping may be required where appropriate.

B An earth bank diversion drain should be constructed upslope of the area to divert stormwater run-on if this is appreciable (see Inset A and Standard Drawing No.12B).

C Secondary treatment system (with disinfection) – the irrigation pump must provide adequate head at the highest sprinkler in the irrigation system at a flow rate that matches the output of the system. This figure will vary when alternative sprinklers are used - check with council and the supplier that alternative sprinklers are acceptable. A full hydraulic design should be carried out on each system.

D A 150 mesh, 100 micron cylindrical filter should be installed prior to the sequencing valve and cleaned regularly.

E An automatic, hydraulically operated sequencing valve should be installed to deliver effluent evenly to the two (or more) areas. If preferred the valve can be set up to deliver effluent to the four laterals independently.

F In situations where the irrigation areas are above the pumpwell non-return valves should be installed.

G Manifold and laterals should be 25mm polyethylene pipe buried 100mm below the ground surface. Exact layout will depend on individual circumstances. Lateral spacing is typically 5m and sprinklers spacing typically 4m.

H Standard design based on use of typical heavy droplet rotary sprinklers with design throw radius 2m, height 400mm, flow rate 0.05L/s and operating pressure of 80-100kPa. Some pop-up and/or gear driven models may have different characteristics. Approval will be at the discretion of council.

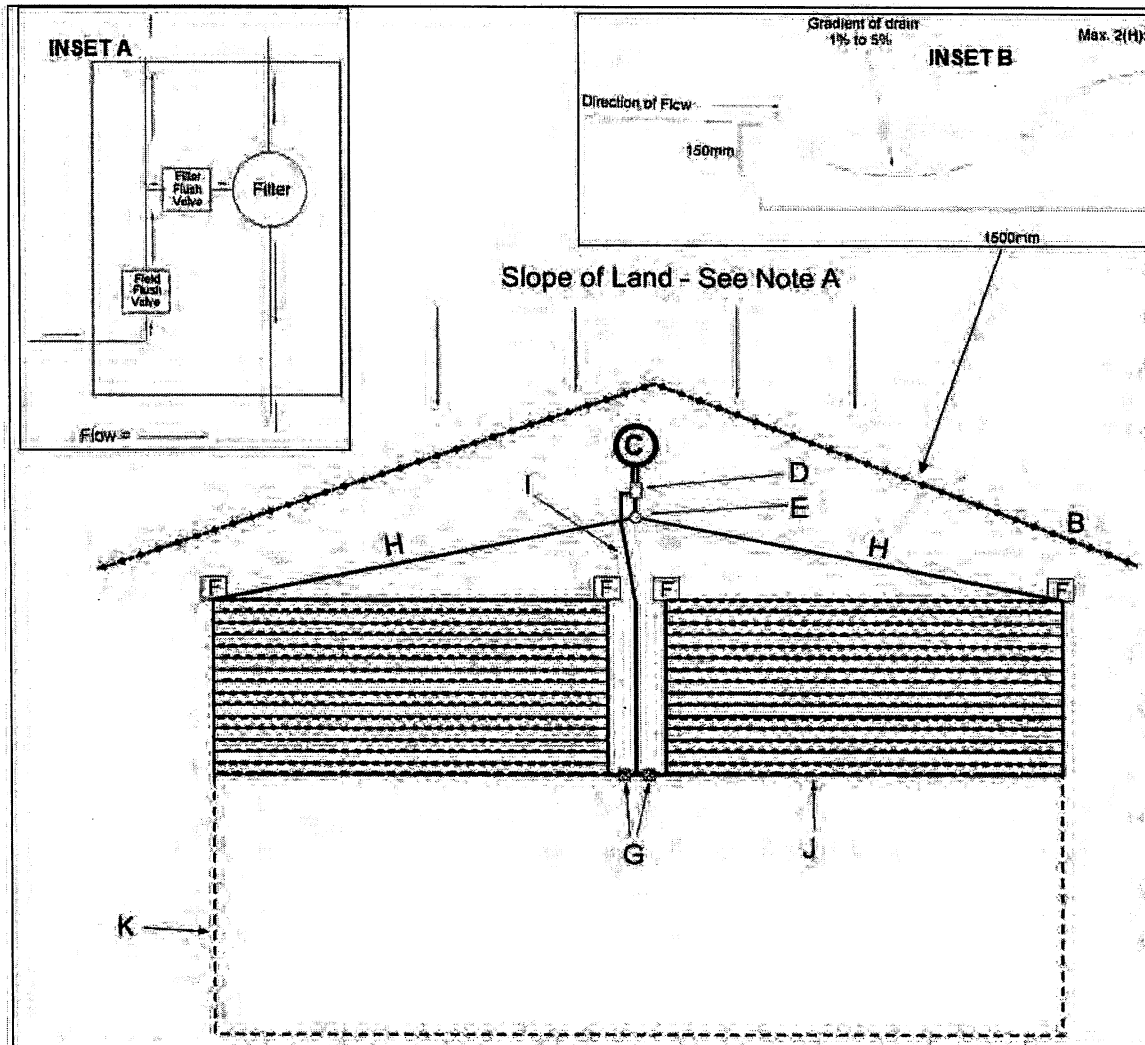
I Irrigation areas can be either landscaped garden beds or lawn areas. The irrigation area should be planted with species appropriate for effluent irrigation.

J Nutrient uptake area

Irrigation area design shall be based on hydraulic loading. This standard drawing is a simplified design based on typical conditions that does not eliminate the need for a site and soil evaluation to be carried out or any additional consideration of site specific issues. It should be used as a generic guide only. Nutrient uptake area shall be based on the nutrient balance of either Total Phosphorus or Total Nitrogen, whichever is greater.

Standard Drawing 12C – Surface Irrigation of Effluent

(not to scale)



This standard design has been based on a generic area of irrigation based on typical conditions. It does not eliminate the need for a site and soil evaluation to be carried out or any additional consideration of site specific issues. It should be used as a generic guide only.

Subsurface Irrigation Area Construction

A Design for relatively uniform slope. Additional design work may be required where slope exceeds 12% or if system is to be installed over undulating ground.

B An earth bank diversion drain must be constructed upslope of the area to divert stormwater run-on if this is appreciable (see Inset B and Standard Drawing No.13A).

C Secondary treatment system – the irrigation pump must provide a *minimum* 20m head and a flow rate that matches the design output of the selected dripline. Flow rate will vary depending on emitter spacing, flow rate and lineal metres of line. A full hydraulic design must be carried out. Each area should be capable of discharging a minimum of 80L/min.

D Filtration and flushing mechanism (see Inset A) – a field flush valve must be installed on the return line to facilitate periodic flushing to the treatment tank. An additional filter flush valve should be installed downstream of the field flush valve. A (minimum) 150 mesh; 100 micron cylindrical filter should be installed and cleaned regularly.

E An automatic, hydraulically operated sequencing valve should be installed to deliver effluent evenly to the two areas.

F Air release valves must be installed at high points in each area. Additional air release valves may be required in undulating terrain.

G Check valves are required for each irrigation field to facilitate periodic flushing.

H Distribution manifolds should be 25mm uPVC or polyethylene pipe buried 300mm below the ground surface.

I Flushing return manifold should be 25mm uPVC or polyethylene pipe buried 100-150mm below the ground surface.

J Pressure compensating (PC) subsurface drip line laterals (typically 16mm) with emitters and laterals at 600mm spacings and buried to a depth 100-150mm. A pressure regulator will be required where non-PC line is used. Only subsurface dripline specifically designed for effluent irrigation must be used.

K Nutrient Uptake Area – based on Nutrient Balance of Total Phosphorus or Total Nitrogen, whoever requires the greater uptake area.

Standard Drawing 13B – Subsurface Effluent Irrigation

(not to scale)

Appendix 1
Phosphorus Sorption Uptake Values

Soil Category	Texture	Structure	Acceptable P_{sorp}* (mg/kg)
1	Gravels and sands	Structureless	50
2a	Sandy loams	Weak	100
2b	Sandy loams	Massive	100
3a	Loams	High / moderate	200
3b	Loams	Weak / massive	200
4a	Clay loams	High / moderate	400
4b	Clay loams	Weak	400
4c	Clay loams	Massive	400
5a	Light clays	Strong	500
5b	Light clays	Moderate	500
5c	Light clays	Weak / massive	500
6a	Med-heavy clays	Strong	600
6b	Med-heavy clays	Moderate	600
6c	Med-heavy clays	Weak / massive	600

* If soil parent material is basalt then increase Psorp by 100mg/kg

Nutrient Uptake Rates

Vegetation Type	Total Nitrogen (kg/ha/year)	Total Phosphorus (kg/ha/year)
Good quality woodland	90	25
Poor quality woodland	65	20
Lawn – fully managed (clippings removed)	240	30
Lawn – unmanaged	120	12
Improved pasture	280	24
Perennial pasture	99	11
Shrubs and some trees – fully managed	150	16
Shrubs and some trees – unmanaged	75	8

For **bulk density (g/cm^3)**, apply the following values:

Sandy soil – 1.8g/cm^3
Intermediate – 1.5g/cm^3
Clayey soil – 1.3g/cm^3


DP 67095
DP 1292533
DP 750207
DP 32269
DP 750242
A
B
C
D
E2
3ha.
DP 130034
150m
1·54ha.
1·5ha
1·57ha
1·87ha
DP 750207
70
70
70
72
E1
5600m²
100
DP 243596
DP 750242
DP 1116035
DP 726776
DP 32269
=1·4000