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ALLIED PINNACLE FLOUR AND MAIZE MILL

PROPOSED MODIFICATION (DA-318-12-2004)

NOVEMBER 2021

PUBLIC

APPENDIX F

ONSITE WASTEWATER ASSESSMENT REPORT

REF: 4763WW

VERSION [1.1]

SEPTEMBER 20, 2021

ONSITE WASTEWATER MANAGEMENT FOR PROCESS WASTEWATER

ALLIED PINNACLE PTY LTD, PICTON

LGA: Wollondilly

Lot 1 DP 1128013

PROJECT MANAGER WSP Australia Ltd

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VERSION CONTROL

Title	Onsite Wastewater Management for process wastewater			
Site address	ALLIED PINNACLE PTY LTD, PICTON			
Description	Wastewater management system for			
Created By	Sean Harris			
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1. INTRODUCTION

This On Site Wastewater Assessment and System Design was prepared by Harris Environmental Consulting for Allied Mills Pty (Allied Mills) who are looking to expand its flour and maize milling facility at 330 Picton Road, Maldon (Lot 1 DP 1128013). The proposed development is within the Wollondilly Local Government Area and operating under DA-318-12-2004. The proposed development is for a modification of DA, and involved the expansion of the existing building to include a kitchen and mixing facility to prepare bulk bakery like products. The proposed development will require 10 additional staff and 30 construction staff.

The proposed development will generate *process wastewater* as the mixing equipment will need to be washed after each mixing batch. The 10 additional staff will *increase the domestic wastewater* for permanent employees from 2000L/d to 2500L/d. The existing AWTS has capacity for 3000L/d.

This report addresses both wastewater sources separately. For the domestic wastewater, this report proposes continued use of the existing AWTS, but with a larger irrigation area. For the process wastewater, this report proposes a new wastewater management system.

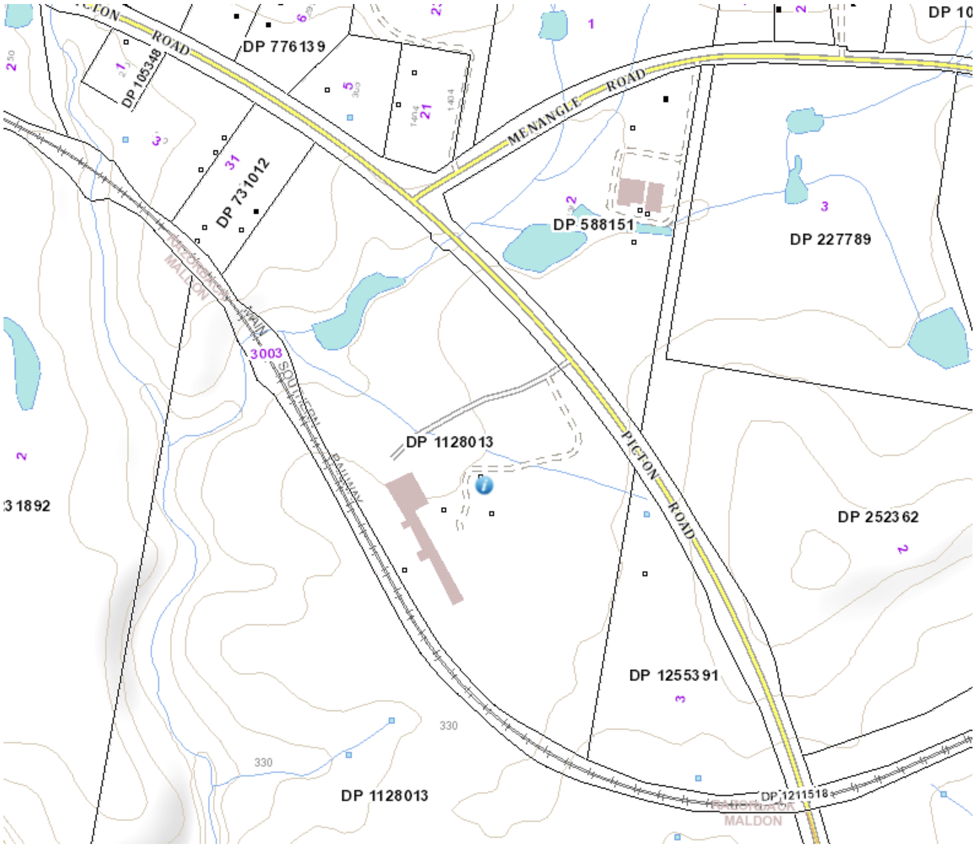
Fieldwork was undertaken by Harris Environmental Consulting (HEC) on the 3rd September 2021. This plan is based on the primary investigation of the soils, topography and hydrology of the site observed on the day of inspection. Soil samples and photos of the site were taken for further analysis. This report relies on soil analysis of the proposed irrigation area undertaken by Lanfax Laboratories (7 July 2021).

2. ASSESSMENT CRITERIA

The relevant design guidelines that were used to assess the site and design an on site wastewater management system that is relevant for this type of development include:

- AS/NZ 1547:2012 On-site wastewater management (Standards Australia, 2012).
- WaterNSW (2019), Designing and Installing On Site Wastewater Systems. A Water NSW Current Recommended Practice
- NSW EPA (2004) Use of Effluent by Irrigation (EPA 2004)
- Department of Land and Water Conservation New South Wales (1998) The Constructed Wetlands Manual, Volume 1.

FIGURE 1 LOCATION



Source: SixMaps

3. SITE INFORMATION

Principal client representative	Norm Cuthbert Mb: 0422632799 Email: Norm.Cuthbert@alliedpinnacle.com
Project manager and representative	WSP Australia Pty Limited Dr Mark Maund 02 49242950 Mark.Maund@wsp.com Level 3 55 Bolton St Newcastle, NSW, NSW 2300 Australia
Postal address:	Allied Pinnacle Pty Ltd 4 The Crescent Kingsgrove NSW 2208
Size of property:	Approx. 20ha
Legal title:	Lot 1 DP 1128013
Local Government:	Wollondilly Shire Council
Water supply:	Town water
Date site assessed:	September 3, 2021
Date report prepared:	September 20, 2021
Report prepared by	Sean Harris
Site assessor:	Sean Harris Msc Env Science (UOW), Grad dip Nat Res (UNE), BscAppSc, Agriculture (HAC)

4. SITE ASSESSMENT

Climate - rainfall	Picton Council Depot Rainfall Station (median annual 567mm)
Climate - evaporation	Badgerys Creek (median 1557mm)
Flood potential	Proposed wastewater treatment system is above 1 in 100-year flood level; minor limitation. Proposed wastewater disposal area above 1 in 20-year flood level; minor limitation.
Frost potential	The site is not known to be subject to severe frosts, minor limitation
Exposure	Southern aspect; minor limitation
Slope	8% spray irrigation area; moderate limitation
Landform	Uniform slope, minor limitation
Run-on and seepage	Moderate upslope stormwater run-on; upslope stormwater diversion proposed, minor limitation
Erosion potential	Minor erosion potential
Site drainage	Well drained, permeable soil profile; minor limitation
Evidence of fill	No evidence of fill; minor limitation
Domestic groundwater use	The Department of Primary Industries Office of Water search of groundwater bores found there are **no known groundwater bores** within 100m of the proposed effluent management area
Surface rock	No surface rock; minor limitation
Current land use	Managed grassland

5. SOIL ASSESSMENT

Geological unit:	Wianamatta Group (Ashfield Shale; Bringelly Shale)		
Soil landscape:	Blacktown Soil Landscape		
Great Soil Group:	Red and Brown Podzolic Soils		
Method:	Crowbar/shovel		
Depth to bedrock (m):	>1000mm to restrictive layer; minor limitation		
Bulk density:	Friable, well structured soil profile; minor limitation		
Depth to high soil water table:	No groundwater or subsoil mottling encountered at a depth of 1000mm; minor limitation		
Layer 1 (Surface soil)		DIR	Permeability class
Field texture Soil Colour (moist) Depth Structure Coarse frag.	Loam Dark reddish black (5YR 2/4) 0-350mm Moderate to well structured	4.0mm/day	3
Layer 2 (B horizon)		DIR	Permeability class
Field texture Soil Colour (moist) Depth Structure Coarse frag.	Clay loam Reddish brown (2.5YR 3/6) 350-700mm Moderate to well structured, NA	3.5mm/day	4
Layer 3 (B2 horizon)		DIR	Permeability class
Field texture Soil Colour (moist) Depth Structure Coarse frag.	Light clay Reddish brown (5YR 4/8) 300-1000mm Moderate to well structured, NA	3.0mm/day	5

6. SOIL ANALYSIS

Layer 1 (Surface soil)		Comment
Salinity	112 uS/cm 0.112 dS/m	Non saline
pH (water)	6.96 (range 6.72-7.12)	Ideal for pasture / no lime required
Nitrate-N	7.7mgN/kg	Indicates deficiency / Ideal N 20mgN/kg+
Total N	0.34%	Low, poor reserves for micro-organisms
Available P	7.07mg P /kg	Significantly low. Plans require >20mg/kg_
Total P	830mg/kg	Very high, ideal for phosphorus sorption
Organic C	1.97%	Lower than ideal
ESP	1.3%	Non sodic
CEC	14.4 cmol+/kg	Idea, for nutrient retention
Emerson's Aggregate Test	Class 7	Non dispersible

Layer 2 (B horizon)		Comment
Salinity	113S/cm 0.011 dS/m	Non saline
pH (water)	7.3	Ideal for pasture / no lime required
Nitrate-N	0.20mgN/kg	Indicates deficiency Ideal N 20mgN/kg+
Total N	0.081%	Evidence that total nitrogen is not mobile
Available P	<0.01 mg P /kg	Significantly low. Plans require >20mg/kg_
Total P	350mg/kg	
ESP	6.3%	Sodic: As the soil is not disturbed at this depth, there is no issue with this elevated value.
Emerson's Aggregate Test	Class 3/6, slake 2	Non dispersible
Layer 3 (B2 horizon)		**DIR**
Salinity	234 uS/cm 0.234 dS/m	Non saline
pH (water)	5.7	Ideal for pasture / no lime required
Nitrate-N	0.04mgN/kg	Indicates deficiency / Ideal N 20mgN/kg+
Total N	0.06%	Evidence that total nitrogen is not mobile
Available P	<0.01 mg P /kg	Significantly low. Plans require >20mg/kg_
Total P	394mg/kg	
ESP	15.8%	Highly sodic: as the soil is not disturbed at this depth, there is no issue with this elevated value.
Emerson's Aggregate Test	Class 3/6, slake 2	Non dispersible

Photo 1 Soil Profile (within proposed process irrigation area)

Photo 2 Existing irrigation area for domestic wastewater

Photo 3 Proposed irrigation area for process wastewater irrigation

Photo 4 Looking upslope over land proposed for process wastewater irrigation

7. SUMMARY OF SOIL AND SITE CONSTRAINTS

The soil and site constraints discussed below are applicable to the site available for wastewater management and assessed for wastewater disposal.

Land use and terrain of proposed irrigation area

The site proposed for wastewater disposal includes cleared land under managed grassland. The proposed irrigation is on a 8% slope.

Buffers to watercourses, dams and drainage depressions

The proposed irrigation for both the domestic and washdown wastewater is more than 100m from the nearest intermittent watercourse. The site drains to a modified drainage depression runs under the entrance road via a culvert. This drainage channel then enters another constructed drainage channel, but unlike the former, this section of channel has native wetland species.

The proposed irrigation area conforms to the DEC (2004) criteria for both low and high strength effluent and WaterNSW (2019) buffers for <u>domestic</u> wastewater. See Table 1.

TABLE 1 RECOMMENDED BUFFER DISTANCES

ASSESSMENT GUIDELINES	BUFFER DISTANCES		
WaterNSW (2019)	100 metres to permanent surface waters (e.g. rivers, creeks, streams, lakes etc.) 40 metres to other waters (e.g. dams, intermittent water courses, overland flow paths etc.)		
DEC (2004)		**Low effluent strength**	**High effluent strength**
	Where spray irrigation gives rise to aerosols near houses, schools, playing fields, public open spaces and water bodies.	50m*	50m
	Natural water bodies (e.g. rivers and lakes)	50m	50m
	Other waters (e.g. artificial water with beneficial uses, small streams, intermittent streams, water distribution, drainage channels and dams)	Site-specific	Site-specific
	Others sensitive areas (e.g. waters in drinking water catchments, aquatic ecosystems with high conservation value, wetlands, native stands for vegetation)	Site-specific	250m
	Domestic well used for household water supply	Site-specific	250m
	To town water supply bores	Site-specific	1000m

* Recommended in ARMCANZ, ANZECC and NHMRC (2000) for spray application of reclaimed water from sewerage systems.

Soils

The results of soil testing do not indicate any problems with pH, salinity, potential for phosphorus sorption or cation exchange capacity that would otherwise need consideration the design for on site wastewater management.

Of special consideration is sodium. Only the subsoils are sodic and this layer will not be disturbed. Both the sodium concentration and the sodium adsorption ratio of effluent will need to be determined once the processing plant is operational, but the characteristics of the process wastewater is expected to be the medium strength category for the purpose of this assessment.

8. DOMESTIC WASTEWATER MANAGEMENT

The current treatment system is understood to be receiving 2000L/d from the current use with 40 staff (Lanfax Laboratories, 2021). This is derived from water-meter monitoring of the flow from the AWTS to the irrigation area.

The current irrigation area is 1250m^2. It consists of 2 rows of 4 sprinklers that are manually controlled by gate valves.

The proposed development will increase the amount of domestic wastewater generated from the amenities as there will be an additional 10 staff employed to operate the new plant.

The 10 additional staff is likely to generate additional wastewater in the same proportions as the current use. This is equivalent to 50L/p, which is slightly higher than the 43L/d guideline value from NSW Health (2001) for factory/office worker.

Factories and offices	WC, urinal, basin WC, urinal, basin, shower WC, urinal, basin, shower, kitchen	27 41 43	Persons x 27 Persons x 41 Persons x 43	Persons = total staff/day Septic tank capacity = daily flow + 1550 Litres

Assuming 50L/p, this will mean the design flow will increase from 2000L/d to 2500L/d. The existing AWTS has capacity for 3,000L/d. The existing irrigation area has been re -sized for 3,000L as a precautionary measure.

8.1 SIZING THE IRRIGATION AREA FOR DOMESTIC WASTEWATER IRRIGATION

The irrigation area needed to manage the design volume of 3000L /d was calculated using monthly water and nutrient balance, following the method described in DLG (1998). Soil texture classification for Design Irrigation Rate is from ASNZ1547(2012).

The ***water balance*** requires a **1375m^2** irrigation area based on the following variables:

- Picton Council Depot Rainfall median monthly rainfall;
- Badgerys Creek monthly average evaporation; and
- Application rate of 17.5mm/week or 2.5mm/day.

The ***nitrogen balance*** requires a **1500m^2** irrigation area based on the following variables:

- AWTS will reduce Total Nitrogen to 30mg/L; and
- Vegetative rate for managed pastures is assumed to be 240kg/N/ha/year

The ***phosphorus balance*** requires an area of **620m^2** irrigation area based on the following variables:

- AWTS will reduce Total Phosphorus to 10mg/L;
- P-sorption of 500mg/kg;
- Predicted sorption for a soil depth of 1m. Crop uptake is assumed to be 30kg/ha/annum; and
- 50 year design life of system.
- Bulk density of 1.5g/cm^3

The largest area (most limiting) is required. For this site, the largest area is 1500m^2. An additional 500m^2 is proposed as a precautionary measure, **increasing the total irrigation area to 1750m^2.**

9. VOLUME AND CHARACTERISTICS OF PROCESS WASTEWATER

Volume

There will be two batches of product mixed per day, and each batch is estimated to require 1500L for cleaning equipment. In the longer term, there is the possibility this volume could increase to 4 batch's per day, so the design of the wastewater management system is for 6000L/d.

Characteristic of wastewater

As this facility is not producing any wastewater, it is not possible to obtain samples of typical wastewater.

The proposed mixing plant does not conform to a conventional bakery which produces the final products using the pre mixed products that the proposed development would produce.

The proposed mixing facility will produce 78 different blends that include numerous ingredients. Each blend consists of 2-3 bulky ingredients such as a flour, oil and sugar, along with other ingredients present at much smaller quantities.

After each batch is mixed, the mixing equipment will be swept clean to remove as much of the dry product possible. It will not be possible to remove all dry product, and it is estimated that 5% of the ingredients used for each batch will be mixed with wash water and becomes the source of pollutants to be treated.

The quantity of raw ingredients, and by default, the waste product that is mixed with the wastewater has been estimated for each blend. An example of one of 78 blends is Product A, which is shown in Table 2 below.

TABLE 2 INGREDIENTS OF PRODUCTS TO BE MIXED

		Ingredient name per product per batch		0.50%	Waste quantity per batch, Kg
AP Code	Product Name	RM Description	KG		
108487	PRODUCT A	WHEATEN CORNFLOUR 25KG	319		1.595
		MAN CANOLA OIL 100 PALLECONS 920KS	290		1.45
		PREGEL STARCH 20KG	200		1
		STARCH PREGETLATINSED	139		0.695
		MERMAID SUPERFINE SALT 25KG 1.2T(CW)	12		0.06
		CALCIUM CARBONATE 25	6.5		0.0325
		SAPP 28 25KG	6.5		0.0325
		SODIUM BICARB - SOBICA7430	5		0.025
		POTASSIUM SORBATE (FINER GRADE)	2		0.01
		GUM GUAR-25	2		0.01
		MYVATEX MYTEX K 20KG (MB)	1		0.005
		SSL ADMUL 1078K S351 MB 25KG	1		0.005
		LUMISORB PSMS-20 NGM 213KG MB	1		0.005
		SILICA PRECIPITATED - SIPERNAT 22S 20405512	10		0.05
		TRICALCIUM PHOSPHATE 25KG	5		0.025

In the case of Product A (Table 2), the bulk ingredients include wheaten cornflour (319kg, of which 1.595 kg is mixed with wastewater) and canola oil (290kg, of which 1.45 kg is mixed with wastewater).

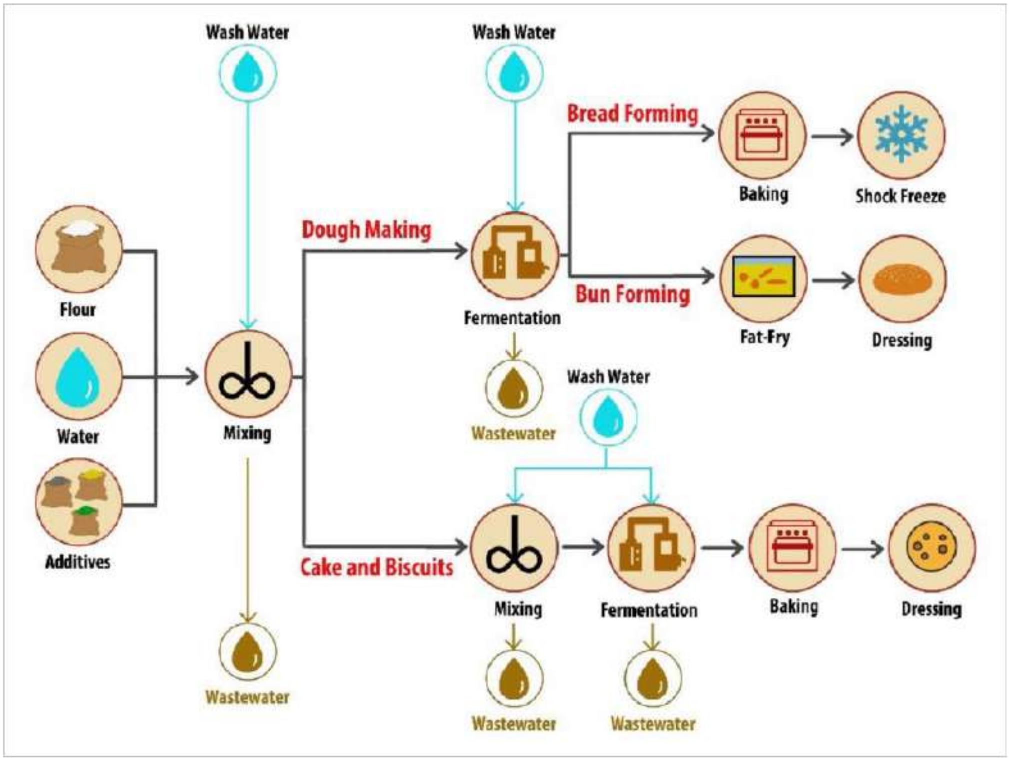
Typically, these bulky ingredients that make up the core of the waste product would be found in quantities over 1 kg or more products. See Table 3 below. Of the 78 products that may be produced, some will be produced more often than others, but none would include more than two or three of the more bulky components shown in Table 3 and none would include more than one of these products at the maximum quantity shown in Table 3.

TABLE 3 BULKY INGREDIENTS OF EACH BLEND

Parameter	Typical range (kg)
Flour/pastry bulk	1.3-3.4
Sugar	0.6-4.7
Corn starch	1.6
Salt	0.4-4
Oil (canola)	1.45
Cocoa powder	1.45
Whey powder	1.4-1.9
Starch	1-2.4

The proposed development is basically the first stage of a conventional bakery, as shown in Figure 2, from Hashem et al, (2021). The conventional bakery goes on to use the mixed products to produce dough, cake and biscuits, and in doing so creates a much stronger wastewater strength than what is proposed for this development.

FIGURE 2 CONVENTIONAL BAKERY



From Hashem et al, (2021) Comprehensive review of water management and wastewater treatment in food processing industries in the framework of water-food-environment nexus.

Hashem et al (2021) provides an estimate of the wastewater from a conventional bakery, which has been shown in Table 4 (reference Mohan et al., 2017). The third column in Table 4 is an estimate of wastewater strength adopted for this assessment. An assessment of the likely wastewater contaminants is described below.

TABLE 4 CHARACTERISTICS OF BAKERY WASTEWATER

Parameter	Mohan et al., 2017	Estimated value for this assessment
Total Nitrogen	60-90	60
Total Phosphorus mg/L	30-100	15
BOD_5 mg/L	2250	800
TDS mg/L	3600	700
TSS mg/L	1180	700
pH	6.05	6

BOD

The waste flour, sugar, starch and simple organic acids would be the primary source of BOD from washdown water. The estimated BOD for a conventional bakery is 2250mg/L, but this is likely to be far greater than what is anticipated. This assessment estimates the BOD will 800mg/L, but the outcome of this assessment shows that BOD is not a limiting factor in sizing the irrigation area. The proposed irrigation area could accommodate a much higher BOD, such as the reported 2250mg/L.

pH

The use of cleaning substances can cause the wastewater to have high or low pH, depending on whether acid or alkaline chemicals are used. The assumed pH is 7, but this could fluctuate depending on the use of acid and alkaline cleaning agents.

TSS

The estimated TSS of 2800mg/L assumes:

- Each batch will leave 5% as waste to be washed with wastewater, leaving behind 4.2kg of waste material per 1500L batch of wastewater.
- 100% of the ingredients will be suspended prior to treatment by the grease trap.
- $4.2 / 1500L \times 10^6 = 2800mg/L$

Nitrogen

There is no specific ingredient of concern that could elevate nitrogen, but as a precautionary measure, this assessment has adopts 60mg/L.

Phosphorus

The phosphorus comes from the cleaning agents and its concentration is governed by the water ratio and cleaning agents used. Low phosphorus cleaning agents will be used to reduce the amount of phosphorus within wastewater. There is no specific ingredient of concern that could elevate nitrogen, but as a precautionary measure, this assessment has adopts 15mg/L.

TDS

The majority of the waste product will be organic material including semolina, rice flour, maize flour, wheat flour, ground herb powders. The raw and pre manufactured food additives include salt and powders will contain dissolved mineral salts, including sodium, calcium, potassium, boron, chloride, sulfate, carbonate and bicarbonate. Of these, chloride, bicarbonate and boron are the major ions that need to be considered when effluent is used for irrigation.

Until the plant is operational, it is necessary to make a precautionary estimate of the likely concentration of the potential TDS of wastewater to provide some preliminary guidance on the design of the irrigation area. This precautionary approach assumes that 25% of the ingredients will be a potential source of TDS, but the actual TDS of these ingredients is not known.

Three blends are used as an example to show the range of ingredients used an potential TDS within:

Product A, the estimated quantity of material that contaminates the wastewater at 5% is 4.045kg. This includes 1.595 kg of materials that would make a minor contribution to TDS, including wheaten cornflour and 1.45kg of canola oil. The remaining 1.3kg includes 1 kg of starch (unknown TDS) and 0.31 kg of various additives including salt (60g), calcium carbonate (32g), sodium carbonate (25g), potassium sorbate (10g) and tricalcium phosphate (25g).

Product B includes 4.1kg of table salt, 0.15kg of ground nutmeg, 0.3kg of ground black pepper and 0.45kg of Ng-monosodium glutam as waste material to be mixed with wastewater. This product has the highest salt content of all the blends.

Product C includes caster sugar, canola oil, oat fibre, ground cassia, nutmeg, cardamon and cloves. While dissolved sugar will contribute to TDS, there is only 1mg of sodium per 100g of sugar (4.5g of waste sugar, so 45g of salt). This product may be the lowest salt content of all the blends.

This assessment assumes each 1500L batch of wastewater could contain of 700mg/L TDS based on the following assumptions:

- Each batch leaves 5% of ingredients that is mixed with wastewater, carrying 4.2kg of waste material per 1500L batch of wastewater.
- 25% of the waste ingredients will be a source of TDS in wastewater. This is equivalent to 1kg per 1500L batch of wastewater.
- 1kg / 1500L x 10^6 = 700mg/L

Bacteria and pathogens

Unlike domestic wastewater, wastewater from the proposed development is not contaminated with bacteria or pathogens.

10. TREATMENT TARGETS FOR WASTEWATER DISPOSAL

In accordance with DEC (2004), the wastewater will be treated to a standard that will allow it to be characterised as low strength for all constituents except for TDS, which would fall within the medium strength concentration.

TABLE 5 CLASSIFICATION OF EFFLUENT FOR ENVIRONMENTAL MANAGEMENT DEC (2004)

	Strength (Average concentration mg/L)[1]		
Constituent	**Low[2]**	**Medium**	**High**
Total Nitrogen	<50	50-100	>100
Total Phosphorus	<10	10-20	>20
BOD_5	<40	40-1,500	>1,500
TDS[3]	<600	600-1,000	>1,000-2,500
Other pollutants	Effluent with more than five time[4] the ANZECC and ARMCANZ (2000) long-term water quality trigger values for irrigation waters must be considered high strength for the purpose of establishing a strength class for runoff and discharge controls and will require close examination to ensure soil is not contaminated.		
Grease & Oil	Effluent with more than 1,500mg/L of grease and oil must be considered high strength and irrigation rates and practices must be managed to ensure soil and vegetation is not damaged.		

The estimate concentration of all pollutants is based on best guess estimates. Unlike TDS, it is possible to design a treatment system and size an irrigation area to reduce BOD, TN and TP down from the estimated values to low strength concentrations shown in Table 5 above.

It is likely that the level of TDS will be found to be lower than the estimated 700mg/L. As a precautionary measure, the following actions are possible to counteract the uncertainty associated with the proposed wastewater. This includes:

- Once the plant is operating, the Sodium Adsorption Ratio (SAR) of wastewater will be tested. If the SAR is found to be high, calcium in the form of gypsum, ash or organic matter can be applied to the irrigated soil to counteract the potential negative impacts on soil structure.

- In addition, a higher TDS can be managed by providing more area for land under irrigation than is calculated by water or nutrient balance equations to compensate for the high salt concentrations (DEC 2004, pg 48).

- The use of chemicals will also be part of the management plan for managing the process wastewater. This will include the use of low phosphorus and sodium detergents to reduce the risk of producing a high phosphorus or SAR effluent.

- As with the SAR, the EC of the wastewater will not be known until the wastewater is produced. However, the EC can be estimated (at 25^{0}C) in units of dS/m (error of 10%) by multiplying TDS, in mg/L, by 0.0015. Assuming the TDS is 700mg/L, the EC would by 1.085dS/m, which would be in the low water salinity rating. See Table 6 below, which is extract from DEC, (2004) (pg 27).

TABLE 6 IRRIGATION WATER EC AND PLANT SUITABILITY

Table 3.4: General irrigation water salinity ratings based on electrical conductivity

EC (dS/m)	Water salinity rating	Plant suitability
<0.65	Very low	Sensitive crops
0.65–1.3	Low	Moderately sensitive crops
1.3–2.9	Medium	Moderately tolerant crops
2.9–5.2	High	Tolerant crops
5.2–8.1	Very high	Very tolerant crops
>8.1	Extreme	Generally too saline

Source: Adapted from DNR (1997), cited in ANZECC and ARMCANZ (2000).

- The water balance will be used as the default method for sizing the irrigation area for TDS.

Treatment of grease and oil will be undertaken within a grease trap. This will be followed by a treatment train that will sequentially remove BOD, TN and TP.

Table 7 shows the % reductions needed to achieve the targets for treatment.

TABLE 7 TARGET FOR TREATMENT

Parameter	Assumed concentration	Low Strength	% reduction
Total Nitrogen	60	<50	16.6
Total Phosphorus	15	<10	33
BOD_5	800	<40	95
Grease & Oil	>1500mg/L	<1500mg/L	

Parameter	Assumed concentration	Medium Strength	% reduction
TDS	700	600 -1,000	0

11. PROPOSED WASTEWATER TREATMENT

The proposed process wastewater treatment system is described below.

11.1 STAGE 1, SOURCE CONTROL

The washdown water will drain through grated floor traps set into the floor or outlet drains to capture the coarse organic matter (suspended solids) before it enters the grease trap.

11.2 STAGE 2, GREASE TRAP

A 1500L trap is to be installed to allow grease and oil float to the top, while the heavier food particles to sink to the bottom. The location of the proposed grease trap is shown on the attached site plan.

11.3 STAGE 3, AERATION AND SETTLEMENT AND PUMPWELL

STAGE 3A - AERATION

The BOD of the wastewater being applied by irrigation needs to be reduced so it is within the suitable range that will allow the land available to be used for irrigation. The BOD of wastewater can be reduced by supplying the organic compounds within the wastewater with dissolved oxygen to allow the aerobic microorganisms to convert non-settleable solids to settleable solids.

The rate of treatment will depend on residence time and the volume of aeration. The requirements for oxygen is assumed to be similar to that of brewery wastewater. Naydayil et al, (2015) found that the BOD of brewery wastewater was reduced from 1985 mg/L down to 150mg/L after 24 hrs of aeration, which represents a 92% reduction. As the effectiveness of aeration on this wastewater will not be known until it is first produced, the aeration is assumed to reduce BOD by 50%. Therefore, 50% removal of BOD would reduce BOD from 800 to 400mg/L.

TABLE 8 ESTIMATED RATES OF TREATMENT BY AERATION (NAYDAYIL ET AL, 2015)

TABLE 1: Characteristics of wastewater

PARAMETERS	INITIAL VALUE (mg/L)
COD	3705.88
BOD	1985.52
pH	6
TURBIDITY	289
OIL AND GREASE	2.17

Table 4: Characteristics of wastewater after providing aeration at a flow rate of 4 L/min for aeration period of 24, 48 and 72

PARAMETER	OBTAINED VALUE AFTER AERATION (24 HOURS) (mg/L)	% REMOVAL	OBTAINED VALUE AFTER AERATION(48 HOURS) (mg/L)	% REMOVAL	OBTAINED VALUE AFTER AERATION (72 HOURS) (mg/L)	% REMOVAL
COD	252.616	93.18	182.84	95.06	158.78	95.71
BOD	150.56	92.41	109.7	94.45	91.35	95.88
pH	7	--	7	--	7	--
TURBIDITY	180	37.72	180	37.72	180	37.72
OIL & GREASE	2.17	--	2.17	--	2.17	--

Hence optimum air flow rate was obtained as 4 L/min and optimum time period was found to be 72 hour.

STAGE 3B - SETTLEMENT

The decanted aerobic wastewater will overflow from the 6,000L aeration tank into a 6,000L settling tank so solids and biomass can settle and be removed (24 hrs). The accumulation of sediment will need to be monitored and periodically removed.

STAGE 3C - PUMPWELL

The settlement tank will overflow to a 6,000L pump well, with a pump operated by float switch. The pumpwell will normally kept empty so it has capacity for storing wastewater in the event of pump failure

The three tanks required for Stage 3 could be combined within a 20,000L inground concrete tank fitted with two baffle walls to provide three x 6,000L compartments.

11.4 STAGE 4, BIOLOGICAL TREATMENT

This assessment proposes to reduce TN and TP through biological treatment using one of two methods described below. Further detail is provided in the Appendices.

<u>Option 1, Horizontal Flow Subsurface Reedbed (HFSR)</u>

The subsurface reed bed requires a water body filled with gravel and plants. Typically, this would be constructed by excavating the required depth and dimensions and lining this excavation with a an impermeable membrane, filling this with gravel and planting with wetland plants (macrophytes) such as reeds and rushes. Wastewater passes through the root zone of the reeds where it undergoes treatment via physical, chemical and biological interactions between the wastewater, plants, micro-organisms, gravel and atmosphere. Inlet and outlet pipes are positioned below the gravel surface, so that the water always remains below the surface.

Option 2, Floating Treatment Wetland (FTW)

Floating Treatment Wetlands also require a water body, but plants are grown hydroponically on floating structures while their roots are extended down into the water to a depth of at least 500mm .

The biological processes are more effective in FTWs than reedbeds because of the free suspension of roots in the water column which allows direct contact between contaminants and the root-associated microbial community. Microorganisms decompose organic matter into simple nutrients which are removed by plants through direct uptake.

This assessment has not included detailed sizing because the exact strength of the wastewater is not known. As a precautionary measure, this assessment propses that each method would be sized to provide 5 days of residence time, and each method would be able to reduce BOD by 75%, TP by 33%, and TN by 50% over 5 days.

As a result, the TN target of 50mg/L for low strength wastewater would be met.

Parameter	Assumed concentration	Low Strength target	Assumed concentration after biological treatment
Total Nitrogen	60mg/L	<50mg/L	30mg/L
Total Phosphorus	15mg/L	<10mg/L	10mg/L
BOD_5	400mg/L	<40mg/L	100mg/L
Grease & Oil	>1500mg/L	<1500mg/L	

For 5 days residence time, each option for treatment requires the water body to hold 30m^3 of wastewater.

For the **HFSR**, the gravel has occupies 70% of the leaving 30% for water storage. This means that 100m^3 of submerged gravel is needed to provide 30m^3 for 5 days residence time. The average depth of a reedbed is 600mm and the preferred ratio is 4:1. Therefore, the surface area of the reedbed option would need to be approx. 170m^2 and dimensions of 7m x 25m.

For the **FTW,** the size is much smaller because the plants sit on the surface. The 30m^3 water body would be approximately 1m – 1,5m deep x 9m long x 4m wide, The actual floating wetland would only occupy 50% of the surface area (15m^2).

11.5 IRRIGATION

With each biological treatment option, the treated wastewater will be collected in a pumpwell prior spray irrigation. Typically, the pumpwell would consist of a 3,000L buried concrete tank with a submersible pump that operates by float switch. The pumpwell would provide emergency storage in the event of pump failure.

The land to be irrigated is a grassed slope downslope of the domestic wastewater irrigation area. This is land with a slope less than 8% and located more than 100m from the nearest drainage depression. An upslope stormwater diversion bank is required to keep upslope stormwater from entering the irrigation area. See Appendix III.

The required irrigation area is the largest area required of the four contaminants of concern, which includes BOD, total nitrogen, total phosphorus and TDS, which uses the water balance as the default method.

11.5.1 SIZING THE IRRIGATION FOR BOD_5 REMOVAL

The maximum daily organic loading rate that can be applied by irrigation is calculated using the equation from DEC (2004) shown below. The equation assumes the organic material is applied at a rate greater than the soil's ability to assimilate it, so the soil pores do not become clogged which can lead to anaerobic odorous conditions. The equation assumes soils can receive a maximum organic loading average loading rate of 1500kg/ha/month.

A = CQ / (1,000 x Lc)

Where:
A = irrigation area (ha)
C = concentration of BOD5 (mg/L)
Q = average effluent flow rate (kL/month)
Lc = critical loading rate of constituent (kg/ha/month)

A = irrigation area (ha)	0.012
C = concentration of BOD_5 (mg/L)	100
Q = average effluent flowrate (kL/month)	180
Lc = critical loading rate of constituent (kg/ha/month)	1500

Therefore, the required irrigation area for BOD is 0.012ha, or 120m^2.

11.5.2 SIZING THE IRRIGATION FOR TN REMOVAL

A nitrogen balance was used to calculate the required irrigation area, following the method described in DLG (1998). Soil texture classification for Design Irrigation Rate is from ASNZ1547(2012). The ***nitrogen balance*** requires a **2,750m^2 i**rrigation area based on the following variables:

- Biological treatment will reduce Total Nitrogen to 30mg/L; and

- Vegetative rate for managed pastures is assumed to be 240kg/N/ha/year

11.5.3 SIZING THE IRRIGATION FOR TP REMOVAL

A ***phosphorus balance*** was used to calculate the required irrigation area, following the method described in DLG (1998). The phosphorus balance requires a **1,250m^2** irrigation area based on the following variables:

- Biological treatment will reduce Total Phosphorus to 10mg/L;
- P-sorption of 500 mg/kg for light clay subsoils;
- Predicted sorption for a soil depth of 1m. Crop uptake is assumed to be 30kg/ha/annum; and
- 50-year design life of system.
- Bulk density of 1.3g/cm^3 for intermediate soil.

11.5.4 SIZING THE IRRIGATION FOR TDS, USING THE WATER BALANCE

A water balance is used to as the surrogate method for calculating the area required for TDS. This approach is in accordance with DEC (2004) which suggests that TDS can be managed by providing more area for land under irrigation than is calculated by water or nutrient balance equations to compensate for the high salt concentrations (DEC 2004, pg 48).

The water balance follows the method described in DLG (1998). The soil texture classification for calculating Design Irrigation Rate (DIR) would normally adopt 3.0mm for the light clay subsoils found at this site. However, in recognition of the need to increase the land under irrigation, a more conservative value of 2.5mm/d is used.

The ***water balance*** requires a **2750m^2** irrigation area based on the following variables:

- Picton Council Depot median monthly rainfall;
- Badgerys Creek monthly average evaporation; and
- Application rate of 17.5mm/week or 2.5mm/day.

The largest of the three methods (BOD, nitrogen and phosphorus balance) is required. For this site, the largest of the three methods is 2750m^2 required for the water balance and nitrogen balance.

12. SUMMARY

This report includes a wastewater management assessment for the proposed development, that will see an increased workforce and the generation of process wastewater associated with the mixing of ingredients used for baking.

The additional domestic wastewater can be managed within the existing commercial AWTS, which has capacity for 3,000L/d. The design wastewater load will increase from 2,000L/d to 2,500L/d, but this assessment has re sized the irrigation area for 3,000L/d.

The proposed mixing facility is expected to generate 6000L / d when fully operational. The process wastewater will need a new wastewater management system that has been described as 5

- Stage 1 - Source control within the proposed facility;
- Stage 2 - 1500L grease trap
- Stage 3a - 6,000L aeration tank
- Stage 3b - 6,000L settlement tank
- Stage 3c - 6,000L pump well/emergency storage
- Stage 4 - Biological treatment, using either a subsurface reedbed or floating treatment wetland
- Stage 5 - 2750m^2 of spray irrigation

13. REFERENCES

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WaterNSW (2019), Designing and Installing On Site Wastewater Systems. A Sydney Catchment Authority Current Recommended Practice

Department of Environment and Conservation (NSW) (2004), Use of Effluent By Irrigation

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APPENDIX I FLOATING TREATMENT WETLAND

Buoyancy frame

The buoyancy floating frames consist of 110mm PVC pipe, welded frame that includes a support structure that provides a layer of coir which supports the plants. The bouyancy rafts would cover 50% of the surface area of the water body.

Impervious liner

Must be a durable to resist being punctured by gravel during installation, rocks, macrophyte rhizomes and external tree roots. The liner should be flexible (HDPE, PVC or butyl rubber). with a minimum thickness of 0.75mm. The liner should be sandwiched between two protective layers of geotextile or similar product and UV stable. A suitable product is attached as Appendix.

At least 300mm of freeboard surrounding the reedbed to prevent overflow during wet weather. This can be an earth bank. Upslope stormwater should be designed so it does not receive upslope stormwater runoff.

Plants

Planted at a density of 10 plants per m^2. This includes *Phragmites australis, Schoenoplectus validus, Baumea articulate, Carex fascicularis and Carex appressa.*

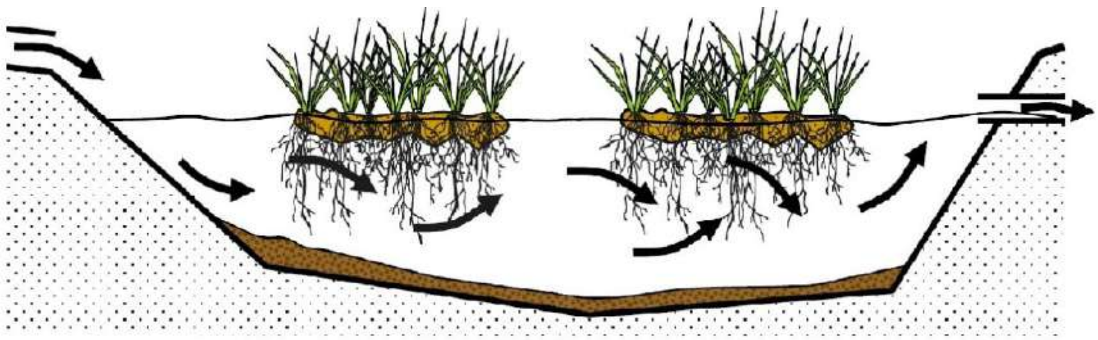


Figure 1. A Floating Treatment Wetland (FTW). Emergent plants are grow within a floating artificially constructed material. The roots are directly in contact with the effluent and can intercept suspended particles. The roots also provide a high surface area for microbiological activity. Image: Headley and Tanner (2006).

APPENDIX II SUBSURFACE REEDBED

Inlet distribution and outlet collection.

Typically, a 100mm PVC sewer pipe is used for the inlet spreader and outlet collection pipes. A series of 5-10mm holes are drilled in the pipe and a circular saw is used to create a series of slots to allow wastewater to discharge or enter the pipe. The outlet controls should allow for the height of water to be adjusted.

Impervious liner

Must be a durable to resist being punctured by gravel during installation, rocks, macrophyte rhizomes and external tree roots. The liner should be flexible (HDPE, PVC or butyl rubber). with a minimum thickness of 0.75mm. The liner should be sandwiched between two protective layers of geotextile or similar product and UV stable. A suitable product is attached as Appendix.

At least 300mm of freeboard surrounding the reedbed to prevent overflow during wet weather. This can be an earth bank. Upslope stormwater should be designed so it does not receive upslope stormwater runoff.

Gravel media

Filled with 10-20mm washed gravel (blue metal) 600mm depth. Large rocks approximately 50-100mm diameter or rail ballast should be placed at the entry and exits points of the reedbed to prevent the intrusion of reed roots and to enhance the distribution into the reedbed.

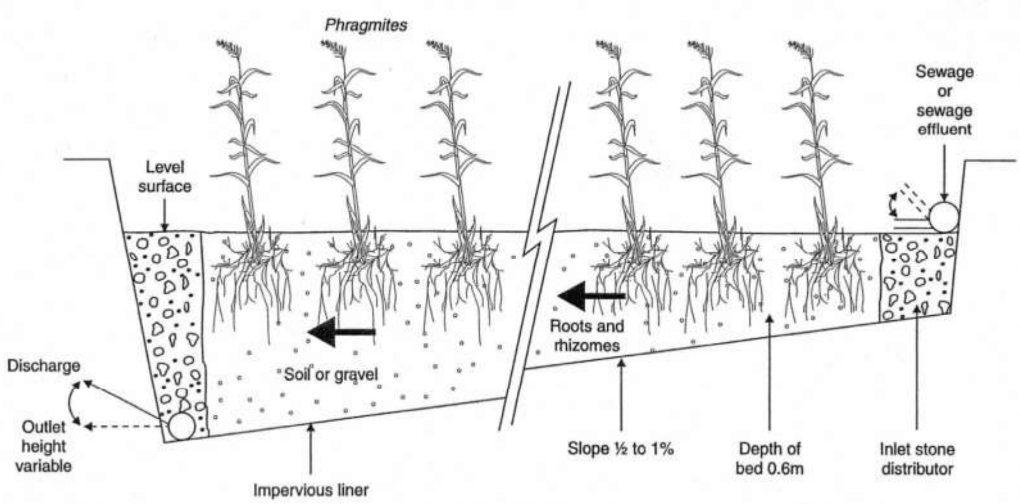
Base slope of 0-5 to 1%. Length to width ratio of between 4:1 and 1:1. In practice, the dimensions are governed by the width of the liner.

Plants

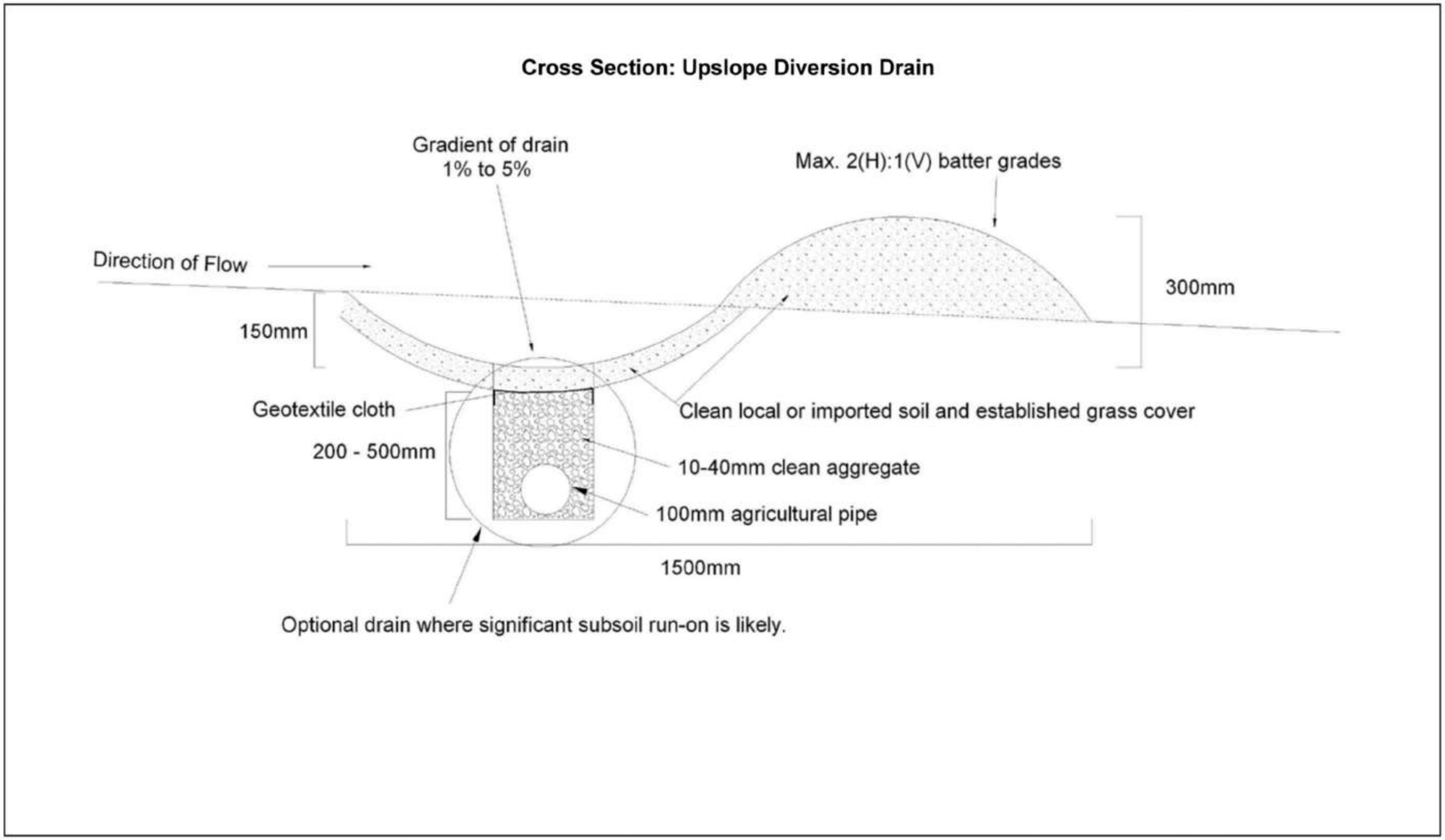
Planted at a density of 4 to 5 plants per m^2 (30-40cm apart). This includes *Phragmites australis, Schoenoplectus validus, Baumea articulate, Carex fascicularis and Carex appressa.*

Example of Phragmites australis in reedbed

FIGURE 3 CROSS SECTION OF HORIZONTAL FLOW SUBSURFACE REEDBED



APPENDIX III STANDARD DRAWING 9A - UPSLOPE DIVERSION DRAIN



APPENDIX IV WATER BALANCE FOR PROCESS WASTEWATER

Nominated Area Water Balance for Zero Storage

Site Address: **Allied Pinacle. Picton**

INPUT DATA			
Design Wastewater Flow	Q	6000	L/day
Design DIR (from AS/NZ 1547,2012)	DIR	17.5	mm/week
Daily DIR		2.5	mm/day
Nominated Land Application Area	L	**2750**	m sq
Rainfall Data	Picton Council Depot median		
Evaporation Data	Badgerys Creek		

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	P	\	mm/month	66.3	66.2	67.2	47.4	30.8	43.8	25.9	25.2	37.1	49.2	55.5	53.2	**567.8**
Evaporation	E	\	mm/month	202	157	136	105	81	63	81	96	120	152	183	220	**1557**
Crop Factor	C			0.80	0.75	0.70	0.65	0.60	0.60	0.60	0.60	0.65	0.70	0.75	0.80	
INPUTS																
Precipitation	(P)		mm/month	66.3	66.2	67.2	47.4	30.8	43.8	25.9	25.2	37.1	49.2	55.5	53.2	567.8
Effluent Irrigation	(W)	(Q x D) / L	mm/month	67.6	61.1	67.6	65.5	67.6	65.5	67.6	67.6	65.5	67.6	65.5	67.6	**796.36364**
Inputs		(P+W)	mm/month	133.9	127.3	134.8	112.9	98.4	109.3	93.5	92.8	102.6	116.8	121.0	120.8	1364.2
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	162	118	95	68	49	38	49	58	78	106	137	176	**1133.05**
Percolation	B	(DIR/7)xD	mm/month	77.5	70	77.5	75.0	77.5	75.0	77.5	77.5	75.0	77.5	75.0	77.5	**912.5**
Outputs		ET+B	mm/month	239.1	187.75	172.7	143.3	126.1	112.8	126.1	135.1	153.0	183.9	212.3	253.5	**2045.6**
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	S	(P+I)-(ET+B)	mm/month	-105.2	-60.5	-37.9	-30.4	-27.7	-3.5	-32.6	-42.3	-50.4	-67.1	-91.3	-132.7	
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	**0.00**
Largest M	**(V)**		mm	**0.00**												
		(V x L)/1000	m^3	**0.0**												

APPENDIX V NITROGEN BALANCE FOR PROCESS WASTEWATER

NITROGEN BALANCE				
SITE ADDRESS	**Allied Pinacle. Picton**			
Daily volume	6000	L/day		
TN effluent conc	30.0	mg/L		
TN	0.18	kg/d		
	65.7	kg/yr		
Irrigation Area	**2,750**	**m2**	**0.275**	ha
TN annual application rate	0.024	kg/m2/yr		
	238.9	kg/ha/yr		
Denitrification	20%			
TN Uptake (managed land)	240	kg/ha/yr		
TN available for leaching	-1	kg/ha/yr		
Or for site	**-0.24**	kg/yr		

APPENDIX VI PHOSPHORUS BALANCE FOR PROCESS WASTEWATER

PHOSPHORUS BALANCE			
SITE ADDRESS	**Allied Pinacle. Picton**		
Daily hydraulic load	6000	L/day	
TP effluent conc	10	mg/L	
TP effluent conc per day	60000	mg/day	
	21900	g/year	
P sorption rate of soil	500	mg/kg	
Bulk density of soil	1.5	g/cm3	
	1500	kg/m3	
Land application area	**1250.0**	**m2**	
Soil depth	1	m	
Volume of soil	1250.000	m3	
Mass of soil	1875000	kg	
Total P sorption capacity	937500	g	
Vegetation	Grass		
P annual uptake by vegetation	30	kg/ha/yr	
	3750	g/yr	
Net annual P (in soil)	18150	g/yr	
Life of system	51.7	years	

APPENDIX VII WATER BALANCE FOR DOMESTIC WASTEWATER

Nominated Area Water Balance for Zero Storage

Site Address: **Allied Pinacle. Picton, domestic wastewater**

INPUT DATA			
Design Wastewater Flow	Q	3000	L/day
Design DIR (from AS/NZ 1547,2012)	DIR	17.5	mm/week
Daily DIR		2.5	mm/day
Nominated Land Application Area	L	**1375**	m sq
Rainfall Data	Picton Council Depot median		
Evaporation Data	Badgerys Creek		

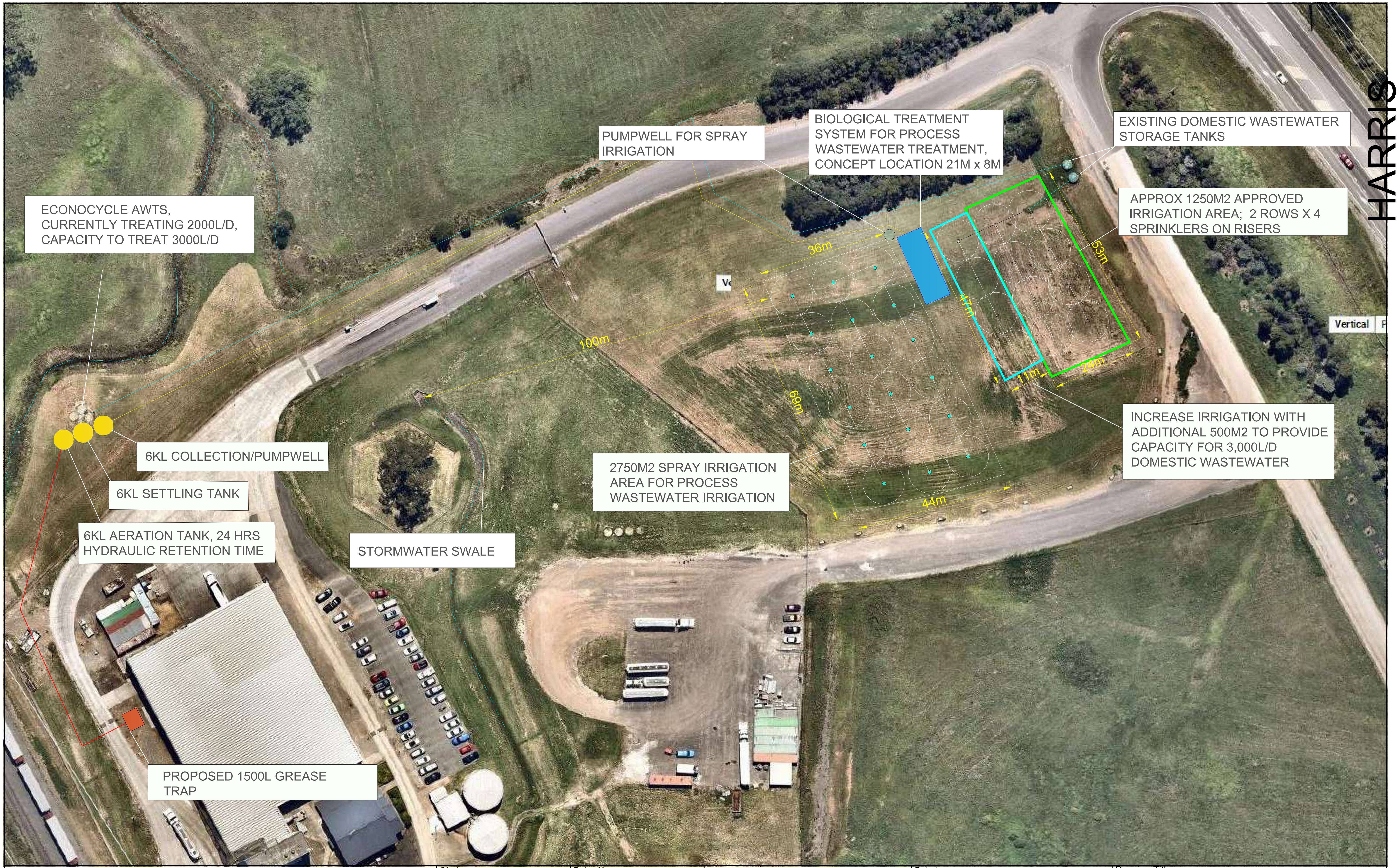
Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D	\	days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	P	\	mm/month	66.3	66.2	67.2	47.4	30.8	43.8	25.9	25.2	37.1	49.2	55.5	53.2	**567.8**
Evaporation	E	\	mm/month	202	157	136	105	81	63	81	96	120	152	183	220	1557
Crop Factor	C			0.80	0.75	0.70	0.65	0.60	0.60	0.60	0.60	0.65	0.70	0.75	0.80	
INPUTS																
Precipitation	(P)		mm/month	66.3	66.2	67.2	47.4	30.8	43.8	25.9	25.2	37.1	49.2	55.5	53.2	567.8
Effluent Irrigation	(W)	(Q x D) / L	mm/month	67.6	61.1	67.6	65.5	67.6	65.5	67.6	67.6	65.5	67.6	65.5	67.6	**796.36364**
Inputs		(P+W)	mm/month	133.9	127.3	134.8	112.9	98.4	109.3	93.5	92.8	102.6	116.8	121.0	120.8	1364.2
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	162	118	95	68	49	38	49	58	78	106	137	176	**1133.05**
Percolation	B	(DIR/7)xD	mm/month	77.5	70	77.5	75.0	77.5	75.0	77.5	77.5	75.0	77.5	75.0	77.5	**912.5**
Outputs		ET+B	mm/month	239.1	187.75	172.7	143.3	126.1	112.8	126.1	135.1	153.0	183.9	212.3	253.5	**2045.6**
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	S	(P+I)-(ET+B)	mm/month	-105.2	-60.5	-37.9	-30.4	-27.7	-3.5	-32.6	-42.3	-50.4	-67.1	-91.3	-132.7	
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	**0.00**
Largest M	**(V)**		mm	**0.00**												
		(V x L)/1000	m^3	**0.0**												

APPENDIX VIII PHOSPHORUS BALANCE FOR DOMESTIC WASTEWATER

PHOSPHORUS BALANCE			
SITE ADDRESS	**Allied Pinacle. Picton, domestic wastewater**		
Daily hydraulic load	3000	L/day	
TP effluent conc	10	mg/L	
TP effluent conc per day	30000	mg/day	
	10950	g/year	
P sorption rate of soil	500	mg/kg	
Bulk density of soil	1.5	g/cm3	
	1500	kg/m3	
Land application area	**620.0**	**m2**	
Soil depth	1	m	
Volume of soil	620.000	m3	
Mass of soil	930000	kg	
Total P sorption capacity	465000	g	
Vegetation	Grass		
P annual uptake by vegetation	30	kg/ha/yr	
	1860	g/yr	
Net annual P (in soil)	9090	g/yr	
Life of system	51.2	years	

APPENDIX IX NITROGEN BALANCE FOR DOMESTIC WASTEWATER

NITROGEN BALANCE				
SITE ADDRESS	**Allied Pinacle. Picton, domestic wastewater**			
Daily volume	3000	L/day		
TN effluent conc	34.0	mg/L		
TN	0.102	kg/d		
	37.23	kg/yr		
Irrigation Area	**1,500**	**m2**	**0.15**	ha
TN annual application rate	0.025	kg/m2/yr		
	248.2	kg/ha/yr		
Denitrification	20%			
TN Uptake (managed land)	240	kg/ha/yr		
TN available for leaching	7	kg/ha/yr		
Or for site	**0.98**	kg/yr		



Issue:	Description:	Date	Drawn	Approved
A	Issue for client review	20.09.2021	SH	SH

North: N

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Project:
PROPOSED FLOUR AND MAIZE MILLING FACILITY
LOT 1 DP1128013
330 Picton Road, Maldon, NSW
LGA: Wollondilly

Drawing Title:
WASTEWATER MANAGEMENT PLAN DETAILS SHEET No.1

Drawn:	Date:	Paper Size:	Q.A. Check:	Date:
SH	20.09.2021	ISO Expand A3	Complete	20.09.2021
Designed:	Our reference:	Scale:	Dwg. No.	Issue:
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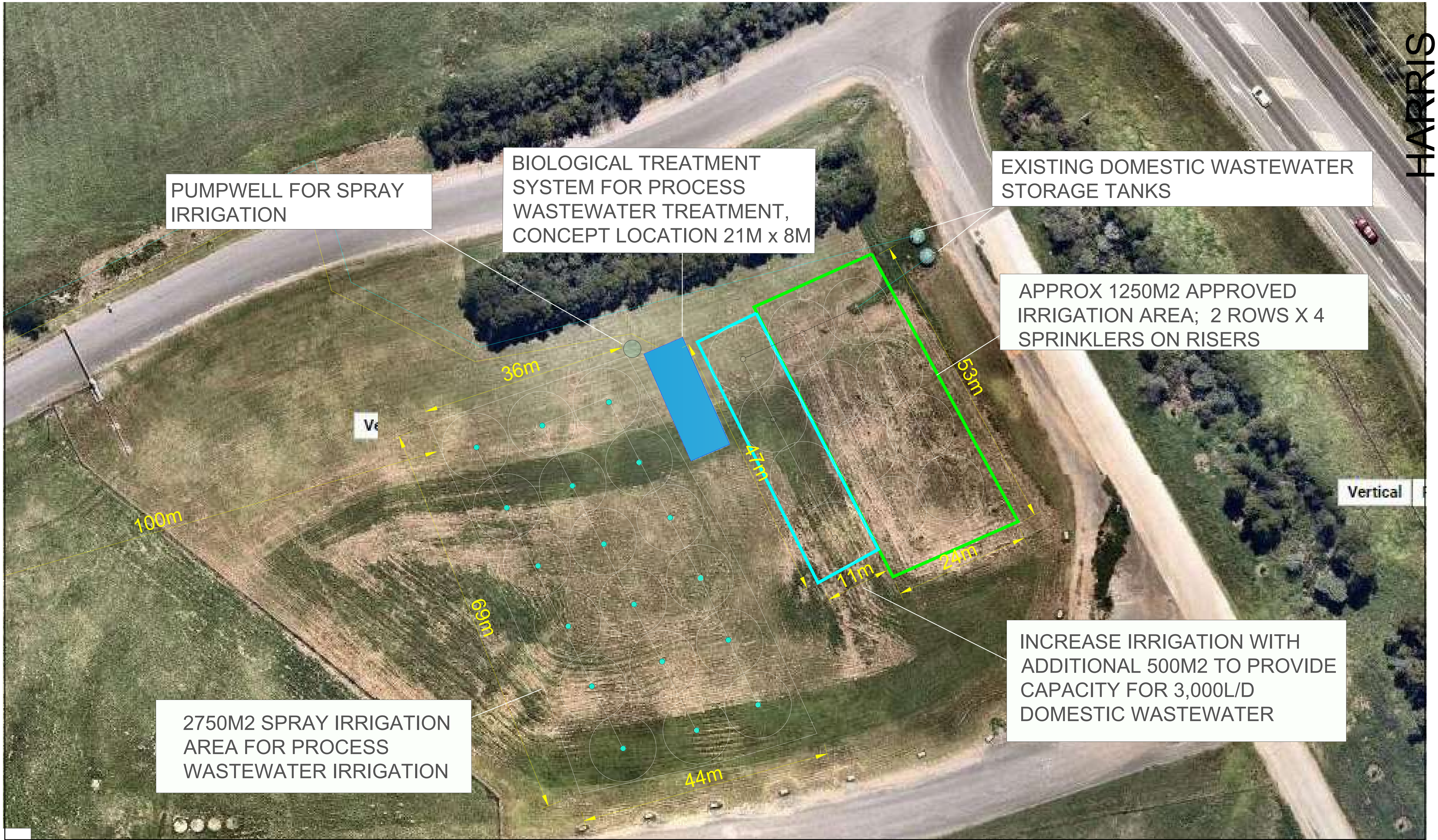

Issue:	Description:	Date	Drawn	Approved
A	Issue for client review	20.09.2021	SH	SH

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Project:
PROPOSED FLOUR AND MAIZE MILLING FACILITY
LOT 1 DP1128013
330 Picton Road, Maldon, NSW
LGA: Wollondilly

Drawing Title:
WASTEWATER MANAGEMENT PLAN DETAILS SHEET No.2

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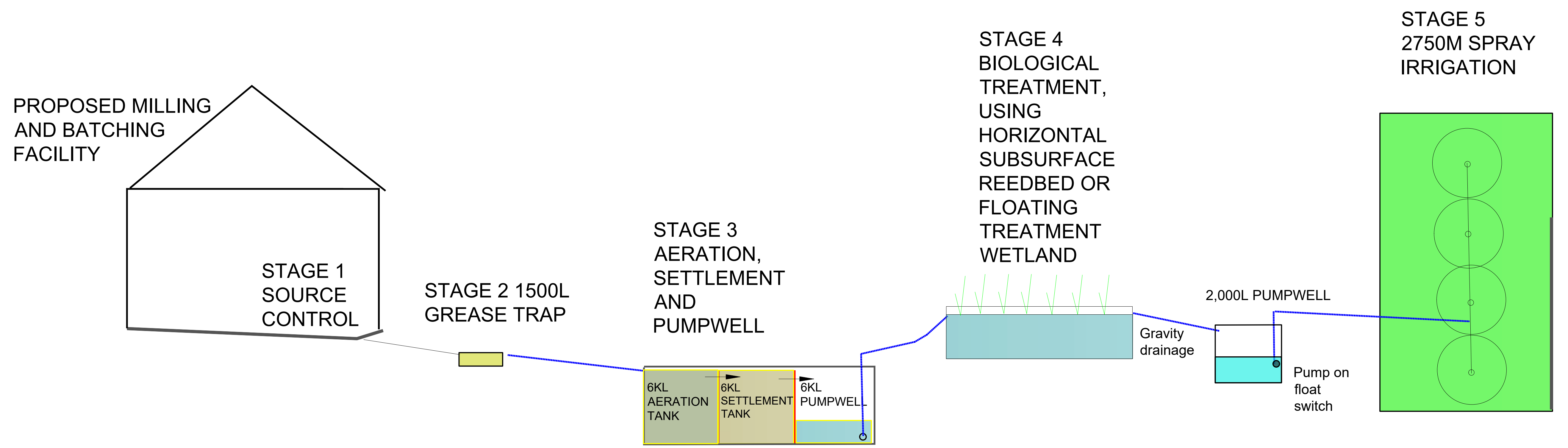

HARRIS

Issue:	Description:	Date	Drawn	Approved
A	Issue for client review	20.09.2021	SH	SH

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Wastewater | Bushfire | Stormwater

Project:

PROPOSED FLOUR AND MAIZE MILLING FACILITY

LOT 1 DP1128013

330 Picton Road, Maldon, NSW

LGA: Wollondilly

Drawing Title:

WASTEWATER MANAGEMENT PLAN DETAILS SHEET No.3

Drawn:	Date:	Paper Size:	Q.A. Check:	Date:
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