PLANNERS NORTH

abn: 56 291 496 553
6 Porter Street, Byron Bay, NSW, 2481
PO Box 538, Lennox Head, NSW, 2478
Telephone: 1300 66 00 87

TECHNICAL MEMORANDUM

15th October 2021
Our reference: 1548.3838

TO: The General Manager
Byron Shire Council

RE: Consolidated description of the Wastewater Arrangements concerning DA 2021-170

1. Preamble

Council by letter dated 16th August 2021 provided the proponent for DA 2021-170 with a Request for Further Information (RFI). Item 7 of that request required "*an accurate, succinct report that clearly describes the current waste water management system, proposed upgrades and the final waste water management system/s to be approved*". This document has been prepared by PLANNERS NORTH in response to that request.

2. Existing Facilities

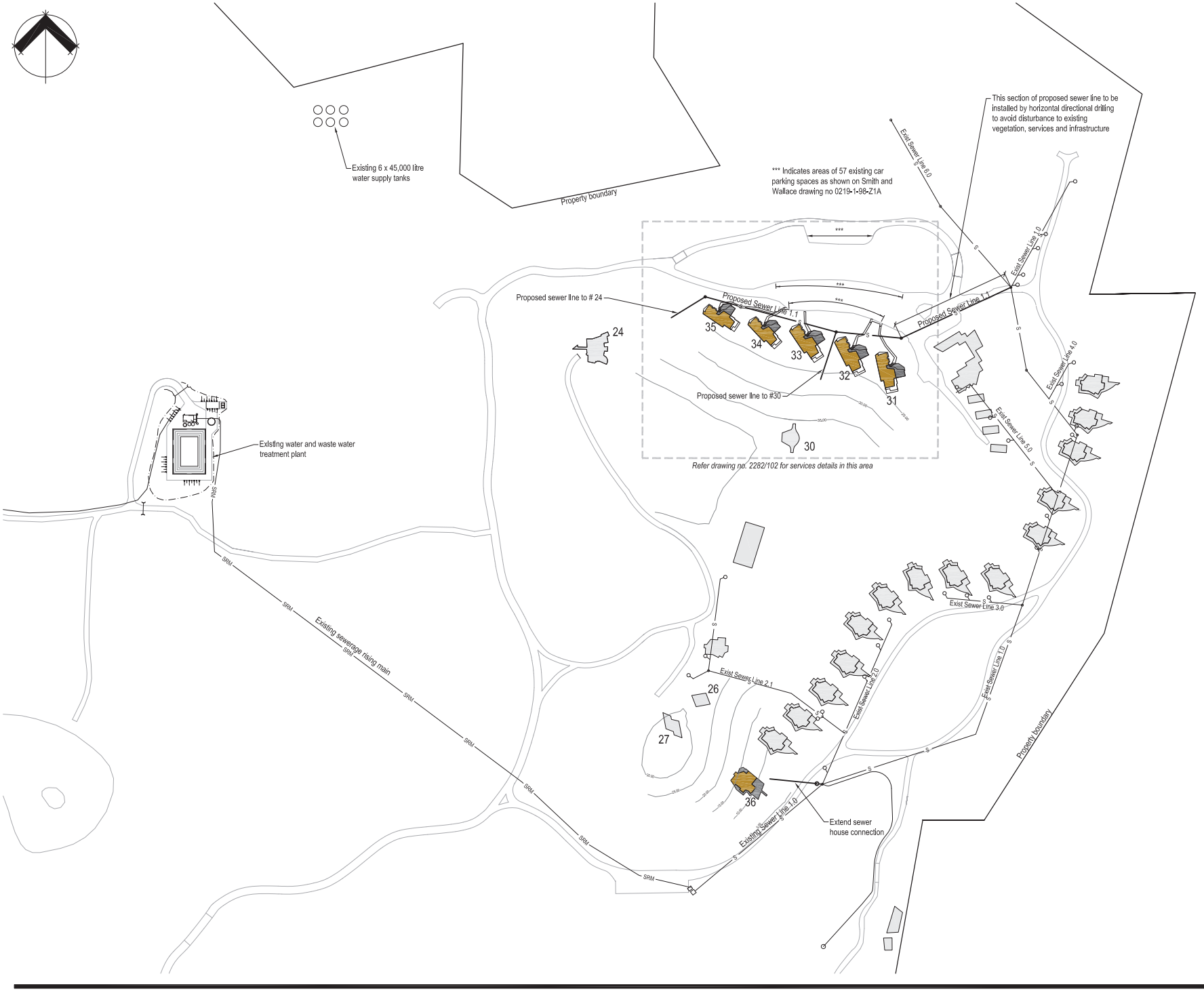
As shown in **Plan 1**, wastewater is currently collected from the accommodation units and community buildings in 100 mm and 150 mm nominal diameter gravity mains that deliver the wastewater to the sewage pump station. There is also a separate single pressure sewer unit servicing building CB.08 (the Crab community building). This pressure sewer also delivers wastewater to the sewage pump station. The existing pump station has a pumping capacity of 3.0 L/s.

The wastewater is pumped to the Wastewater Treatment Plant (WTP) where it is treated through an Intermittent Aeration Tank with a minimum operating volume of 18.2 kL. The approved treatment rate of 16.8 kL/d equates to 150 L/p/d for the maximum limit of 112 people currently approved to be accommodated on the site. The capacity of the treatment plant (as designed) has previously been assessed as 18.1 kL/d. The Hydraulic Retention Time (HRT) through this tank varies depending on the number of people on the site and the associated wastewater load. The Linnaeus Estate currently has the approval to treat 16.8 kL/d. The average wastewater generation rate of Linnaeus Estate has never exceeded 6 kL/d. At 6 kL/d, the HRT is approximately 3 days.

The system is designed for sludge to be pumped onto the drying beds and the decanted treated water to be stored in a dedicated pond until conditions are suitable for irrigation. Prior to being pumped to the irrigation site, the water is chlorinated in a chlorine contact tank.

There are 4 approved Irrigation Fields at the site. Fields 1 and 2 (approval #70.2002.639.1) and Fields 3 & 4 (Approval #70.2006.1039.1). These fields are shown in **Plan 2**.

Plan 1 The existing reticulation system



LEGEND

- Existing surface contour (5 m intervals)
- Existing sewer main, house connection and manhole
- Proposed sewer main and manhole
- Building under previous approval
- Proposed accommodation unit

Rev.	Description	Date	Des.	App.	Chk.

Amendments

GeoLINK environmental management and design
www.geolink.net.au

Level 1, 64 Ballina Street
PO Box 119
LENNOX HEAD NSW 2478
T 02 6687 7666
F 02 6687 7782
info@geolink.net.au

23 Gordon Street
PO Box 1446
COFFS HARBOUR NSW 2450
T 02 6651 7666
F 02 6651 7733

quality solutions sustainable future

Project Title
BHCF

Client
Broken Head Coastal Foundation

Designed	RBS	Drawn	RBS
Approved		Date	Nov 2013
XREFs			

Scale
metres 0 10 20 30 40 50

Drawing Title
Proposed Accommodation Units
Overall Site Plan

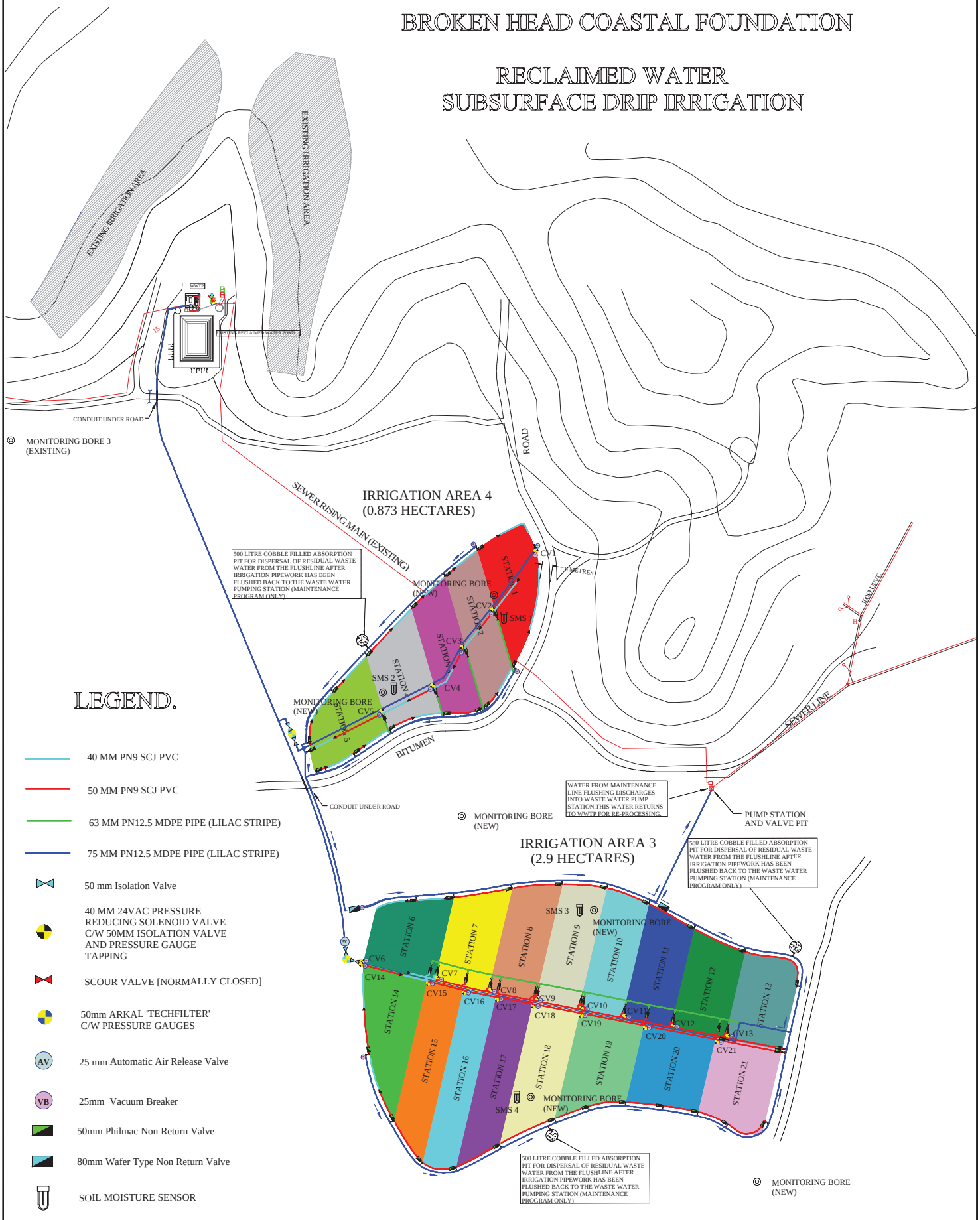
2282-1005

Drawing Number 2282/101 *Revision*

Plan 2 Approved irrigation Fields

BROKEN HEAD COASTAL FOUNDATION

RECLAIMED WATER SUBSURFACE DRIP IRRIGATION



LEGEND.

- 40 MM PN9 SCJ PVC
- 50 MM PN9 SCJ PVC
- 63 MM PN12.5 MDPE PIPE (LILAC STRIPE)
- 75 MM PN12.5 MDPE PIPE (LILAC STRIPE)
- 50 mm Isolation Valve
- 40 MM 24VAC PRESSURE REDUCING SOLENOID VALVE C/W 50MM ISOLATION VALVE AND PRESSURE GAUGE TAPPING
- SCOUR VALVE [NORMALLY CLOSED]
- 50mm ARKAL 'TECHFILTER' C/W PRESSURE GAUGES
- AV — 25 mm Automatic Air Release Valve
- VB — 25mm Vacuum Breaker
- 50mm Philmac Non Return Valve
- 80mm Wafer Type Non Return Valve
- SOIL MOISTURE SENSOR

NOTE : This drawing is intended for hydraulic presentation only. It is not to be used as a survey drawing.

FERNIE HOLDINGS Pty Ltd TRADING AS
ROTHWELLS PUMP & IRRIGATION.
24 RUSSELLTON DRIVE ALSTONVILLE NSW 2477 PH 02 6628 6689 FX 02 6628 7997

SCALE :	DATE :	DRAWN :	REFERENCE :
1 :2000A3	11th October 2005	Lee Rothwell	BHCF3443 A

3. Assessment of the Proposed Development

The estimated wastewater generation associated with the development as originally proposed is set out in **Table 1** below.

Table 1 Original Scheme Wastewater Generation Calculations

Design criteria / assumptions

		Wastewater generation	150L/d/EP (as per AS1547
Existing wastewater treatment plant capacity	18,100 L/d	Assumed occupancy for ecotourism	1.7 EP per bedroom (for resort room) 1.5 EP per bedroom (for 3 bed Type A)
Existing pump station capacity	3/Ls	Resort Staff	49 staff 0.13 EP/statt

Proposed Ecotourism and Private Educational Facility								
No.	**Name**	**Number of Buildings**	**Category**	**Calculation Unit**	**EP per Calculation Unit**	**Calculation Units per Building**	**EP**	**Av. Daily Wastewater Generation (L)**
2, 34	Hill House	2	Residence	Bedroom	1.5	3	9.0	1,350
12-16 & 18	Accommodation Type A - education	6	Accomm - 3 beds	Bedroom	1.5	3	27.0	4,050
3-11 & 17	Accommodation Type A – resort	10	Accomm - 3 beds	Bedroom	1.5	3	45.0	6,750
24-27	Accommodation Type B – resort	4	Resort room	Bedroom	1.7	1	6.8	1,020
A.1-A.8	Beach Cabin	8	Resort room	Bedroom	1.7	1	13.6	2,040
A.9-A.22	Treehouse Cabin	14	Resort room	Bedroom	1.7	1	23.8	3,570
B.1-B.4	Rainforest retreat	4	Resort room	Bedroom	1.7	1	6.8	1,020
C.1	Treehouse retreat	1	Resort room	Bedroom	1.7	1	1.7	255
	Resort staff						6.4	956
CB.1	Centre (kitchen)	*From ET calculations based on Council's Policy – Water and Sewer Equivalent Tenements 2018*						614
CB.4	Pool amenities – existing	*Estimated additional wastewater generation (above 150 L/p/d allowance)*						40
CB.4	Pool – food offering	*From ET calculations based on Council's Policy – Water and Sewer Equivalent Tenements 2018*						378
CB.4	Pool – day spa	*Estimated additional wastewater generation (above 150L/p/d allowance_*						560
						Total	**140.1**	**22,602**

The amended proposal for which consent is now sought changes the wastewater demand. Set out below in **Table 2** is our tabulation of the assessed updated wastewater demand.

Table 2 Amended Scheme Wastewater Generation Calculations

Design criteria / assumptions

		Wastewater generation	150L/d/EP (as per AS1547
Existing wastewater treatment plant capacity	18,100 L/d	Assumed occupancy for ecotourism	1.7 EP per bedroom (for resort room) 1.5 EP per bedroom (for 3 bed Type A)
Existing pump station capacity	3/Ls	Resort Staff	49 staff 0.13 EP/statt

Proposed Ecotourism and Private Educational Facility								
No.	**Name**	**Number of Buildings**	**Category**	**Calculation Unit**	**EP per Calculation Unit**	**Calculation Units per Building**	**EP**	**Av. Daily Wastewater Generation (L)**
2, 34	Hill House	2	Residence	Bedroom	1.5	3	9.0	1,350
12-16 & 18	Accommodation Type A - education	6	Accomm - 3 beds	Bedroom	1.5	3	27.0	4,050
3-11 & 17	Accommodation Type A – resort	10	Accomm - 3 beds	Bedroom	1.5	3	45.0	6,750
24-27	Accommodation Type B – resort	4	Resort room	Bedroom	1.7	1	6.8	1,020
A.1-A.8	Cabin A	8	Resort room	Bedroom	1.7	1	13.6	2,040
B.1-B.4	Cabin B	4	Resort room	Bedroom	1.7	1	6.8	1,020
#28-32	DA2013.600 Accommodation	5	Accomm - 3 beds	Bedroom	1.5	3	22.5	3,375
	Resort staff						6.4	956
CB.1	Centre (kitchen)	*From ET calculations based on Council's Policy – Water and Sewer Equivalent Tenements 2018*						614
CB.4	Pool amenities – existing	*Estimated additional wastewater generation (above 150 L/p/d allowance)*						40
CB.4	Pool – food offering	*From ET calculations based on Council's Policy – Water and Sewer Equivalent Tenements 2018*						378
CB.4	Pool – day spa	*Estimated additional wastewater generation (above 150L/p/d allowance_*						560
						Total	**137.1**	**22,153**

To summarise the above tables, the total average daily wastewater generation rate for the original submission was estimated as 22.6 kL/d. For the amended design, the estimate is 22.2 kL/d. This exceeds

both the approved treatment limit of 16.8 kL/d and the assessed capacity of the WTP. As such, the WTP requires an upgrade to increase capacity.

4. The Proposed Wastewater Treatment Plant

A revision to the existing approved WTP design has been prepared by Aerofloat. Aerofloat are a specialist wastewater treatment firm that has designed and commissioned more than 750 wastewater treatment systems over the past 40 years. The Aerofloat design will increase the treatment capacity to 30 kL/d and would be accommodated within a similar footprint to the approved plant.

The Aerofloat design incorporates improved treatment technologies including:

- Relocated screen to remove solids from the raw sewage pumped from the buildings; discharges via gravity to the new MBBR;
- A new 3KL capacity Moving Bed Biofilm Reactor (MBBR) which includes removable air lances, hydrostatic level transmitter, DO sensor, bio media and screened overflow;
- The proposed Intermittent Aeration Tank (IAT) utilises the existing concrete tank and is fittedwith an aerator, decant system and an ultrasonic level sensor; and
- All required pipework, sensors and controls.

The Aerofloat design Process Flow Diagram is shown in **Plans 3. Plan 4** depicts the upgrading components for the WPT. The expected effluent quality from the upgraded WTP will be in accordance with **Table 3.**

Table 3 Treated effluent quality from upgraded WTP (Source: Council specified criteria)

Parameter	Value (90th Percentile)
pH	6.5-8.0
Suspended Solids (mg/L)	<30
BOD5 (mg/L)	<20
Total Nitrogen (mg/L)	<10
Total Phosphorus (mg/L)	<1
Faecal Coliforms (CFU/100mL)	<30

5. Disposal

The property does not have access to a reticulated municipal sewage treatment system and an on-site disposal system has been designed and partially constructed. The existing portion of the irrigation area has been used since 2002 within ongoing management and maintenance provided by ThinkWater.

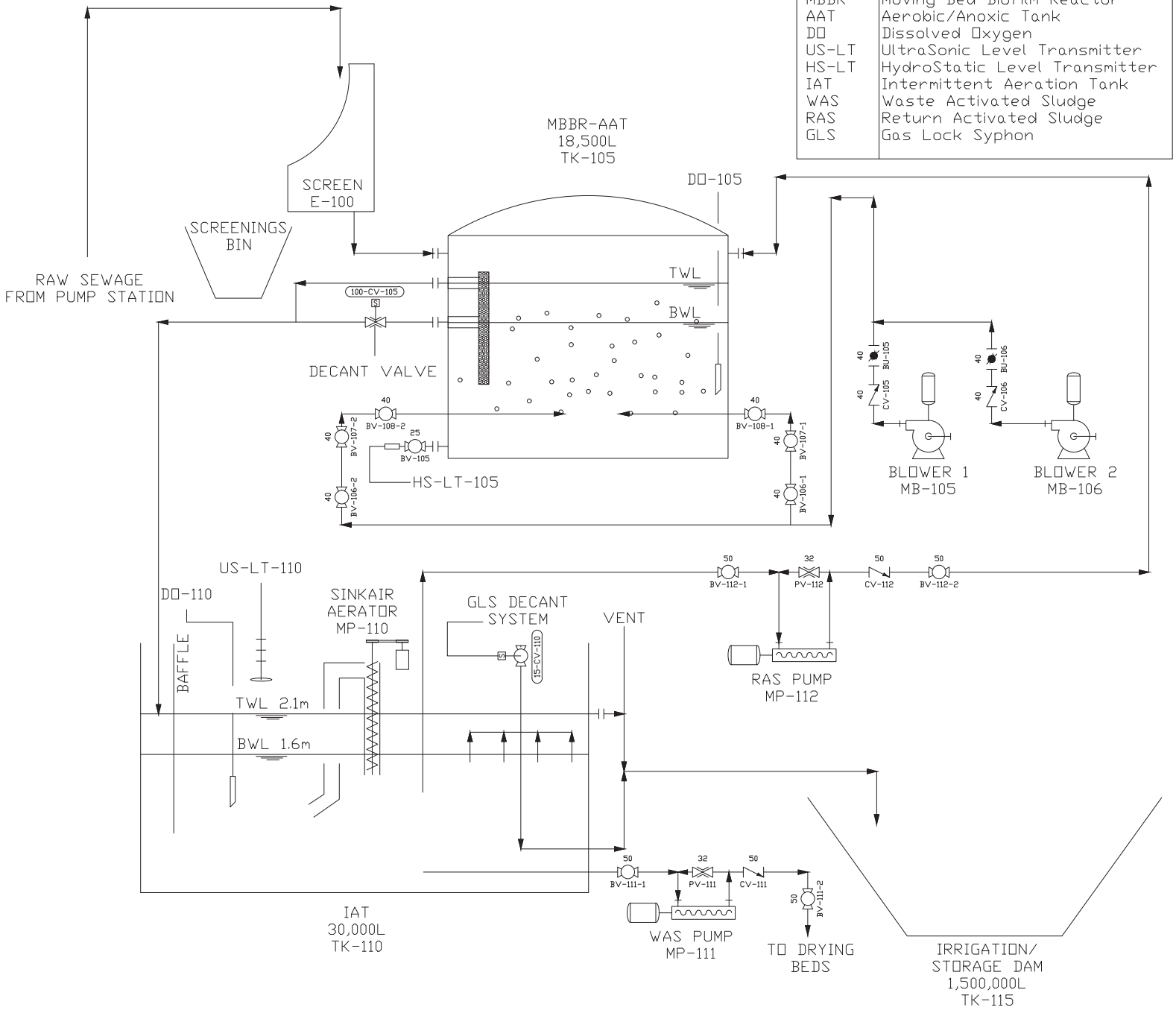
5.1. The proposed Drip Irrigation System

Water from the effluent retention pond is pumped via two (2) electro-submersible stainless steel multi stage pump sets operating in duty/standby control configuration. Each pump will be capable of the duty point 2 l/sec at 35 metres TDH (Total Dynamic Head). Pumps start on low-level signal from Irrigation Water Holding Tank and run until the holding tank is full or until filters are required to be backwashed. Pump operation is designed to cease on low Holding Dam level, re-initiating on dam level rise.

Reclaimed water is filtered prior to discharge into the holding tank. This is done through a two-stage process using media tanks as filter beds.

Plan 3 Process diagram of the upgrade to the Proposed Wastewater Treatment Plant

Acronym	Definition
MBBR	Moving Bed Biofilm Reactor
AAT	Aerobic/Anoxic Tank
DO	Dissolved Oxygen
US-LT	UltraSonic Level Transmitter
HS-LT	HydroStatic Level Transmitter
IAT	Intermittent Aeration Tank
WAS	Waste Activated Sludge
RAS	Return Activated Sludge
GLS	Gas Lock Syphon



CLIENT: Broken Head Coastal Foundation

DESIGNER: Aerofloat

PROJECT: Broken Head Coastal Foundation

TITLE: BHCF Process Flow Diagram

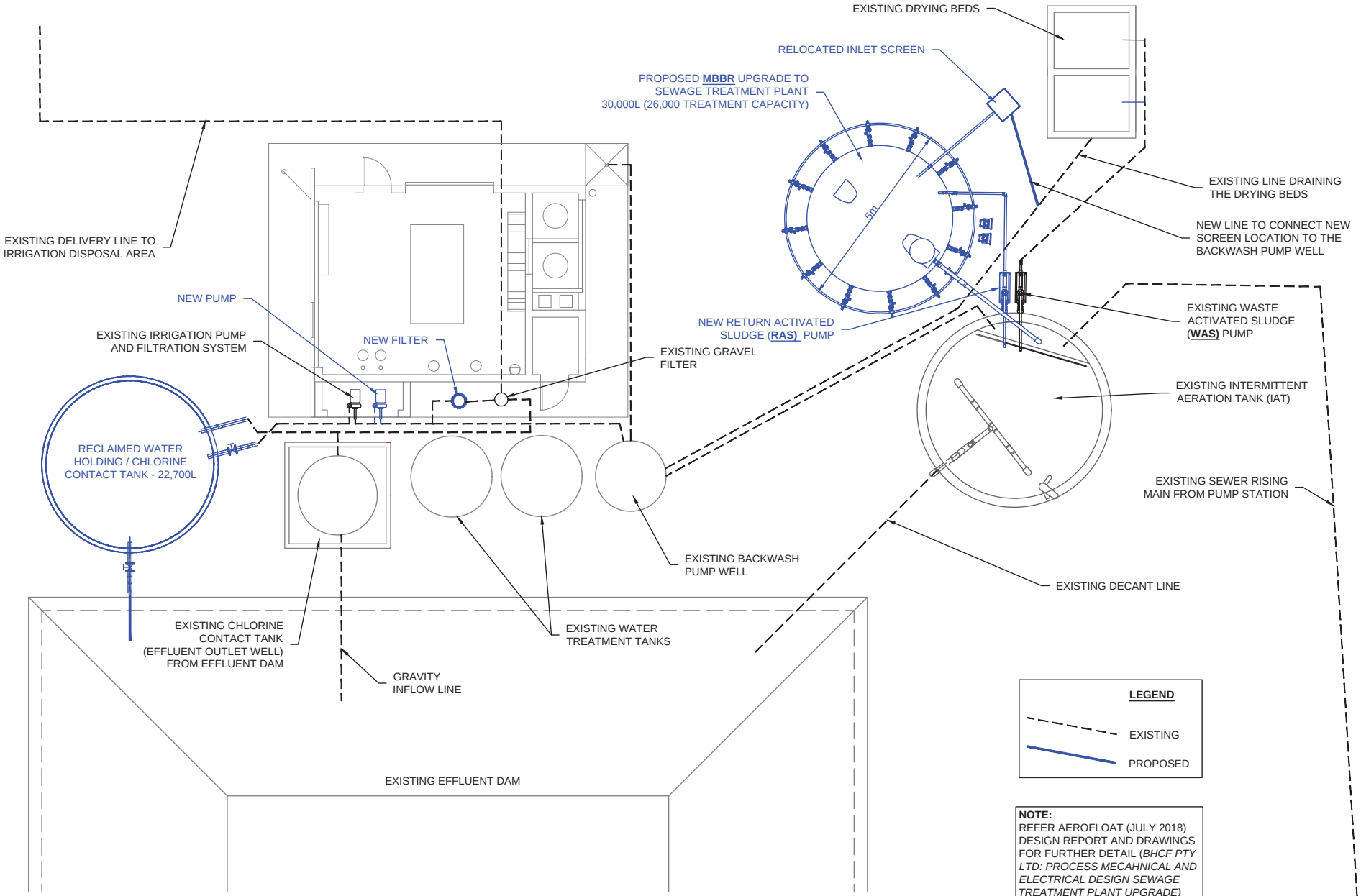
DRAWN BY	DESIGNED BY	DATE
NL	RA NL	15/02/2018
CHECKED BY	APPROVED BY	SCALE
RA	RA	NTS

DRAWING NUMBER	REVISION
BHCF-AF-PFD-001	0

REVISION	AMENDMENT	DATE
0	DRAFT FOR REVIEW	15/02/2018

Aerofloat Australia Pty Ltd
1 / 60 Box Rd, Taren Point, NSW,2229
sales@aerofloat.com.au
www.aerofloat.com.au

Plan 4 Plan of upgrading components for the WPT



AWC
Australian Wetlands Consulting Pty Ltd
8 GEORGE ST
BANGLOW NSW 2479
P (02) 6687 1550 | 1300 998 514
www.awconsult.com.au

CLIENT: **BHCF Pty Ltd**

DO NOT SCALE FROM PLANS, TO BE ADAPTED ON SITE BY CONTRACTOR & CONFIRMED BY PROJECT SUPERVISOR, SIZING, CALCULATIONS, STRUCTURES, & COMPACTION TO BE CONFIRMED BY ENGINEER OR SUITABLY QUALIFIED PERSONS. ENGINEERS CERTIFICATE BY OTHERS.

REV.	ISSUE / AMENDMENTS	DATE
A	REVISION A	24/07/2020
B	REVISION B	19/10/2020

DESIGNED	JM
DRAWN	JM
CHECKED	DM

PROJECT: **LINNAEUS STP UPGRADE - 2020**

DRAWING: EXISTING AND PROPOSED STP COMPONENTS

SCALE: NOT TO SCALE - SCHEMATIC ONLY

DRAWING CREATED: 17 / 06 / 2020

DWG No.: 1-16804_STP2020_

CAD FILE No.: 1-16804_STP2020.dwg

REV.: B

Stage 1

- 400mm diameter tank.
  - Crushed Basalt Media
  - Removal of suspended solids down to 80 micron.
  - Filtering Velocity 57.30 m/hr

Stage 2

- 2 x 600mm diameter tanks (GRP)
- Media 1 Under-bed Gravel 1.5 to 3.0mm
- Media 2 Sand 0.55 to 1.1mm
- Media 3 Anthracite
- Filtering Velocity – 12.73 m/hr

Filters are designed to be sequentially backwashed using pre-filtered water from the holding tank, supplied under pressure from the irrigation pumping system. Supply pumps are isolated during the backwash process. Backwash water is directed to an existing in-ground collection sump from where it is pumped to the WTP for re-processing. The filtration system operation is coordinated via a dedicated backwash controller.

Chlorination of the reclaimed water is achieved via the use of a dosing pump which is activated via an in line flow switch located on the return line. The central control system determines the start up sequence through sensor output data from the Reclaimed Water Outlet Well (RWOW) level and the IWHT level. The 22.7 KL holding volume of the IWHT and inlet flow of 2 l/sec (7.2 kl/hr) ensures that reclaimed water has a minimum contact period of 3 hours.

The tank is concrete construction, with a tank volume which is nominally 22,700 litres. The tank drainage line returns to the Reclaimed Water Holding Pond, as would the emergency overflow.

Pumping system operates to maintain a constant line discharge pressure across the range of flow rates encountered over the various irrigation blocks, both for water injection into the soil,and for system flushing.

Pumps are be activated from the Irrigation Controller for irrigation and for filter backwash. Once activated, the pumps operate in sequence to maintain a continuous pressure.

To ensure pumps cannot exceed their maximum flow rate, a pressure sustaining valve is fitted on the downstream side of the pump unit to maintain sufficient backpressure to prevent pump damage (or nuisance low pressure fault shutdown) and to ensure adequate pressure for effective filter backwash.

A flow meter is installed downstream of the pump unit, (after the backwash water line) to record system flow (both instantaneous and historic records). The flow meter data is used to assess the integrity of the irrigation system. By matching the correct irrigation station flow rates against the actual currentirrigation flow rates, the control system can determine whether a fault condition has occurred and therefore isolate and report the problem area.

The irrigation area is designed to be divided into two (2) zones. They are Stage 1 (Existing) 1.458 Ha and Stage 2 (2.008 Ha) is the next proposed implementation[1]. These approved areas are shown in **Plan 5.** The Irrigation System Process Diagram is shown in **Plan 6.**

The Stage 1 area has three (3) irrigation stations. The Stage 2 area will have four (4) irrigation stations. The irrigation stations will operate sequentially from 1 to 7. Areas that are constrained due to excessive soil moisture levels or high ground water levels will be isolated from this sequence until such time as the constraints are removed, or the Reclaimed Water Holding Pond is excessively high.

The irrigation water dispersal system is comprised of subsurface integrated pressure compensated dripline.

System flushing will occur every time an irrigation station changes to the nextstation, as the flushing solenoid valves (Normally open) allow the residual water in the line to drain under gravity back to the Effluent Outlet Well at eachstation change. This system has been working without issue since the installation of Stage 1 LAA in 2002.

An irrigation controller is installed in the plant room to accept inputs from external sensors, start pumps, and to power the irrigation solenoid valves thatautomate the irrigation sequence. It will be programmed to provide the logic for high/low level pump control and over ride of irrigation due to holding dam, groundwater and soil moisture levels.

The Effluent Outlet Well and the Reclaimed Water Holding/Contact Tank will be fitted with Multitrode level sensors and a Multitrode Indicator Controller foreach probe. These will provide a reliable level indication to the Central Control System (CCS).

The CCS will control the two supply pumps according to the level in the treated effluent well, but also according to the filtered water tank level and the filter flush cycle. In the case of potential Reclaimed Water Holding Pond overflow, limited irrigation will be turned on at a rate of 1 mm/day to the irrigation area, regardless of soil moisture or ground water level. These eventswill be provided in the report.

Groundwater quality from the existing Monitoring Bore is sampled pursuant to the routine monitoring and reporting program.

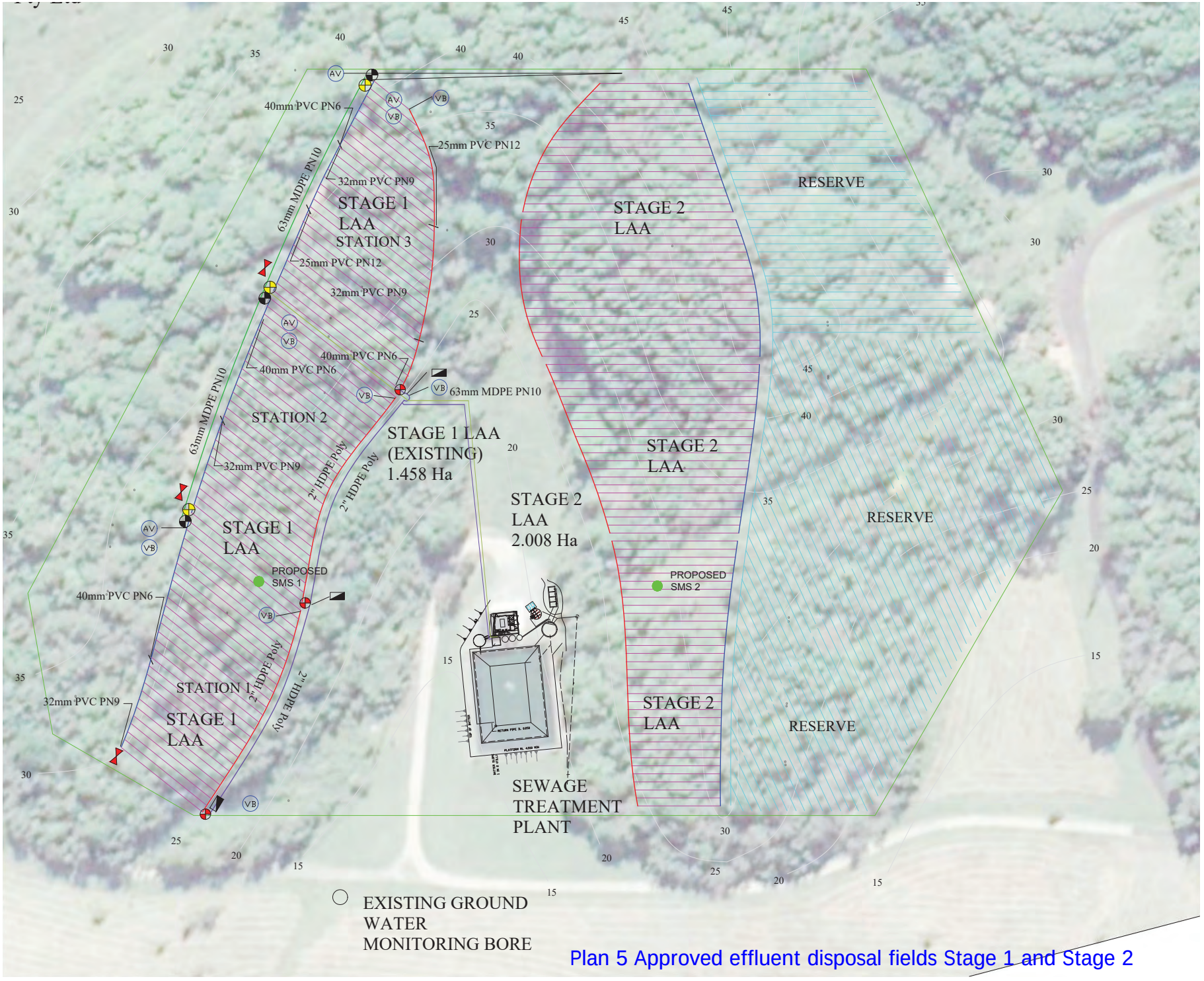
A rain switch will be located at the plant room, and will pause the irrigation cycle when any significant downpours (events > 5mm/hour) occur.

Soil moisture content will be measured continuously using two (2) Sentek soilmoisture sensors. Within stage 1 area, and another on the stage 2 area. Sensors are designed to provide live data to a depth of 600mm to the operator to allow for refined irrigation management based on soil real time moisture levels.

Irrigation of reclaimed water will cease (in the corresponding areas) when soil moisture levels exceed 80% of field capacity.

A flow meter has been designed into the system to measure total flow from the irrigation pumps. This allows reported along with the flow to each block, calculated from the on time of the particular block control valve. The normal irrigation rate will be 2 mm/day to each block (30 minutes duration /irrigation station) unless it is overridden by soil moisture status. High holding dam level will override soil moisture level inputs, initiating irrigation to the field at a rate of 1 mm/day (maximum) until the dam level recedes below the critical level.

[1] In the course of Councils onsite inspection, it was suggested that the Council may prefer the utilisation of approved disposal fields 3 and 4 (Simmons and Bristow design). The proponent has no objection to a condition to that effect.



Plan 5 Approved effluent disposal fields Stage 1 and Stage 2

ORIGINAL PLANS SUPPLIED BY:

Do not scale from drawing. Use indicated dimensions at all times. Verify all dimensions and set-outs on site before commencing work. Clarify discrepancies before commencing work.

ISSUE	REV.	AMENDMENT	BY	DATE
A		GENERAL OVERVIEW	LIR	22.6.20
B		GENERAL OVERVIEW	LIR	21.7.20

AV AUTOMATIC AIR RELEASE VALVE

VB VACUUM BREAKER

NETAFIM DM17 DRIPLINE
2.3 l/hr @ 1.0 m SPACING.

SCOUR VALVE [Normally Closed]

ISOLATION VALVE [Normally Open]

Horizontal Checkvalve

Automatic Control Valve [Normally Closed]

Automatic Control Valve [Normally Open]

40 mm STD Filter. 130 micron

CLIENT:

BHCF Pty Ltd
PO Box 464
LENNOX HEAD NSW 2478

PROJECT TITLE:

TREATED WASTEWATER DISPOSAL SYSTEM

DRAWING TITLE:

LAND APPLICATION AREA OVERVIEW

thinkwater.
BEYOND IRRIGATION
Fernie Holdings Pty Ltd
ABN 97 003 867 481
24 - 26 Russelton Drive
Alstonville NSW 2477
Phone: (02) 6628 6609
Fax: (02) 6628 7997
lee.rothwell@thinkwater.com.au

SCALE @ A1: NTS

SCALE @ A3: NTS

SCALE BAR:

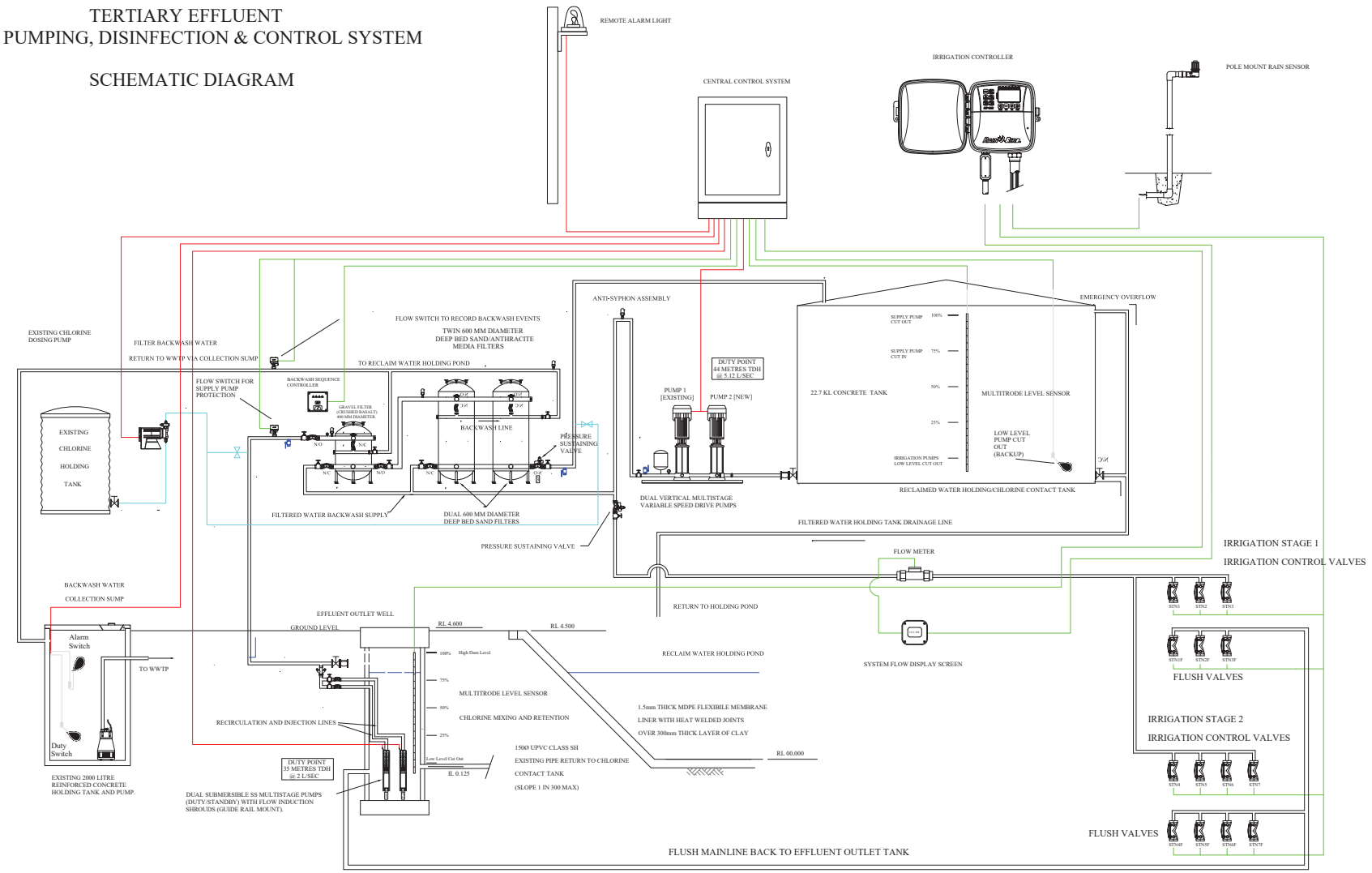
NORTH

PROJECT NUMBER:	DRAWING NUMBER:	REVISION NUMBER:
1304	1304-1	A1

Plan 6 Irrigation System Process Diagram

TERTIARY EFFLUENT
PUMPING, DISINFECTION & CONTROL SYSTEM

SCHEMATIC DIAGRAM



ORIGINAL PLANS SUPPLIED BY:

Do not scale from drawing. Use indicated dimensions at all times. Verify all dimensions and set-outs on site before commencing work. Clarify discrepancies before commencing work.

ISSUE	REV.	AMENDMENT	BY	DATE
A		GENERAL OVERVIEW	LIR	22.6.20
B		GENERAL OVERVIEW	LIR	21.7.20

CLIENT:

BHCF Pty Ltd
PO Box 464
LENNOX HEAD NSW 2478

PROJECT TITLE:

TREATED WASTEWATER DISPOSAL SYSTEM

DRAWING TITLE:

EFFLUENT DISPOSAL PUMP AND FILTRATION PROCESS DIAGRAM.

thinkwater.
BEYOND IRRIGATION
Ferrie Holdings Pty Ltd
ABN 97 003 667 481
24 - 26 Russellton Drive
Alstonville NSW 2477
Phone: (02) 6628 6609
Fax: (02) 6628 7997
lee.rothwell@thinkwater.com.au

SCALE @ A1: NTS
SCALE @ A3: NTS
SCALE BAR:

NORTH

PROJECT NUMBER: 1304
DRAWING NUMBER: 1304-2
REVISION NUMBER: A1

6. Land Capability

Australian Wetland Consulting (AWC) has undertaken an assessment to determine the land capability of the proposed total irrigation area in terms of land application of treated effluent. The assessment showed that the 3.446 ha of irrigation area has the capability of accepting a loading of 51.7 kilolitres a day with an application rate of only 1.5mm/day depending on various management and weather factors.

6.1 Constraints

The primary constraint of the existing irrigation area is the slope. Typically slopes greater than 15% are considered constrained. The slopes of the existing irrigation area are typically between 20-30%. This constraint has been addressed through a number of safeguards and conservative actions concerning land capability assessment. These include:

- The WTP will produce very highly treated wastewater;
- The irrigation area has established forest vegetation that will absorb the vast majority of water and nutrients applied;
- The development will rarely have 100% capacity, so although the site will be given an equivalent population capacity, that number will be the peak with occupancy generally lower; and
- In accordance with AS1547:2012, the slope constraint has been accounted for by a 50% reduction in application rate, i.e. affecting a 100% increase in the total irrigation area.

6.2 Byron Shire Council OSMS Model

In order to assess the capability of the existing disposal field, and after discussion between AWC and Council Officers, the Byron OSMS Model was determined to be appropriate for use.

Byron Shire Council has a proprietary model that was formulated to determine the size of land application areas for On-site Sewage Management Systems. This model uses specific localised climatic data to undertake long time-period water and nutrient balances and was used to assess the capacity of the existing disposal field.

Because this model is designed for use on individual properties with individual effluent disposal fields, the model was run using 10% of the actual disposal to enable fast and more accurate model runs; results were then multiplied by 10. The results of the model show that 103,500L/day can be adequately disposed of using the existing irrigation field.

Table 4 below sets out the inputs to the model, **Appendix A** details the results of the Byron OSMS Model.

Table 4 – Inputs to the BSC OSMS model and comments

Parameter	Model Input	Comment/Justification
Total daily flow	10,350L/d	As per the explanation above, the model was run at 10% of the actual values. The number of people was set at 69 in order to generate a total daily flow of 10,350L
Buffer to permanent water/intermittent water	100m/40m	All applicable buffers can be achieved
Block size	50,000m² (5ha)	The total block is substantially larger, approximately 112ha, this was used as multiple assessments will take place. (50ha when multiplied)
Daily effluent flow according to type	150L/p.d	As per AS:1547 2012 for reticulated water supply. The actual daily usage is expected to be less as: • occupancy is typically substantially less than 100%;

		• water supply is collected, treated and stored on site however the supply is reticulated within the development; and • water saving devices are standard fixtures
Treatment system	AWTS	This is default to simulate the high treatment of the proposed system.
N loss in treatment system (% reduction)	87%	Based on the 'approval to install an on-site wastewater management system' (BSC 2007) the effluent quality from the STP will be <10mg/L TN and <1mg/L TP which equates to an 87% reduction in TN. Calculation: Raw sewage = 4.2kg/y/person TN =0.011kg/p/day TN = 76.7mg/L Treated sewage = 10mg/L thus reduction value = 86.96% ((76.7mg/l - 10mg/L)/76.6mg/L)
Phosphorus production per person per year	0.06kg/p/yr	This is reduced from 0.6kg/p/yr based on the effluent concentrations of <1mg/Kg. Calculation: concentration of 1mg/L after treatment = 150mg/day/person (1mg/L * 150L) = 54,750mg/p/yr (150mg/d/p * 365days) = 0.055kg/yr/person (rounded up to 0.6)
P soil sorption according to soil type	Duplex Soils (8,000kg/ha/m)	Based on soil maps (Morand, 1994) and soil borehole test, the site is located on the Billinudgel (bi) soil landscape.
Soil texture & structure beneath system	Light clays – strongly structured (Ksat 0.12-0.5m/day)	Clay subsoils based on the soil borelog provided in the Simmonds & Bristow (2004) document and soil borehole test.
% Effective rainfall	Mounded bed	Irrigation area is on steep land.
Soil Texture in root zone	Clay	Sandy clay loams in the topsoil based on the soil borelog provided in the Simmonds & Bristow (2004) document and soil borehole test.
Water Table/Bedrock Depth	3.0m	water table >3.0m below ground surface.
Land Application Type	SSI	SSI = Subsurface Irrigation Laterals at 2.0m separation.
Percolation (mm/d)	4mm/day	BSC OSMS model default of 4mm/day. Already conservative value based on percolation testing by Simmonds & Bristow where the minimum percolation rate equalled 240mm/day for subsoil.
Average depth of root zone	0.5m	The default in the OSMS model is 0.3m, however as the existing disposal area has established forest vegetation, a conservative root zone depth of 0.5m

		was used.

6.3 Reduction in DIR due to slope

As a conservative measure, and in recognition that the irrigation field has steep slopes the Design Irrigation Rate (DIR) has been reduced. Table M2, *Recommended Reductions in DIR According to Slope,* within AS 1547:2012 *Onsite domestic wastewater management* recommends a 50% reduction in DIR for slopes of 20-30%. Essentially this reduces the potential hydraulic load and application rate to the irrigation area by half. Therefore, the land capability of the existing irrigation area has been determined as 51,750L/day (50% x 103,500L/day). This is higher than the average daily wastewater generation rate of 22,200L/day (22.2kL/day) for the amended design.

The daily volume of 51,750L over the area of the existing irrigation field (3.446 ha) equates to a daily application rate of 1.5mm.

6.4 AS1547:2012

Further to the above analysis, a cross check with AS1547:2012 was made by AWC to ensure the capacity was appropriate. In accordance with *Table M1 Recommended design irrigation rate (DIR) for irrigation systems* of AS1547:2012, drip irrigation on light clays should be applied at 3mm/day. When the 50% loading is applied due to slope, it equals the application rate calculated and determined through using the BSC OSMS model (1.5mm/day).

6.5 MEDLI Modelling

As a further check of the suitability of the proposed effluent irrigation scheme, JG Environmental were engaged by AWC to undertake hydraulic and nutrient balance modelling using the MEDLI software.

MEDLI stands for "Model for Effluent Disposal using Land Irrigation". MEDLI is a daily timestep mathematical model with scientific rigour for designing and assessing effluent reuse systems using land irrigation. MEDLI was developed to simulate the operation of an effluent irrigation scheme over a 'long' period, typically many decades. The model's basis is a 'physical system' comprising a field of crop or pasture that has been irrigated with effluent supplied from a tank or pond. This in turn provides a buffer storage to hold incoming effluent at times when water is not being applied to the soil. MEDLI uses a material balance between storage systems, soil systems and crop growth. This provides information on the fate of the irrigated wastewater, nutrients, salts and pathogens and their potential impact in the receiving environment. The model can be used to design the effluent irrigation scheme and provides details of the required land area and wet weather storage, in addition to guide strategies for irrigation.

The modelling results at **Appendix B** utilised 22.3 kL/d (8,145 kL/yr) as the effluent volume released from the WTP and available for reuse. This is slightly higher than the average daily wastewater generation rate for the amended design (22.2 kL/d). The MEDLI modelling scenario was calibrated to have nitrogen, phosphorus and salinity concentrations based on the predicted new WTP (10 mg/L N, 1 mg/L P and 600 mg/L TDS). A 50-year (1971-2020) daily climate file for the site was obtained from the SILO database operated by the Bureau of Meteorology (BOM). The mean annual rainfall is ~1720 mm/year, whilst the mean annual pan evaporation is 1539 mm/year. The soil parameters were determined from data collected during previous investigations by AWC. The effluent irrigation area was set at 3.446 ha and the vegetation type modelled was *Melaleuca alternifolia.* The irrigation input data includes the irrigator type, scheduling rules and irrigation area size. The irrigation method modelled was underground drip with scheduling based daily and irrigated until reaching 5mm below the soil's drained upper limit (DUL). This means that irrigation will cease below the saturation point, which is the maximum water held in the soil before drainage or runoff takes place.

The modelling shows that the daily timestep hydraulic and nutrient balance modelling for 22.3 KL/d meets the requirements of *Use of Effluent by Irrigation; Environmental Guidelines* (DEC 2004).

6.6 Reserve Area

Due to the overall size of the Linnaeus Estate, there is ample opportunity (for example approved Fields 3 and 4) as replicate reserve disposal areas.

7. Pump Stations

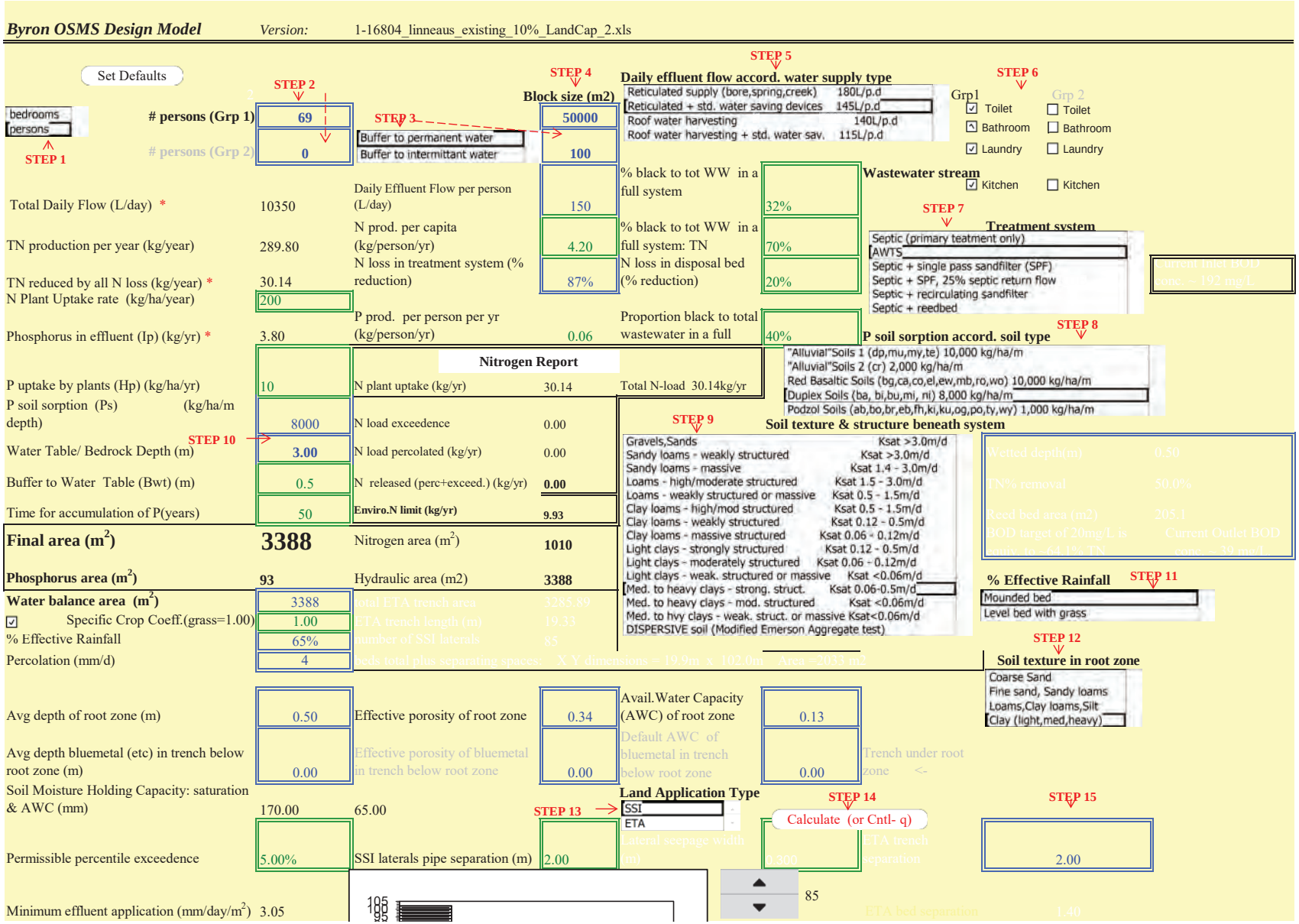
The sewage pump station has a current theoretical pumping capacity of 3.0 L/s. The calculated Peak Wet Weather Flow (PWWF) rate for the proposed development is 2.7 L/s. Given the emergency storage volume available (10.8 kL) and the expected storm duration of any single event, it is expected that the existing pump station will have capacity to accommodate the increased wastewater flows associated with the proposed development.

The existing gravity reticulation has a capacity in excess of 5 L/s in the 100 mm nominal diameter pipework and in excess of 10 L/s in the 150 mm nominal diameter pipework. These capacities are therefore able to accommodate the expected Peak Wet Weather Flow of 2.7 L/s for the proposed development.

The filter backwash wastewater from the pools and spas is not included in the wastewater generation calculations presented in **Tables 1 and 2**. It is proposed that the filter backwash wastewater, which is estimated at an average of 1.1 kL/d, would be collected, treated and discharged via a separate system. This system would be designed and assessed at the detailed design stage.

PLANNERS NORTH
Stephen Connelly RPIA (Fellow)
PARTNERSHIP PRINCIPAL
(m) 0419 237 982
(e) steve@plannersnorth.com.au

APPENDIX A


Byron OSMS Design Model
Version: 1-16804_linneaus_existing_10%_LandCap_2.xls
Set Defaults
STEP 1
bedrooms
persons
STEP 2
persons (Grp 1) 69
persons (Grp 2) 0
STEP 3
Buffer to permanent water
Buffer to intermittant water
STEP 4
Block size (m2)
50000
100
STEP 5
Daily effluent flow accord. water supply type
Reticulated supply (bore,spring,creek) 180L/p.d
Reticulated + std. water saving devices 145L/p.d
Roof water harvesting 140L/p.d
Roof water harvesting + std. water sav. 115L/p.d
STEP 6
Grp1
Grp 2
Toilet
Bathroom
Laundry
Kitchen
Wastewater stream
Total Daily Flow (L/day) * 10350
Daily Effluent Flow per person (L/day) 150
% black to tot WW in a full system 32%
TN production per year (kg/year) 289.80
N prod. per capita (kg/person/yr) 4.20
% black to tot WW in a full system: TN 70%
TN reduced by all N loss (kg/year) * 30.14
N loss in treatment system (% reduction) 87%
N loss in disposal bed (% reduction) 20%
N Plant Uptake rate (kg/ha/year) 200
Phosphorus in effluent (Ip) (kg/yr) * 3.80
P prod. per person per yr (kg/person/yr) 0.06
Proportion black to total wastewater in a full 40%
STEP 7
Treatment system
Septic (primary teatment only)
AWTS
Septic + single pass sandfilter (SPF)
Septic + SPF, 25% septic return flow
Septic + recirculating sandfilter
Septic + reedbed
Current Inlet BOD conc. ~ 192 mg/L
STEP 8
P soil sorption accord. soil type
"Alluvial"Soils 1 (dp,mu,my,te) 10,000 kg/ha/m
"Alluvial"Soils 2 (cr) 2,000 kg/ha/m
Red Basaltic Soils (bg,ca,co,el,ew,mb,ro,wo) 10,000 kg/ha/m
Duplex Soils (ba, bi,bu,mi, ni) 8,000 kg/ha/m
Podzol Soils (ab,bo,br,eb,fh,ki,ku,og,po,ty,wy) 1,000 kg/ha/m
Nitrogen Report
P uptake by plants (Hp) (kg/ha/yr) 10
N plant uptake (kg/yr) 30.14
Total N-load 30.14kg/yr
P soil sorption (Ps) (kg/ha/m depth) 8000
N load exceedence 0.00
STEP 9
Soil texture & structure beneath system
Gravels,Sands Ksat >3.0m/d
Sandy loams - weakly structured Ksat >3.0m/d
Sandy loams - massive Ksat 1.4 - 3.0m/d
Loams - high/moderate structured Ksat 1.5 - 3.0m/d
Loams - weakly structured or massive Ksat 0.5 - 1.5m/d
Clay loams - high/mod structured Ksat 0.5 - 1.5m/d
Clay loams - weakly structured Ksat 0.12 - 0.5m/d
Clay loams - massive structured Ksat 0.06 - 0.12m/d
Light clays - strongly structured Ksat 0.12 - 0.5m/d
Light clays - moderately structured Ksat 0.06 - 0.12m/d
Light clays - weak. structured or massive Ksat <0.06m/d
Med. to heavy clays - strong. struct. Ksat 0.06-0.5m/d
Med. to heavy clays - mod. structured Ksat <0.06m/d
Med. to hvy clays - weak. struct. or massive Ksat<0.06m/d
DISPERSIVE soil (Modified Emerson Aggregate test)
Vetted depth(m) 0.50
N% removal 50.0%
Reed bed area (m2) 205.1
BOD target of 20mg/L is Current Outlet BOD
STEP 10
Water Table/ Bedrock Depth (m) 3.00
N load percolated (kg/yr) 0.00
Buffer to Water Table (Bwt) (m) 0.5
N released (perc+exceed.) (kg/yr) 0.00
Time for accumulation of P(years) 50
Enviro.N limit (kg/yr) 9.93
Final area (m2) 3388
Nitrogen area (m2) 1010
Phosphorus area (m2) 93
Hydraulic area (m2) 3388
Water balance area (m2) 3388
Total ETA trench area 3285.89
Specific Crop Coeff.(grass=1.00) 1.00
ETA trench length (m) 19.33
% Effective Rainfall 65%
Number of SSI laterals 85
Percolation (mm/d) 4
Beds total plus separating spaces: X Y dimensions = 19.9m x 102.0m Area =2033 m2
% Effective Rainfall
STEP 11
Mounded bed
Level bed with grass
STEP 12
Soil texture in root zone
Coarse Sand
Fine sand, Sandy loams
Loams,Clay loams,Silt
Clay (light,med,heavy)
Avg depth of root zone (m) 0.50
Effective porosity of root zone 0.34
Avail.Water Capacity (AWC) of root zone 0.13
Avg depth bluemetal (etc) in trench below root zone (m) 0.00
Effective porosity of bluemetal in trench below root zone 0.00
Default AWC of bluemetal in trench below root zone 0.00
Trench under root zone <-
Soil Moisture Holding Capacity: saturation & AWC (mm) 170.00 65.00
Land Application Type
STEP 13
SSI
ETA
STEP 14
Calculate (or Cntl- q)
STEP 15
Permissible percentile exceedence 5.00%
SSI laterals pipe separation (m) 2.00
Lateral seepage width (m) 3.300
ETA trench separation 2.00
85
Minimum effluent application (mm/day/m2) 3.05
ETA bed separation 1.40

APPENDIX B

MEDLI REPORT - FULL RUN

Enterprise: STP treated effluent reuse

Description:
Linnaeus Estate

Client: AWC

MEDLI User: DESKTOP-OCGS845\Justin

Scenario Details:
22.3 kL/d all year. Sizing of wet weather storage and land area.

DESCRIPTION

Climate Data: Broken Head -28.75_153.60, -28.75°, 153.6°

Run Period: 01/01/1971 to 31/12/2020 50 years, 0 days

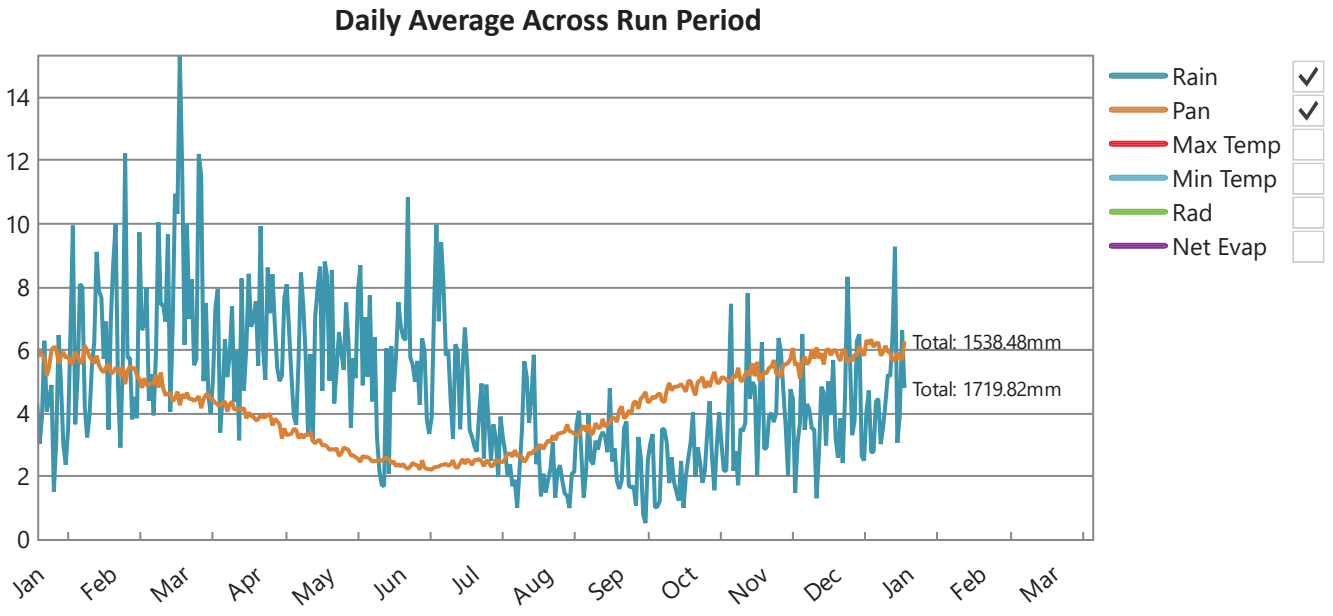
Climate Statistics:

	5th Percentile	50th Percentile	95th Percentile
Rainfall (mm/year)	1168	1674	2346
Pan Evaporation (mm/year)	1339	1533	1712

Climate Data:

Chart Table

Monthly Daily

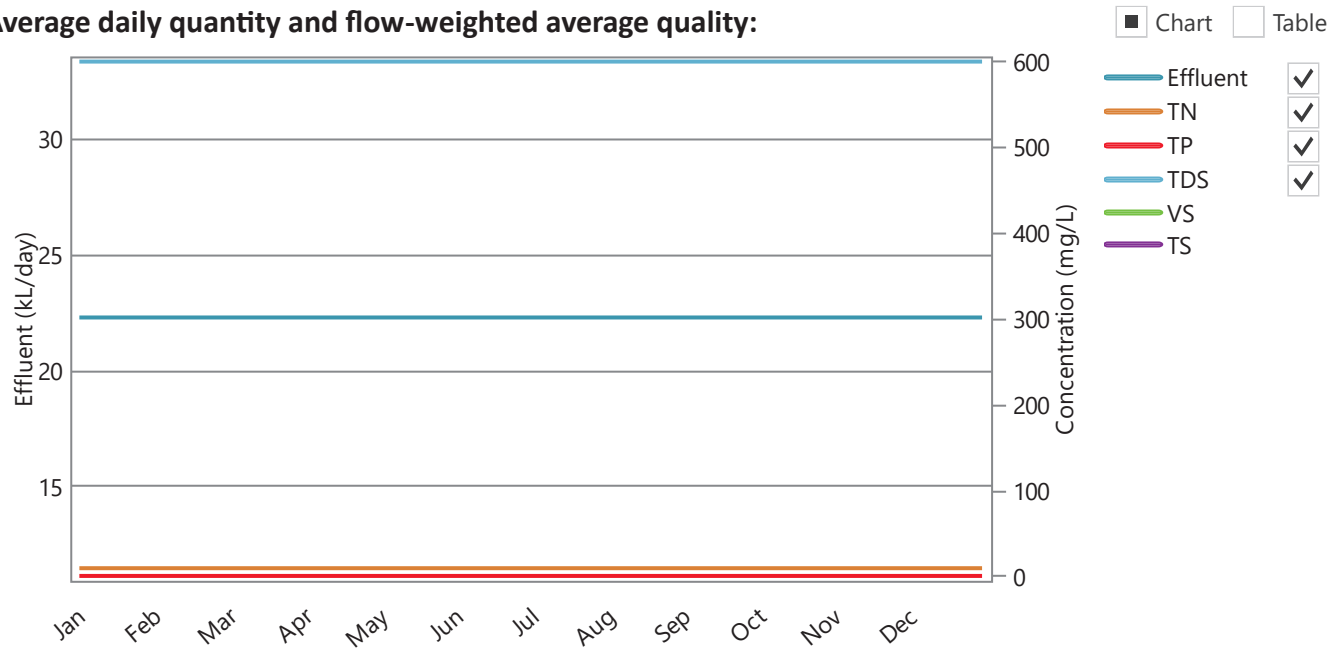


DESCRIPTION

Effluent type: New Generic System

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: 8145.30 kL/year or 22.30 kL/day (Min-Max: 22.30 - 22.30)

Flow-weighted average (minimum - maximum) daily effluent quality entering pond system:

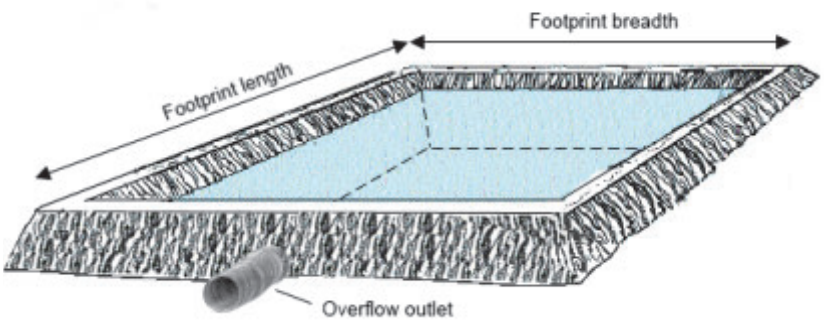
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	10.00 (10.00 - 10.00)	81.45 (81.39 - 81.62)
Total Phosphorus	1.00 (1.00 - 1.00)	8.15 (8.14 - 8.16)
Total Dissolved Salts	600.00 (600.00 - 600.00)	4887.18 (4883.70 - 4897.08)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

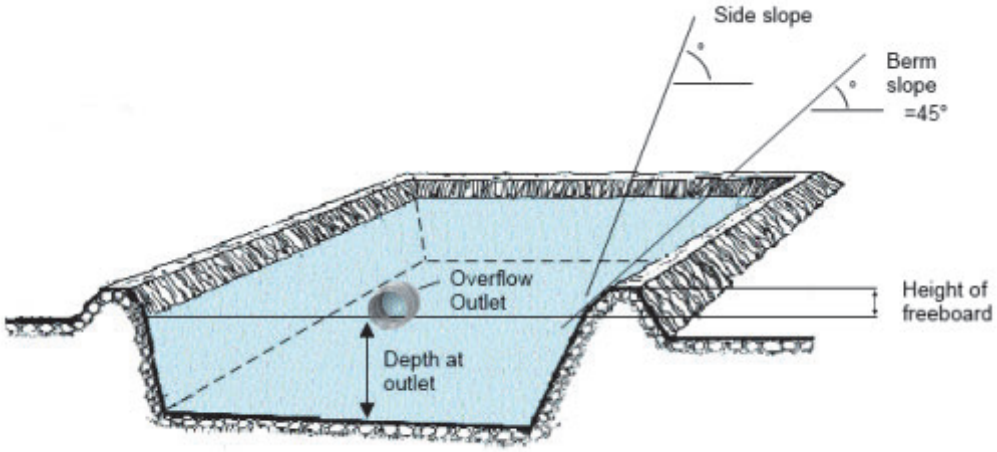
DESCRIPTION

Pond system: 1 facultative, aerobic or storage pond

Pond system details:

	Pond 1
Maximum pond volume (kL)	1310.00
Minimum allowable pond volume (kL)	35.53
Pond depth at overflow outlet (m)	4.20
Maximum water surface area (m2)	475.29
Pond footprint length (m)	27.90
Pond footprint width (m)	19.00
Pond catchment area (m2)	530.13
Average active volume (kL)	150.99





Irrigation pump limits:

Minimum pump rate per area limit (ML/day/ha)	0.00
Maximum pump rate limit (ML/day)	0.50

Shandying water:

Annual allocation of fresh water available for shandying (kL/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

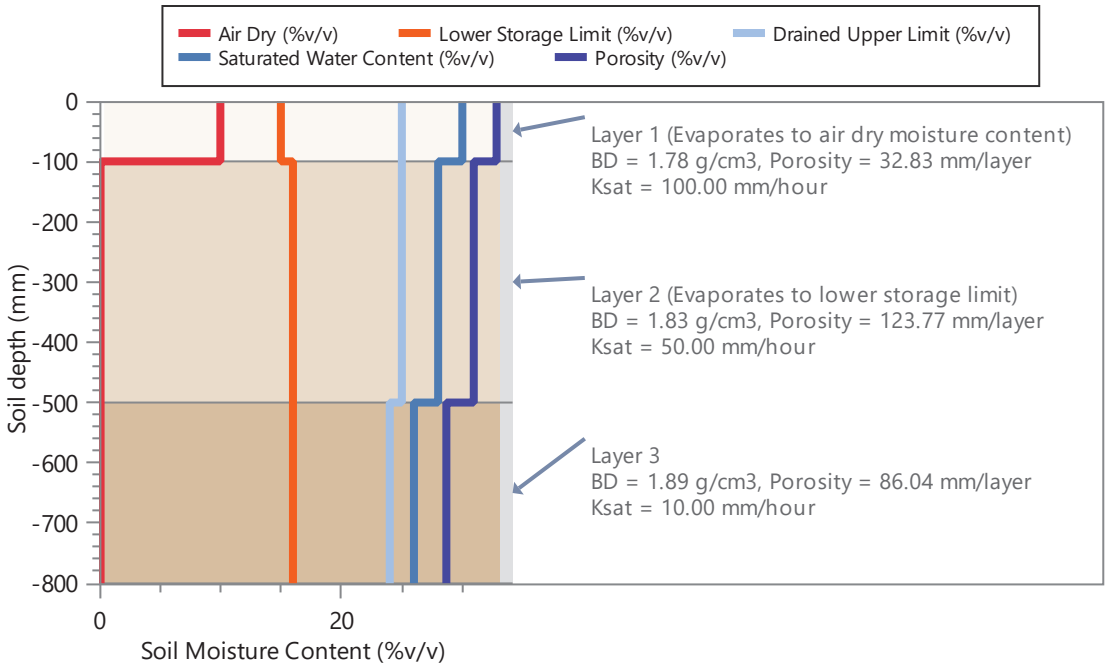
DESCRIPTION

Land: New Paddock

Area (ha): 3.45

Soil Type: Moderately deep yellow podzolic, 800.00 mm defined profile depth

Profile Porosity (mm)	242.64
Profile saturation water content (mm)	220.00
Profile drained upper limit (or field capacity) (mm)	197.00
Profile lower storage limit (or permanent wilting point) (mm)	127.00
Profile available water capacity (mm)	70.00
Profile limiting saturated hydraulic conductivity (mm/hour)	10.00
Surface saturated hydraulic conductivity (mm/hour)	100.00
Runoff curve number II (coefficient)	80.00
Soil evaporation U (mm)	10.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Melaleuca alternifolia

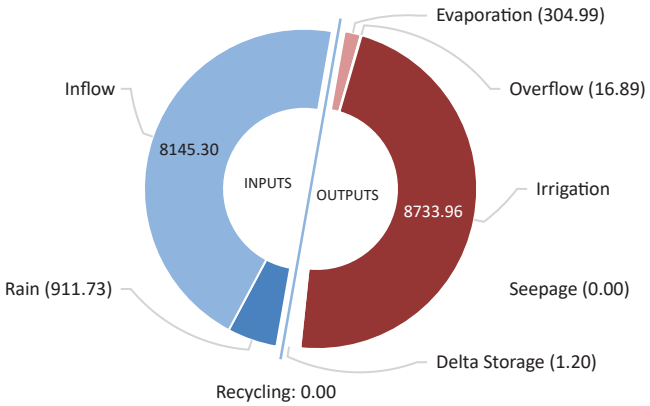
Average monthly cover (%) (minimum - maximum)	51.02 (47.59 - 55.34)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.9 x Pan coefficient 1)	0.90
Total plant cover (both green and dead) left after harvest (%)	25.00
Maximum potential root depth in defined soil profile (mm)	800.00
Salt tolerance	Tolerant
Salinity threshold EC sat. ext. (dS/m)	8.00
Proportion of yield decrease per dS/m increase (%/dS/m)	5.00

PERFORMANCE

Pond System Water Performance - Overflow: 1 facultative, aerobic or storage pond

Capacity of wet weather storage pond: **1310 kL**

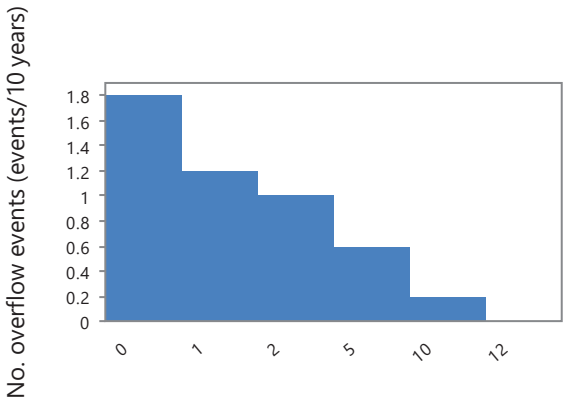
Pond System Water Balance (kL/year)



Name	Value
Rain	911.73
Inflow	8145.30
Recycling	0.00
Evaporation	304.99
Overflow	16.89
Irrigation	8733.96
Seepage	0.00
Delta Storage	1.20

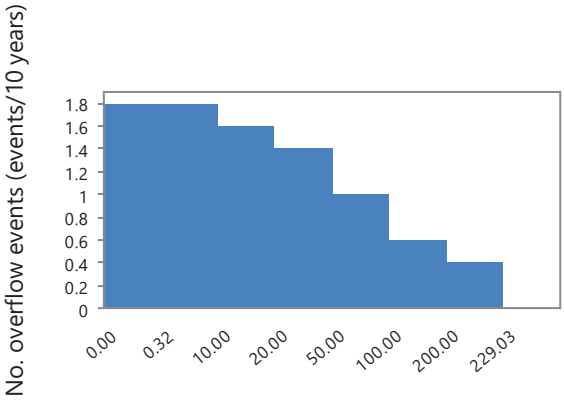
Overflow Diagnostics

Volume of overflow (kL/year)	16.89
No. days pond overflows (days/year)	0.84
Average duration of overflow (days)	4.67
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (%)	99.81
Probability of at least 90% reuse (%)	100.00



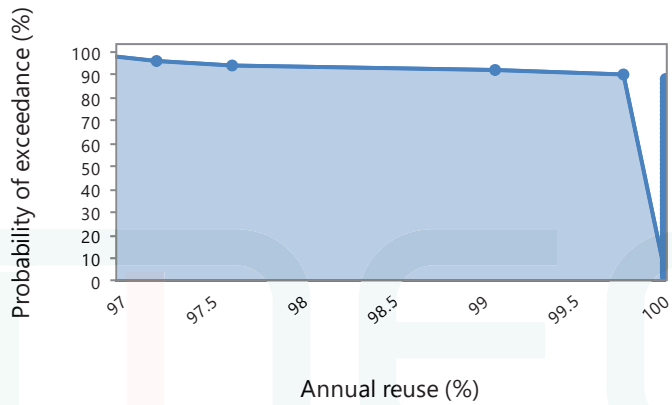
Overflow event duration exceeded (days)

Export plot



Overflow volume exceeded (kL)

Export plot



Annual reuse (%)

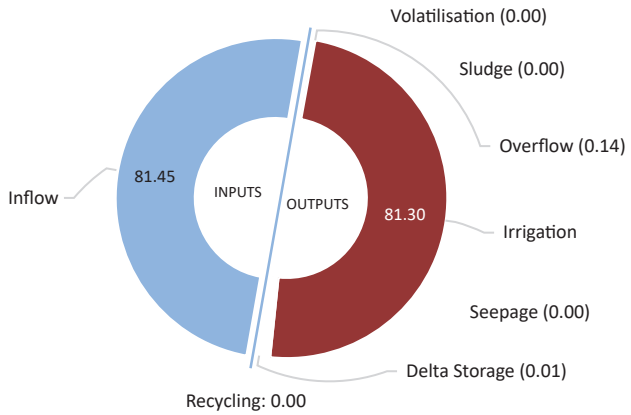
Export plot

PERFORMANCE

Pond System Performance - Nutrient: 1 facultative, aerobic or storage pond

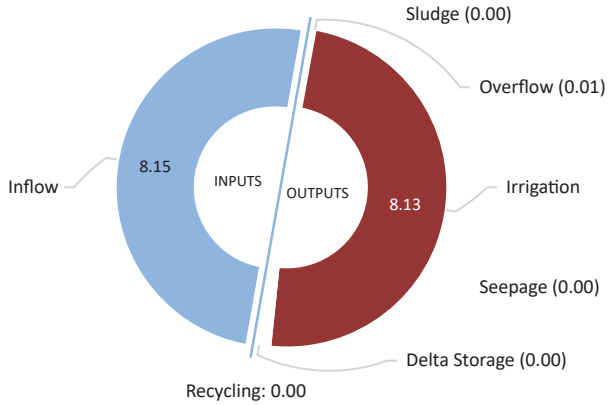
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



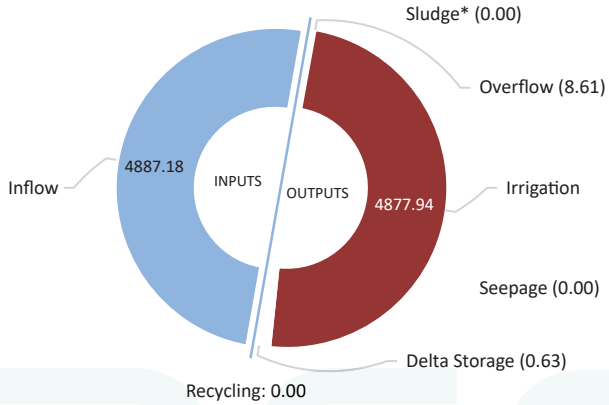
Name	Value
Inflow	81.45
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.14
Irrigation	81.30
Seepage	0.00
Delta Storage	0.01

Phosphorus Balance (kg/year)



Name	Value
Inflow	8.15
Recycling	0.00
Sludge	0.00
Overflow	0.01
Irrigation	8.13
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)



Name	Value
Inflow	4887.18
Recycling	0.00
Sludge*	0.00
Overflow	8.61
Irrigation	4877.94
Seepage	0.00
Delta Storage	0.63

* Salt removal in sludge is not calculated from the pond salt balance. However if salt could be assumed to be present in the sludge at the same concentration as in the pond supernatant (up to a maximum of salt added in inflow) - then salt accumulation in the sludge could be 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

PERFORMANCE

Pond System Performance - Nutrient: 1 facultative, aerobic or storage pond

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	8.54
Average phosphorus concentration of pond liquid (mg/L)	0.85
Average salinity of pond liquid (dS/m)	0.80

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	8.71
Final phosphorus concentration of pond liquid (mg/L)	0.87
Final salinity of pond liquid (dS/m)	0.82

PERFORMANCE

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (kL/year)	8733.96
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (kL/year)	8733.96
Proportion of irrigation events requiring shandying (% of events)	0.00
Proportion of years shandying water allocation of 0 kL/year is exceeded (% of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation Quality:

Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	9.31
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	9.31
Average phosphorus concentration of irrigation water (mg/L)	0.93
Average salinity of irrigation water (dS/m)	0.87

Irrigation Diagnostics:

Proportion of Days irrigation occurs (%)	69.57

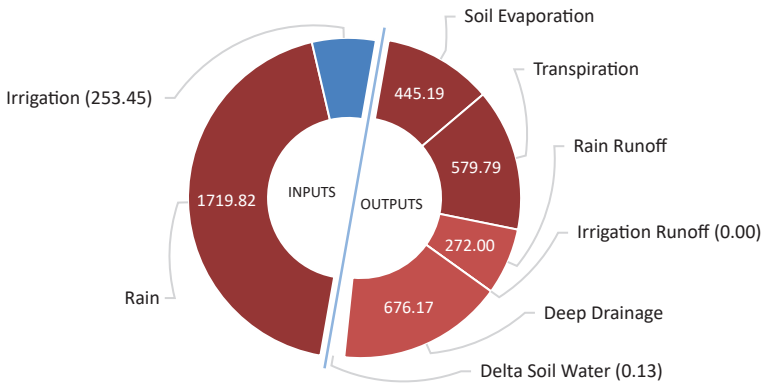
PERFORMANCE

Land Performance - Soil Water

Paddock: New Paddock, 3.446 ha
Soil Type: Moderately deep yellow podzolic, 70.00 mm PAWC at maximum root depth

Land Water Balance (mm/year):

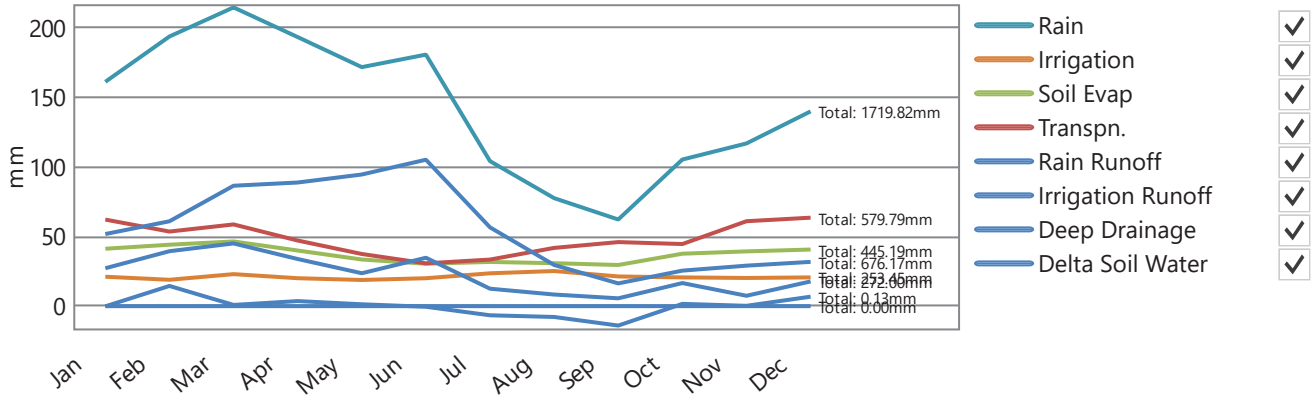
mm/year % Total inputs



Name	Value
Rain	1719.82
Irrigation	253.45
Soil Evaporation	445.19
Transpiration	579.79
Rain Runoff	272.00
Irrigation Runoff	0.00
Deep Drainage	676.17
Delta Soil Water	0.13

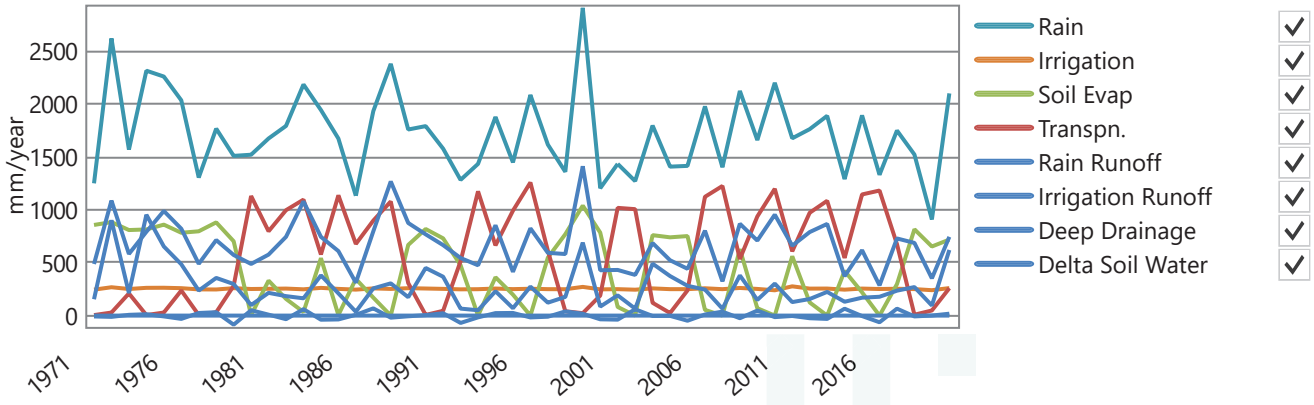
Average Monthly Totals (mm):

Chart Table



Average Annual Totals (mm/year):

Chart Table



PERFORMANCE

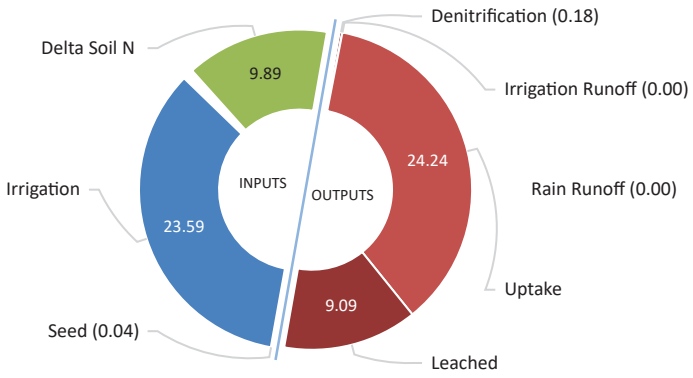
Land Performance - Soil Nutrient

Paddock: New Paddock, 3.446 ha

Soil Type: Moderately deep yellow podzolic

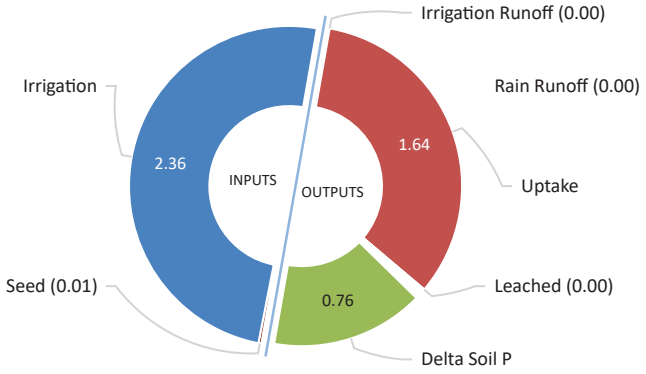
Irrigation ammonium volatilisation losses (kg/ha/year): 0.00
Proportion of total nitrogen in irrigated effluent as ammonium (%): 0.00

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	0.04
Irrigation	23.59
Denitrification	0.18
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	24.24
Leached	9.09
Delta Soil N	-9.89

Land Phosphorus Balance (kg/ha/year)



Name	Value
Seed	0.01
Irrigation	2.36
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	1.64
Leached	2.20E-03
Delta Soil P	0.76

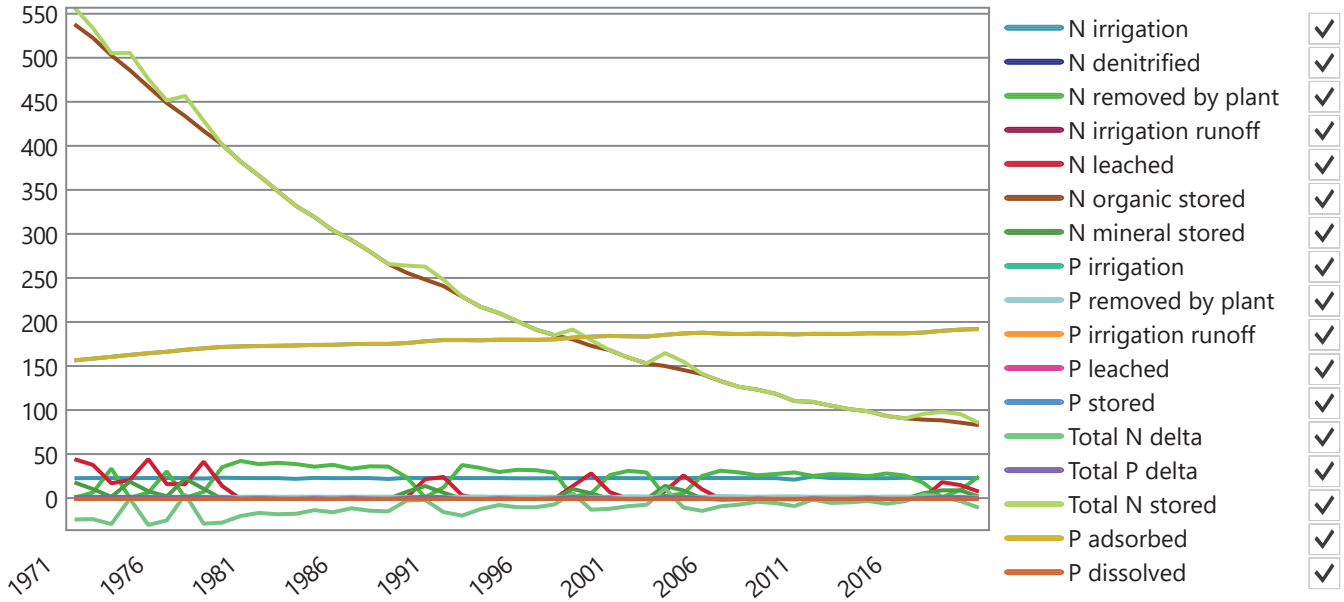
PERFORMANCE

Land Performance - Soil Nutrient

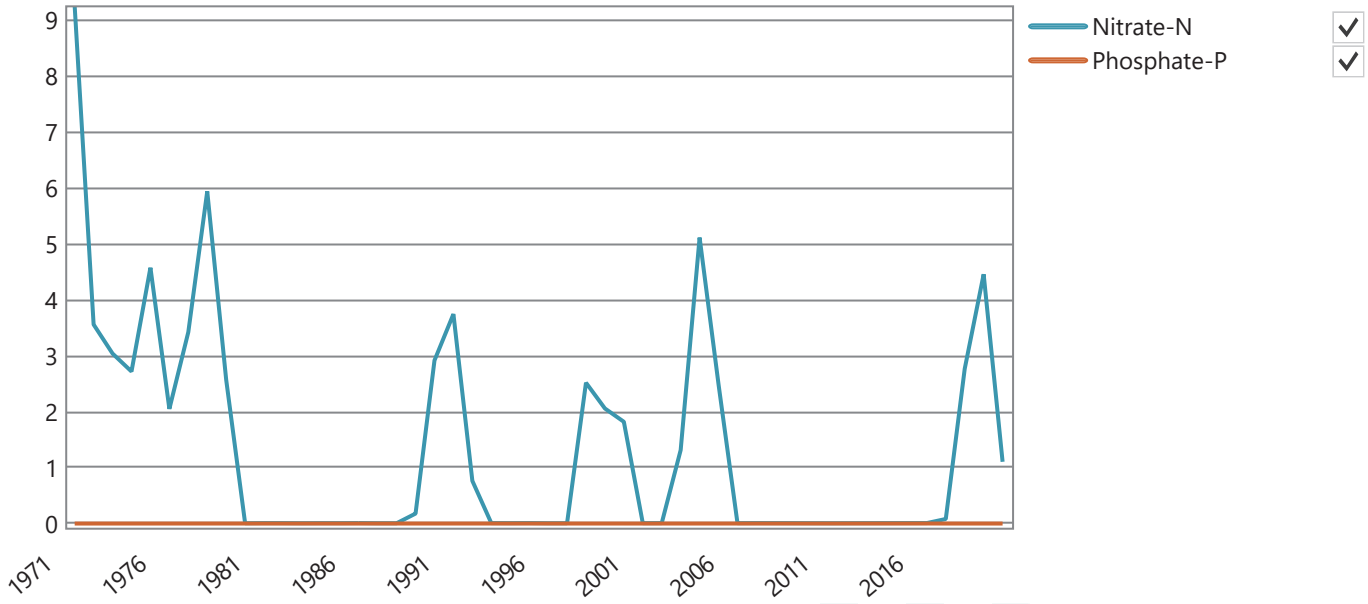
Paddock: New Paddock, 3.446 ha

Soil Type: Moderately deep yellow podzolic

Annual Nutrient Totals (kg/ha):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

Plant Performance and Nutrients

Paddock: New Paddock, 3.446 ha

Soil Type: Moderately deep yellow podzolic

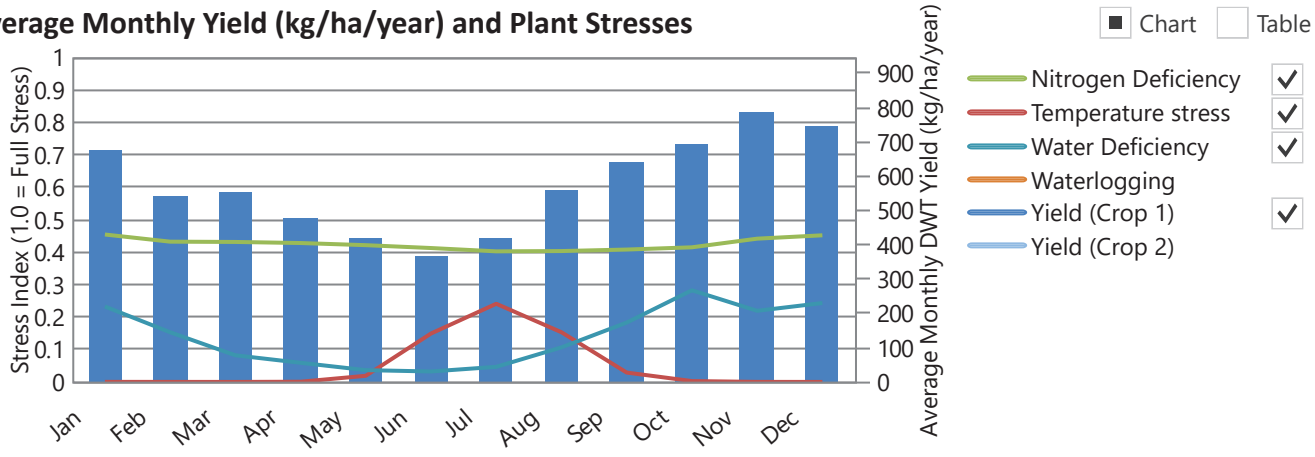
Plant: Continuous Melaleuca alternifolia

Average annual shoot dry matter yield (kg/ha/year)	6871.77 (150.28 - 14532.86)
Average monthly plant (green) cover (%) (minimum - maximum)	51.02 (47.59 - 55.34)
Average monthly root depth (mm) (minimum - maximum)	541.65 (521.69 - 566.16)

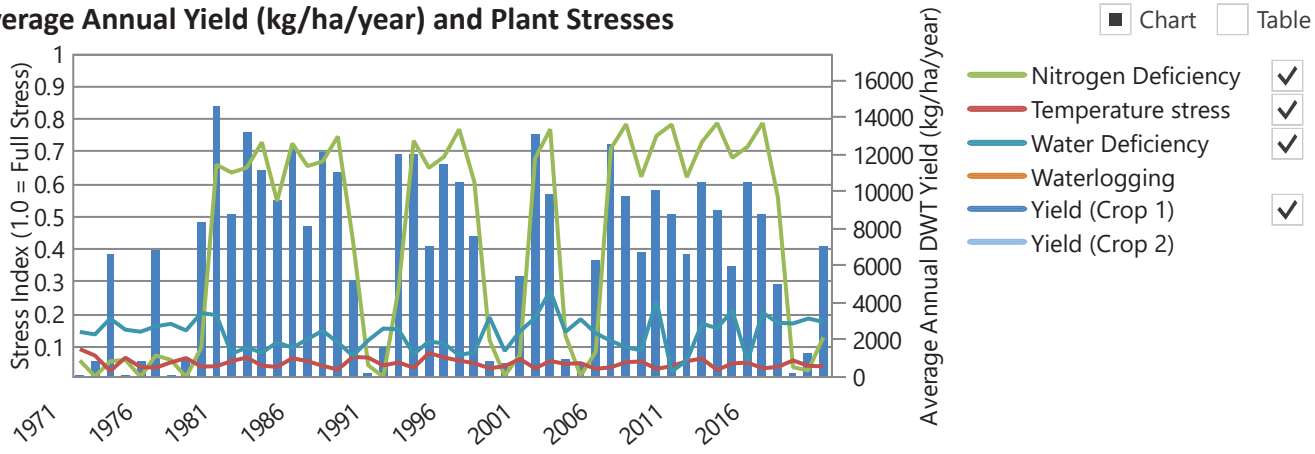
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/ha/year)	24.24 (1.19 - 43.08)
Average annual net phosphorus removed by plant uptake (kg/ha/year)	1.64 (0.16 - 3.30)
Average annual shoot nitrogen concentration (fraction dwt)	0.01 (0.00 - 0.01)
Average annual shoot phosphorus concentration (fraction dwt)	0.001 (0.000 - 0.003)

Average Monthly Yield (kg/ha/year) and Plant Stresses



Average Annual Yield (kg/ha/year) and Plant Stresses



No. of harvests/year: 0.22 (normal), 0.14 (forced by crop death due to water stress (0.14))
No. days without crop/year (days/year): 1.24 due to water stress (1.24)

PERFORMANCE

Land Performance

Paddock: New Paddock, 3.446 ha

Soil Type: Moderately deep yellow podzolic

Plant: Continuous Melaleuca alternifolia

Salt tolerance	Tolerant
Salinity threshold EC sat. ext. (dS/m)	8.00
Proportion of yield decrease per dS/m increase (%/dS/m)	5.00
No. years assumed for leaching to reach steady-state (years)	10.00

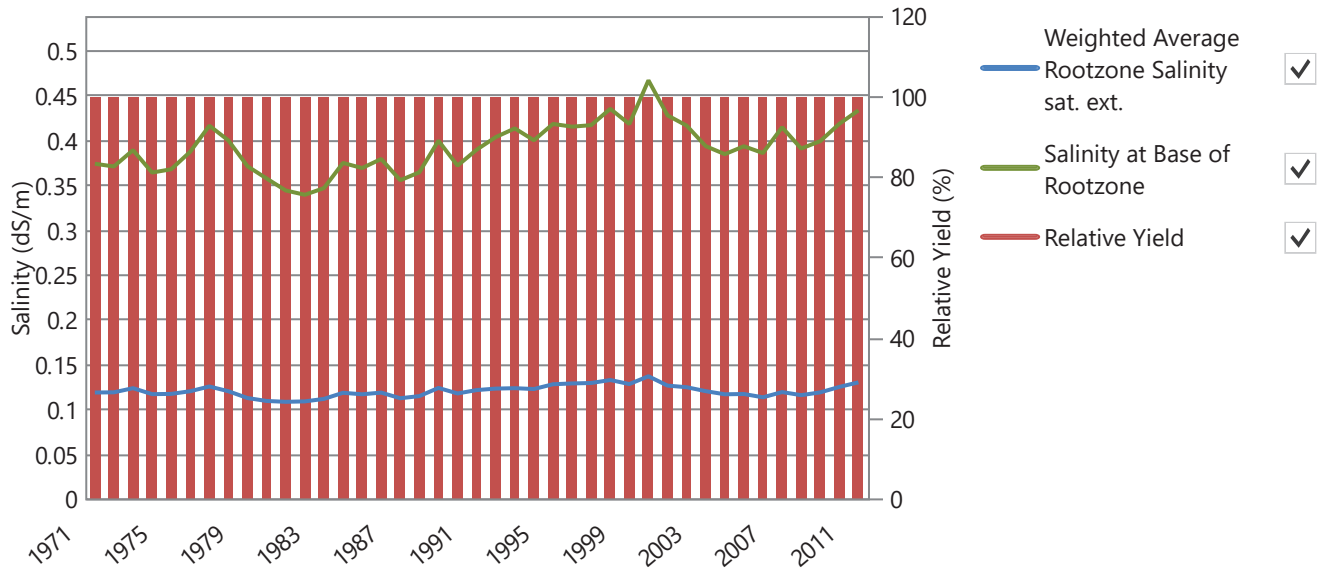
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.15
Salt added by rainfall (kg/ha/year)	277.98
Average annual effluent salt added & leached at steady state (kg/ha/year)	1693.52
Average leaching fraction based on 10 year running averages (fraction)	0.58
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.12
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.39
Relative crop yield expected due to salinity (%)	100.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (%)	0.00

Average Annual Rootzone Salinity and Relative Yield:

Chart Table

All values based on 10 year running averages



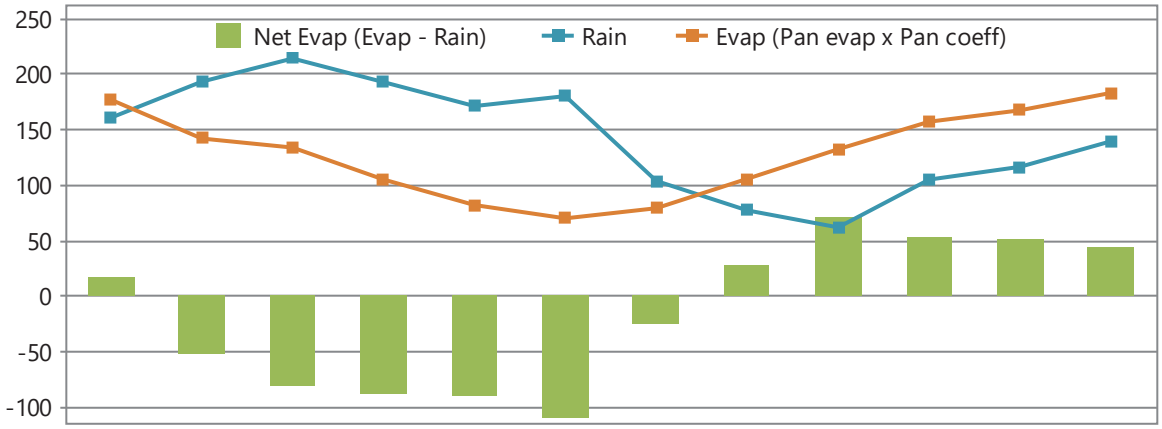
DIAGNOSTICS

Sustainability Diagnostics: STP treated effluent reuse

Averaged Historical Climate Data Used in Simulation (mm)

Location: Broken Head -28.75_153.60, -28.75°, 153.6°

Run Period: 01/01/1971 to 31/12/2020 50 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	161.0	193.5	214.4	193.1	171.6	180.5	104.1	77.5	62.2	105.2	116.8	139.8	1719.8
Evap	177.3	142.3	134.1	105.3	82.3	70.3	79.5	106.0	132.7	157.4	167.7	183.4	1538.5
Net Evap	16.3	-51.2	-80.3	-87.8	-89.2	-110.2	-24.6	28.5	70.5	52.2	51.0	43.6	-181.3
Net Evap/day	0.5	-1.8	-2.6	-2.9	-2.9	-3.7	-0.8	0.9	2.3	1.7	1.7	1.4	-0.5

DIAGNOSTICS

Sustainability Diagnostics: STP treated effluent reuse

Pond System: 1 facultative, aerobic or storage pond

New Generic System - 8145.30 kL/year or 22.30 kL/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.26 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	10.00 (10.00 - 10.00)	81.45 (81.39 - 81.62)
Total Phosphorus	1.00 (1.00 - 1.00)	8.15 (8.14 - 8.16)
Total Dissolved Salts	600.00 (600.00 - 600.00)	4887.18 (4883.70 - 4897.08)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

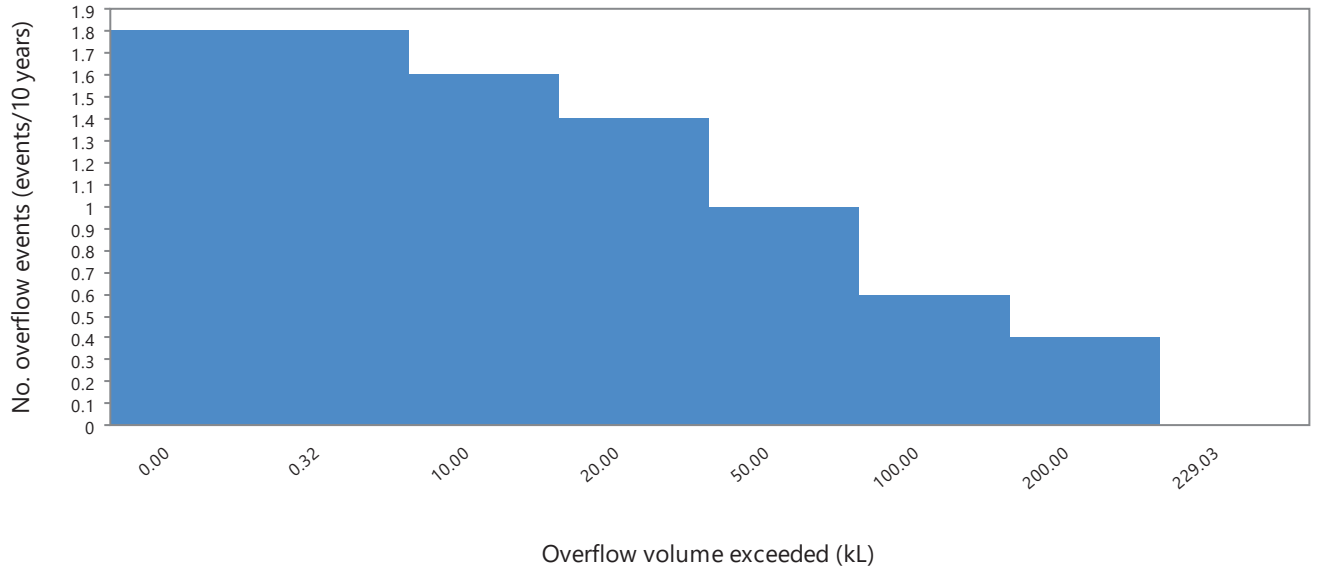
Last pond (Wet weather store): 1310.00 kL

Theoretical hydraulic retention time (days)	58.74
Average volume of overflow (kL/year)	16.89
No. overflow events per year exceeding threshold* of 0.32 kL (no./year)	0.18
Average duration of overflow (days)	4.67
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (%)	99.81
Probability of at least 90% effluent reuse (%)	100.00
Average salinity of last pond (dS/m)	0.80
Salinity of last pond on final day of simulation (dS/m)	0.82
Ammonia loss from pond system water area (kg/m2/year)	0.00

* The threshold is the volume equivalent to the top 1 mm depth of water of a full pond

Overflow exceedance:

Chart Table



Export plot

DIAGNOSTICS

Sustainability Diagnostics: STP treated effluent reuse

Irrigation Information

Irrigation: 3.446 ha total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (kL)	8733.96	2534.52
Total nitrogen applied (kg)	81.30	23.59
Total phosphorus applied (kg)	8.13	2.36
Total salts applied (kg)	4877.94	1415.54

Shandying

Annual allocation of fresh water for shandying (kL/year)	0.00
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)
Proportion of irrigation events requiring shandying (% of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation occurs (%)	69.57

DIAGNOSTICS

Sustainability Diagnostics: STP treated effluent reuse

Paddock Land: New Paddock: 3.446 ha

Irrigation: Underground Drip with 0% ammonium loss during irrigation

Irrigation triggered every 1 days
Irrigate up to a soil water content of drained upper limit plus -5.00 mm
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 0 days must be skipped between irrigation events

Soil Water Balance (mm): Moderately deep yellow podzolic, 70.00 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	161.0	193.5	214.4	193.1	171.6	180.5	104.1	77.5	62.2	105.2	116.8	139.8	1719.8
Irrigation	21.1	18.9	23.0	20.0	18.8	20.0	23.6	25.2	21.3	20.6	20.2	20.6	253.5
Soil Evap	41.2	44.1	46.4	39.9	33.5	30.5	31.7	30.8	29.5	37.6	39.3	40.6	445.2
Transpn.	62.1	53.5	58.7	47.1	37.4	30.7	33.4	41.8	46.0	44.6	61.0	63.5	579.8
Rain Runoff	27.2	39.4	45.0	33.8	23.6	34.7	12.5	8.3	5.6	16.6	7.4	17.7	272.0
Irr. Runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drainage	51.8	60.9	86.4	88.7	94.5	105.1	56.5	29.5	16.3	25.5	29.1	31.8	676.2
Delta	-0.1	14.5	0.9	3.6	1.3	-0.4	-6.6	-7.8	-13.9	1.6	0.2	6.8	0.1

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	23.59
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	24.24
Average annual soil nitrogen removed by denitrification (kg/ha/year)	0.18
Average annual soil nitrogen leached (kg/ha/year)	9.09
Average annual nitrate-N loading to groundwater (kg/ha/year)	9.09
Soil organic-N kg/ha (Initial - Final)	544.00 - 83.76
	36.93 - 2.56
Average nitrate-N concentration of deep drainage (mg/L)	1.35
Max. annual nitrate-N concentration of deep drainage (mg/L)	9.24

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/ha/year)	2.36
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	1.64
Average annual soil phosphorus leached (kg/ha/year)	2.20E-03
Dissolved phosphorus (kg/ha) (Initial - Final)	3.88E-03 - 0.01
Adsorbed phosphorus (kg/ha) (Initial - Final)	154.95 - 192.84
Average phosphate-P concentration in rootzone (mg/L)	3.10E-03
Average phosphate-P concentration of deep drainage (mg/L)	3.25E-04
Max. annual phosphate-P concentration of deep drainage (mg/L)	1.03E-03
Design soil profile storage life based on average infiltrated water phosphorus concn. of 0.14 mg/L (years)	752.05

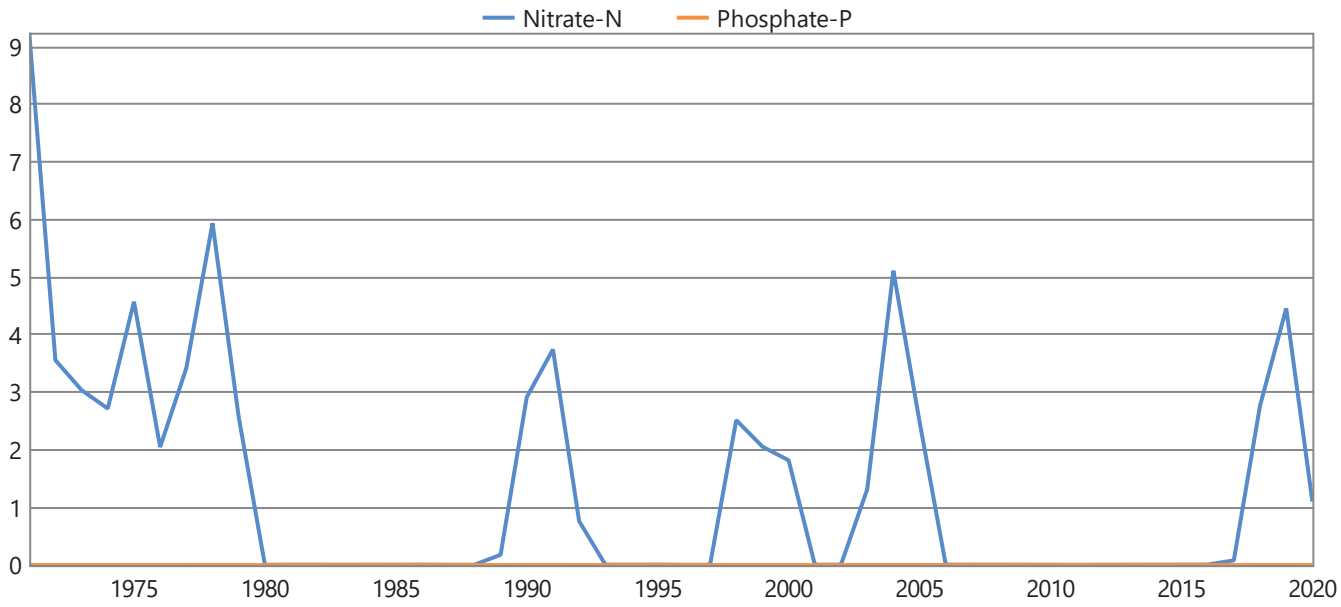
DIAGNOSTICS

Sustainability Diagnostics: STP treated effluent reuse

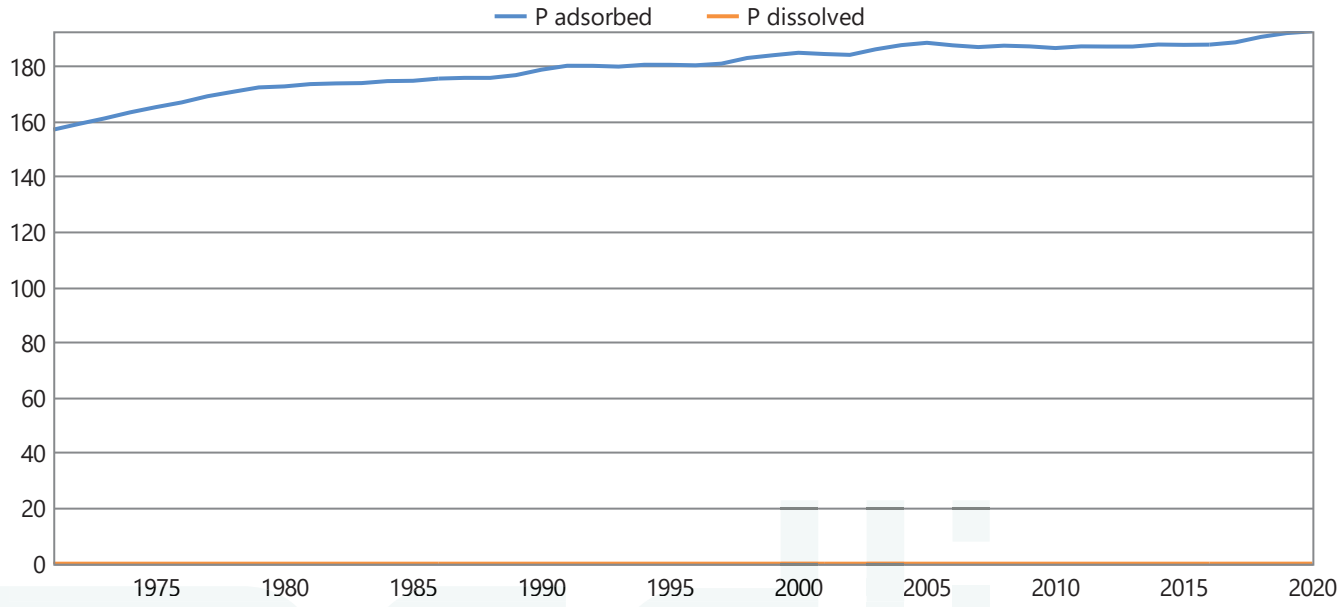
Paddock Land: New Paddock: 3.446 ha

Irrigation: Underground Drip with 0% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/ha)



DIAGNOSTICS

Sustainability Diagnostics: STP treated effluent reuse

Paddock Plant Performance: New Paddock: 3.446 ha

Average Plant Performance (Minimum - Maximum): Continuous Melaleuca alternifolia

Average annual shoot dry matter yield (kg/ha/year)	6871.77 (150.28 - 14532.86)
Average monthly plant (green) cover (%)	51.02 (47.59 - 55.34)
Average monthly crop factor (fraction)	0.46 (0.43 - 0.50)
Total plant cover (both green and dead) left after harvest (%)	25.00
Average monthly root depth (mm)	541.65 (521.69 - 566.16)
Average number of normal harvests per year (no./year)	0.22 (0.00 - 1.00)
Average number of normal harvests for last five years only (no./year)	0.20
Average number of crop deaths per year (no./year)	0.14 (0.00 - 1.00)
Average number of crop deaths for last five years only (no./year)	0.40
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.43 (0.01 - 0.79)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.01)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.24 (0.03 - 0.48)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.14 (0.03 - 0.28)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	1.24

Soil Salinity - Plant salinity tolerance: Tolerant

Assumes 1.0 dS/m Electrical Conductivity = 640 mg/L Total Dissolved Salts

All values based on 10 year running averages

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.15
Salt added by rainfall (kg/ha/year)	277.98
Average annual effluent salt added & leached at steady state (kg/ha/year)	1693.52
Average leaching fraction based on 10 year running averages (fraction)	0.58
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.12
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.39
Relative crop yield expected due to salinity (%)	100.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (%)	0.00

DIAGNOSTICS

Run Messages

Messages generated when the scenario was run:

Full run chosen