MEDLI REPORT

ASHBOURNE – INTERIM WASTEWATER TREATMENT SYSTEM (IWTS)

TRUEWATER COMMUNITY

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MEDLI REPORT

Site Address:

32 Lovelle Street and 141 Yarrawa Road, Moss Vale, NSW 2571

Lot 3 DP706194 and Lot 12 DP8660366

Client:

Prime Moss Vale Pty Ltd

Suite 30.02, Level 30, 420 George Street, Sydney NSW 2000

Prepared By:

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Document Control

Version History

Date	Version:	Revision Description	Approved by:
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Executive Summary

This document covers the Model for Effluent Disposal by Land Irrigation (MEDLI) for the Ashbourne Interim Wastewater Treatment System (IWTS). The service area is in Moss Vale – New South Wales.

The Ashbourne IWTS will service Stage One of the development (178 dwellings) for a short period until permanent Utility connection is provided. The IWTS will operate from 2024 until 2027, considering expected construction rates of up to 50 dwellings per year, it is likely that the IWTS shall never service 178 dwellings. However, MEDLI Modelling has been completed assuming total load for the 178 dwellings and has been completed for a fifty-year period.

The allocated effluent dispersal area is 9.68hectares. Fixed spray irrigation will disperse effluent at a maximum rate of 1mm/m^2/day.

MEDLI is a simulation process developed by Queensland Department of Environment and Science (DES) that provides Wet Weather Storage capacity, irrigation area sizing requirements, and irrigation application/discharge limitations for a project based on site data and environmental variables. Site specific MEDLI modelling has confirmed:

- Total volume of effluent generation,
- Suitable effluent quality to preserve environmental values,
- Suitable storage to prevent uncontrolled release of sewage or effluent,
- Suitable land size for the irrigation scheme,
- Suitable irrigation rates and irrigation scheduling.

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Appendices

1 Introduction

Modelling of effluent irrigation is undertaken to evaluate potential impacts on the receiving environment. The QLD Government developed Model for Effluent Disposal by Land Irrigation Software (MEDLI) has been employed as it provides an understanding of both hydraulic and nutrient for the site. MEDLI models the complex dynamics of an effluent irrigation system on a daily time-step, using historical climate data to determine the wet weather storage and irrigation area requirements for the specific location.

Effluent often contains levels of nutrients, organic matter, suspended solids, pathogens and other contaminants. It is important effluent is sustainably irrigated, so it does not impact land or the surrounding environment.

MEDLI facilitates the immediate assessment of effluent treatment quality and irrigation scheme viability, allowing designers to identify weaknesses and explore solutions until a robust design is confirmed.

1.1 Purpose

The purpose of MEDLI modelling is to address all effluent irrigation considerations, including; the quality and quantity of effluent, climate conditions, storage and treatment of effluent, irrigation frequency, irrigation amount, the flow paths of water, nitrogen, phosphorus, salt components and plant growth. This accurate assessment confirms suitable effluent treatment quality and irrigation scheme viability, and aids in confirming the scheme design is robust and suitably addresses environmental considerations.

1.2 Scope

The scope of this MEDLI Report is to confirm:

- Effluent generation and total volume,
- Suitable effluent quality,
- Suitable effluent storage,
- Suitable land size for the irrigation scheme,
- Suitable irrigation rates and irrigation scheduling.

2 Site Description

The site consists of two separate and adjoining allotments comprising a total area of 125.7 hectares. The legal description of the site is Lot 3 in DP 706194 (No 32 Lovelle Street) and Lot 12 in DP 8660366 (No 141 Yarrawa Road). The site is bordered by Yarrawarra Road, Lovelle Street, Moss Vale Golf Course, and other urban and rural land zoned lots. The site is currently predominately pastural land, with a dwelling on each of the existing lots.

There is sufficient unconstrained land for sustainable site-specific wastewater management that achieves required offsets to environmental features and property boundaries as required by legislation and guidelines.

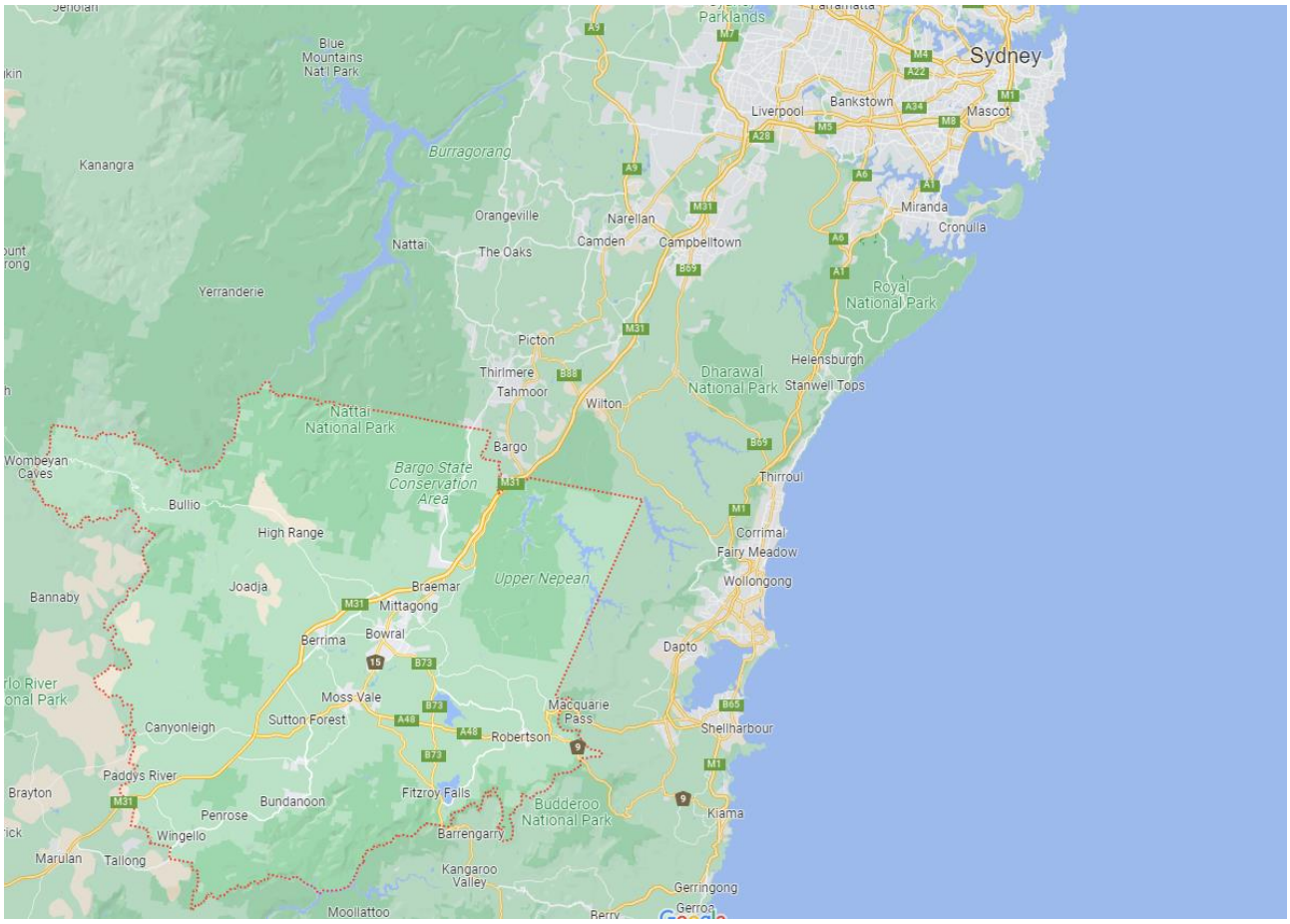


Figure 2.1 – The WWTP is located on the south-eastern fringe of Mossvale, Lot 301 (SP263791) and effluent is disposed of on Lot10 (RP903517)

3 MEDLI Inputs

MEDLI simulates the effluent stream from its production in an enterprise through to the disposal area and integrates waste production, pond water and nutrient balance, irrigation scheduling, soil water balance, plant growth, and soil nutrient cycling on a daily time-step. It also estimates steady-state soil salinity balance, nitrate transport through groundwater and performs simple quantitative microbial risk analysis. The Multirun option allows MEDLI to be run automatically for different combinations of wet-weather storage volume and irrigation area to identify the optimum design based on cost or environmental performance criteria such as overtopping amounts and frequency.

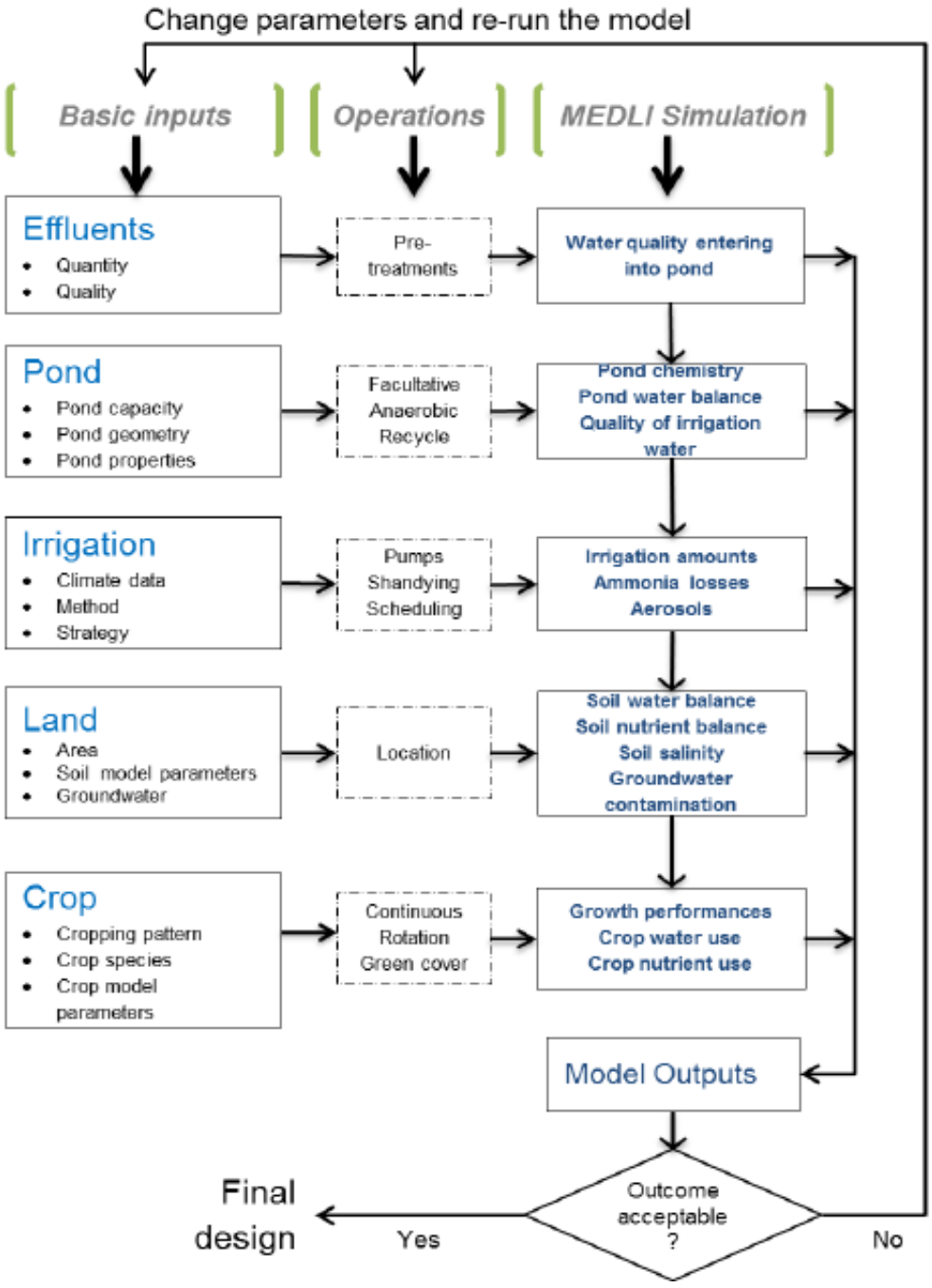


Figure 3.1 – Flowchart of the MEDLI modelling process from the DES Technical Guideline for Disposal of Effluent via Irrigation

3.1 Modelling Scenario

The general modelling for the Ashbourne IWTS includes Stage One of the development (178 dwellings). The area available for spray irrigation is 9.68ha and target effluent quality for TN is 20mg/L and TP of 10mg/L. MEDLI Report is attached as *Appendix 1 – Ashbourne IWTS - MEDLI Report*.

3.1.1 Infrastructure Capacity

MEDLI runs have been completed using the Average Annual Flow (AAF) of 92,916L/day. The IWTP will have a nominal daily treatment capacity of 110kL/day and a peak treatment capacity of 137.5kL/day.

3.2 Climate Data

Silo Data from the nearest weather station has been entered (Moss Vale).

3.3 Waste Estimation

The waste estimation module of MEDLI generates the daily composition and volume of effluent before pre–treatment, storage, or irrigation for an IWTS.

3.3.1 Daily Effluent Production

The AAF per EP for the site is 180L/EP/day. The AAF is 92,916L/day.

3.3.2 Infiltration – Wet Weather

The development is on a greenfield site, all sewer drainage system will be new and will be constructed, tested, commisioned, and approved under Section 68. There are four infiltration options, zero, low, moderate, high. Considering the interim period is three years and the infrastructure the zero infiltration option could be adopted, however to ensure a conservative approcah to modelling the MEDLI scenario assumes Low infiltration.

3.3.3 Total Nitrogen

MEDLI runs have been completed with a Total Nitrogen (TN) target effluent quality of 20mg/Litre.

3.3.4 Total Phosphorus

MEDLI runs have been completed with a Total Phosphorus (TP) target effluent quality of 10mg/Litre.

3.3.5 Electrical Conductivity

Due to interim nature of the IWTS the Electrical Conductivity (EC) have not been considered.

3.4 Pond System

The capacity of Wet Weather Storage for the current EP is 4,079m^3.

3.4.1 Pond System Type

The pond system type will be a lined wet weather storage lagoon.

3.4.2 Pond Volume at Outlet

The pond system will have a volume at the outlet of 4,079m^3.

3.4.3 Initial Status of Pond

The initial status of the pond will be empty.

3.4.4 Pond System Water Balance

The capacity of the Wet Weather Storage will aim to ensure 0mm effluent overflow and 0mm of seepage.

3.5 Pump & Shandy

There will be no shandying of effluent. Pump volumes will be set considering Rate per Area.

3.5.1 Pump Minimum

The pump minimum is set at 10,000L/day.

3.5.2 Pump Maximum

The maximum pump limit is set to 100,000L/day.

3.6 Paddock

A new Paddock will be established.

3.6.1 Paddock Area

The irrigation area will be 9.68ha.

3.6.2 Irrigation Operation – Scheduling Window

The scheduling window for the irrigation is from 1 January to 31 December.

3.6.3 Irrigation Operation – Trigger Irrigation

Irrigation is triggered at Specified Fixed Frequency. The Fixed Frequency is once day when weather permits.

3.6.4 Irrigation Operation – Irrigation Method

The irrigation method is Fixed Sprinkler, therefore the ammonia loss during irrigation is 0.2.

3.6.5 Irrigation Operation – Apply Irrigation

Irrigation is applied to Specified Fixed Depth. The Fixed Depth is 1mm.

3.6.6 Irrigation Operation – Irrigation Overrides

The minimum allowable days between irrigation is set to 0 days.

3.6.7 Planting Parameters – Cropping Regime

The crop is Non-Rotation.

3.6.8 Planting Parameters – Plant Model

The plant model is Pasture.

3.6.9 Planting Parameters – Paddock Plant Pasture

The plant is Kikuyu 2 Pasture.

3.6.10 Planting Parameters – Growth Parameters

The growth parameters for Kikuyu 2 Pasture with green cover set to 0.97.

3.6.11 Planting Parameters – Harvest Parameters

The harvest parameters are as per the auto setting for Kikuyu 2 Pasture.

3.6.12 Paddock Soil

See the Soil Assessment, soils are consistent with Duplex 2 as per the MEDLI library settings.

4 MEDLI Summary

The MEDLI Report for the IWTS is attached as *Appendix 1 - Ashbourne IWTS - MEDLI Report*.

The MEDLI Report summarises the findings of the specific MEDLI run and provides tables and graphs which presents the data in formats that are easy to view and assess. A MEDLI Report is generally composed of four sections:

1. General information which provides general scenario details.
2. Description section which provides a summary of climate variables, waste stream characteristics and details of the irrigation land and any health risk analyses.
3. Performance section which summarises the model predictions including the hydraulic, nitrogen, phosphorus and salinity mass balances for the pond system including:
    - frequency/size of pond overtopping events,
    - nutrients stored and removed from the pond in the sludge and supernatant,
    - hydrology components of the irrigation area (runoff, drainage, irrigation, transpiration etc.),
    - components of the soil nitrogen, phosphorus, and salinity balances,
    - plant growth and any soil salinity restrictions and nutrient storage values,
    - information on groundwater quality due to nitrate leaching beneath the irrigation area, and
    - details of health risk analyses.

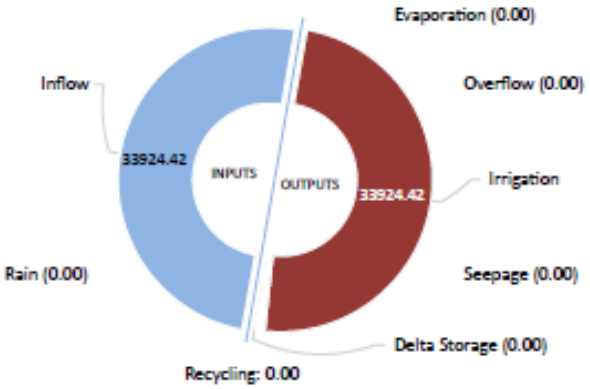
4.1 Pond System Water Performance – Overflow

The Pond System will have a final storage capacity of 4,079m^3 resulting in 0mm of overflow.

Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: **4079 m3**

Pond System Water Balance (m3/year)



Name	Value
Rain	0.00
Inflow	33924.42
Recycling	0.00
Evaporation	0.00
Overflow	0.00
Irrigation	33924.42
Seepage	0.00
Delta Storage	0.00

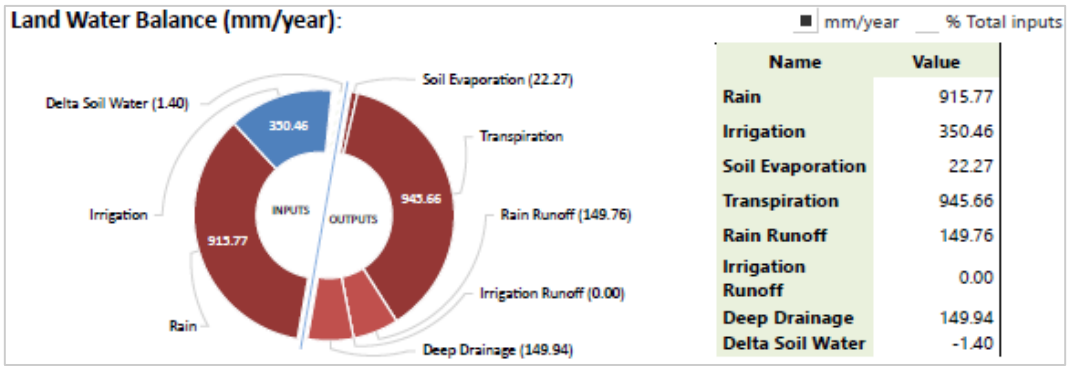
Overflow Diagnostics

Volume of overflow (m3/year)	0.00
No. days pond overflows (days/year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% reuse (fraction)	1.00

Figure 4.1 – Ashbourne MEDLI Run - Pond System Performance

4.2 Land Water Balance

The Land Water confirms 0mm of irrigation run off per year.

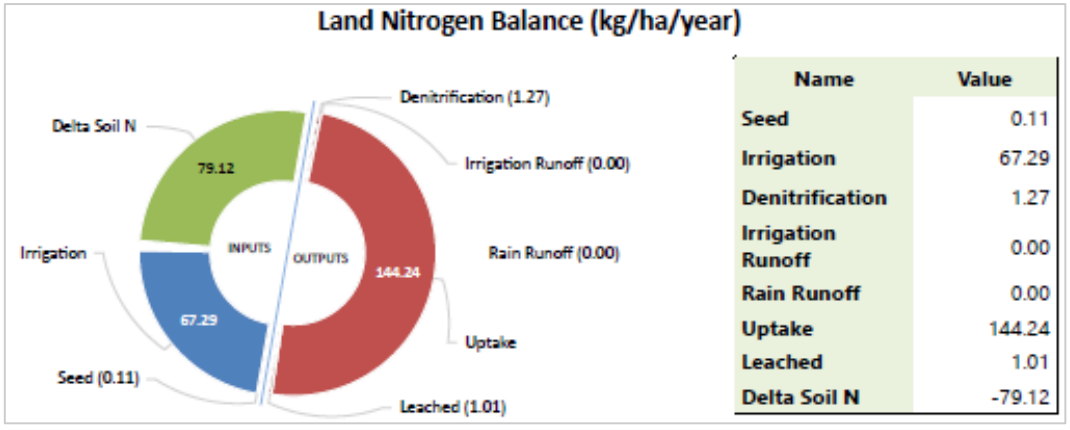


Name	Value
Rain	915.77
Irrigation	350.46
Soil Evaporation	22.27
Transpiration	945.66
Rain Runoff	149.76
Irrigation Runoff	0.00
Deep Drainage	149.94
Delta Soil Water	-1.40

Figure 4.2 – Ashbourne MEDLI Run - Land Water Balance

4.3 Land Nitrogen Balance

The Nitrogen Balance confirms a total leached nitrogen volume of 1.01kg/ha/year through the 1.5m soil profile.

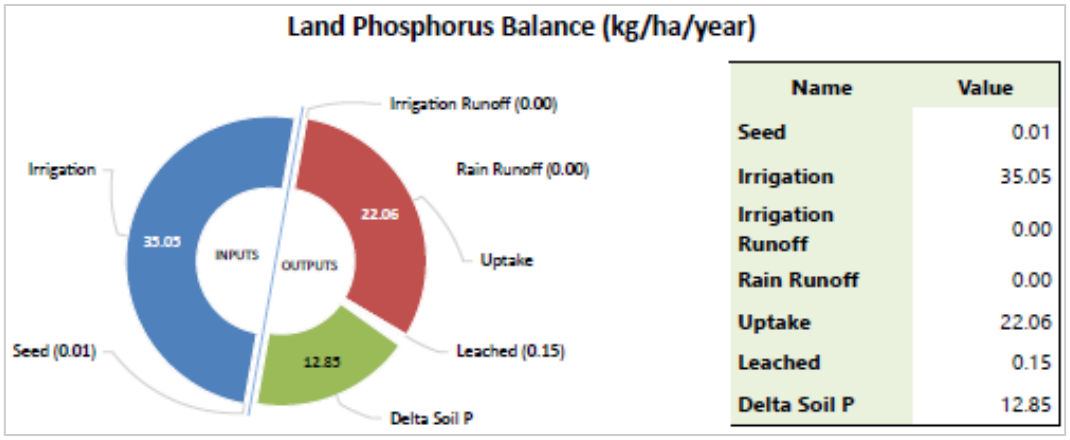


Name	Value
Seed	0.11
Irrigation	67.29
Denitrification	1.27
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	144.24
Leached	1.01
Delta Soil N	-79.12

Figure 4.3 – Ashbourne MEDLI Run - Land Nitrogen Balance

4.4 Land Phosphorous Balance

The Phosphorus Balance confirms the total leached phosphorus volume of 0.15kg/ha/year through the 1.5m soil profile.



Name	Value
Seed	0.01
Irrigation	35.05
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	22.06
Leached	0.15
Delta Soil P	12.85

Figure 4.4 – Scenario 1 MEDLI Run, Land Phosphorus Balance

4.5 Sustainability Diagnostics

The Sustainability Diagnostics confirm the maximum annual Nitrate–N concentration of deep drainage of 0.68mg/L. And confirm the design soil profile storage life based on average infiltrated water phosphorus concentration of 0.1mg/L/year is 90.87years.

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	67.29
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	144.24
Average annual soil nitrogen removed by denitrification (kg/ha/year)	1.27
Average annual soil nitrogen leached (kg/ha/year)	1.01
Average annual nitrate-N loading to groundwater (kg/ha/year)	1.01
Soil organic-N kg/ha (Initial - Final)	4620.00 - 940.28
	118.20 - 0.06
Average nitrate-N concentration of deep drainage (mg/L)	0.68
Max. annual nitrate-N concentration of deep drainage (mg/L)	20.77

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/ha/year)	35.05
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	22.06
Average annual soil phosphorus leached (kg/ha/year)	0.15
Dissolved phosphorus (kg/ha) (Initial - Final)	0.48 - 2.47
Adsorbed phosphorus (kg/ha) (Initial - Final)	2300.27 - 2914.92
Average phosphate-P concentration in rootzone (mg/L)	0.36
Average phosphate-P concentration of deep drainage (mg/L)	0.10
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.10
Design soil profile storage life based on average infiltrated water phosphorus concn. of 3.14 mg/L (years)	90.87

Figure 4.5 – Ashbourne MEDLI Run - Sustainability Diagnostics

Appendix 1

Ashbourne IWTS

MEDLI Report

MEDLI REPORT - FULL RUN

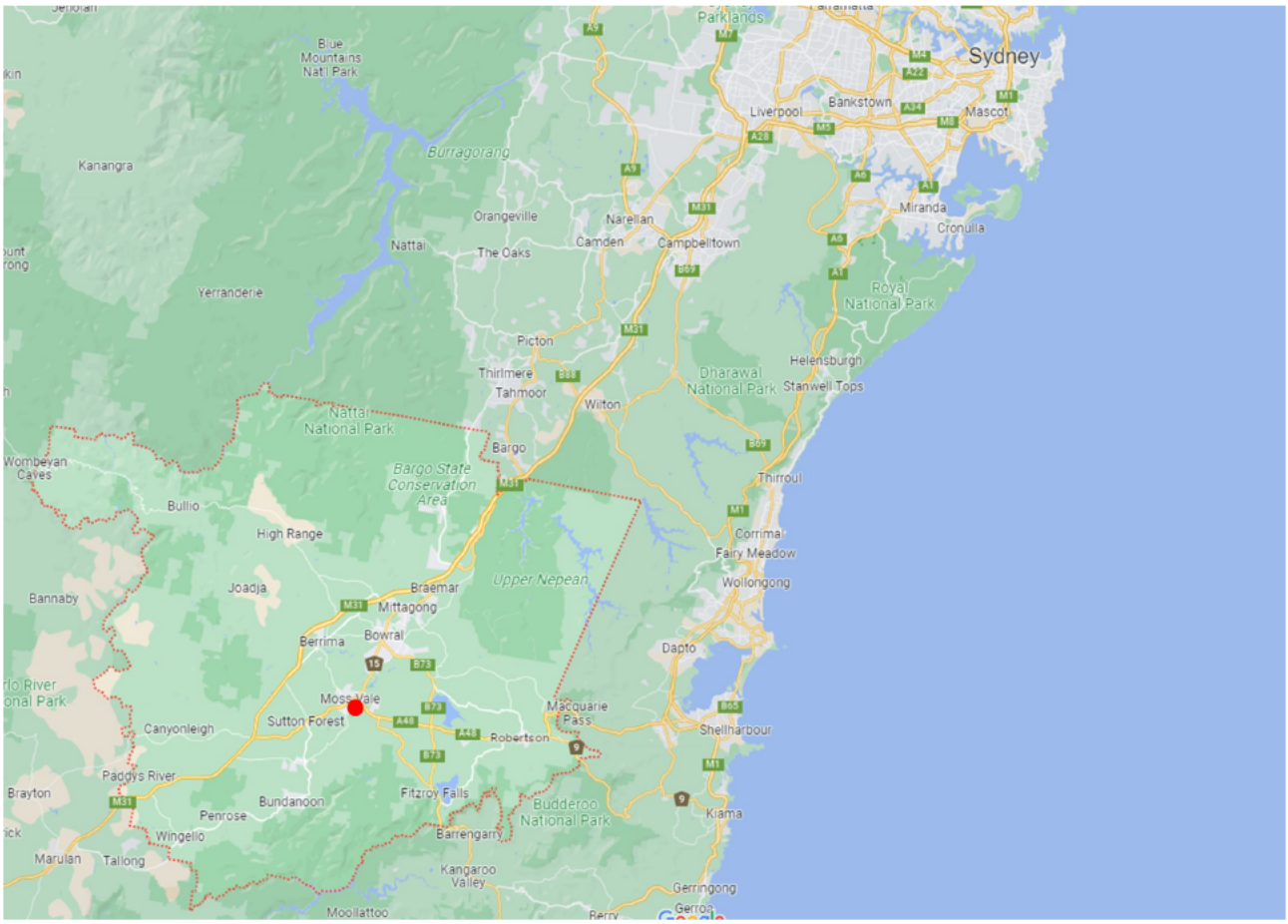
Enterprise: ASHBOURNE INTERIM WASTEWATER TREATMENT SYSTEM (IWTS)

Description:
MEDLI Modelling for Effluent Irrigaiton

Client: Aoyuan

MEDLI User: JM-OFFICE-ALPHA\jim-m

Scenario Details:
178 Lots (516 - Conservative EP)
9.68Hectare Spray Irrigation
50year MEDLI Run



DESCRIPTION

Climate Data: Ashbourne Moss Vale, -34.55°, 150.4°

Run Period: 01/01/1971 to 31/12/2018 48 years, 0 days

Climate Statistics:

	5th Percentile	50th Percentile	95th Percentile
Rainfall (mm/year)	546	896	1478
Pan Evaporation (mm/year)	1052	1227	1496

Climate Data:

Chart ■ Table

■ Monthly Daily

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain (mm)	77.0	104.7	97.4	75.7	69.3	102.7	52.1	69.6	57.5	64.6	79.6	65.5	915.8
Pan (mm)	173.3	132.9	115.2	77.3	52.9	38.1	44.6	67.9	95.9	126.6	142.7	175.1	1242.4
Max Temp (oC)	25.3	24.2	22.2	19.0	15.5	12.3	11.7	13.3	16.4	19.1	21.4	24.0	18.7
Min Temp (oC)	13.6	13.7	11.9	8.8	5.9	3.7	2.5	3.2	5.5	7.8	10.0	12.1	8.2
Rad (MJ/m2/day)	21.6	18.9	16.4	13.5	10.4	8.7	10.0	13.3	17.1	20.0	21.5	22.9	16.2
Net Evap (mm)	96.2	28.2	17.8	1.6	-16.3	-64.6	-7.4	-1.7	38.4	62.0	63.0	109.6	326.7

DESCRIPTION

Effluent type: New Sewage Treatment Plant

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality: ☐ Chart ■ Table

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Effluent (m3)	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92 9	92.9
TN (mg/L)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
TP (mg/L)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
TDS (mg/L)	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
VS (mg/L)	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
TS (mg/L)	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

Wastestream after any recycling and pretreatment if applicable

Effluent quantity: 33924.42 m3/year or 92.88 m3/day (Min-Max: 92.88 - 92.88)

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

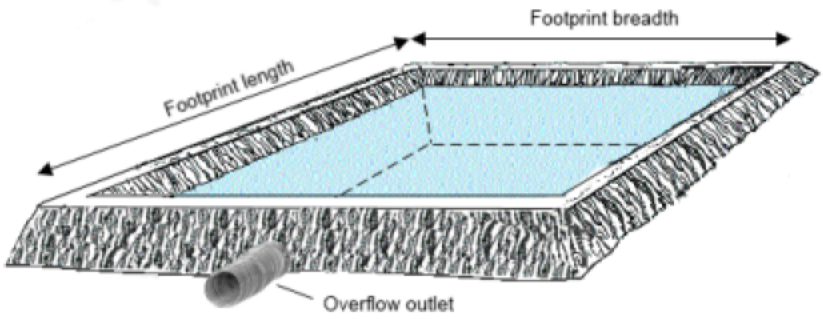
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	20.00 (20.00 - 20.00)	678.49 (678.02 - 679.88)
Total Phosphorus	10.00 (10.00 - 10.00)	339.24 (339.01 - 339.94)
Total Dissolved Salts	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

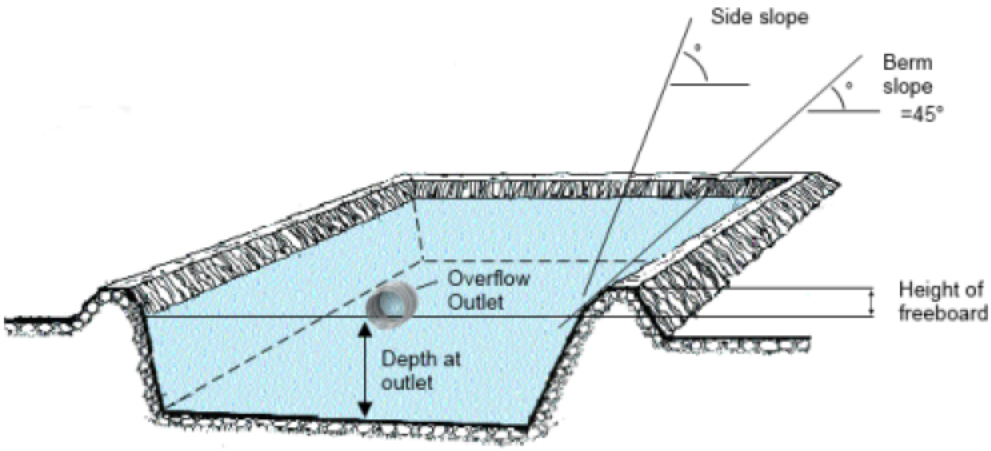
DESCRIPTION

Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (m3)	4079.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	3.00
Maximum water surface area (m2)	1573.05
Pond footprint length (m)	97.15
Pond footprint width (m)	16.19
Pond catchment area (m2)	1573.05
Average active volume (m3)	0.00





Irrigation pump limits:

Minimum pump rate limit (ML/day)	0.01
Maximum pump rate limit (ML/day)	0.10

Shandying water:

Annual allocation of fresh water available for shandying (m3/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

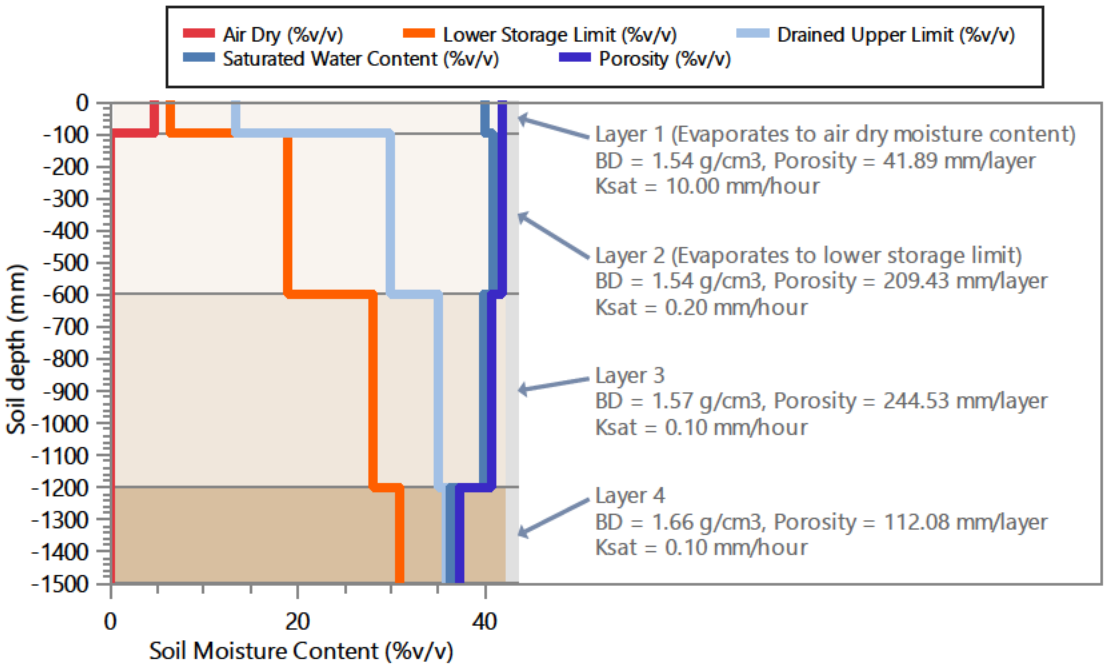
DESCRIPTION

Land: New Paddock

Area (ha): 9.68

Soil Type: Duplex 2, 1500.00 mm defined profile depth

Profile Porosity (mm)	607.92
Profile saturation water content (mm)	593.10
Profile drained upper limit (or field capacity) (mm)	482.00
Profile lower storage limit (or permanent wilting point) (mm)	362.70
Profile available water capacity (mm)	119.30
Profile limiting saturated hydraulic conductivity (mm/hour)	0.10
Surface saturated hydraulic conductivity (mm/hour)	10.00
Runoff curve number II (coefficient)	82.00
Soil evaporation U (mm)	8.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Kikuyu 2 Pasture -2

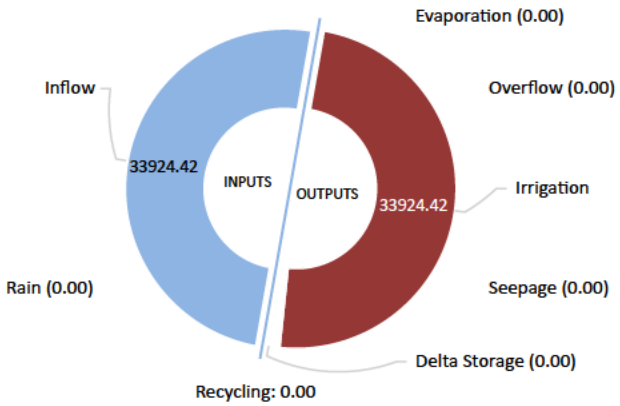
Average monthly cover (fraction) (minimum - maximum)	0.97 (0.92 - 1.00)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 1 x Pan coefficient 0.95)	0.95
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Maximum potential root depth in defined soil profile (mm)	1200.00
Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03

PERFORMANCE

Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: 4079 m3

Pond System Water Balance (m3/year)



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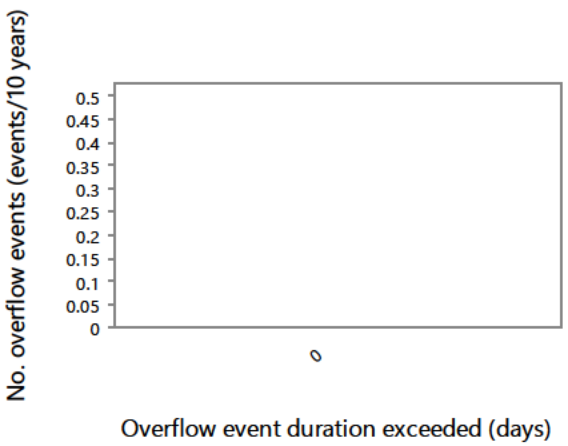
Evaporation	0.00
Overflow	0.00
Irrigation	33924.42
Seepage	0.00
Delta Storage	0.00

Overflow Diagnostics

Volume of overflow (m3/year)	0.00
No. days pond overflows (days/year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% reuse (fraction)	1.00



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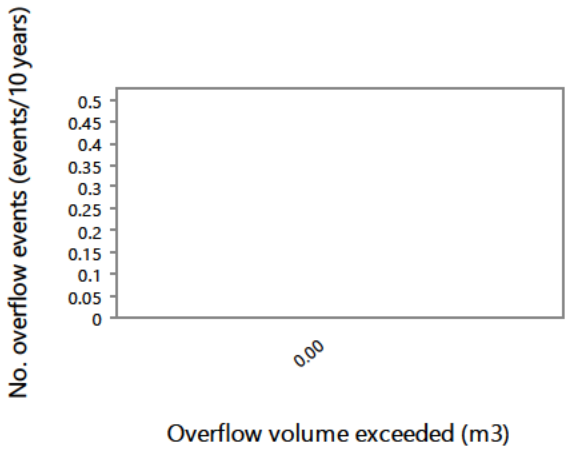

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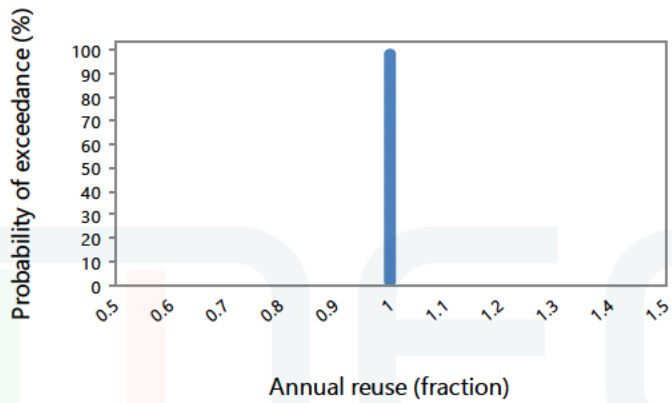

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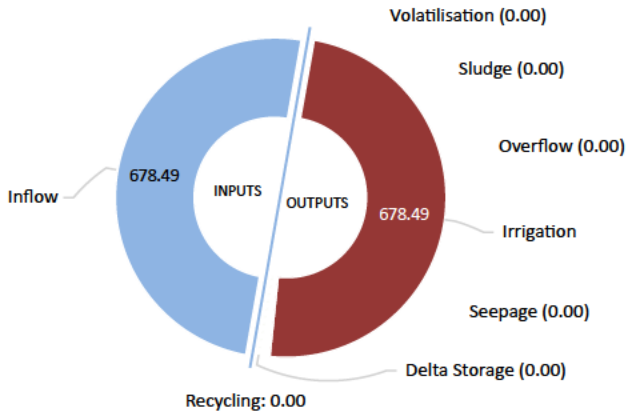
PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

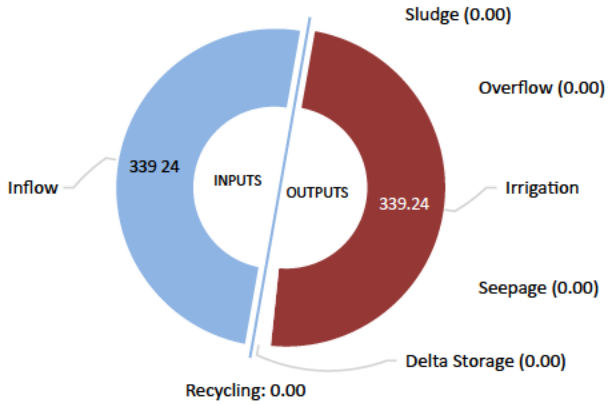
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



Name	Value
Inflow	678.49
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	678.49
Seepage	0.00
Delta Storage	0.00

Phosphorus Balance (kg/year)



Name	Value
Inflow	339.24
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	339.24
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)

(no data available)

Name	Value
Inflow	0.00
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta Storage	0.00

* 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 closed storage tank

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	20.00
Average phosphorus concentration of pond liquid (mg/L)	10.00
Average salinity of pond liquid (dS/m)	0.00

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	20.00
Final phosphorus concentration of pond liquid (mg/L)	10.00
Final salinity of pond liquid (dS/m)	0.00

PERFORMANCE

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (m3/year) Average Shandy water irrigation (m3/year) (minimum - maximum)	33924.42 0.00 (0.00 - 0.00)
Total water irrigated (m3/year) Proportion of irrigation events requiring shandying (fraction of events)	33924.42 0.00
Proportion of years shandying water allocation of 0 m3/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction 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)	20.00
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	19.20
Average phosphorus concentration of irrigation water (mg/L) Average salinity of irrigation water (dS/m)	10.00 0.00

Irrigation Diagnostics:

Proportion of Days irrigation occurs (fraction)	1.00

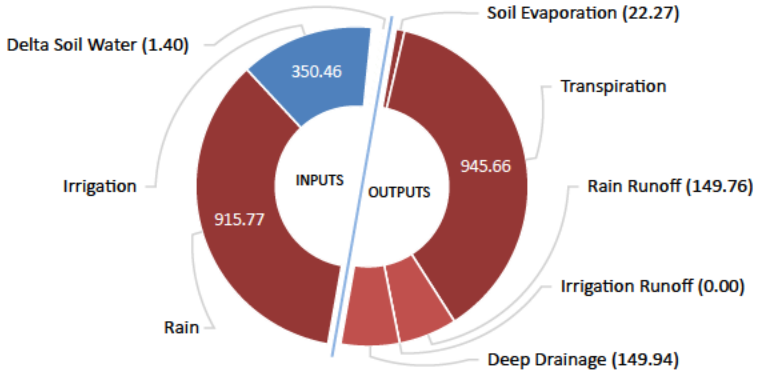
PERFORMANCE

Land Performance - Soil Water

Paddock: New Paddock, 9.68 ha
Soil Type: Duplex 2, 104.00 mm PAWC at maximum root depth

Land Water Balance (mm/year):

■ mm/year ☐ % Total inputs



Name	Value
Rain	915.77
Irrigation	350.46
Soil Evaporation	22.27
Transpiration	945.66
Rain Runoff	149.76
Irrigation Runoff	0.00
Deep Drainage	149.94
Delta Soil Water	-1.40

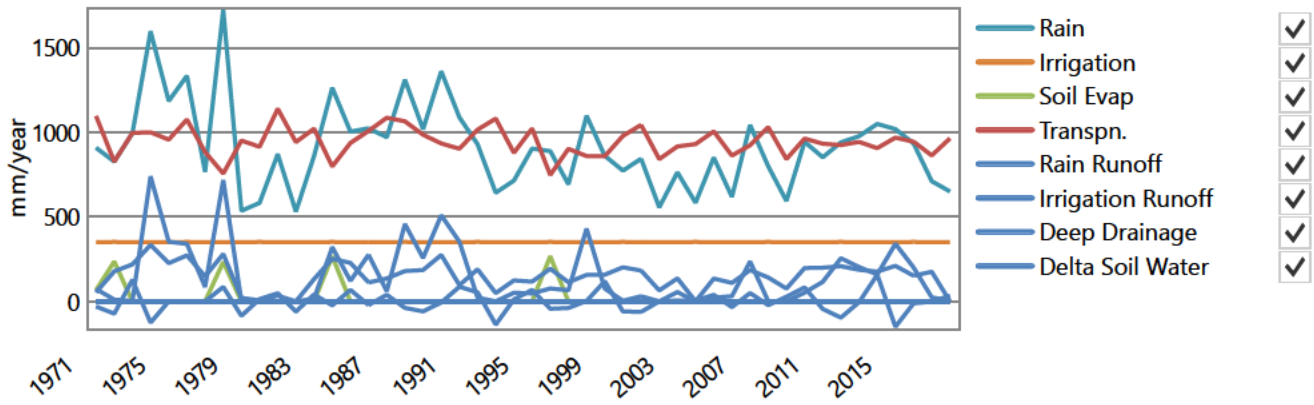
Average Monthly Totals (mm):

☐ Chart ■ Table

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rain	77.0	104.7	97.4	75.7	69.3	102.7	52.1	69.6	57.5	64.6	79.6	65.5	915.8
Irrigation	29.7	27.1	29.7	28.8	29.7	28.8	29.7	29.7	28.8	29.7	28.8	29.7	350.5
Soil Evap	1.3	0.1	0.0	0.0	0.0	1.2	2.7	4.3	4.4	5.0	3.1	0.2	22.3
Transpn.	104.1	94.6	91.5	63.8	48.2	33.9	38.0	58.2	81.4	103.2	108.2	120.5	945.7
Rain Runoff	0.1	3.3	15.6	16.7	11.2	41.5	16.5	30.5	4.7	4.8	3.6	1.3	149.8
Irrigation 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
Deep Drainage	1.3	2.3	5.9	8.6	13.7	20.5	25.8	25.6	20.0	13.6	8.1	4.4	149.9
Delta Soil Water	-0.2	31.6	14.2	15.4	25.8	34.3	-1.1	-19.3	-24 2	-32.2	-14.6	-31.2	-1.4

Average Annual Totals (mm/year):

■ Chart ☐ Table



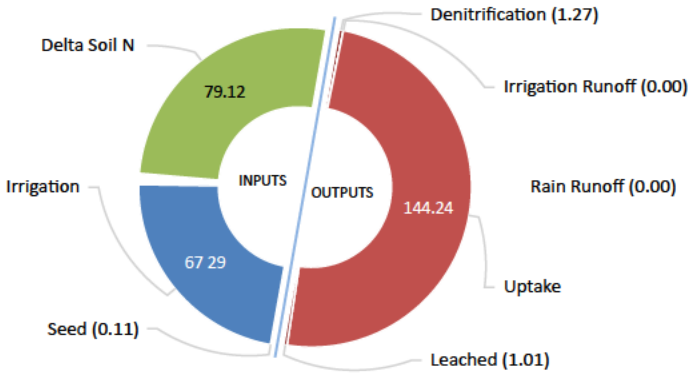
PERFORMANCE

Land Performance - Soil Nutrient

Paddock: New Paddock, 9.68 ha **Soil Type**: Duplex 2

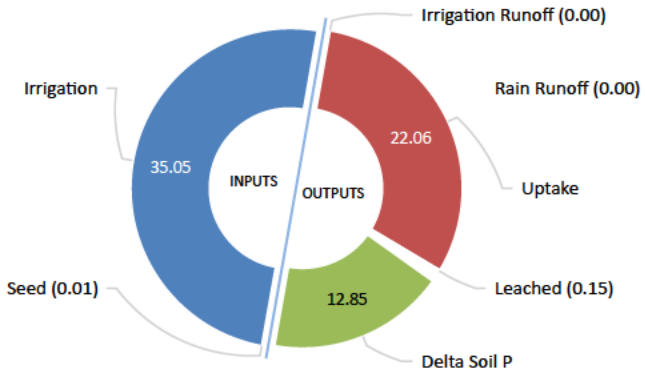
Irrigation ammonium volatilisation losses (kg/ha/year): 2.80
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.20

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	0.11
Irrigation	67.29
Denitrification	1.27
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	144.24
Leached	1.01
Delta Soil N	-79.12

Land Phosphorus Balance (kg/ha/year)



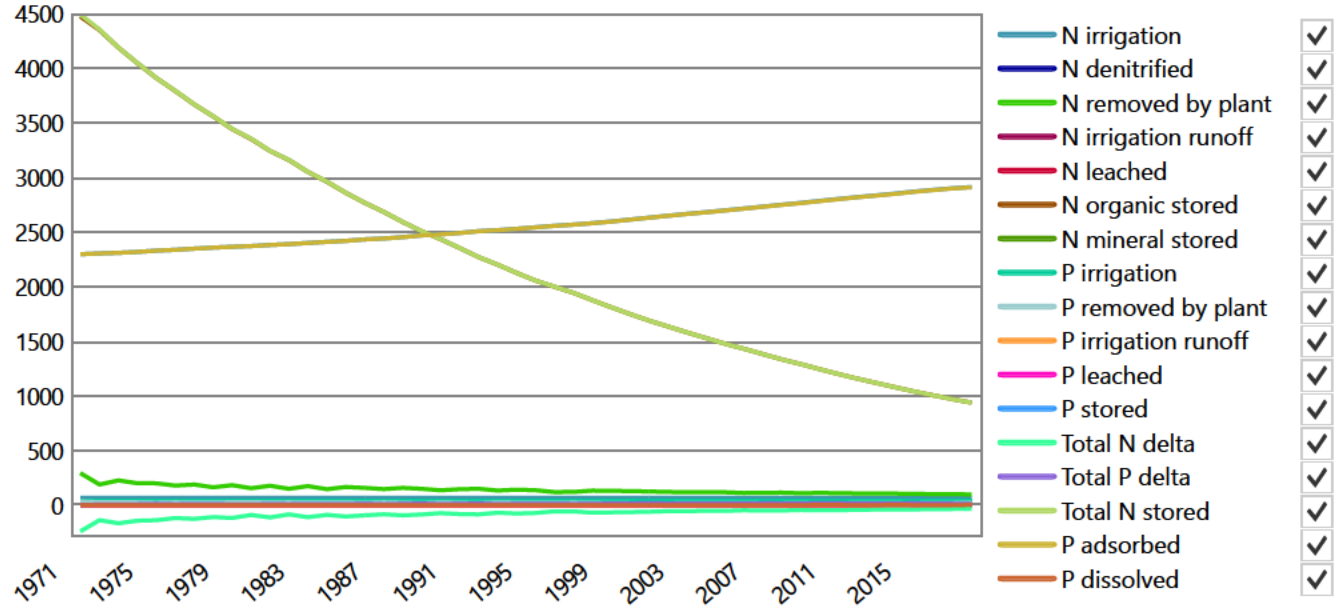
Name	Value
Seed	0.01
Irrigation	35.05
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	22.06
Leached	0.15
Delta Soil P	12.85

PERFORMANCE

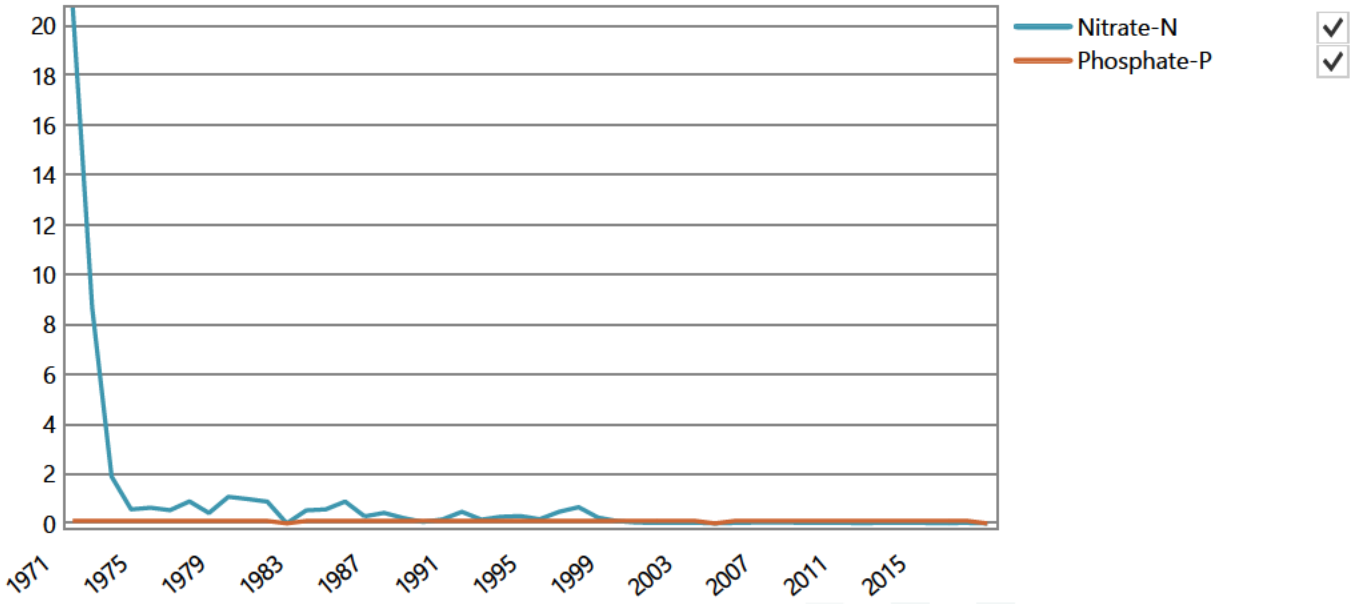
Land Performance - Soil Nutrient

Paddock: New Paddock, 9.68 ha **Soil Type**: Duplex 2

Annual Nutrient Totals (kg/ha):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

Plant Performance and Nutrients

Paddock: New Paddock, 9.68 ha **Soil Type**: Duplex 2

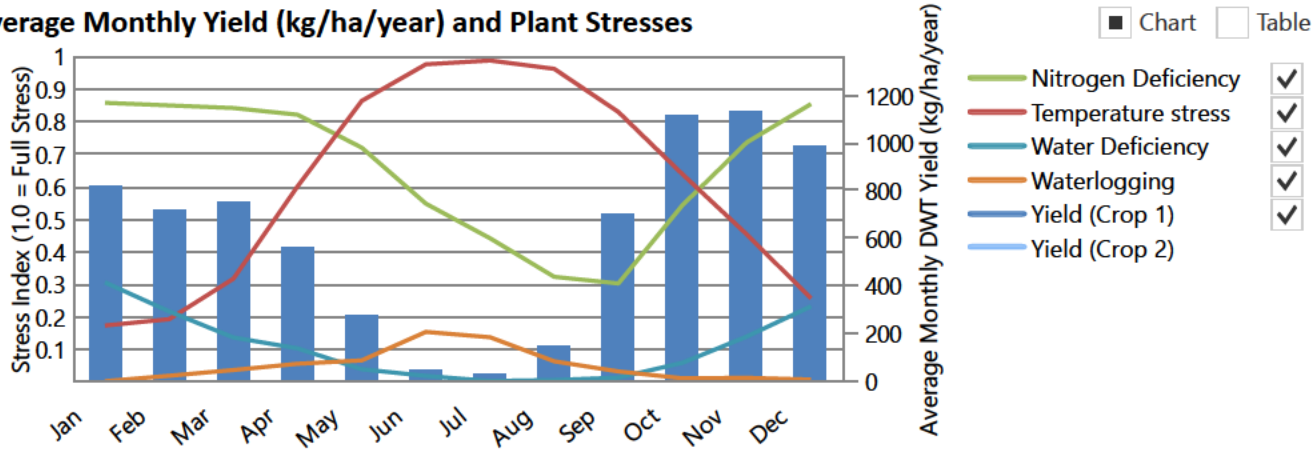
Plant: Continuous Kikuyu 2 Pasture -2

Average annual shoot dry matter yield (kg/ha/year)	7296.30 (5473.99 - 13845.21)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.97 (0.92 - 1.00)
Average monthly root depth (mm) (minimum - maximum)	1162.26 (1104.17 - 1200.00)

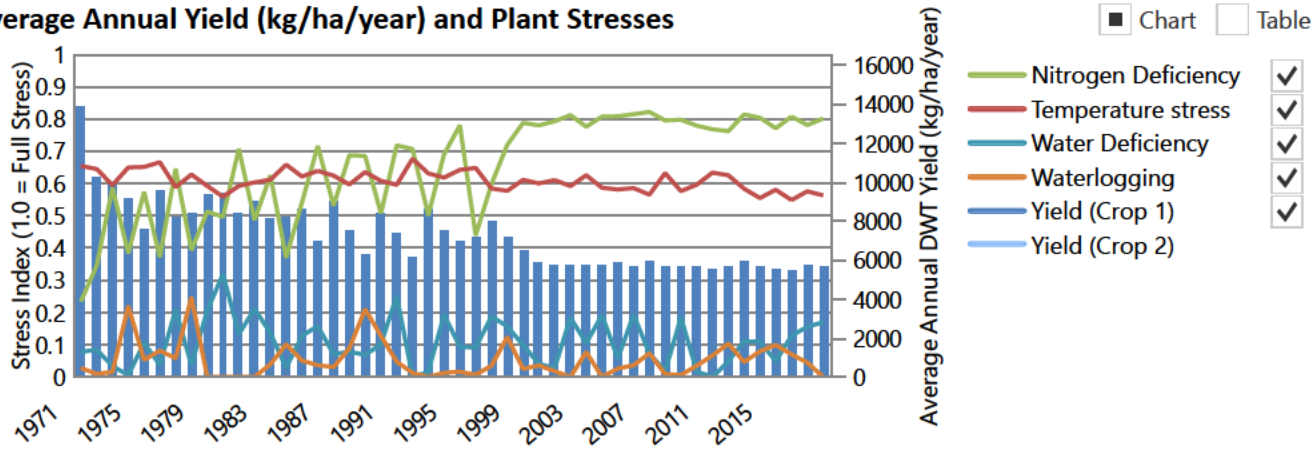
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/ha/year)	144.24 (99.45 - 294.13)
Average annual net phosphorus removed by plant uptake (kg/ha/year)	22.06 (16.39 - 34.10)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.02 - 0.03)
Average annual shoot phosphorus concentration (fraction dwt)	0.003 (0.003 - 0.005)

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



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



No. of harvests/year: 1.25 (normal), 0.10 (forced by crop death due to frosting (0.08), water stress (0.02))
No. days without crop/year (days/year): 2.29 due to frosting (0.58), temperature stress - not frost (1.60), water stress (0.06), waterlogging (0.04)

PERFORMANCE

Land Performance

Paddock: New Paddock, 9.68 ha **Soil Type**: Duplex 2

Plant: Continuous Kikuyu 2 Pasture -2

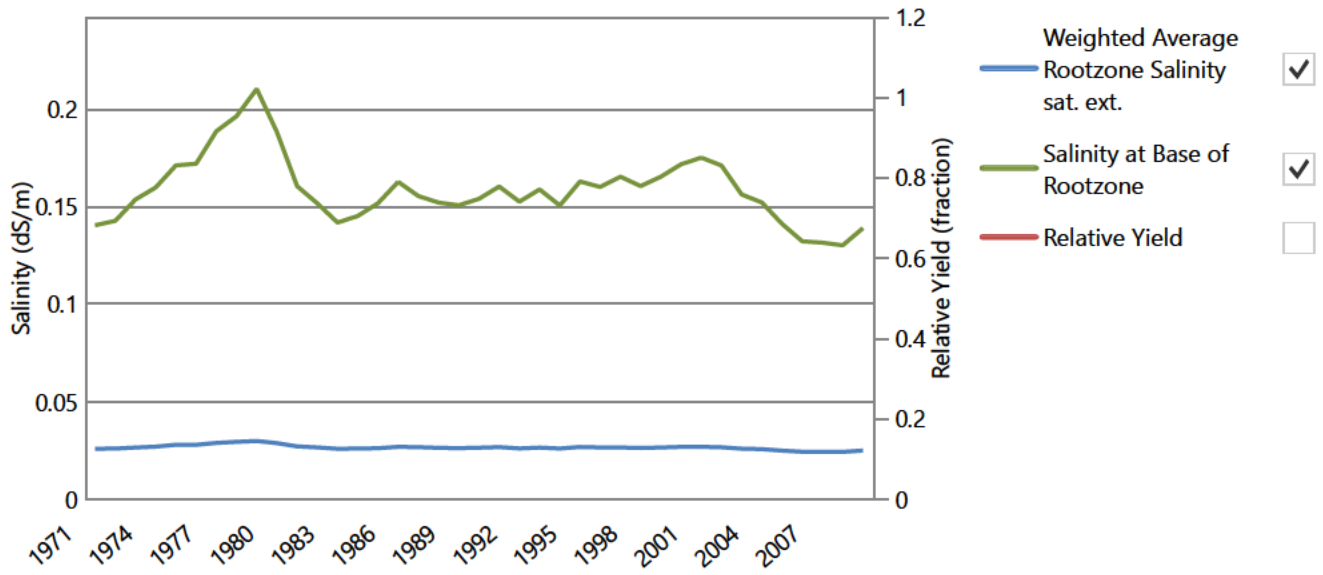
Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03
No. years assumed for leaching to reach steady-state (years)	10.00

Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.02
Salt added by rainfall (kg/ha/year)	147.08
Average annual effluent salt added & leached at steady state (kg/ha/year)	147.08
Average leaching fraction based on 10 year running averages (fraction)	0.35
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.03
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.16
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

Average Annual Rootzone Salinity and Relative Yield:

All values based on 10 year running averages



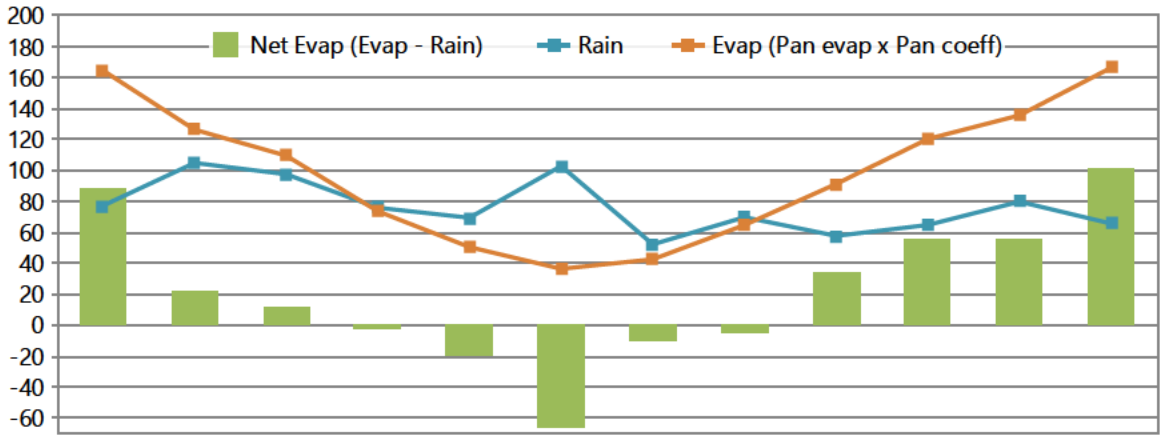
DIAGNOSTICS

Sustainability Diagnostics: ASHBOURNE INTERIM WASTEWATER TREATMENT SYSTEM (IWTS)

Averaged Historical Climate Data Used in Simulation (mm)

Location: Ashbourne Moss Vale, -34.55°, 150.4°

Run Period: 01/01/1971 to 31/12/2018 48 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	77.0	104.7	97.4	75.7	69.3	102.7	52.1	69.6	57.5	64.6	79.6	65.5	915.8
Evap	164.6	126.2	109.4	73.5	50.3	36.2	42.4	64.5	91.1	120.2	135.5	166.3	1180.3
Net Evap	87.6	21.5	12.0	-2.3	-19.0	-66.5	-9.7	-5.1	33.6	55.6	55.9	100.8	264.5
Net Evap/day	2.8	0.8	0.4	-0.1	-0.6	-2.2	-0.3	-0.2	1.1	1.8	1.9	3.3	0.7

DIAGNOSTICS

Sustainability Diagnostics: ASHBOURNE INTERIM WASTEWATER TREATMENT SYSTEM (IWTS)

Pond System: 1 closed storage tank

New Sewage Treatment Plant - 33924.42 m3/year or 92.88 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.25 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	20.00 (20.00 - 20.00)	678.49 (678.02 - 679.88)
Total Phosphorus	10.00 (10.00 - 10.00)	339.24 (339.01 - 339.94)
Total Dissolved Salts	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
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): 4079.00 m3

Theoretical hydraulic retention time (days)	43.92
Average volume of overflow (m3/year)	0.00
No. overflow events per year exceeding threshold* of 0 26 m3 (no./year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% effluent reuse (fraction)	1.00
Average salinity of last pond (dS/m)	0.00
Salinity of last pond on final day of simulation (dS/m)	0.00
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

Overflow volume exceeded (m3)	No. overflow events (events/10 years)
0.00	0.00

DIAGNOSTICS

Sustainability Diagnostics: ASHBOURNE INTERIM WASTEWATER TREATMENT SYSTEM (IWTS)

Irrigation Information

Irrigation: 9.68 ha total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (m3)	33924.42	3504.59
Total nitrogen applied (kg)	651.35	67.29
Total phosphorus applied (kg)	339.24	35.05
Total salts applied (kg)	0.00	0.00

Shandying

Annual allocation of fresh water for shandying (m3/year)	0.00
Average Shandy water irrigation (m3/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 (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation occurs (fraction)	1.00

DIAGNOSTICS

Sustainability Diagnostics: ASHBOURNE INTERIM WASTEWATER TREATMENT SYSTEM (IWTS)

Paddock Land: New Paddock: 9.68 ha

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Irrigation triggered every 1 days
Irrigate a fixed amount of 1.00 mm each day 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): Duplex 2, 104.00 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	77.0	104.7	97.4	75.7	69.3	102.7	52.1	69.6	57.5	64.6	79.6	65.5	915.8
Irrigation	29.7	27.1	29.7	28.8	29.7	28.8	29.7	29.7	28.8	29.7	28.8	29.7	350.5
Soil Evap	1.3	0.1	0.0	0.0	0.0	1.2	2.7	4.3	4.4	5.0	3.1	0.2	22.3
Transpn.	104.1	94.6	91.5	63.8	48 2	33.9	38.0	58.2	81.4	103.2	108.2	120.5	945.7
Rain Runoff	0.1	3.3	15.6	16.7	11 2	41.5	16.5	30.5	4.7	4.8	3.6	1.3	149.8
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	1.3	2.3	5.9	8.6	13.7	20.5	25.8	25.6	20.0	13.6	8.1	4.4	149.9
Delta	-0.2	31.6	14.2	15.4	25.8	34.3	-1.1	-19.3	-24.2	-32.2	-14.6	-31.2	-1.4

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	67.29
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	144.24
Average annual soil nitrogen removed by denitrification (kg/ha/year)	1.27
Average annual soil nitrogen leached (kg/ha/year)	1.01
Average annual nitrate-N loading to groundwater (kg/ha/year)	1.01
Soil organic-N kg/ha (Initial - Final)	4620.00 - 940.28
	118 20 - 0.06
Average nitrate-N concentration of deep drainage (mg/L)	0.68
Max. annual nitrate-N concentration of deep drainage (mg/L)	20.77

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/ha/year)	35.05
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	22.06
Average annual soil phosphorus leached (kg/ha/year)	0.15
Dissolved phosphorus (kg/ha) (Initial - Final)	0.48 - 2.47
Adsorbed phosphorus (kg/ha) (Initial - Final)	2300.27 - 2914.92
Average phosphate-P concentration in rootzone (mg/L)	0.36
Average phosphate-P concentration of deep drainage (mg/L)	0.10
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.10
Design soil profile storage life based on average infiltrated water phosphorus concn. of 3.14 mg/L (years)	90.87

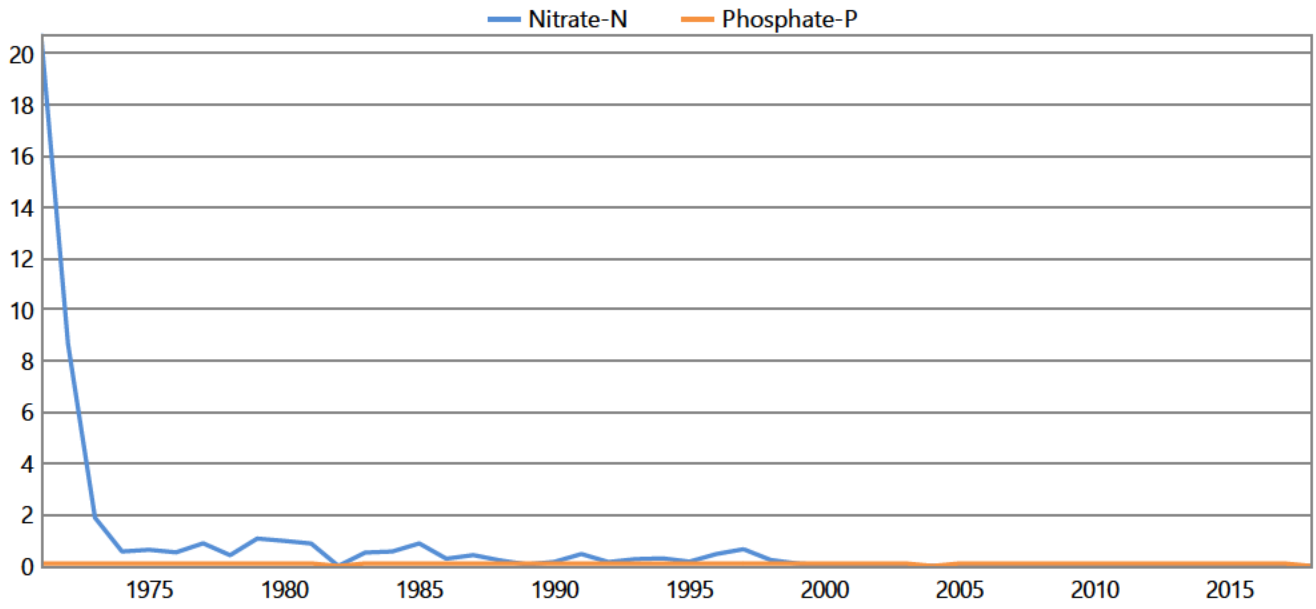
DIAGNOSTICS

Sustainability Diagnostics: ASHBOURNE INTERIM WASTEWATER TREATMENT SYSTEM (IWTS)

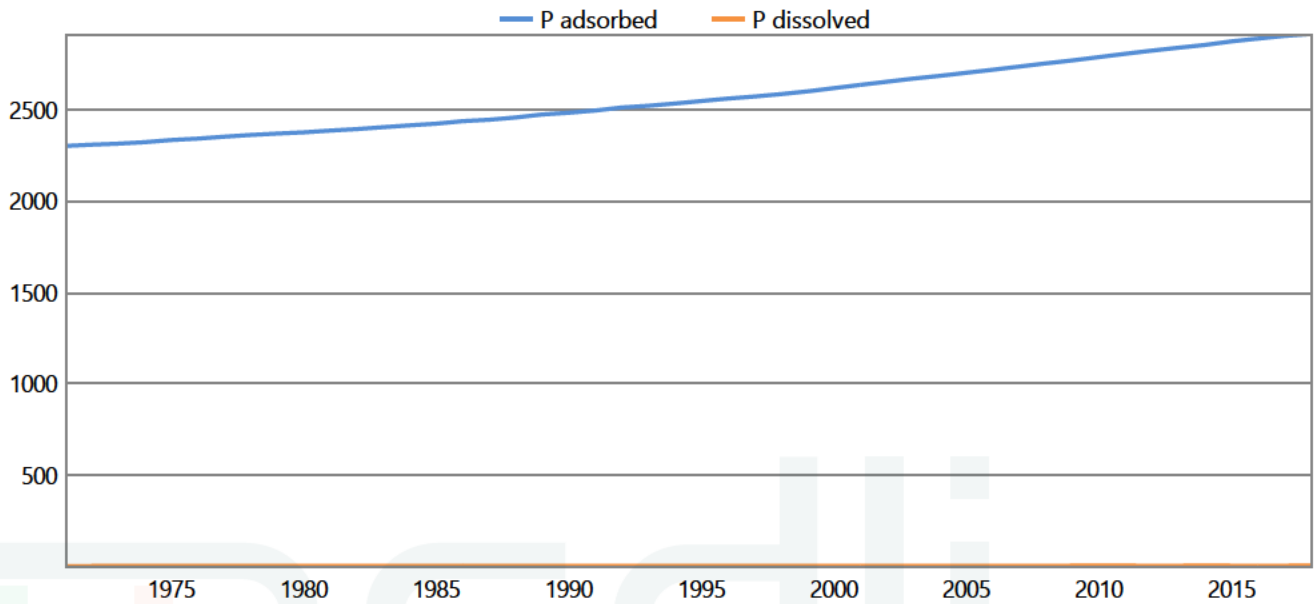
Paddock Land: New Paddock: 9.68 ha

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/ha)



DIAGNOSTICS

Sustainability Diagnostics: ASHBOURNE INTERIM WASTEWATER TREATMENT SYSTEM (IWTS)

Paddock Plant Performance: New Paddock: 9.68 ha

Average Plant Performance (Minimum - Maximum): Continuous Kikuyu 2 Pasture -2

Average annual shoot dry matter yield (kg/ha/year)	7296.30 (5473.99 - 13845.21)
Average monthly plant (green) cover (fraction)	0.97 (0.92 - 1.00)
Average monthly crop factor (fraction)	0.92 (0.87 - 0.95)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	1162.26 (1104.17 - 1200.00)
Average number of normal harvests per year (no./year)	1.25 (1.00 - 2.00)
Average number of normal harvests for last five years only (no./year)	1.00
Average number of crop deaths per year (no./year)	0.10 (0.00 - 2.00)
Average number of crop deaths for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.65 (0.23 - 0.82)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.18 (0.08 - 0.37)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.99 (0.95 - 1.00)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.11 (0.01 - 0.31)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.05 (0.00 - 0.16)
No. days without crop/year (days)	2.29

Soil Salinity - Plant salinity tolerance: Moderately 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)	0.02
Salt added by rainfall (kg/ha/year)	147.08
Average annual effluent salt added & leached at steady state (kg/ha/year)	147.08
Average leaching fraction based on 10 year running averages (fraction)	0.35
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.03
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.16
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

DIAGNOSTICS

Run Messages

Messages generated when the scenario was run:

Full run chosen