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Clarence Ridge Estate P/L
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Onsite Wastewater Management Report for subdivision proposal at 206 Fotheringay Road, Clarence Town NSW

Whitehead & Associates Environmental Consultants Pty Ltd (W&A) were engaged by Clarence Ridge Estate P/L (the Client) to prepare an Onsite Wastewater Management Report (WMR) for a proposed five (5) lot subdivision at 206 Fotheringay Road, Clarence Town NSW.

It is understood the Client proposes to submit a Development Application (DA) with Dungog Shire Council (Council or DSC) for the residential subdivision of the existing lot, creating five (5) lots of ~8ha.

As the area is not serviced by reticulated sewer, each dwelling within the subdivision will be serviced by an onsite wastewater management system (OWMS). The design parameters and performance requirements of the OWMS is provided in this WMR.

1 Author Statement

This WMR was prepared by Errol Delandro. Errol is an Environmental Consultant with W&A, holding a B. EnvSc. and Mgmt. from the University of Newcastle (2023). Errol has completed the On-site Wastewater Management professional short-course with the Centre for Environmental Training (CET) and has prepared WMRs across the Port Stephens, Dungog, Hunter, Central Coast and MidCoast regions.

2 Property Information

The following table summarises information on the Site investigated.

Feature	Description
Site Address	206 Fotheringay Road, Clarence Town NSW
Lot / DP	Lot 111 DP1002308
Local Government Area	Dungog Shire Council
Land Zoning	R5 - Large Lot Residential
Lot Size (ha)	4.03ha
Sewer Connection Available	No
Potable Water Supply	On-site (tank) water supply

3 Policies, Standards and Guidelines

This WMR has been prepare in accordance with the following guidelines and standards:

- Dungog Shire Council (2015), *On-site Sewage Development Assessment Framework*, V1.4 (DSC DAF, 2015);
- Dungog Shire Council (2015), *On-site Sewage Management Technical Manual* (Technical Manual, 2015);
- Department of Planning, Housing and Infrastructure (2025), *Onsite Wastewater Management Guidelines* (DPHI, 2025); and
- Standards Australia / Standards New Zealand (2012), *AS/NZS 1547:2012 On-site domestic wastewater management* (*AS/NZS 1547:2012*).

3.1 DSC DAF Requirements

Council have adopted a comprehensive Development Assessment Framework (DAF) for On-site Wastewater Management (OWM), which sets out required standards for investigation, acceptable solutions and minimum standards for OWM in unsewered areas within the Local Government Area (LGA). The DSC DAF (2015) identified each allotment within the LGA as having a Low, Medium, High or Very High Hazard for OWM. Correspondence with Council (21/04/2026) confirms that the Site is considered a 'Medium Hazard' for unsewered development.

As per Note 1 of Table 2-3 of the DSC DAF (2015), a Cumulative Impact Assessment (CIA) is mandatory within drinking water catchment areas to ensure that water quality exported from the Site is protected.

A critical component in the assessment of subdivisions is that created lots must demonstrate that ≥4,000m^2 of Useable Land (UL) is available for effluent management (lots area, less areas inside surface water setbacks).

Given the proposed subdivision layout and identified surface water features, ≥4,000m^2 of UL can only be achieved within all created lots with a 50% reduction in the applied buffers. Therefore, complying with Table 2-13 of the DSC DAF (2015), a 'Standard' CIA is provided with the application to support the design and demonstrate compliance with Environment and Health Protection (E&HP) targets. This approach is supported by the DSC DAF (2015) for 'Medium Hazard' allotments.

The following table outlines minimum standards for a WMR on a 'Medium Hazard' allotment, as reproduced from Table 3-5 of the DSC DAF (2015).

DAF Minimum Standards for WMR (Medium Hazard – Increase in Building Entitlements)		
Report Element	**Minimum Standard**	**Completed**
Introduction and Background	• Name, contact details and qualifications of author(s). • Site location and owner. • Allotment size (m² or ha). • Proposed / existing water supply. • Number of bedrooms and occupants. • Availability of sewer.	✓ ✓ ✓ ✓ ✓ ✓
Site and Soil Assessment	• Broad overview of locality and landscape characteristics. • Details of the date and time of assessment in addition to statements confirming the methods used to complete the assessment.	✓ ✓

DAF Minimum Standards for WMR (Medium Hazard – Increase in Building Entitlements)		
Report Element	**Minimum Standard**	**Completed**
	• Site assessment that considers all parameters listed in Table 28 of the DAF in accordance with *AS/NZS1547:2012*.	✓
	• Summary of available published soils information for the Site.	✓
	• Soil assessment that considers all parameters listed in Table 28 of the DAF in accordance with *AS/NZS1547:2012*.	✓
	• Brief and clear explanation of the implications of observed site and soil features for system design and performance.	✓
	• Recommendations on any soil amelioration required.	✓
System Selection	• Summarise potential treatment and land application systems considered including advantages and limitations.	✓
	• Brief statement justifying selection of treatment and land application system.	✓
Design	• Site specific calculation of design wastewater generation rates in accordance with Section 6.2.	✓
	• Accreditation details for the selected treatment system.	
	• Hydraulic sizing calculations as per Section 6 of the DAF (rationale in *Technical Manual)*.	✓
	• Annual nutrient balance calculations in accordance with *Technical Manual.*	✓
	• Confirm standard upslope setback (buffer) distances can be met and therefore off-site impact requirements (Table 37).	✓
	• All data sources used in design	✓
Site Plan	• Nominated Effluent Management Area (EMA) clearly shown;	✓
	• Survey plan;	✓
	• Location of soil boreholes;	✓
	• Location of tank(s);	✓
	• Location of boundaries, buildings, swimming pools, paths, groundwater bores, dams and waterways;	✓
	• Location of primary and reserve disposal areas;	✓
	• Location of stormwater diversion drains and earth bunds (if applicable);	✓
	• Setback (buffer) distances to the above features;	✓
	• Two metre elevation contours;	✓
	• Location of drainage pipework (centreline).	
Appendices	• Soil bore logs for all test pits (Permeability test results).	✓
	• Raw laboratory results for soil analysis.	✓
	• All design calculations and assumptions.	✓

4 Development

A five (5) lot residential subdivision is proposed for the Site, with all created lots having an area of 8ha. It is noted that an existing six (6) bedroom dwelling is located within proposed Lot 3, and is to remain following the subdivision. An access easement is provided within the centre of the subdivision, providing access to the proposed lots.

5 Site and Soil Assessment

The Site investigation was undertaken by Errol Delandro and Sophie Grossenbacher of W&A on 24 April 2026.

A description of the site constraints and the degree of limitation they pose to OWM is provided in the following table. Reference is made to the rating scale in Table 4-1 of NSW DPHI (2025) and, where appropriate, Table 6-1 of DSC DAF (2015).

SITE ASSESSMENT			
Parameter	**Data / Observation**	**Reference**	**Classification / Outcome**
Climate	Southern Rainfall Zone.	Figure 8-1 of the Technical Manual (2015)	Minor limitation
	Average annual rainfall of 929mm. Average annual evaporation of 1,570mm.	Table 8-2 of the Technical Manual (2015)	
Geology	Porous sedimentary regolith	Moderate limitation	
Shallow Bedrock	No shallow bedrock / hardpan identified <750mm.	Minor limitation	
Surface Rock	None identified or anticipated.	Minor limitation	
Fill	None observed or apparent.	Minor limitation	
Landform	Linear planar to linear divergent, with a north-easterly aspect.	Minor limitation	
Slope	<10%.	Minor limitation	
Erosion Potential	None observed.	Minor limitation	
Run-on / Seepage	Moderate potential for run-on and minor potential for up-slope seepage.	Moderate limitation	
Flooding	Clarence Town Flood Risk Management Study and Plan indicate the 1% AEP flood level for Clarence Town is 13.8m Australian Height Datum (AHD) (BMT, 2014). Lowest point within Site is 18m AHD.	Minor limitation	
Site Drainage	Very well drained and no visible signs of surface dampness. However, presence of mottling indicates seasonal waterlogging.	Moderate limitation	
Exposure	High sun and wind exposure.	Minor limitation	
Land Area	Each proposed Lot is approximately $8,000m^2$ comprising managed pasture. The UL of each proposed lot with standard buffers to surface water features is show here (refer Figure 1, Appendix A).	Minor limitation	

SITE ASSESSMENT			
Parameter	**Data / Observation**	**Reference**	**Classification / Outcome**
	Lot 1 – 1,736m^2; Lot 2 – 1,666m^2; Lot 3 – 8,123m^2; Lot 4 – 1,736m^2; and Lot 5 – 3,909m^2.		
Concluding Remarks Geology, run-on potential and restricted vertical drainage pose moderate constraints to OWM. Geology and drainage limitations will be mitigated by conservative OWMS design (refer Sections 8 and 9). Run-on to be mitigated via storm water management measures (refer Section 11.3). The proposed Lot 1, Lot 2, Lot 4, and Lot 5 cannot satisfy the DSC DAF (2015) 'deemed to comply' minimum standard of >4,000m² of UL on all proposed Lots due to required buffer distances to water features. Additional modelling (standard Cumulative Impact Assessment) and justification is provided in this WMR for a reduction in the available setbacks surface water features within proposed Lots to achieve the required UL criteria (refer Section 10) as per Table 2-13 DSC DAF (2015).			

SOIL ASSESSMENT			
Parameter	**Data / Observation**	**Reference**	**Classification / Outcome**
Soil Landscape	The Site is located on the Clarencetown **'cl'** Soil Landscape. Landscape: Undulating low hills on Carboniferous sediments in the Clarencetown Hills region. Slope gradients 5-15%, elevation 40-80m, relief 30-70m. Partially cleared tall open-forest and open-forest. Soils: Moderately deep (55->100cm), moderately well to imperfectly drained yellow Soloths, shallow (<50cm), moderately well-drained Lithosols. Limitations: Very high-water erosion hazard, shallow soils, rock outcrop, seasonal waterlogging (localised), stony acid soils of very low fertility.	1:100,000 Dungog Soil Landscape Map (Henderson, 2000)	
Soil Depth	750-≥1,200mm.	Moderate limitation	
Soil Profile	**<u>BH1-6</u>** A: 0mm – 150/300mm, weak, clay loam (Cat 4). B: 150/300mm – 750/1,200mm, strong/weak, medium clay (Cat 6). Borehole locations shown in Figure 3 of Appendix A. Borelogs and laboratory results are presented in Appendix B.	N/A	

SOIL ASSESSMENT				
Parameter	**Data / Observation**		**Reference**	**Classification / Outcome**
Soil Permeability	<0.06m/day (indicative).		Weakly structured Cat 6 soils (Table 4-7 of DPHI, 2025)	Major limitation
Depth to Water Table	Shallow groundwater not encountered.		Minor limitation	
Coarse Fragments	2-20% (6-20mm).		Minor limitation	
Bulk Density	1.4g/cm^3 (inferred).		Minor limitation	
pH	4.92 – 6.20	Slightly to very strongly acidic	Moderate limitation	
EC (EC_e)	0.23 – 0.79	Non-saline	Minor limitation	
ESP (%)	3.9	Non sodic	Previous soil analysis on the 'cl' soil landscape (refer to Appendix B)	Minor limitation
CEC (me/100g)	6.3	Low fertility		Moderate limitation
P-sorption (kg/ha)	8,300	High		Minor limitation
Modified Emerson Aggregate Class	Topsoil: 7. Subsoil: 2(3).	Negligible to very highly dispersive / unstable.	Moderate limitation	
Concluding Remarks Soil depth and permeability presents major limitations to OWM at the Site. These limitations can be mitigated by conservative OWMS design (refer to Section 8 and 9). Acidity (pH), instability / dispersion (EAT) and fertility (CEC) present moderate limitations to OWM at the Site. These limitations will be mitigated by soil improvement measures (refer Section 11.1).				

5.1 Assessment Outcomes

Overall, the Site is moderately constrained for OWMS, with run-on potential and soil chemistry (acidity, dispersion and fertility) requiring mitigation (refer Section 11). All other limitations can be mitigated with conservative OWMS design.

6 Wastewater Generation

Wastewater will be generated from the existing and all future dwellings on each lot via kitchen, bathroom (WC, basin, shower) and laundry fixtures. No other wastewater generating activities are assumed.

6.1 Wastewater Quantity

Potable water to the Site will be provided by on-site (tank) water supply. The following table summarises the anticipated wastewater loads from existing and future dwellings on each lot. For the basis of this assessment, W&A have conservatively assumed a maximum five (5) bedroom dwelling on each Lots 1, 2, 4 and 5, as well as the existing six (6) bedroom dwelling on Lot 3.

Parameter	Value	Reference / Comment
Occupancy Rate (EP)	1.6	Section 6.2 DSC DAF (2015) design occupancy per bedroom
Wastewater Generation (L/person /day)	120	Table 6-2 of DSC DAF (2015) for residential premises with on-site (tank) supply
Bedrooms (Proposed Lots)	5	Conservative assumption
Wastewater Generation Per Proposed Lot (L/day)	960	5-beds x 1.6 EP x 120L/person/day
Bedrooms (Existing Dwelling)	6	5 bedroom + 1 study room
Wastewater Generation for Existing Dwelling (L/day)	1,152	6-beds x 1.6 EP x 120L/person/day

6.2 Wastewater Quality

Wastewater generated with dwelling are expected to be of ‘typical’ domestic nature. As such, with appropriate pre-treatment, generated wastewater is expected to have characteristics similar to that described in the following table.

Parameter	Loading	Greywater %	Blackwater %
Daily Flow	-	65	35
Biochemical Oxygen Demand	200-300mg/L	35	65
Suspended Solids	200-300mg/L	40	60
Total Nitrogen	20-100mg/L	20-40	60-80
Total Phosphorus	10-25mg/L	50-70	30-50
Faecal Coliforms	10^3 – 10^{10}cfu/100ml	Medium – High	High

7 Existing OWMS

The existing dwelling is serviced by an aerated wastewater treatment system (AWTS) dispersing effluent via a 380m^2 surface spray irrigation EAA.

The AWTS was found to be in sound structural condition and appeared to be operating effectively with no signs of poor performance. The AWTS is maintained under a servicing contract with All Septic Services P/L. The AWTS is considered appropriate to continue servicing the existing dwelling.

The surface spray irrigation EAA is located ~10m north of the existing dwelling (refer Figure 3 of Appendix A) and is installed across the proposed subdivision boundaries; therefore, a new EAA must be installed (refer Section 9) to contain all treated effluent within the allotment.

8 Proposed Wastewater Treatment

Given the identified Site and soil limitations, specifically slowly permeable subsoils, primary treatment systems (i.e. septic tanks) are not recommended as they significantly limit effluent disposal and reuse options and pose a higher risk to human and environmental health compared to secondary or tertiary treatment systems.

Therefore, a minimum effluent quality standard of secondary treatment with disinfection is recommended to service the proposed lots.

8.1 Treatment System

The NSW Ministry of Health (NSW Health) provides accreditation for domestic (≤10EP) secondary treatment systems in NSW. The selected STS must hold such an accreditation. A detailed list of suitable NSW Health accredited systems can be found at:

http://www.health.nsw.gov.au/environment/domesticwastewater/Pages/default.aspx

A disinfection unit must be installed, with domestic systems typically employing ultraviolet irradiation and / or chlorination methods.

Final system selection is the responsibility of the Owner; however, selection and installation of the system must follow the requirements of Section 6.3 of the DSC DAF (2015).

8.1.1 Treated Effluent Quality

Table 5-2 in DPHI (2025) describes the minimum standard for secondary effluent with disinfection, as reproduced in the following table.

Parameter	Loading
Biochemical Oxygen Demand	≤20mg/L
Suspended Solids	≤30mg/L
Faecal Coliforms	≤30cfu/100mL
Total Nitrogen	≤30mg/L
Total Phosphorus	≤15mg/L

8.2 System Siting

The exact positioning of the treatment systems will depend on the local gradient and level controls and can be determined in consultation with a licensed plumber and Council prior to obtaining consent for the installations.

All plumbing, drainage, and electrical work must be completed in accordance with Section 6.3.8 of the DSC DAF (2015). Nominal location for the systems are presented in Figure 3 of Appendix A.

8.3 System Operation and Management

Successful performance of wastewater treatment systems relies on periodic monitoring and maintenance, which will be the responsibility of the future property owners. The selected treatment systems will be subject to a contractual servicing agreement and must be serviced by a suitably qualified technician at the prescribed intervals.

9 Proposed Effluent Management

This section describes the Site's capability for effluent management and provides sizing of the required EAAs and required buffers to sensitive features.

9.1 Onsite Effluent Management Options

The following table summarises the range of effluent land application options considered and presents recommendation for the preferred approach to be used in conjunction with the secondary treatment system on each lot.

Land Application Option	Suitable	Reasoning
Absorption Trenches/ Beds	No	Considered unsuitable in Cat 6 subsoils without substantially greater design detail and special distribution techniques.
ETA Beds	Possible	Considered suitable; however, discounted due to installation substantial cost and suitability of other options.
Wisconsin Sand Mound		
Surface Irrigation	No	Generally, not permitted for new OWMS (as per Section 6.6 of DSC DAF, 2015).
Subsurface Irrigation (SSI)	Yes	Considered suitable as effluent is able to be applied high in the soil profile, maximising evapotranspiration and vegetation uptake.

Based on the identified site and soil constraints, ETA beds, Wisconsin Sand Mounds and SSI are considered the most viable EAA options for the Site.

9.2 Preliminary EAA Sizing

Table 2-4 of the DSC DAF (2015) requires preliminary design calculations for a minimum two (2) EAA options, along with clear justification for the preferred solution.

Based on the limiting Category 6 soils identified throughout the Site, the following (secondary) soil loading rates are recommended (as per Table 6-4 of DPHI, 2025):

- ETA Beds = 5mm/day;
- Wisconsin mound = 5mm/day; and
- Subsurface irrigation = 2mm/day.

Section 6.4.3 of the DSC DAF (2015) provides a simplified hydraulic sizing equation, with a climate adjustment factor (CAF) for use in sizing EAAs. This has been used as the basis for preliminary EAA sizing, as shown.

$$EAA = Q / (DLR - CAF)$$

Where;

EAA = Effluent Application Area (basal area in m^2);

Q = Design Wastewater Generation Rate (L/day);

DLR = Design Irrigation Rate (mm/day); and

CAF = Climate Adjustment Factor (mm/day).

The Site is situated in the Southern Climate Zone; therefore, a CAF of 0mm/day has been adopted as per Table 9-3 of the DSC Technical Manual (2015).

The following table provides a summary of the preliminary EAA sizing for ETA beds, Wisconsin Sand Mounds and SSI systems.

Option	Development	Required Area	Comment
ETA Beds	**Proposed Dwelling**	192m^2	960L/day / 5mm/day
	Existing Dwelling	230m^2	1,152L/day / 5mm/day
Wisconsin Sand Mounds	**Proposed Dwelling**	192m^2	960L/day / 5mm/da
	Existing Dwelling	230m^2	1,152L/day / 5mm/day
SSI	**Proposed Dwelling**	480m^2	960L/day / 2mm/day
	Existing Dwelling	576m^2	1,152L/day / 2mm/day

Whilst all options are practically achievable at the Site, the ETA bed and Wisconsin Sand Mound options present a significant cost burden and will require complex hydraulic design to ensure even application across multiple distribution manifolds. Therefore, SSI is the preferred effluent application method to service all Lots in the subdivision.

9.2.1 Subsurface Irrigation

SSI is suitable within lawn and landscaped areas and applies effluent within the root-zone of plants for optimum irrigation efficiency. It is an ideal option for ensuring even, widespread coverage of the EAA. SSI installation does not require any bulk materials or heavy machinery; irrigation lines can be simply installed with a small trench digger or “ditch-witch”.

The preliminary SSI EAA of 480m^2 (Lots 1, 2, 4, 5) and 576m^2 (Lot 3) have been used as the basis of the risk assessment presented in the CIA (refer Section 10).

9.3 Buffers

The following (minimum) environmental buffers are required for SSI EAAs, based on Table 6-10 of the DSC DAF (2015):

- 250m from domestic groundwater bores;
- 100m from permanent surface waters;
- 40m from farm dams, intermittent waterways and drainage channels;
- 6m if area up-gradient and 3m if area down-gradient of dwellings and buildings, swimming pools, property boundaries and driveways; and
- 0.6m vertical separation from hardpan or bedrock.

Most of the recommended buffers are achievable at the Site, except for the buffers to surface water features (intermittent waterways and farm dams).

A reduced buffer of 20m to surface water features is required in order to achieve the required minimum UL of 4,000m² on all proposed lots.

9.4 EAA Positioning

Available and suitable areas for effluent application are shown in Figure 3 of Appendix A as 'Available EMA'. These areas exclude adopted setback distances as described in Section 9.4. Recommended EAA locations are shown in Figure 3 of Appendix A.

9.5 Reserve EAA

The provision of reserve EAAs is not required for secondary OWMS, as per Section 6.4.4, DSC DAF (2015).

10 Cumulative Impact Assessment

As per 'Note 1' of Table 2-3 in the DSC DAF (2015), a Cumulative Impact Assessment (CIA) is mandatory within drinking water catchment areas to ensure that water quality exported from the Site is protected.

As shown (refer Figure 2, Appendix A), a 50% reduction in buffers to water features (20m) is required to achieve the minimum UL of 4,000m^2 within all lots. Therefore, as per Table 2-13 of the DSC DAF (2015), a Standard CIA is required.

CIA is an indicative risk assessment tool that involves the use of continuous daily soil / water modelling to optimise a sustainable OWM design and provide a high level of assurance when assessing potential impacts on receiving environments.

The adopted methodology involves establishing background pollutant loads and contaminant concentrations; calculation of catchment surface and subsurface discharge characteristics; and integration of site-specific OWM inputs using an appropriate modelling package to estimate the potential for human health and environmental impacts from OWM.

Table 2-14 in the DSC DAF (2015) outlines the minimum assessment requirements for a Standard CIA, as reproduced in the following table.

Risk Assessment Component	Minimum Standard
On-lot EAA Assessment	Daily water and nutrient mass balance modelling for each general on-site system EAA type within the subject site used to derive average annual hydraulic and pollutant loads to surface and subsurface export routes. Also used to estimate frequency of hydraulic failure (surcharge).
Rainfall-Runoff	Average annual estimate of runoff volume using a volumetric coefficient of rainfall. Recommend use of Figure 2.3 (and subsequent equations) from Fletcher *et al.* (2004).
Surface and Subsurface Pollutant Export	Application of catchment attenuation factor (provided in Table 10-7 of the Technical Manual) to combined surface and subsurface on-site loads based on broad characteristics of the receiving environment. Mass balance combining attenuated on-site system flows and loads with catchment inputs.
Background Pollutant Loads / Concentrations	Sourced from Tables 2.44 - 2.45 or Figures 2.15 – 2.23 of Fletcher *et al.* (2004). Acceptable export rates / concentrations sourced from published local studies.

Risk Assessment Component	Minimum Standard
E&HP Targets	No more than 10% increase in average annual nitrogen and phosphorus loads (kg/year) based on existing undeveloped background loads. Average virus concentration <1 MPN/100mL after application of attenuation rates. All land application areas sized to ensure hydraulic failure (surcharge) accounts for only 5% of total wastewater generated (i.e. 95% containment via evapotranspiration and deep drainage).

10.1 Modelling Overview

Available desktop and field data was used to build spatial model(s) to simulate hydrology, catchment pollutant export, OWMS operation, groundwater recharge, pollutant discharge and nutrient attenuation in groundwater flow for the Site.

Fletcher *et al.* (2004) was used to derive average annual pre-development pollutant values (refer Section 10.2).

The Model for Effluent Disposal using Land Irrigation (MEDLI) was used to derive average annual hydraulic and pollutant loads from OWMS to surface and subsurface export routes (refer Sections 10.3 and 10.4).

The average annual loads from the MEDLI model are compared to derived pre-development loads to demonstrate that the proposed subdivision can comply with the E&HP targets (refer Section 10.6).

MEDLI does not provide pathogen modelling. Therefore, viral die-off modelling is provided to determine the minimum buffer distances required to protect groundwater from any pathogens remaining in the effluent (refer Section 10.7).

Note: Modelling is designed for use as a decision-making tool and will not necessarily produce results that accurately reflect measured pollutant loads to receiving waters. Instead it aims to assess predicted increases in pollutant loads against existing conditions or alternative development concepts.

10.2 Existing Baseline Condition

The effective impervious area of the Site was set at 5% for the existing condition, based on a conservative assumption considering the rural land (cleared pasture) and existing development footprint (existing dwelling, shed, driveway, water tanks).

To estimate the average annual background pollutant load for the Site, the annual rainfall runoff coefficient was first obtained using the calculation provided in Section 2.2 of Fletcher *et al.* (2004):

$$C = (0.83 - 0.00018R) \times Imp + 0.0013R^{0.8} - 0.095$$

Where;

C = Annual Runoff Fraction;

R = Mean Annual Rainfall (mm/year); and

Imp = Impervious Fraction.

Average annual rainfall for the Site is 929mm (Table 8-2 in DSC Technical Manual, 2015) which equates to a volumetric runoff coefficient (C) of 0.25 for the catchment.

The average annual runoff volume is then calculated using the Rational Method:

$$Q = C \times I \times A$$

Where;

Q = Annual Runoff Volume (ML/year);

I = Average Annual Rainfall (mm/year); and

A = Site Area (m^2).

Given the total site area of approximately 40,276m^2, the expected runoff volume equates to 9.2ML/year (9,204,469L/year).

10.3 Pollutant Generation Export

Background nutrient (N and P) export concentrations were derived using recommended 'typical' values from Tables 2.44 and 2.45 of Fletcher et al. (2004) for 'rural' land use.

Section 10.1.1.4 of the Technical Manual (2015) recommends applying dry weather concentrations for 20% of the runoff volume and wet weather concentrations to the remaining 80%. A summary of the background nutrient export loads and average concentrations is provided in the following table.

Parameter	Average Background Loads (kg/year)	Weighted Concentration (mg/L)
Total Phosphorus (TP)	1.73	0.19
Total Nitrogen (TN)	16.38	1.78

10.4 OWMS Modelling

Continuous daily soil-water modelling is the recognised standard for broad-scale irrigation system design in Australia. Continuous models dynamically calculate infiltration, soil water storage, plant uptake, deep drainage and runoff for multiple soil horizons on a daily time-step. They then carry water in soil storage over to the next day, month and year to ensure antecedent conditions are accounted for.

The most recent version of the model (MEDLI V2.5.04, released 2025) was used for this assessment. Detail on the model can be found in the following documents:

- Queensland Department of Environment and Science (2023), *Model for Effluent Disposal using Land Irrigation User Manual* (MEDLI User Manual, 2023); and
- Queensland Department of Environment and Science (2023), *Model for Effluent Disposal using Land Irrigation Technical Reference* (MEDLI Technical Manual, 2023).

Individual MEDLI models were developed for the two (2) development scenarios, representing the existing six (6) bedroom dwelling within Lot 3 and assumed five (5) bedroom dwellings within all other lots. Each model was parameterised using site-specific data to provide the best representation of actual conditions and the preferred EAA solutions for the proposed lots.

10.5 Model Inputs

The simulation was run for a period of ~60 years (1965-2025), representing a conservative estimate of long-term performance based on available information and a set of assumptions as detailed within this document.

SILO Point climate data for the Site (-32.6, 151.76) was obtained within MEDLI and utilised for the 60-year model period.

Using the Australian Soil Classification (ASC) system, the most relevant default soil group was selected from the MEDLI soil library, with nominated topsoil and subsoil depths adjusted to reflect available soil profile data for the landscape, as follows:

- RUN001 & RUN002 = Kurosols (0.15m topsoil, 0.750m subsoil).

Output data for individual model runs were then aggregated to represent the ‘total’ annual hydraulic and pollutant loads from subdivision OWMS, based on their corresponding wastewater loads and OWMS arrangement, as follows:

- RUN001 = 1,152L/day of disinfected secondary effluent to 576m^2 of SSI (existing dwelling, Lot 3); and
- RUN002 = 960L/day of disinfected secondary effluent to 480m^2 of SSI (proposed Lots 1, 2, 4 and 5).

10.5.1 Pollutant Attenuation Factors

Natural attenuation of excess effluent nutrient loads from an EAA will occur within the underlying soil and groundwater, providing reductions in contaminant concentrations to mitigate off-site export.

Established pollutant attenuation rates for hydraulics, pathogens, nitrogen and phosphorus are adopted from Table 10-7 of the Technical Manual (2015). These attenuation rates have been established through modelling undertaken in several case studies for both ‘Inland / Rolling Hills’ and ‘Coastal / Estuarine’ catchment scenarios and depending on whether DSC prescribed setbacks are achievable.

Based on the location and soil characteristics of the property, the ‘Inland / Rolling Hills’ catchment scenario has been adopted, with attenuation rates of 40% for hydraulics, 90% for nitrogen and 98% for phosphorus considered appropriate based on 50% of all standard DSC DAF (2015) setbacks.

10.6 Modelling Results and Compliance

Hydraulic and nutrient exports in MEDLI are divided into ‘runoff’ or ‘deep drainage’. As no irrigation runoff occurred, all runoff exports reflect rainfall only.

The following sections outline the results of the modelling and their compliance with the adopted E&HP targets.

The model was run to confirm that the proposed subdivision can sustainably assimilate the projected wastewater loads.

10.6.1 Hydraulic Exports

Modelling of the movement of water, from both applied effluent and rainfall, through the soil is a key component of MEDLI. The following table presents the average annual ‘soil water balance’ of each simulation.

Parameter	RUN001	RUN002
Inputs		
Rainfall (%)	58.88	58.88
Effluent Irrigation (%)	41.10	41.10
Delta Soil Water (%)	~0.1	~0.1
Outputs		
Soil Evaporation (%)	0.07	0.07
Transpiration (%)	55.11	55.1
Rainfall Runoff (%)	29.83	29.83
Irrigation Runoff (%)	0.00	0.00
Deep Drainage (%)	15.00	15.00

As shown, no irrigation runoff is anticipated within any simulation with applied effluent managed by cover crop transpiration and deep drainage.

10.6.2 Nutrient Results

The following table summarises the mean annual nutrient loads generated by the sum of all OWMS proposed and existing for the subdivision.

Parameter	RUN001	RUN002	Total
TN Deep Drainage Output (kg/year)	0.07	0.22	0.29
TP Deep Drainage Output (kg/year)	0.51	1.71	2.22

10.6.3 Pollutant Attenuation

Nutrient loads generated at the EAAs will continue to undergo assimilation (capture, conversion, destruction etc.) within the soil environment as treated effluent moves away from the EAA. The attenuation factors specified in Section 10. have been applied for nitrogen and phosphorus loads from the combined EAAs.

The resulting pollutant export concentrations are presented in the following table.

Parameter	TN	TP
Background Load (kg/year)	16.38	1.73
Total OWM Export (kg/year)	0.29	2.22
Attenuation Factor (%)	90	98
Attenuated Export Load (kg/year)	0.03	0.04
Background Load + Attenuated Export Load (kg/year)	16.78	2.14
Increase from Background Export Load (%)	**0.20**	**2.07**

As shown, attenuated nutrient export loads are expected to achieve the required E&HP target of <10% above background load annually. Taking into consideration the proposed EAA locations, application methods and compliance with prescribed buffers, nutrient impacts to sensitive receptors are not anticipated.

Pathogen exports are expected to reach 100% attenuation well within the adopted setbacks (refer Section 10.7).

10.7 Pathogen Transport Modelling

To address any residual concern regarding the transport of pathogens away from each EAA towards sensitive receptors, W&A have considered the movement of viruses using an established 1-dimensional viral die-off model developed by Beavers and Gardner (1993) and refined by Cromer *et al*. (2001). Details of the methodology can be found in Cromer *et al*. (2001).

The model generally applies to wastewater moving in saturated soils (i.e. in shallow groundwater beneath EAAs). These conditions are considered most conducive to pathogen transport. In unsaturated (vadose zone) soils, the travel distances will be substantially less. As such, the method is considered very conservative when applied to sites with drained topsoils and deep water tables. Key assumptions used in the modelling are as follows:

- Bacteria have lesser die-off times than viruses and can therefore be assumed to be eliminated within a shorter distance than viruses (Cromer *et al*., 2001);
- Viral reduction has been set at three (3) orders of magnitude for secondary treatment with disinfection (Cromer *et al*., 2001); and
- Cooler temperatures allow viruses to reside longer in the soil and hence provide potentially greater travel distances. Groundwater temperatures based on the assumption of 12.82°C (-32.6, 151.75) mean minimum temperature.

Modelling inputs and predicted maximum viral transport distances are provided in the following table. Appendix C provides additional information on the modelling methodology and full results.

Parameter	Value
Groundwater temperature (°C)	12.82
Days for Viral Die-off	35
Porosity of soil (decimal)	0.47
K_{sat} (m/day)	0.06
Groundwater gradient (%)	10
Depth to groundwater (m)	0.75
Horizontal distance for 100% viral reduction (m)	0.4

Viral die-off modelling demonstrates that with secondary treatment, 100% pathogen reduction within the soil is expected to occur within 0.4m from the EAA boundary; reducing contaminants to background levels largely within the Site boundary and before reaching any sensitive receptor.

10.8 CIA Outcome

The CIA has addressed the various risks associated with the proposed subdivision based on the following development scenario:

- Lot 3 – Secondary effluent (with disinfection) to 576m² of SSI EAA (RUN001); and
- Lots 1, 2, 4 and 5 – Secondary effluent (with disinfection) to 480m² of SSI EAA (RUN002).

Modelling demonstrates that the predicted hydraulic loads are manageable, with no surface surcharge expected. Nutrients will also be retained within each EAA and surrounding setbacks, with no appreciable increase in nutrient export concentrations over background conditions. Pathogen loads can be effectively attenuated well before they can reach property boundaries or sensitive receptors.

Based on our analysis, the risk of hydraulic, nutrient, and pathogen export to surface waters and groundwater posed by OWMS servicing of the subdivision is low. Furthermore, the human and environmental health risk to neighbouring properties is considered negligible.

11 Mitigation Measures

11.1 Soil Improvement

Given that Site soils are acidic and exhibit some instability / dispersion and low fertility, they may be susceptible to restricted vegetative growth and impaired permeability. These properties can combine to reduce the soils' capacity to sustainably manage wastewater. Prolonged application of sodium rich wastewater can exacerbate the situation.

Application of a calcium mineral is a recognised way of reducing the effects of poor soil fertility and instability. Added calcium will improve the soil CEC and Ca/Mg ratio, improving fertility, while reducing the potential for soil structural degradation. Gypsum is the preferred soil amendment; however, given the elevated acidity, lime application is also recommended to off-set potential future impacts on vegetation and pipework.

Gypsum and lime are only slowly soluble in water, so simply broadcasting is of limited benefit. It is recommended to incorporate a 50/50 gypsum/lime mixture into the subsoil during construction of each EAA. A suitable application rate of approximately 0.2kg/m^2 should be used.

11.2 Vegetation Establishment

A complete vegetation cover is important to reduce the erosion hazard and optimise water and nutrient uptake. Vegetation that is suited to the application of effluent, preferably with high water and nutrient requirements (such as turf) should be maintained within the EAA following installation.

To maximise assimilation of effluent-borne nutrients, vegetation clippings should be removed from the EAA and mulched elsewhere on-site for use on other landscaped areas that are not used for wastewater application. Mulching clippings back onto the area from which they were cut is not recommended. An alternative is to dispose clippings in the general waste bin, or green waste bin collection service, if provided.

11.3 Stormwater Management

The performance of EAAs (and potentially treatment systems) can be adversely affected if stormwater is allowed to run onto these areas. Stormwater diversion berms or drains are designed to collect, divert and dissipate collected run-on away from the EAA.

It is recommended that a stormwater diversion berm be installed upslope of the proposed EAAs within all lots (refer Figure 5, Appendix A) to minimise potential impacts of run-on. The structure should be designed and installed by a suitably qualified professional and be compliant with relevant guidelines and standards. The outlet must be stabilised and must discharge water in a safe location where it will not create an erosion hazard or impact on structures or neighbouring properties.

12 Conclusion and Recommendations

This completes our assessment for sustainable wastewater servicing of the subdivision proposal at 206 Fotheringay Road, Clarence Town NSW.

A standard CIA has been prepared to support the subdivision layout design and demonstrate compliance with the minimum environment and health protection targets. W&A confirm that the unsewered development proposal and subdivision layout comply with the Dungog On-site Sewage Development Assessment Framework 2015.

Specifically, W&A recommend the following:

- Generated wastewater from the dwelling on Lot 3 will continue to be treated by the existing AWTS. The existing SI EAA is to be decommissioned and replaced;
- Generated wastewater from new dwellings on the created Lots is to be treated to a (minimum) secondary standard (with disinfection) by an appropriately sized and located NSW Health accredited secondary treatment system;
- Secondary treated effluent is to be dispersed on each lot via pressure compensating SSI within a new EAA comprised of:
  - 576m^2 for the existing dwelling on Lot 3; and
  - 480m^2 for the future dwellings within Lots 1, 2, 4, 5;
- The proposed EAAs must be located within the available EMA to comply with the adopted buffers (refer Figure 3, Appendix A);
- Each irrigation EAA should be designed and installed by an experienced professional, considering the expected flows and other recommendations contained within this WMR;
- Stormwater should be prevented from running onto the EAA by diverting any runoff away using a stormwater diversion drain;
- A 50:50 application of gypsum/lime should be applied at the base of the EAA systems during installation at a rate of approximately 0.2kg/m^2;
- Vegetation must be established over each EAA immediately after installation; and
- Vehicles and grazing animals must be prevented from entering the designated EAA on each lot.

Yours Sincerely,

Errol Delandro

Environmental Consultant
Whitehead & Associates Environmental Consultants Pty Ltd

Appendix A

Figures

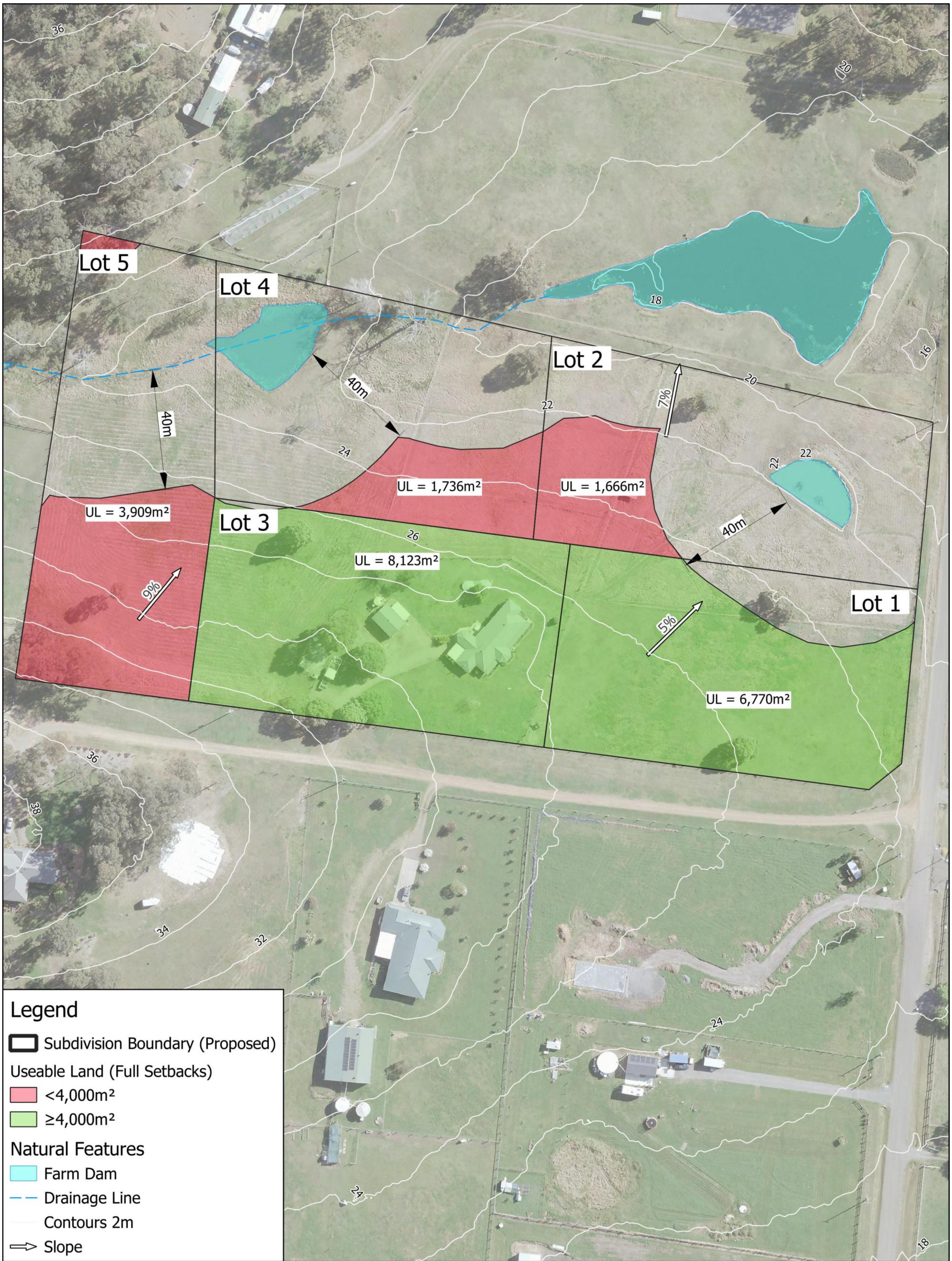


Figure 1: Site Plan Showing Useable Land with Full Setbacks

4105: Onsite Wastewater Management Report for Subdivision Proposal at 206 Fotheringay Road, Clarence Town NSW

N

Whitehead & Associates
Environmental Consultants

0 25 50 75 100 125 150 m

(Approx Scale)

Revision	001
Drawn	E.D
Approved	M.S

Figure 2: Site Plan Showing Useable Land with Reduced Setbacks

4105: Onsite Wastewater Management Report for Subdivision Proposal at 206 Fotheringay Road, Clarence Town NSW

N

Whitehead & Associates Environmental Consultants

0 25 50 75 100 125 150 m

(Approx Scale)

Revision	001
Drawn	E.D
Approved	M.S

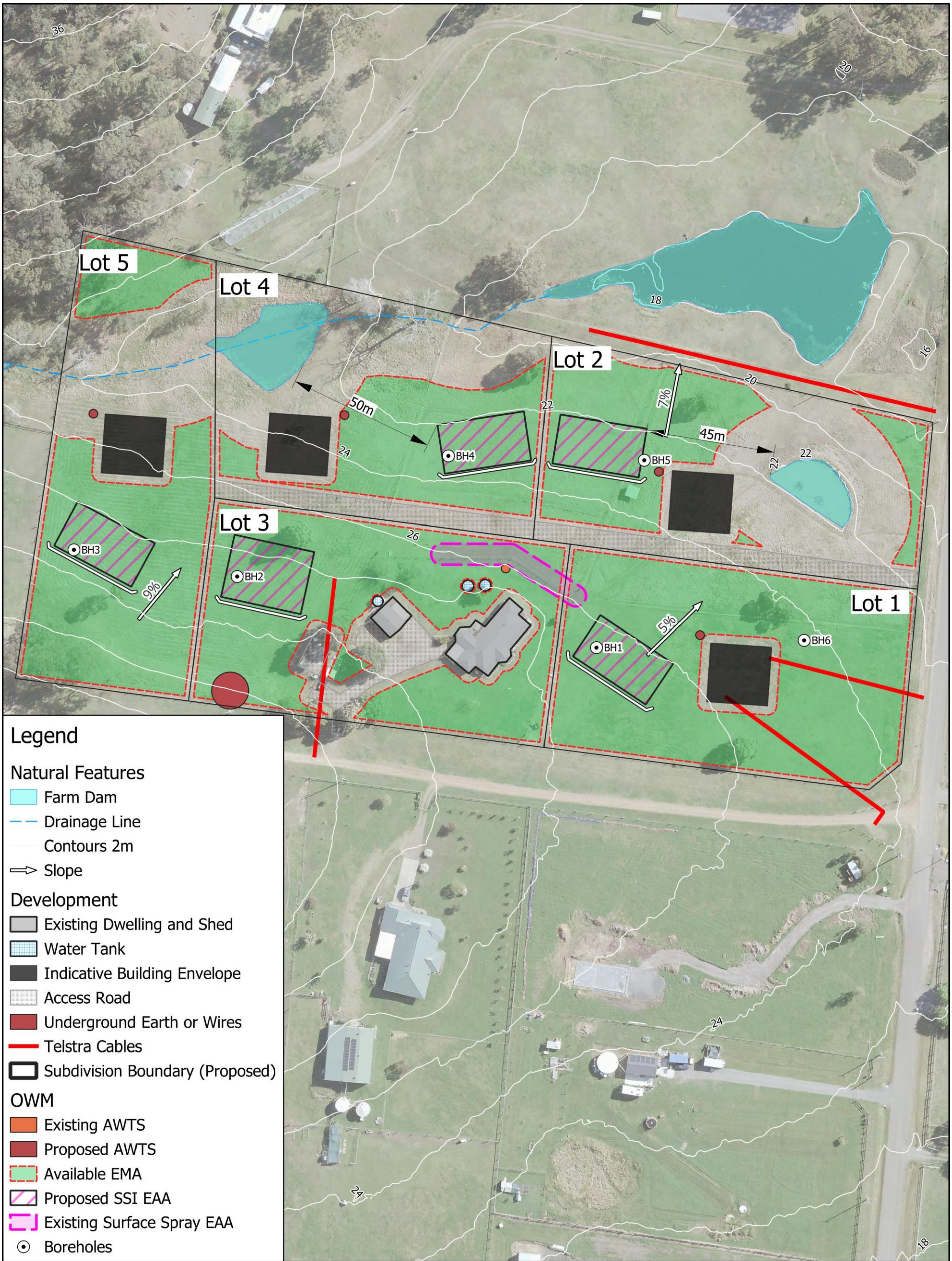


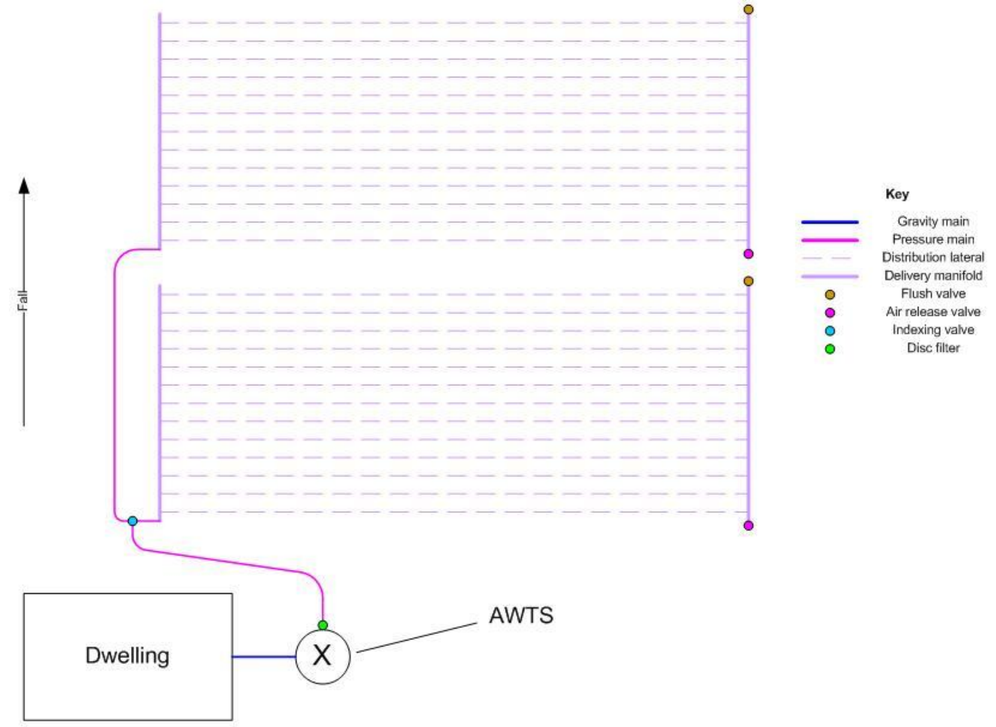
Figure 3: Site Plan Showing Available EMA and OWM

4105: Onsite Wastewater Management Report for Subdivision Proposal at 206 Fotheringay Road, Clarence Town NSW

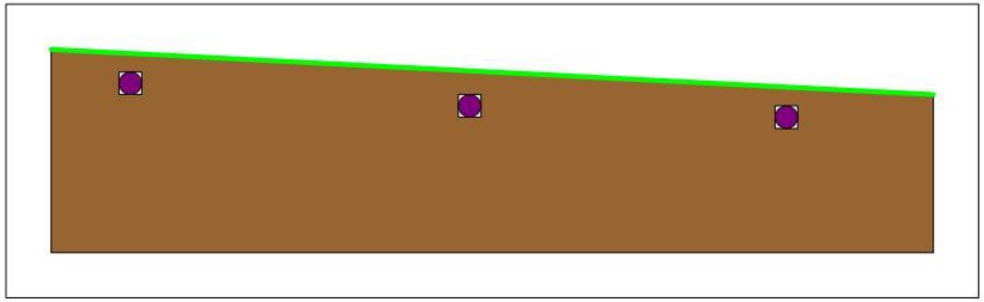
Whitehead & Associates Environmental Consultants

Revision	001
Drawn	E.D
Approved	M.S

Figure 4 - OWM Layout – Not to Scale



Cross-section View



SSI Construction Notes

1. Gradient should not exceed 15% across the EAA in the down slope orientation.
2. The irrigation pump must provide a minimum 20m head and a flow rate that matches the design output of the selected drip line. Flow rate will vary depending on emitter spacing, flow rate and lineal metres of line. A full hydraulic design must be carried out.
3. A field flush valve must be installed on the return line to facilitate periodic flushing to the treatment tank. An additional filter flush valve should be installed downstream of the field flush valve.
4. An automatic, hydraulic operated sequencing valve should be installed to deliver effluent evenly to each zone.
5. Manifolds should be 25mm PVC or polyethylene pipe buried 100mm below ground surface. Exact layout will depend on individual circumstances.
6. The pressure compensating subsurface drip lines with emitters and laterals should have 600mm spacing's and buried to a depth of 100-150mm. Only subsurface drip lines specifically designed for effluent irrigation must be used.
7. Air release valves must be installed at high points in each area.
8. Flush valves are required for each irrigation field to facilitate periodic flushing.

Alignment and Installation

1. Irrigation laterals to be installed parallel to EAA contour.
2. Irrigation laterals to be installed 100-150mm below the surface.
3. A minimum 100mm of topsoil must exist above the top of the SSI manifolds.

Pipework & Fittings

1. Pipes and fittings must comply with relevant standards for pressure applications (AS4129 and AS4130.
2. All pipes must be buried at a minimum depth of 300mm, increasing to 500mm under any trafficable surface.
3. Buried pipework should be marked by using underground marking tape to AS2648 or indicated by signage.

All surface boxes should be provided with lilac-coloured lids to indicate the use of treated effluent. (AS/NZS 1547 M10.2, M10.3, M13)

Wastewater Management Report

OWM Layout

Components

Treatment System:
- Secondary treatment system

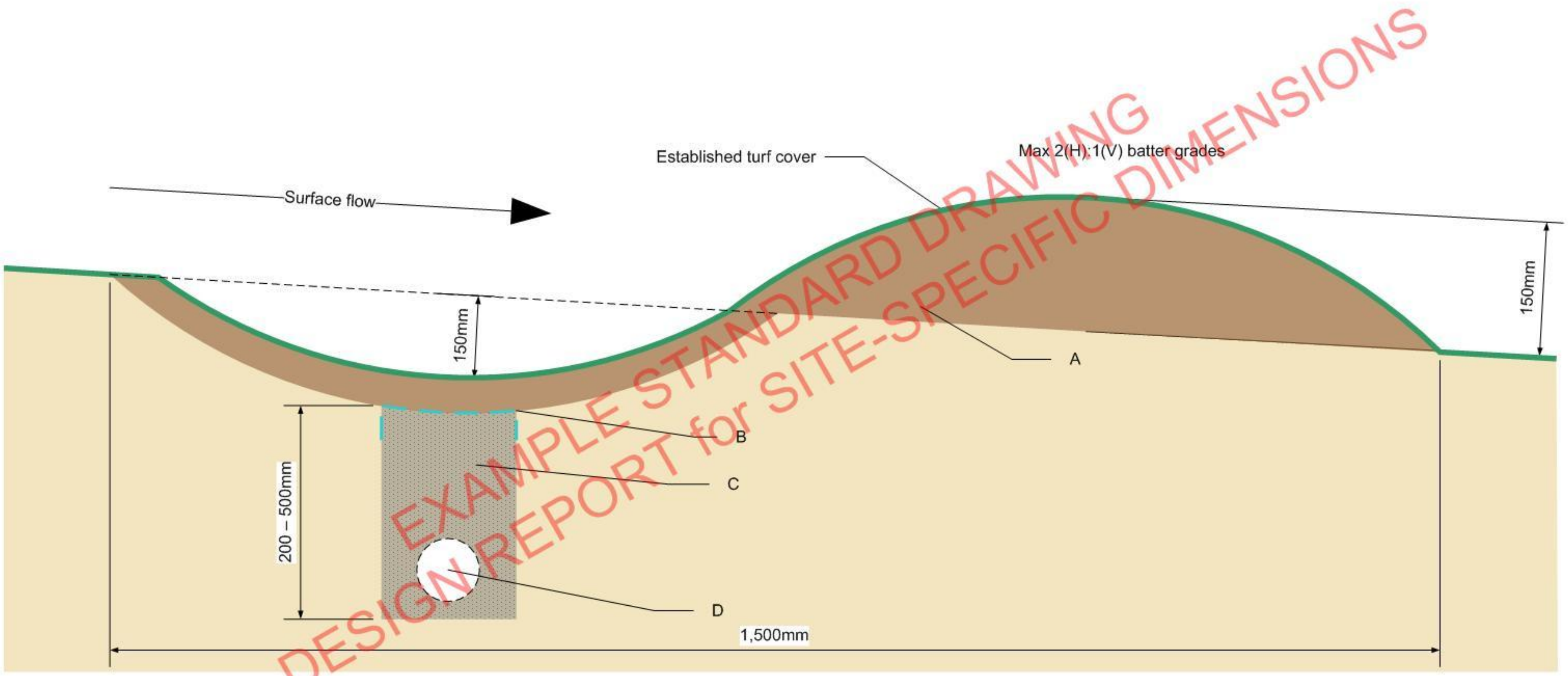
SSI EAA:
- DIR: 2mm/day
- Total EAA:
  Lot 3 = 576m^2
  Lots 1, 2, 4, 5 = 480m^2
- Indexing valve

All drainage work must be undertaken by a licensed plumber/ drainer or irrigation specialist.

Project: 4105
Drawn by: E.D
Date: 29/04/2026
Scale: Not to scale

206 Fotheringay Road, Clarence Town NSW

Whitehead & Associates Environmental Consultants



Notes

A Clean local or imported fill.

B Geotextile cloth.

C 10-40mm clean aggregate.

D 100mm agricultural pipe.

E Establish turf cover.

Whitehead & Associates Environmental Consultants	**Figure 5:** **Stormwater Diversion Drain Standard Drawing**	**Project: 4105** **Drawn: E.D** **Date: 29/4/2026** **Scale: Not to scale**

Appendix B

Soil Borelogs &

Laboratory Results

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Environmental Consultants

Key to Soil Borelogs

Symbols

W	Watertable depth	●	Sample collected
X	Depth of refusal		

Moisture condition

D	Dry
SM	Slightly moist
M	Moist
VM	Very moist
W	Wet / saturated

Graphic Log and Textures

S - Sand LS - Loamy sand CS - Clayey sand	CL - Clay loam SCL - Sandy clay loam SiCL - Silty clay loam	Gravel (G)
SL - Sandy loam	LC - Light clay SC - Sandy clay	Parent material (stiff)
L - Loam LFS - Loam fine sandy SiL - Silty loam	MC - Medium clay HC - Heavy clay	Parent material (weathered)

Soil Bore Log

Whitehead & Associates
Environmental Consultants

Client:	Clarence Ridge Estate P/L	**Test Pit No:**	**BH1**
Site:	206 Fotheringay Road, Clarence Town NSW	Excavated/logged by:	E.D & S.G
Date:	24 April 2026	Excavation type:	Auger and Shovel
Notes:	- refer to site plan for position of test pit		

PROFILE DESCRIPTION

Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Size of Coarse Fragments	Moisture Condition	Comments
0.1		BH1/1	A	CL	Weak	Very Dark Grey	Nil	2 - 10%	2-6mm	D	
0.2–0.5		BH1/2	B1	MC	Strong	Reddish Brown	Orange	2 - 10%	2-6mm	D	
0.6–0.8		BH1/3	B2	MC	Strong	Light Reddish Brown	Orange	2 - 10%	2-6mm	D	
0.9–1.2		BH1/4	B3	MC	Weak	Red	Grey	2 - 10%	2-6mm	D	

Soil Bore Log

Whitehead & Associates
Environmental Consultants

Client:	Clarence Ridge Estate P/L	**Test Pit No:**	**BH2**
Site:	206 Fotheringay Road, Clarence Town NSW	Excavated/logged by:	E.D & S.G
Date:	24 April 2026	Excavation type:	Auger and Shovel
Notes:	- refer to site plan for position of test pit		

PROFILE DESCRIPTION

Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Size of Coarse Fragments	Moisture Condition	Comments
0.1		BH2/1	A	CL	Weak	Very Dark Grey	Nil	10 - 20%	6-20mm	D	
0.2											
0.3		BH2/2	B1	MC	Weak	Dark Grey	Nil	10 - 20%	2-6mm	D	
0.4											
0.5			B2	MC	Strong	Light Brown	Orange	10 - 20%	2-6mm	D	
0.6		BH2/3									
0.7											

SOIL BORE LOG

Whitehead & Associates
Environmental Consultants

Client:	Clarence Ridge Estate P/L	**Test Pit No:**	**BH3**
Site:	206 Fotheringay Road, Clarence Town NSW	Excavated/logged by:	E.D & S.G
Date:	24 April 2026	Excavation type:	Auger and Shovel
Notes:	- refer to site plan for position of test pit		

PROFILE DESCRIPTION

Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Size of Coarse Fragments	Moisture Condition	Comments
0.1		BH3/1	A	CL	Weak	Very Dark Grey	Nil	2 - 10%	6-20mm	D	
0.2 0.3 0.4 0.5		BH3/2	B1	MC	Weak	Grey	Nil	10 - 20%	6-20mm	D	
0.6 0.7 0.8		BH3/3	B3	MC	Strong	Light Brown	Nill	2 - 10%	2-6mm		

SOIL BORE LOG

Whitehead & Associates
Environmental Consultants

Client:	Clarence Ridge Estate P/L	**Test Pit No:**	**BH4**
Site:	206 Fotheringay Road, Clarence Town NSW	Excavated/logged by:	E.D & S.G
Date:	24 April 2026	Excavation type:	Auger and Shovel
Notes:	- refer to site plan for position of test pit		

PROFILE DESCRIPTION

Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Size of Coarse Fragments	Moisture Condition	Comments
0.1		BH4/1	A1	CL	Weak	Very Dark Grey	Nil	< 2%	2-6mm	D	
0.2		BH4/2	A2	CL	Strong	Dark Grey	Nil	< 2%	2-6mm	D	
0.3											
0.4		BH4/3	B	MC	Strong	Reddish Brown	Orange	< 2%	2-6mm	D	
0.5											
0.6											
0.7											
0.8											
0.9											
1.0											
1.1											
1.2											

SOIL BORE LOG

Whitehead & Associates
Environmental Consultants

Client:	Clarence Ridge Estate P/L	**Test Pit No:**	**BH5**
Site:	206 Fotheringay Road, Clarence Town NSW	Excavated/logged by:	E.D & S.G
Date:	24 April 2026	Excavation type:	Auger and Shovel
Notes:	- refer to site plan for position of test pit		

PROFILE DESCRIPTION

Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Size of Coarse Fragments	Moisture Condition	Comments
0.1		BH5/1	A	CL	Weak	Very Dark Grey	Nil	< 2%	2-6mm	D	
0.2 0.3		BH5/2	A2	CL	Strong	Dark Grey	Nil	< 2%	2-6mm	D	
0.4 0.5 0.6 0.7 0.8 0.9		BH5/3	B1	MC	Strong	Reddish Brown	Orange	< 2%	2-6mm	D	
1.0 1.1 1.2		BH5/4	B2	MC	Weak	Yellowish Red	Grey	< 2%	2-6mm	D	

Soil Bore Log

Whitehead & Associates
Environmental Consultants

Client:	Clarence Ridge Estate P/L	**Test Pit No:**	**BH6**
Site:	206 Fotheringay Road, Clarence Town NSW	Excavated/logged by:	E.D & S.G
Date:	24 April 2026	Excavation type:	Auger and Shovel
Notes:	- refer to site plan for position of test pit		

PROFILE DESCRIPTION

Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles	Coarse Fragments	Size of Coarse Fragments	Moisture Condition	Comments
0.1 0.2		BH6/1	A	CL	Weak	Very Dark Grey	Nil	< 2%	2-6mm	D	
0.3 0.4 0.5 0.6		BH6/2	B1	MC	Strong	Strong Brown	Nil	< 2%	2-6mm	D	
0.7 0.8 0.9 1.0		BH6/3	B2	MC	Strong	Pale Brown	Nil	< 2%	2-6mm	D	

Job 4105: 206 Fotheringay Road, Clarence Town NSW

Sheet 1 - Soil Sampling Schedule and Results of pH, EC and Emerson Aggregate Test Analysis

Site	Sample Name	Sample Depth (mm)	Texture Class	EAT [1]	Rating [2]	pH f [3]	pH 1:5 [4]	Rating	EC 1:5 (µS/cm)	ECe (dS/m) [5]	Rating	Other analysis [6]
BH1	1/1	150	CL	7	Negligible	n/a	5.78	Moderately acid	87	0.75	Non-saline	
	1/2	550	MC	2(3)	Very High	n/a	5.50	Strongly acid	36	0.27	Non-saline	
	1/3	850	MC	2(3)	Very High	n/a	5.15	Strongly acid	33	0.25	Non-saline	
	1/4	1200	MC	2(3)	Very High	n/a	4.95	Very strongly acid	31	0.23	Non-saline	
BH2	2/1	200	CL	2(3)	Very High	n/a	5.00	Very strongly acid	38	0.33	Non-saline	
	2/2	400	MC	2(3)	Very High	n/a	5.30	Strongly acid	37	0.28	Non-saline	
	2/3	750	MC	2(3)	Very High	n/a	6.20	Slightly acid	40	0.30	Non-saline	
BH3	3/1	150	CL	7	Negligible	n/a	5.81	Moderately acid	54	0.46	Non-saline	
	3/2	500	MC	2(2)	High	n/a	5.50	Strongly acid	80	0.60	Non-saline	
	3/3	800	MC	2(2)	High	n/a	5.30	Strongly acid	90	0.68	Non-saline	
BH4	4/1	100	CL	7	Negligible	n/a	5.40	Strongly acid	86	0.74	Non-saline	
	4/2	300	CL	2(1)	Mod-High	n/a	5.90	Moderately acid	29	0.25	Non-saline	
	4/3	1200	MC	2(3)	Very High	n/a	5.40	Strongly acid	105	0.79	Non-saline	
BH5	5/1	100	CL	7	Negligible	n/a	5.77	Moderately acid	32	0.28	Non-saline	
	5/2	300	CL	7	Negligible	n/a	5.83	Moderately acid	27	0.23	Non-saline	
	5/3	900	MC	2(3)	Very High	n/a	5.24	Strongly acid	35	0.26	Non-saline	
	5/4	1200	MC	2(3)	Very High	n/a	4.92	Very strongly acid	34	0.26	Non-saline	
BH6	3/1	250	CL	7	Negligible	n/a	5.80	Moderately acid	41	0.35	Non-saline	
	3/2	650	MC	2(3)	Very High	n/a	5.40	Strongly acid	51	0.38	Non-saline	
	3/3	1000	MC	2(3)	Very High	n/a	5.40	Strongly acid	61	0.46	Non-saline	

Notes:- (also refer Interpretation Sheet 1)

n/a not available
n/t not tested
[1] The modified Emerson Aggregate Test (EAT) provides an indication of soil susceptibility to dispersion.
[2] Ratings describe the likely hazard associated with land application of treated wastewater.
[3] pH measured in the field using Raupac Indicator.
[4] pH measured on 1:5 soil:water suspensions using a *Hanna Combo* hand-held pH/EC/temp meter.
[5] Electrical conductivity of the saturated extract (Ece) = $EC_{1:5}$(µS/cm) x MF / 1000. Units are dS/m. MF is a soil texture multiplication factor.
[6] External laboratories used for the following analyses, if indicated:

- CEC (Cation exchange capacity)
- Psorb (Phosphorus sorption capacity)
- Bray Phosphorus
- Organic carbon
- Total nitrogen

Job 1954: 18 Uffington Road Dums Creek Composite sample

Sheet 2 - Results of External Laboratory Analysis

Name	Depth (m)	CEC (me/100g)	Rating	Ca (mg/kg)	Rating	Mg (mg/kg)	Rating	Na (mg/kg)	Rating	K (mg/kg)	Rating	ESP (%)	Rating	P-sorp. (mg/kg)	Rating
18 Uffington Road Dums Creek Composite sample	0 - 1.2	6.3	L	176	VL	203	M	56	L	203	M	3.9	NS	494.0	H

Notes:- (also refer Interpretation Sheet 2)

n/a
n/t

Phone Office/Lab (02) 6775 1157
Fax (02) 6775 1043
email: lanfaxlabs@bigpond.com.au
Website: http://www.lanfaxlabs.com.au
Lab address: 493 Old Inverell Road
Postal address: PO Box 4690 Armidale NSW 2350
Director: Dr Robert Patterson FIEAust, CPSS, CPAg
Soil Scientists and Environmental Engineers

Lanfax Laboratories

ABN 72 212 385 096
Proficiency tested by Aust. Soil & Plant Analysis Council Inc. ASPAC

18th December 2013

Whitehead & Associates
197 Main Road
Cardiff NSW 2285

Soil Report: Project 18 Uffington Road Dums Creek Composite sample
Samples received 10th December 2013
Samples dried to 50°C, crushed and sieved to minus 2 mm prior to analysis

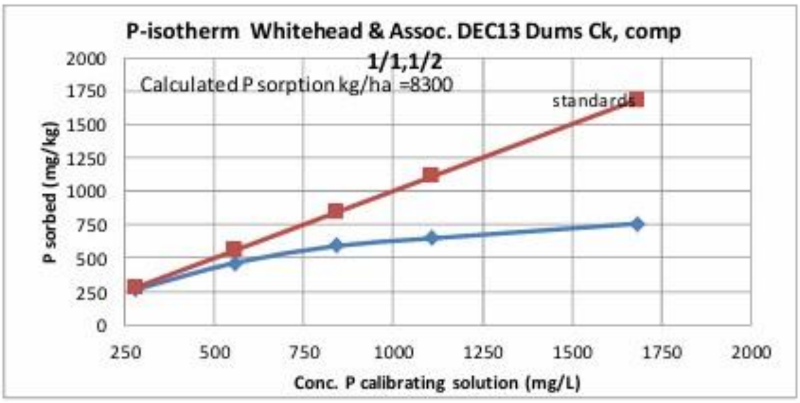
Whitehead & Assoc. Project Dums Creek DEC13

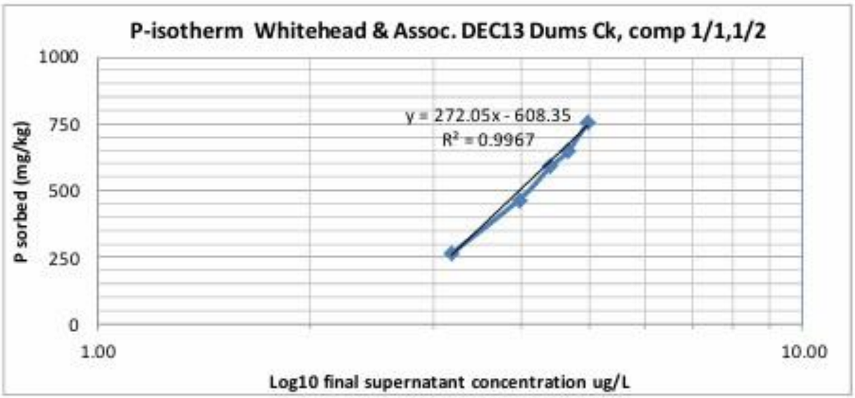
Exc.Al+H	Ca		K		Mg		Na		Sat.	ESP	CEC	Ca/Mg	Site Location
cmol+/kg	mg/kg	cmol+/kg	mg/kg	cmol+/kg	mg/kg	cmol+/kg	mg/kg	cmol+/kg	%	%	cmol+/kg	ratio	Sample ID
2.96	176	0.88	203	0.52	203	1.67	56	0.24	52.8	3.9	6.3	0.5	1185 TP1 comp

Methods: Rayment & Lyons 2011
Exchangeable acidity (H^+, Al^{3+}) Method 15 G1
Effective Cation Exchange Capacity Method 15D3 plus exchangeable acidity
Exchangeable sodium percentage ratio sodium to ECEC
P sorption modified method 9J1 - elevated equilibrating solutions, ICP determination of P

Dr Robert Patterson

Commercial and research laboratory for soil, water and plant analysis.
Soil survey and analytical assessments, landscape analysis and plant nutrient relationships,
Wastewater and effluent reuse specialists - on-site and decentralised





Percent sorbed is the proportion of the initial P sorbed during equilibration

P-isotherm Whitehead & Assoc. DEC13 Dur

Initial P mgP/L	filtrate P mg/L	sorbed P mg/kg	Sample I.D.	Percent sorbed (%)		Std line	filtrate C ugP/L	Y axis Log C	X axis
27.9	1.52	263.4	Whitehead & Assoc. DEC13	94.5		279	1521	3.18	263.4
55.6	9.25	463.2	Dums Ck, comp 1/1,1/2	83.4		556	9250	3.97	463.2
84.1	25.06	590.0		70.2		841	25060	4.40	590.0
110.9	46.20	647.0		58.3		1109	46200	4.66	647.0
168.3	92.65	756.5		44.9		1683	92650	4.97	756.5
	Calculated P sorption kg/ha =	8300							

Appendix C

Viral Die-off Model

Beavers, Cromer, Gardner Viral Dieoff Model
Job 4105: 206 Fotheringay Road, Clarence Town NSW

Whitehead & Associates
Environmental Consultants Pty Ltd

Step 1	Use Figure 1 in Cromer *et al.* (2001) (reproduced below) to determine days travel time using groundwater temperature* and a selected order of magnitude reduction.		
	** If mean groundwater temperature is unavailable, mean daily air temperature can be used in most cases.*		
Groundwater Temperature (^{o}C)	12.82	SILO Data (-32.6, 151.75) Mean minimum temperature	
Order of magnitude reduction	3	3 order of magnitude required for secondary treatment (with disinfection)	
Days required for viral reduction	**35**	(from Figure 1, below)	

Step 2	Calculate the predicted travel distance using Equation 4 from Cromer *et al.* (2001). Dg = (t-d_v.P/K)/(P/K.I)

Time in days	t =	35	days	See notes below for description of values
Effective porosity of soil (fraction)	P =	0.47		
Saturated hydraulic conductivity	K =	0.06	m/day	
Groundwater gradient	I =	10.0%		
Vertical drainage before entering groundwater	d_v =	0.75	m	

Setback Distance	**Distance travelled in groundwater**	**d_g =**	**0.4**	**m**

Notes:

Porosity (P):	Limiting Cat 6 subsoils (Hazelton & Murphy, 2007).
Ksat (K):	Assumed Ksat of 0.06m/day for limiting Cat 6 subsoil
Groundwater gradient (I):	Assumed groundwater gradient of 10% (highest surface slope value).
Vertical drainage (d_v):	Assumed 1.2m of unsaturated flow before reaching groundwater.

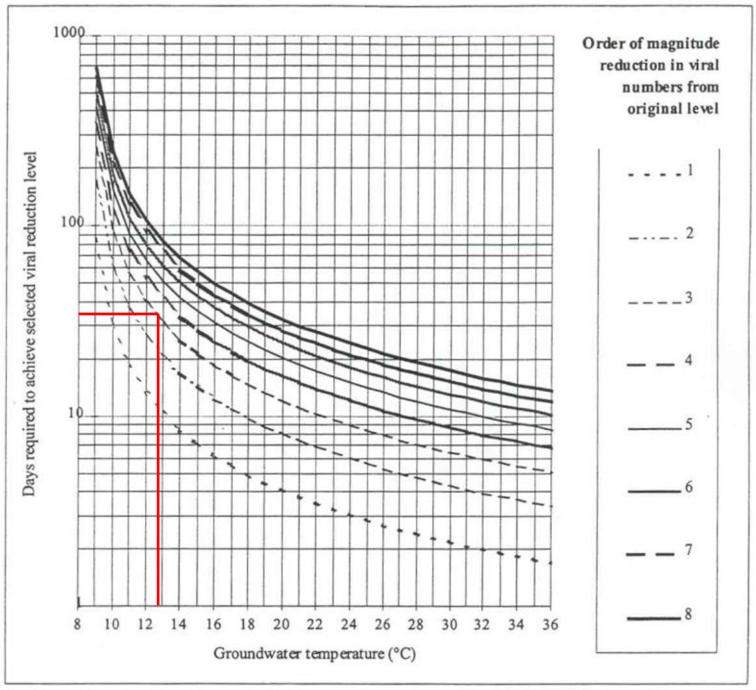


Figure 1. Relationship between Groundwater Temperature and Viral Die-Off Time for Various Order-of-Magnitude Reductions in Viral Numbers

(Figure 1 taken from Cromer et al., 2001)

Appendix D

Daily Soil-Water Modelling

General Information

SCENARIO REPORT: Full run

General information

Enterprise: 206 Fotheringay Road, Clarence Town NSW
Client: Clarence Ridge Estate P/L
MEDLI user: WHITEHEAD2012\marksaunders

Description:

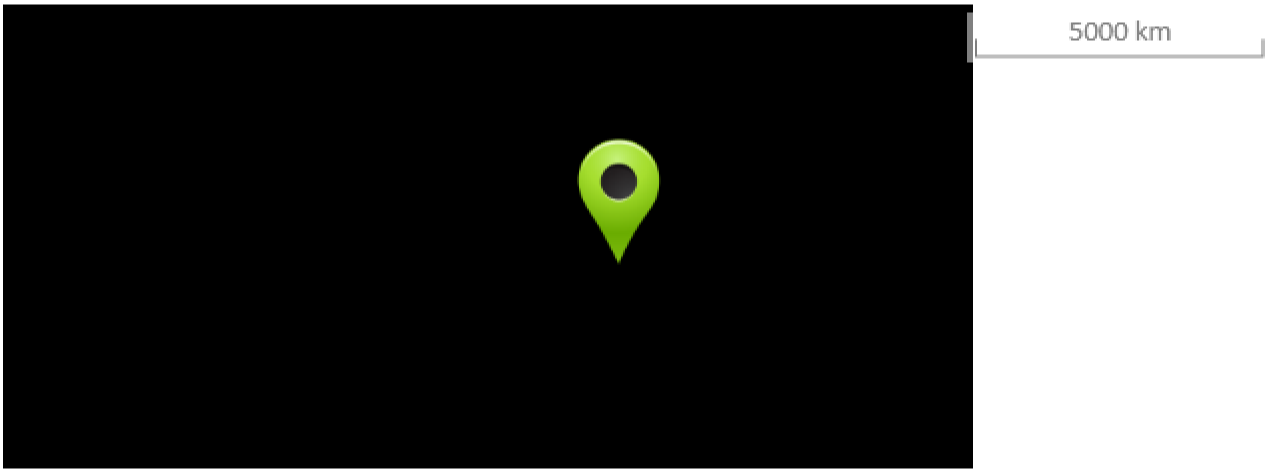
4105_CIA_5_Lot_Subdivision

Scenario details:

RUN_001 (Lot 3): 6-bedroom dwelling (tank water) (1.152kL/d), Zero storage, EDS=574sqm, IRR=SSI, Trigger=Fixed Daily, Application 2.5mm depth fixed.

Map of location:

Note: If the map above appears as a dark box, check that the network is accessible and that the coordinates are not for a location in the ocean.



Description

Climate information

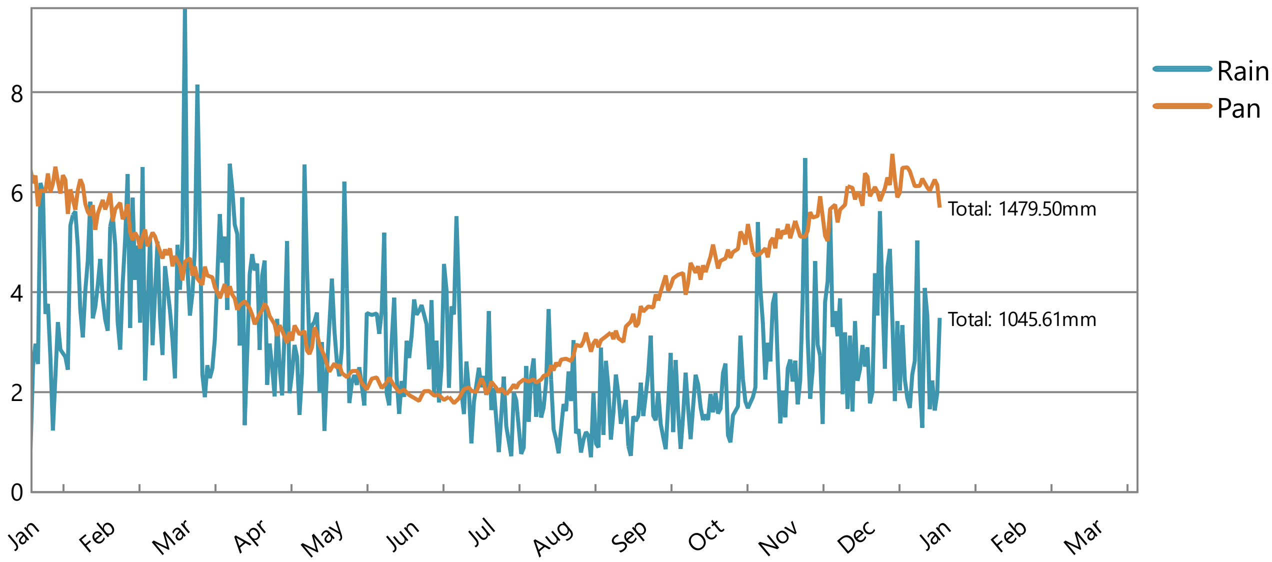
Climate Data Location: Dungog_Clarence_Town_60years, -32.6°, 151.76°
Run Period: 01/01/1965 to 31/12/2025 (61 years)

Climate statistics

	5th Percentile		50th Percentile		95th Percentile	
Rainfall (mm/year)	(Year 2019)	628.2	(Year 1977)	1032.7	(Year 1998)	1434.8
Pan evaporation (mm/year)	(Year 2011)	1278.2	(Year 2001)	1468.5	(Year 2019)	1686.3

Climate data

Daily average across run period:



Description

Wastestream information

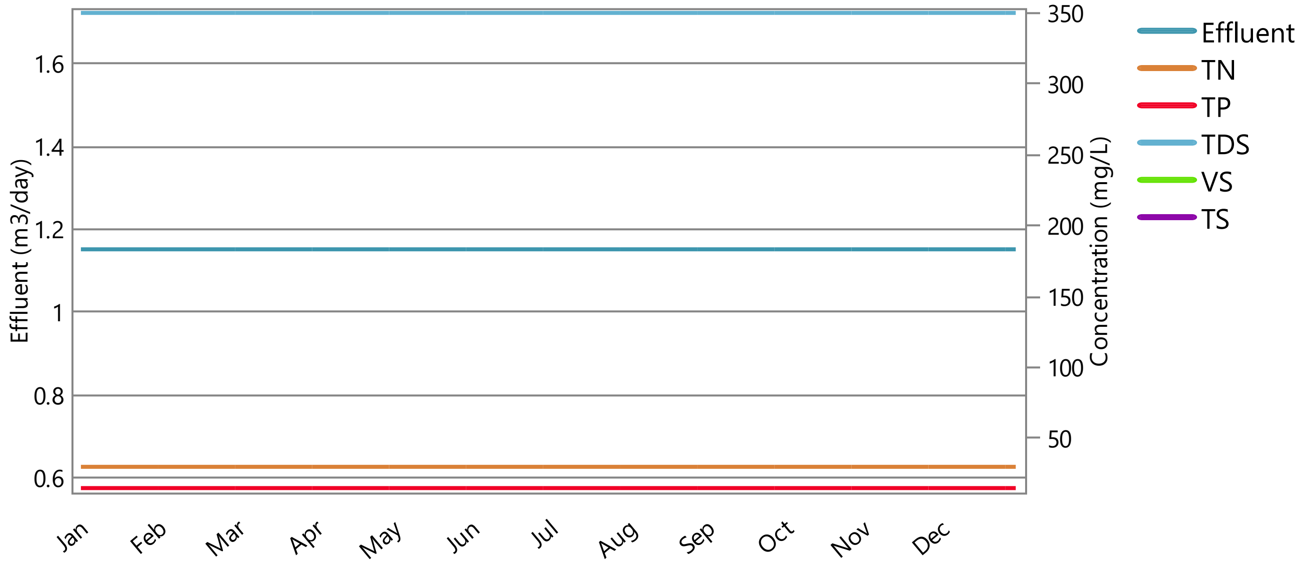
Wastestream Name: - New generic system

Wastestream production description

Daily New generic system data supplied for a representative year. This wastestream is not separately pretreated.

Wastestream

Average Daily Quantity and Flow-Weighted Average Quality:



Wastestream

Effluent Quantity: 420.76 m3/year or 1.15 m3/day (Min-Max 1.15 - 1.15)

Flow-Weighted Average (Min - Max) Daily Effluent Quality Entering the Pond System:

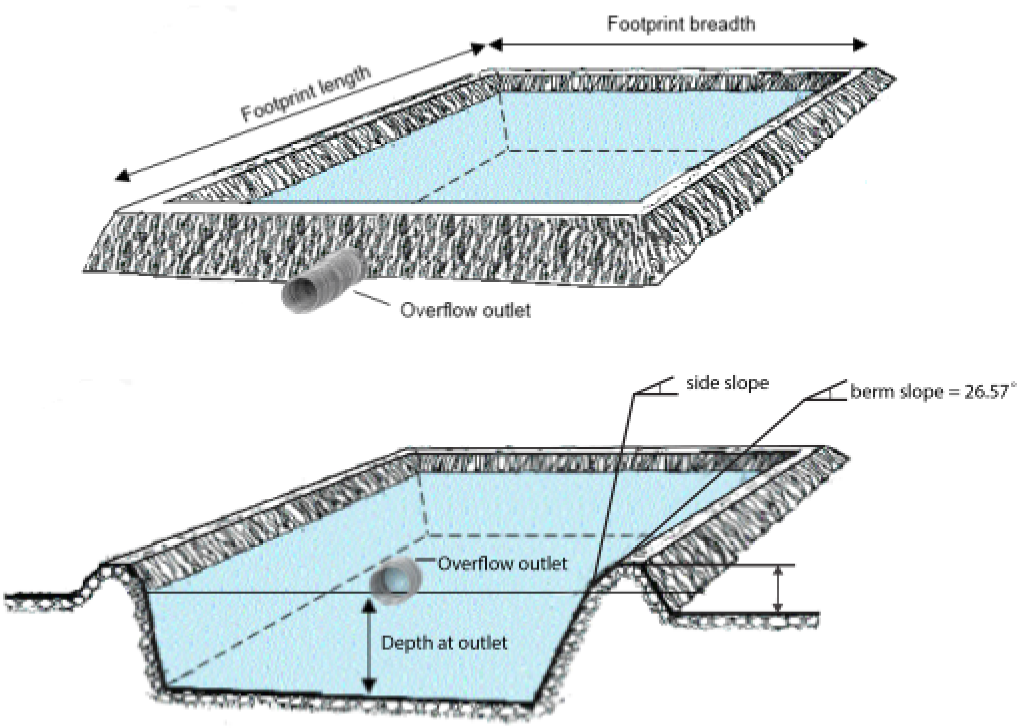
	Concentration (mg/L)	Load (kg/year)
Total nitrogen	30.00 (30.00 - 30.00)	12.62 (12.61 - 12.65)
Total phosphorus	15.00 (15.00 - 15.00)	6.31 (6.31 - 6.32)
Total dissolved salts	350.00 (350.00 - 350.00)	147.27 (147.17 - 147.57)
Volatile solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

Pond system information

Pond System Configuration: 1 closed (sludge-free) storage tank

Pond system details

	Pond 1
Maximum pond volume (m3)	1.50
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	0.90
Maximum water surface area (m2)	4.64
Pond footprint length (m)	2.15
Pond footprint width (m)	2.15
Pond catchment area (m2)	4.64
Average active volume (m3)	0.00



Irrigation pump limits

Minimum pump rate per area limit (ML/day/m2)	0.00
Maximum pump rate per area limit (ML/day/m2)	0.00

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	No

Description

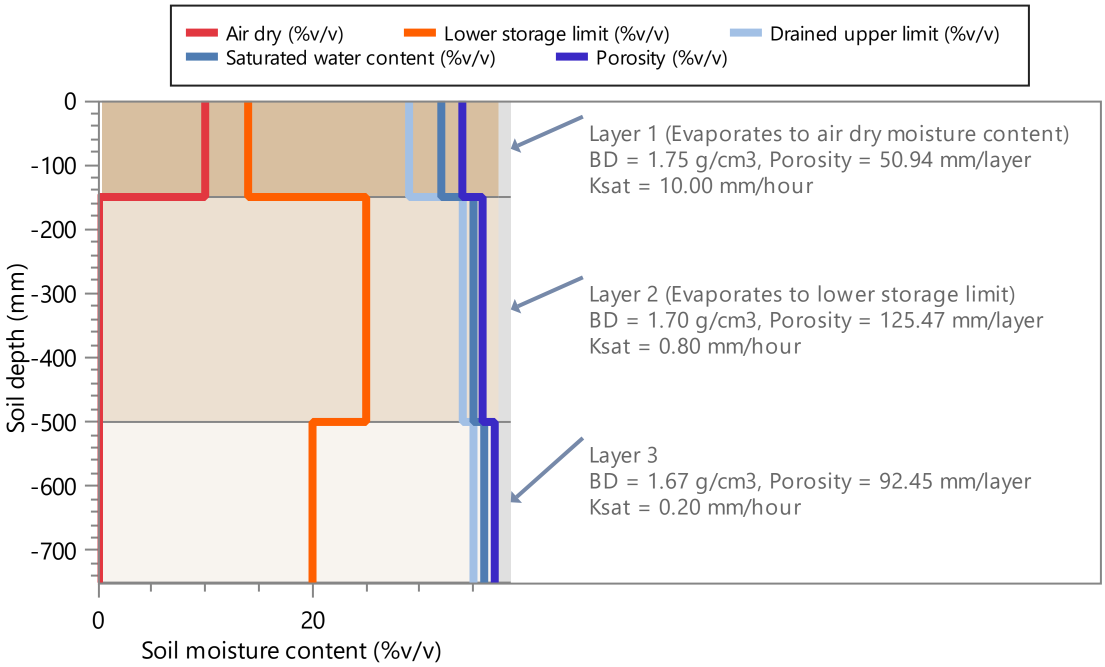
Paddock information

Paddock: 4105 Lot 3, 576 m2

Soil type: 4105_Kurosol 1, 750.00 mm defined profile depth

Profile porosity (mm)	268.87
Profile saturation water content (mm)	260.50
Profile drained upper limit (or field capacity) (mm)	250.00
Profile lower storage limit (or permanent wilting point) (mm)	158.50
Profile available water capacity (mm)	91.50
Profile limiting saturated hydraulic conductivity (mm/hour)	0.20
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

Profile



Planting regime: Continuous Kikuyu 1 pasture

Average monthly cover (fraction) (minimum - maximum)	0.86 (0.83 - 0.90)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Dead cover (if Mthly Covers) or Tot. cover left after harvest (fraction)	1.00
Potential rooting depth in defined soil profile (mm)	750.00
Salt tolerance	Moderately tolerant
Salinity threshold (dS/m soil saturation extract)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03

Irrigation rules: Pressure-compensating SSI

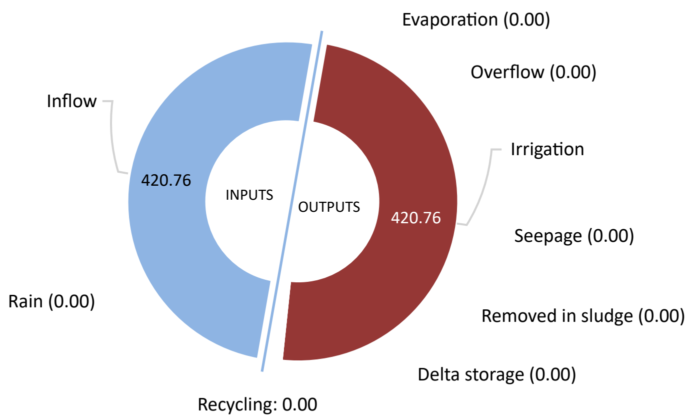
Rule 1. Irrigation triggered every 1 days and rainfall is less than or equal to 10000.00 mm
Rule 2. Irrigate a fixed amount of 2.50 mm each day
Rule 3. Irrigation window from 1/1 to 31/12 including the days specified
Rule 4. A minimum of 0 days must be skipped between irrigation events

Performance

Pond system information

Pond System Configuration: 1 closed (sludge-free) storage tank (wet weather storage pond: 1.5 m3)

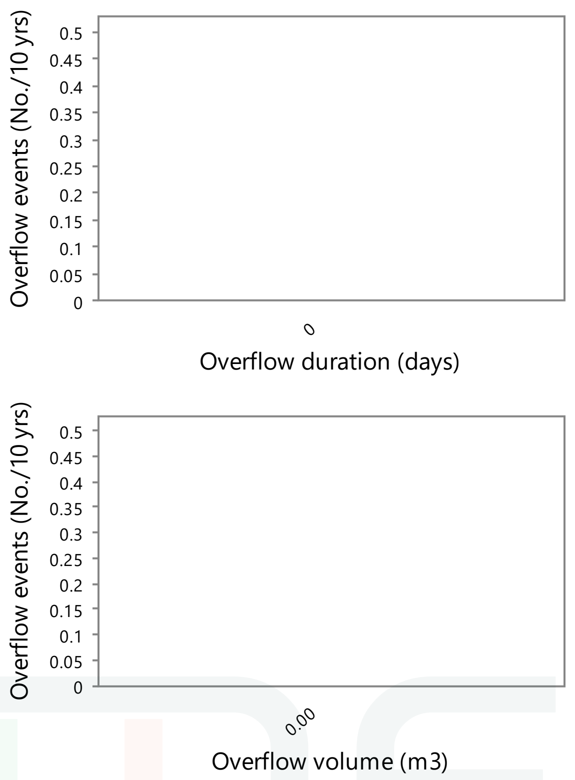
Pond system water balance (m3/year)

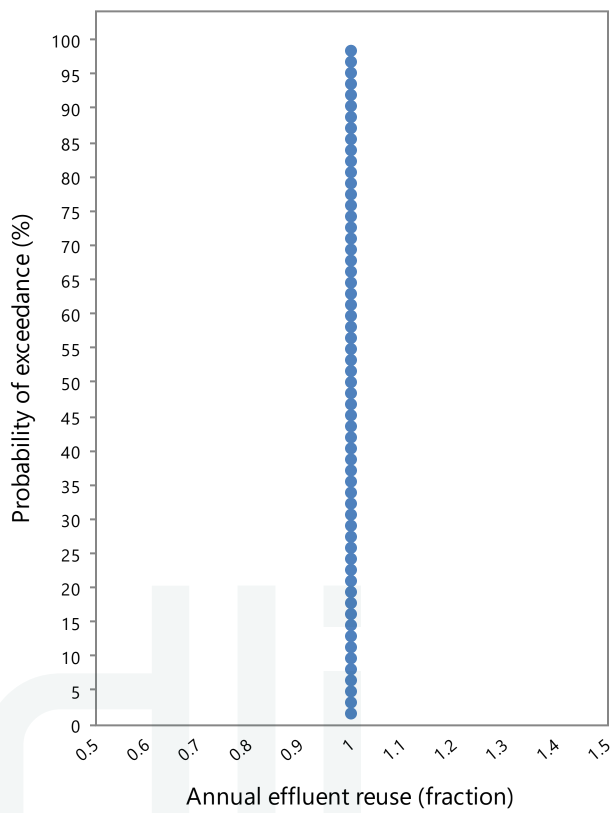


Name	Value
Rain	0.00
Inflow	420.76
Recycling	0.00
Evaporation	0.00
Overflow	0.00
Irrigation	420.76
Seepage	0.00
Removed in sludge	0.00
Delta storage	0.00

Overflow and reuse diagnostics

Metric	Value
Total volume of overflow (m3/10 years)	0.00
Total number of overflow events (events/10 years)	0.00
Total number of pond overflow days (days/10 years)	0.00
Probability of at least 90% effluent reuse (%)	100.00
Effluent reuse (Proportion of inflow + net gain in rain that is irrigated) (fraction)	1.00



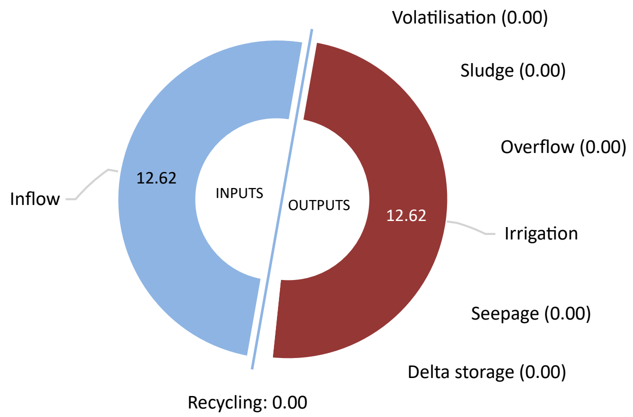


Performance

Pond system information

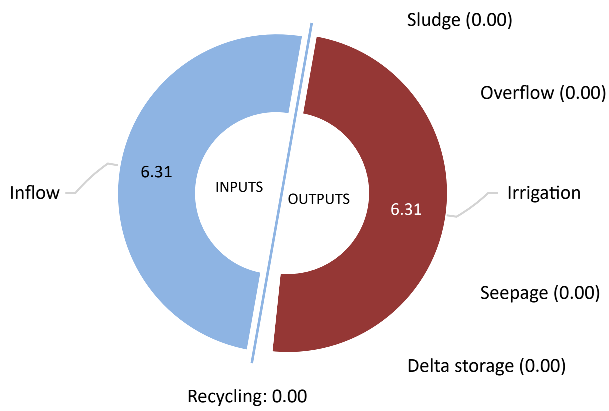
Pond System Configuration: 1 closed (sludge-free) storage tank

Pond system nitrogen balance (kg/year)



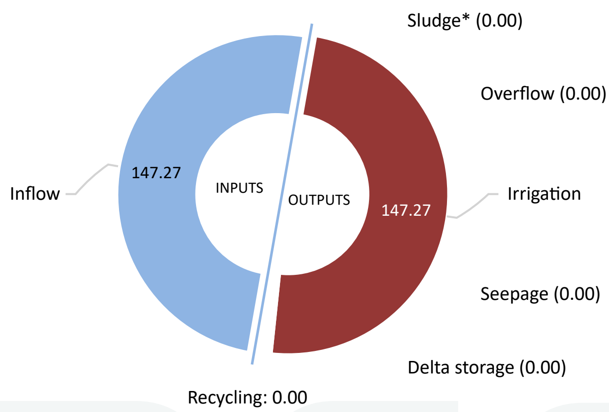
Name	Value
Inflow	12.62
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	12.62
Seepage	0.00
Delta storage	0.00

Pond system phosphorus balance (kg/year)



Name	Value
Inflow	6.31
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	6.31
Seepage	0.00
Delta storage	0.00

Pond system salt balance (kg/year)



Name	Value
Inflow	147.27
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	147.27
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 information

Pond System Configuration: 1 closed (sludge-free) storage tank

Pond nutrient concentrations and salinity

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	30.00
Average phosphorus concentration of pond liquid (mg/L)	15.00
Average salinity of pond liquid (dS/m)	0.55

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	N.D.*
Final phosphorus concentration of pond liquid (mg/L)	N.D.*
Final salinity of pond liquid (dS/m)	N.D.*

* Not determined. Pond is empty.

Performance

Water use (assumes 100% irrigation efficiency)

Metric	Value
Pond water irrigated (m3/year)	420.76
Average shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	420.76
Proportion of irrigation events requiring shandying (fraction of events)	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

Metric	Value
Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	30.00
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	29.40
Average phosphorus concentration of irrigation water (mg/L)	15.00
Average salinity of irrigation water (dS/m)	0.55

Irrigation diagnostics

Metric	Value
No. periods/year without any irrigable effluent in the wet weather storage pond (periods/year)	0.00
Average length of such periods (days)	0.00

Irrigation triggering and application

No. Days without Irrigation Applied per Year: 0.00
No. Days with Irrigation Applied per Year: 365.25 (with supply limited - partial application)
No. Days with Irrigation Triggered per Year: 365.25

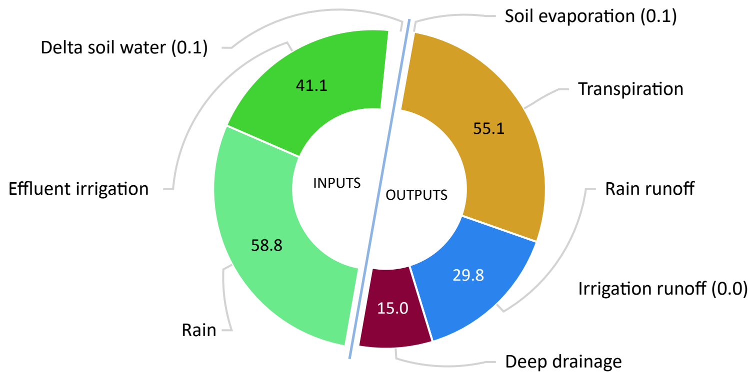
Performance

Paddock information

Paddock: 4105 Lot 3, 576 m2

Soil Type: 4105_Kurosol 1, 91.50 mm PAWC at maximum root depth

Soil water balance (%)



Name	Value
Rain	58.8
Effluent irrigation	41.1
Soil evaporation	0.1
Transpiration	55.1
Rain runoff	29.8
Irrigation runoff	0.0
Deep drainage	15.0
Delta soil water	-0.1

Average monthly totals (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rain	113.7	114.6	135.5	93.5	91.0	89.0	57.0	47.5	52.7	69.9	91.3	89.7	1045.6
Effluent Irrig.	62.0	56.5	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	730.5
Soil evap.	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Transpiration	115.1	93.7	90.2	67.0	47.6	39.3	44.9	63.3	83.4	101.1	107.4	126.4	979.4
Rain runoff	49.0	51.2	77.1	57.6	61.8	63.0	34.9	25.3	21.1	26.4	36.7	25.8	530.1
Irrig. 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	8.9	12.9	20.8	26.2	37.7	46.2	40.0	25.5	17.0	11.5	11.5	8.5	266.5
Delta SW	1.7	13.1	9.4	2.7	5.8	0.4	-0.8	-4.5	-8.8	-7.1	-4.3	-8.8	-1.1

Average annual totals (mm/year)

Year	Rain	Effluent Irrig.	Soil evap.	Transp.	Rain runoff	Irrig. runoff	Deep drainage	Delta SW
1965	537.4	730.0	73.8	925.9	195.3	0.0	101.6	-29.2
1966	748.2	730.0	0.0	946.0	285.9	0.0	252.5	-6.1
1967	1338.6	730.0	0.0	924.6	848.5	0.0	315.0	-19.4
1968	1156.4	732.0	0.0	976.3	633.7	0.0	266.4	12.0
1969	1065.5	730.0	0.0	974.3	508.4	0.0	315.2	-2.4
1970	898.7	730.0	0.0	1158.8	314.5	0.0	107.4	48.0
1971	1392.8	730.0	0.0	1020.5	892.0	0.0	247.2	-36.9
1972	1244.2	732.0	0.0	1048.6	674.7	0.0	275.4	-22.5
1973	786.4	730.0	0.0	1040.0	215.1	0.0	207.6	53.8
1974	1296.7	730.0	0.0	1042.6	715.3	0.0	287.0	-18.2

Performance

Average annual totals (mm/year)

Year	Rain	Effluent Irrig.	Soil evap.	Transp.	Rain runoff	Irrig. runoff	Deep drainage	Delta SW
1975	961.4	730.0	0.0	1025.2	446.3	0.0	211.5	8.4
1976	1200.0	732.0	0.0	953.8	727.0	0.0	323.2	-72.0
1977	1031.6	730.0	0.0	955.3	586.9	0.0	219.7	-0.2
1978	1438.4	730.0	0.0	948.0	812.6	0.0	321.2	86.7
1979	687.7	730.0	0.0	1032.4	306.2	0.0	170.5	-91.4
1980	463.2	732.0	0.0	956.5	68.1	0.0	120.7	50.0
1981	1055.6	730.0	0.0	1033.6	496.9	0.0	224.4	30.6
1982	825.6	730.0	0.0	953.2	412.8	0.0	251.0	-61.4
1983	929.3	730.0	0.0	966.8	353.2	0.0	267.9	71.3
1984	1033.8	732.0	0.0	985.4	529.2	0.0	282.5	-31.4
1985	1145.8	730.0	0.0	953.1	594.6	0.0	356.3	-28.2
1986	812.4	730.0	0.0	1044.7	329.9	0.0	191.4	-23.7
1987	1249.1	730.0	0.0	993.5	619.2	0.0	276.8	89.6
1988	1223.9	732.0	0.0	1003.1	648.6	0.0	309.6	-5.4
1989	1165.8	730.0	0.0	954.3	638.6	0.0	343.7	-40.7
1990	1384.8	730.0	0.0	957.9	873.1	0.0	309.4	-25.6
1991	667.9	730.0	0.0	1024.1	193.9	0.0	105.1	74.8
1992	1048.0	732.0	0.0	902.4	565.1	0.0	335.7	-23.1
1993	831.7	730.0	0.0	967.0	344.6	0.0	273.7	-23.6
1994	829.4	730.0	0.0	1129.4	248.9	0.0	178.7	2.4
1995	1145.5	730.0	0.0	959.6	621.7	0.0	265.2	29.0
1996	821.4	732.0	0.0	1024.9	284.3	0.0	231.1	13.1
1997	861.3	730.0	0.0	929.2	435.6	0.0	306.4	-79.8
1998	1435.7	730.0	0.0	993.4	818.3	0.0	290.2	63.7
1999	1273.1	730.0	0.0	828.9	723.2	0.0	432.7	18.3
2000	960.7	732.0	0.0	1026.4	469.6	0.0	277.8	-81.0
2001	1310.7	730.0	0.0	935.3	777.7	0.0	308.0	19.7
2002	902.4	730.0	0.0	1018.4	401.6	0.0	172.2	40.2
2003	828.3	730.0	0.0	994.6	351.2	0.0	245.4	-32.9
2004	982.6	732.0	0.0	1029.1	423.2	0.0	216.7	45.5
2005	929.4	730.0	0.0	1045.5	405.5	0.0	284.9	-76.5
2006	820.3	730.0	0.0	967.5	291.9	0.0	213.0	77.9
2007	1214.2	730.0	0.0	991.8	703.3	0.0	263.0	-13.9
2008	1329.6	732.0	0.0	928.2	810.6	0.0	321.8	1.0
2009	1214.4	730.0	0.0	1016.0	675.3	0.0	247.0	6.2
2010	856.8	730.0	0.0	947.0	361.4	0.0	319.5	-41.1
2011	1433.9	730.0	0.0	844.8	892.0	0.0	380.9	46.1
2012	904.8	732.0	0.0	907.9	434.1	0.0	304.2	-9.4
2013	1208.5	730.0	0.0	1027.8	716.9	0.0	220.4	-26.6
2014	809.9	730.0	0.0	939.3	280.5	0.0	282.7	37.4
2015	1408.7	730.0	0.0	1013.0	833.6	0.0	296.3	-4.3
2016	1082.1	732.0	0.0	1024.7	592.7	0.0	224.7	-27.9

Performance

Average annual totals (mm/year)

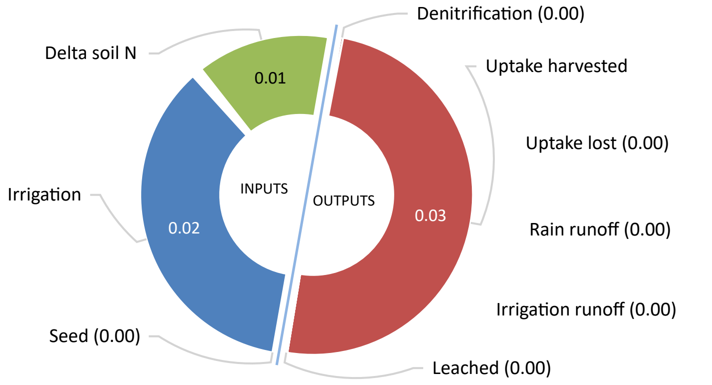
Year	Rain	Effluent Irrig.	Soil evap.	Transp.	Rain runoff	Irrig. runoff	Deep drainage	Delta SW
2017	825.8	730.0	0.0	1029.4	302.0	0.0	244.2	-19.7
2018	899.9	730.0	0.0	941.3	436.4	0.0	223.0	29.1
2019	588.5	730.0	0.0	1022.0	172.7	0.0	193.7	-69.9
2020	1213.6	732.0	0.0	902.2	632.3	0.0	311.1	100.0
2021	1400.9	730.0	0.0	862.9	899.0	0.0	378.6	-9.6
2022	1371.8	730.0	0.0	860.4	864.0	0.0	431.2	-53.8
2023	824.2	730.0	0.0	1078.5	211.1	0.0	205.5	59.1
2024	932.6	732.0	0.0	883.2	450.1	0.0	380.8	-49.5
2025	1540.3	730.0	0.0	973.9	982.9	0.0	336.9	-23.4

Performance

Paddock information

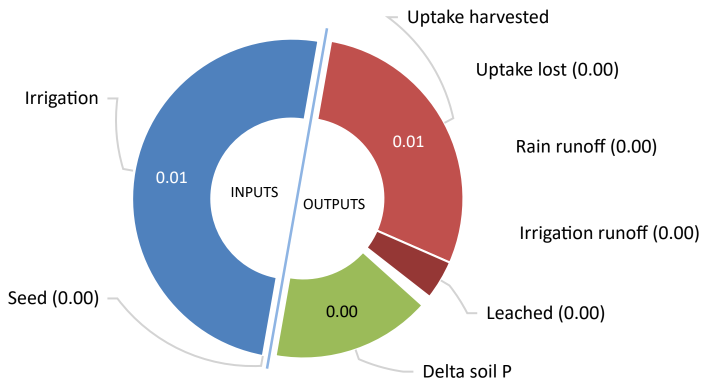
Paddock: 4105 Lot 3, 576 m2
Soil Type: 4105_Kurosol 1
Irrigation Ammonia-N Volatilisation Losses (kg/m2/year): 0.00
Proportion of Total Nitrogen in Irrigated Effluent as Ammonium (fraction): 0.10

Soil nitrogen balance (kg/m2/year)



Name	Value
Seed	1.72E-06
Irrigation	0.02
Denitrification	1.37E-04
Uptake harvested	0.03
Uptake lost	0.00
Rain runoff	0.00
Irrigation runoff	0.00
Leached	1.14E-04
Delta soil N	-0.01

Soil phosphorus balance (kg/m2/year)



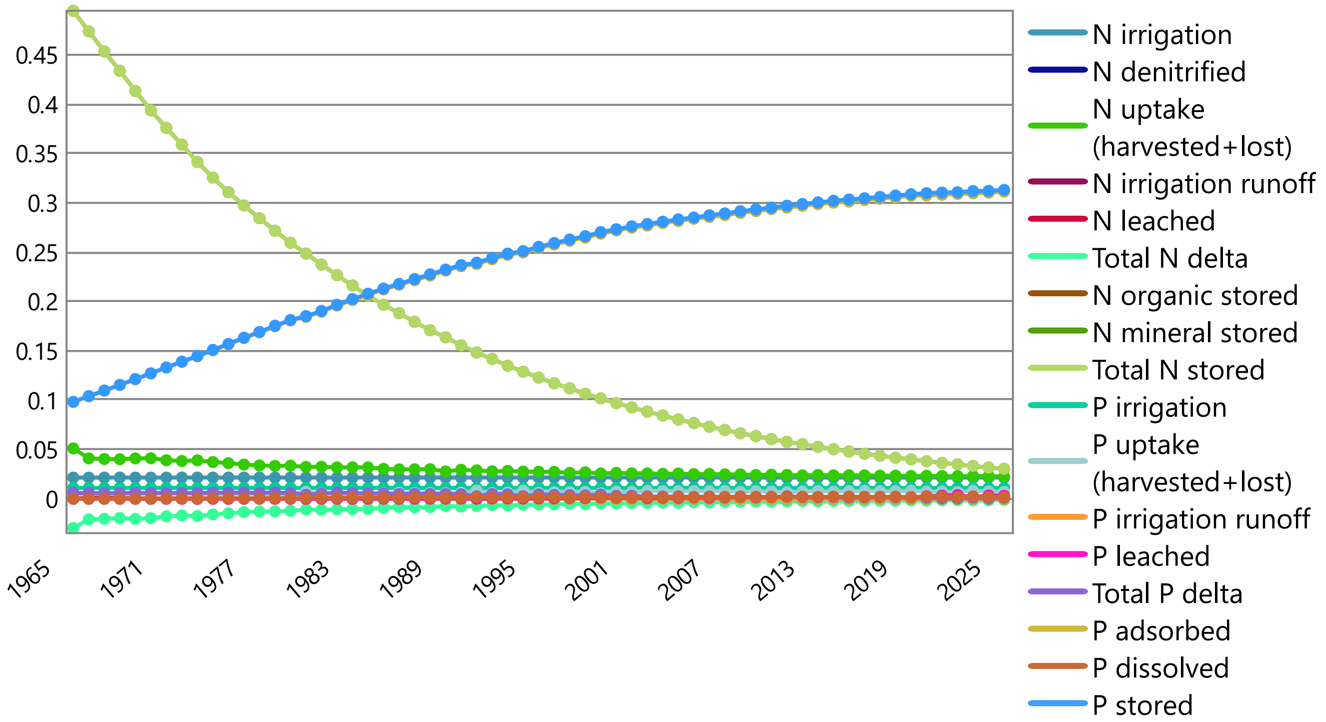
Name	Value
Seed	1.48E-07
Irrigation	0.01
Uptake harvested	0.01
Uptake lost	0.00
Rain runoff	0.00
Irrigation runoff	0.00
Leached	8.89E-04
Delta soil P	3.61E-03

Performance

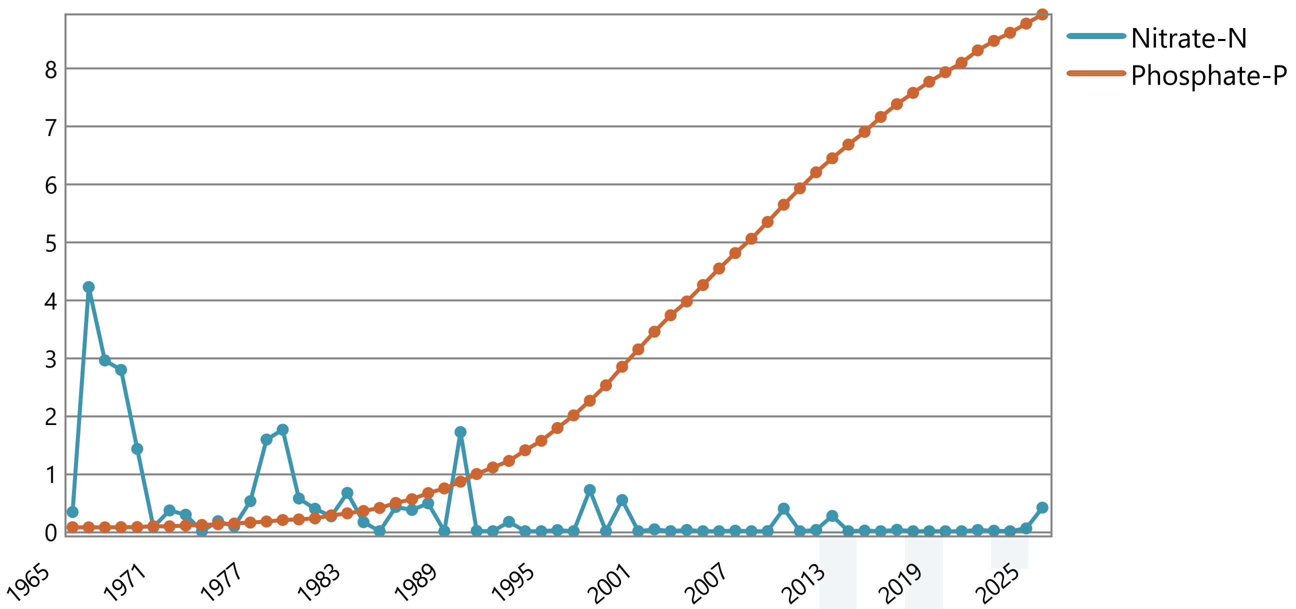
Paddock information

Paddock: 4105 Lot 3, 576 m2
Soil Type: 4105_Kurosol 1

Annual nutrient totals (kg/m2)



Annual nutrient leaching concentration (mg/L)



Performance

Paddock information

Paddock: 4105 Lot 3, 576 m2
Soil Type: 4105_Kurosol 1
Planting Regime: Continuous Kikuyu 1 pasture

Plant growth (minimum - maximum)

Metric	Value
Average annual shoot dry matter harvestable yield* (kg/m2/year)	1.48 (1.20 - 2.01)
Average annual shoot dry matter lost (kg/m2/year)	0.00 (0.00 - 0.00)
Average monthly plant (green) cover (fraction)	0.86 (0.83 - 0.90)
Average monthly root depth (mm)	749.58 (744.99 - 750.00)

Plant nutrient uptake (minimum - maximum)

Metric	Value
Average annual shoot nitrogen in harvestable yield* (kg/m2/year)	0.03 (0.02 - 0.05)
Average annual shoot nitrogen lost (kg/m2/year)	0.00 (0.00 - 0.00)
Average annual shoot phosphorus in harvestable yield* (kg/m2/year)	0.01 (0.00 - 0.01)
Average annual shoot phosphorus lost (kg/m2/year)	0.00 (0.00 - 0.00)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.02 - 0.03)
Average annual shoot phosphorus concentration (fraction dwt)	0.004 (0.003 - 0.006)

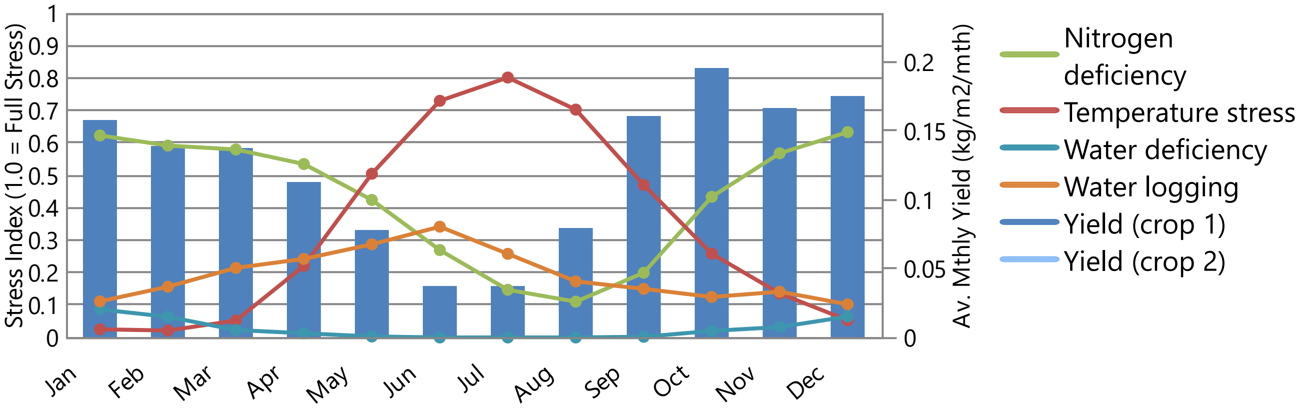
*Harvestable yield is a measure of *net* gain over a nominated period - say monthly. It is the total shoot-dry-matter gain minus any shot-dry-matter loss within a given period. Hence, just like financial investments, negative harvestable yields may occur when the (episodic) losses exceed the gains made within a particular accounting period.

Performance

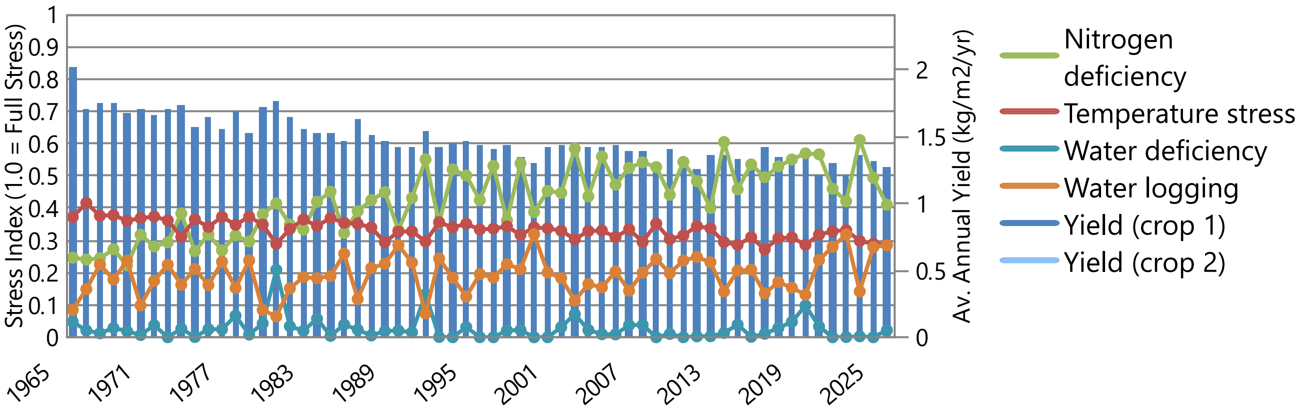
Paddock information

Paddock: 4105 Lot 3, 576 m2
Soil Type: 4105_Kurosol 1
Planting Regime: Continuous Kikuyu 1 pasture

Av. monthly stresses & harvestable yield* (kg/m2/month)



Av. annual stresses & harvestable yield* (kg/m2/year)



*Harvestable yield is a measure of *net* gain over a nominated period - say monthly. It is the total shoot-dry-matter gain minus any shot-dry-matter loss within a given period. Hence, just like financial investments, negative harvestable yields may occur when the (episodic) losses exceed the gains made within a particular accounting period.

Normal and forced harvest information

No. of Harvests per Year: 2.66 (normal).
No. Days without Crop per Year (no./year): 0.00

Performance

Paddock information

Paddock: 4105 Lot 3, 576 m2
Soil Type: 4105_Kurosol 1
Planting Regime: Continuous Kikuyu 1 pasture

Plant salinity tolerance

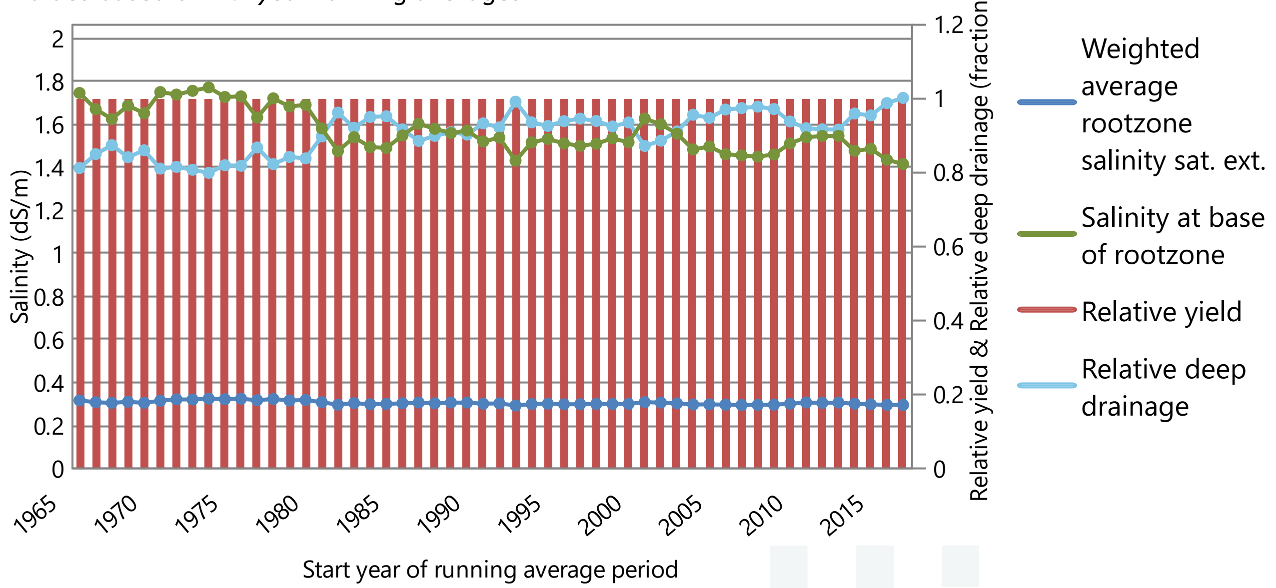
Metric	Value
Salt tolerance	Moderately tolerant
Salinity threshold (dS/m soil saturation extract)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03
No. years assumed for leaching to reach steady-state (years)	10.00

Soil salinity

Metric	Value
Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.33
Salt added by rainfall (kg/m2/year)	0.01
Average annual salt added & leached at steady state (kg/m2/year)	0.27
Average leaching fraction based on 10 -year running averages (fraction)	0.50
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.31
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	1.57
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.

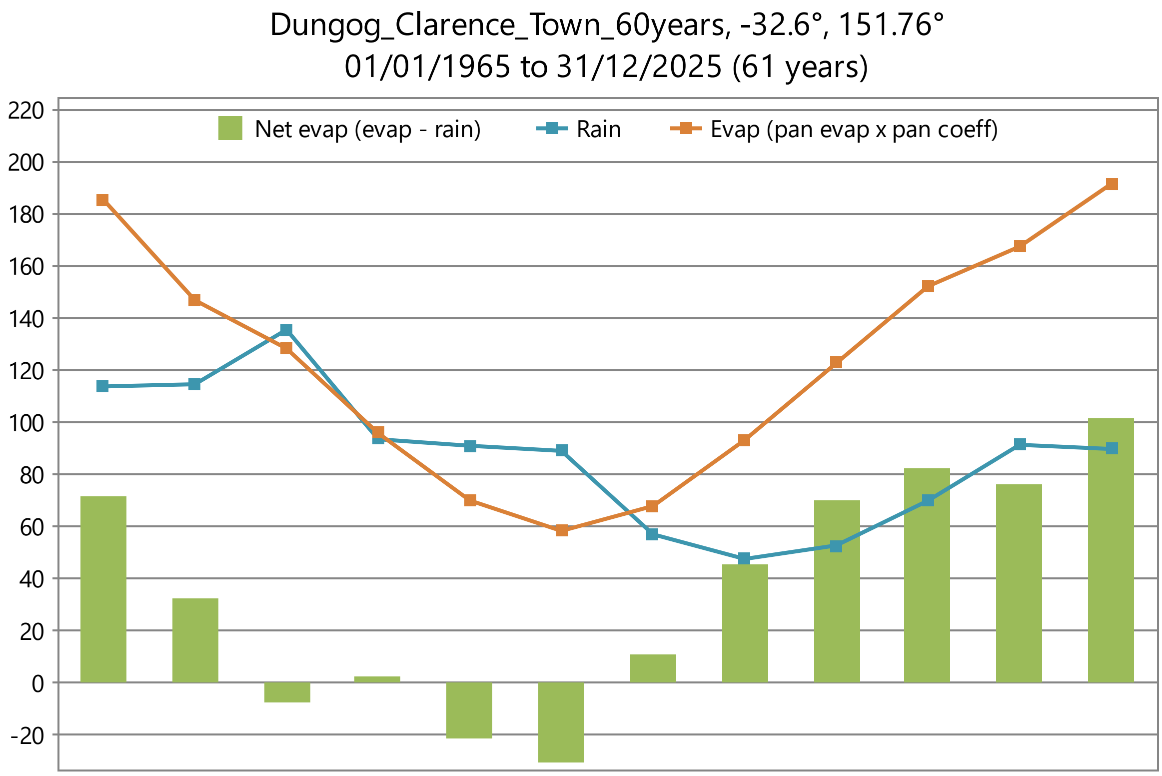


Diagnostics

Scenario information

Enterprise: 206 Fotheringay Road, Clarence Town NSW

Climate long-term monthly averages (mm)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	113.7	114.6	135.5	93.5	91.0	89.0	57.0	47.5	52.7	69.9	91.3	89.7	1045.6
Evap	185.5	146.8	128.3	95.8	70.0	58.3	67.9	93.2	122.7	152.2	167.4	191.5	1479.5
Net evap	71.7	32.2	-7.2	2.3	-21.0	-30.7	10.9	45.6	70.0	82.3	76.1	101.7	433.9
Net evap/day	2.3	1.1	-0.2	0.1	-0.7	-1.0	0.4	1.5	2.3	2.7	2.5	3.3	1.2

Diagnostics

Pond system information

Pond System Configuration: 1 closed (sludge-free) storage tank

Effluent Type: - 420.76 m3/year or 1.15 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/year.*

Constituent	Concentration (mg/L)	Load (kg/year)
Total nitrogen	30.00 (30.00 - 30.00)	12.62 (12.61 - 12.65)
Total phosphorus	15.00 (15.00 - 15.00)	6.31 (6.31 - 6.32)
Total dissolved salts	350.00 (350.00 - 350.00)	147.27 (147.17 - 147.57)
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)

Ammonia-N loss from pond system water surface area: 0.00 kg/m2/year

Last pond (wet weather store): 1.50 m3

Metric	Value
Theoretical hydraulic retention time (days)	1.30
Volume of overflow (m3/year) Average (minimum-maximum)	0.00 (0.00 - 0.00)
Volume of overflow per day (m3/day) Average (minimum-maximum)	0.00 (0.00 - 0.00)
No overflow days - Average per year (Total in run period)	0.00 (0)
No. overflow events per 10 years exceeding threshold of 0.005 m3* (events/10 years)	0.00
Average overflow event recurrence interval (years)	0.00
Average duration of overflow (days)	0.00
Probability of at least 90% effluent reuse (%)	100.00
Effluent reuse (proportion of inflow + net rain gain that is irrigated) (fraction)	1.00
Average salinity (dS/m)	0.55
Salinity on final day of simulation (dS/m)	0.55

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

Volume distribution of the overflow events

Overflow volume (m3)	Overflow events (No./10 yrs)
0	0.00

Diagnostics

Scenario information

Area irrigated: 576 m2 total area

Loading to whole irrigation area: (assuming 100% irrigation efficiency)

	Quantity/year	Quantity/m2/year
Total irrigation applied (m3)	420.76	0.73
Total nitrogen applied (kg)	12.37	0.02
Total phosphorus applied (kg)	6.31	0.01
Total salts applied (kg)	147.27	0.26

Shandying

Metric	Value
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)
Minimum shandy water is used	No

Irrigation issues

Metric	Value

Diagnostics

Paddock information

Paddock: - 4105 Lot 3, 576 m2

Irrigation: Pressure-compensating SSI with 0.2% ammonium loss during irrigation

Irrigation Rules
Irrigation triggered every 1 days and rainfall is less than or equal to 10000.00 mm
Irrigate a fixed amount of 2.50 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): 4105_Kurosol 1, 91.50 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	113.7	114.6	135.5	93.5	91.0	89.0	57.0	47.5	52.7	69.9	91.3	89.7	1045.6
Efflt. irrg.	62.0	56.5	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	730.5
Soil evap	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Transpn.	115.1	93.7	90.2	67.0	47.6	39.3	44.9	63.3	83.4	101.1	107.4	126.4	979.4
Rain runoff	49.0	51.2	77.1	57.6	61.8	63.0	34.9	25.3	21.1	26.4	36.7	25.8	530.1
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	8.9	12.9	20.8	26.2	37.7	46.2	40.0	25.5	17.0	11.5	11.5	8.5	266.5
Delta SW	1.7	13.1	9.4	2.7	5.8	0.4	-0.8	-4.5	-8.8	-7.1	-4.3	-8.8	-1.1

Soil nitrogen balance: (Concentrations are flow-weighted)

Metric	Value
Average annual nitrogen added in seed (kg/m2/year)	1.72E-06
Average annual nitrogen added from irrigation (kg/m2/year)	0.02
Av. annual soil N removed by uptake (harvest + lost) (kg/m2/year)	0.03 (0.03, 0.00)
Av. annual soil nitrogen removed by denitrification (kg/m2/year)	1.37E-04
Average annual soil nitrogen leached (kg/m2/year)	1.14E-04
Average annual nitrate-N loading to groundwater (kg/m2/year)	1.14E-04
Soil organic-N kg/m2 (Initial - Final)	0.52 - 0.03
Soil inorganic-N kg/m2 (Initial - Final)	0.01 - 1.83E-06
Average nitrate-N concentration of deep drainage (Max annual concentration)	
Across all years (mg/L)	0.43 (4.23)
Excluding first year of data (mg/L)	0.43 (4.23)

Soil phosphorus balance: (Concentrations are flow-weighted)

Metric	Value
Average annual phosphorus added in seed (kg/m2/year)	1.48E-07
Average annual phosphorus added from irrigation (kg/m2/year)	0.01
Av. annual soil P removed by uptake (harvest + lost) (kg/m2/yr)	0.01 (0.01, 0.00)
Average annual soil phosphorus leached (kg/m2/year)	8.89E-04
Dissolved phosphorus (kg/m2) (Initial - Final)	2.50E-05 - 1.72E-03
Adsorbed phosphorus (kg/m2) (Initial - Final)	0.09 - 0.31
Average phosphate-P concentration in rootzone (mg/L)	5.56
Average phosphate-P concentration of deep drainage (Max annual concentration)	
Across all years (mg/L)	3.34 (8.94)
Last year only (mg/L)	8.94 (N.D.*)
Design soil profile storage life based on average infiltrated water phosphorus concn. of 8.79 mg/L (years)	47.20

* Not determined

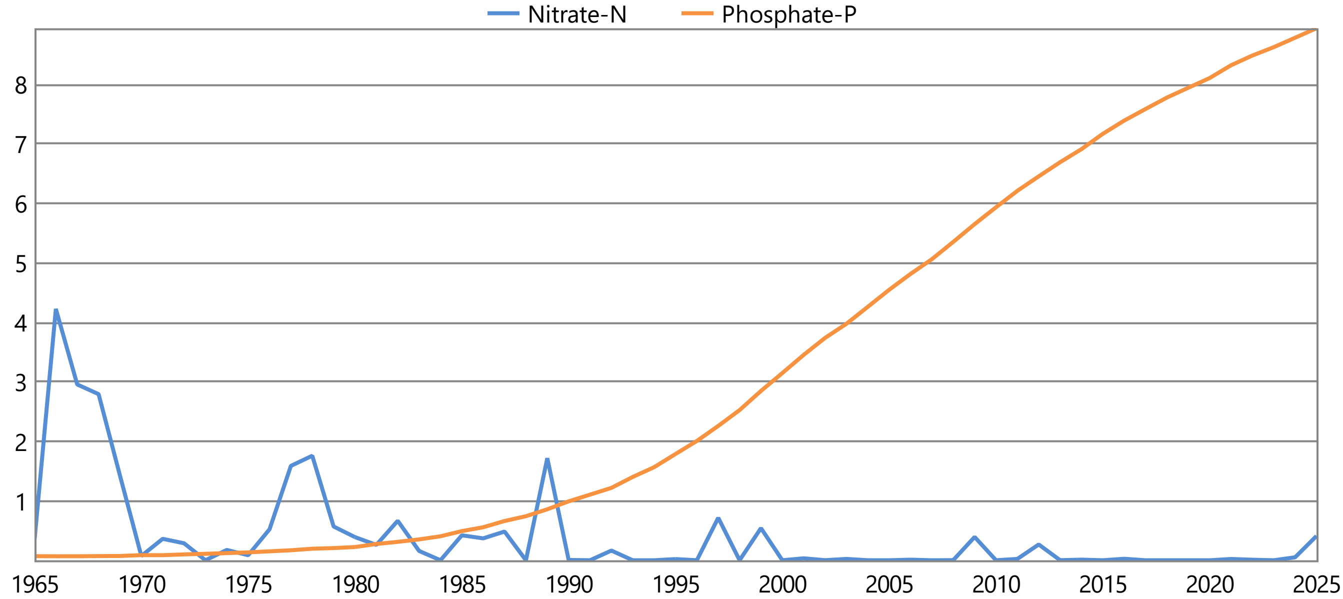
Diagnostics

Paddock information

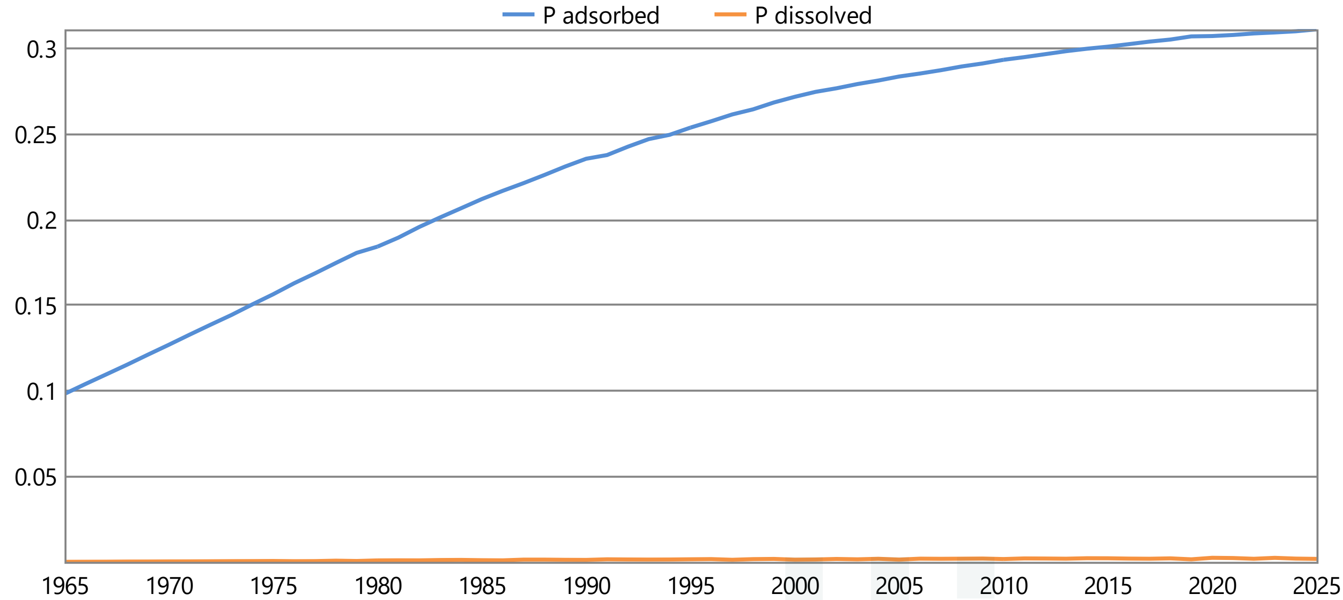
Paddock: 4105 Lot 3, 576 m2

Irrigation: Pressure-compensating SSI with 0.2% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual phosphate-P in soil (kg/m2)



Diagnostics

Paddock information

Paddock: 4105 Lot 3, 576 m2

Planting Regime: Continuous Kikuyu 1 pasture

Average plant performance (minimum - maximum)

Metric	Value
Average annual shoot dry matter harvestable yield (kg/m2/year)	1.48 (1.20 - 2.01)
Average annual shoot dry matter lost (kg/m2/year)	0.00 (0.00 - 0.00)
Average monthly plant (green) cover (fraction)	0.86 (0.83 - 0.90)
Average monthly crop factor (fraction)	0.69 (0.66 - 0.72)
Dead cover (if Mthly Covers) or Tot. cover left after harvest (fraction)	1.00
Average monthly root depth (mm)	749.58 (744.99 - 750.00)
Average number of normal harvests per year (no./year)	2.66 (2.00 - 4.00)
Average number of normal harvests for last five years only (no./year)	2.20
Average number of forced harvests per year (no./year)	0.00 (0.00 - 0.00)
Average number of forced harvests for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.43 (0.22 - 0.61)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.03 (0.00 - 0.09)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.80 (0.68 - 0.93)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.03 (0.00 - 0.09)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.19 (0.10 - 0.34)
No. days without crop per year. Excludes bare fallow days (days)	0.00

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.

Metric	Value
Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.33
Salt added by rainfall (kg/m2/year)	0.01
Average annual salt added & leached at steady state (kg/m2/year)	0.27
Average leaching fraction based on 10 -year running averages (fraction)	0.50
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.31
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	1.57
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 information

Messages generated when the scenario was run
************************************** WASTESTREAM RESULTS **************************************
TABLE OF QUANTITY AND QUALITY OF EACH RAINFALL-INDEPENDENT WASTESTREAM (AFTER PRETREATMENT AND BEFORE ENTERING ANY SEDIMENTATION BASIN)
____
Source Volume_m3/yr N conc_mg/L P conc_mg/L TDS conc_mg/L N load_kg/yr P load_kg/yr TDS load_kg/yr
New generic system 420.8 30.0 15.0 350.0 12.6 6.3 147.3
____
*************************************** END WASTESTREAM RESULTS ************************************
UNCONDITIONAL FINISH

SCENARIO REPORT: Full run

General information

Enterprise: 206 Fotheringay Road, Clarence Town NSW
Client: Clarence Ridge Estate P/L
MEDLI user: WHITEHEAD2012\marksaunders

Description:

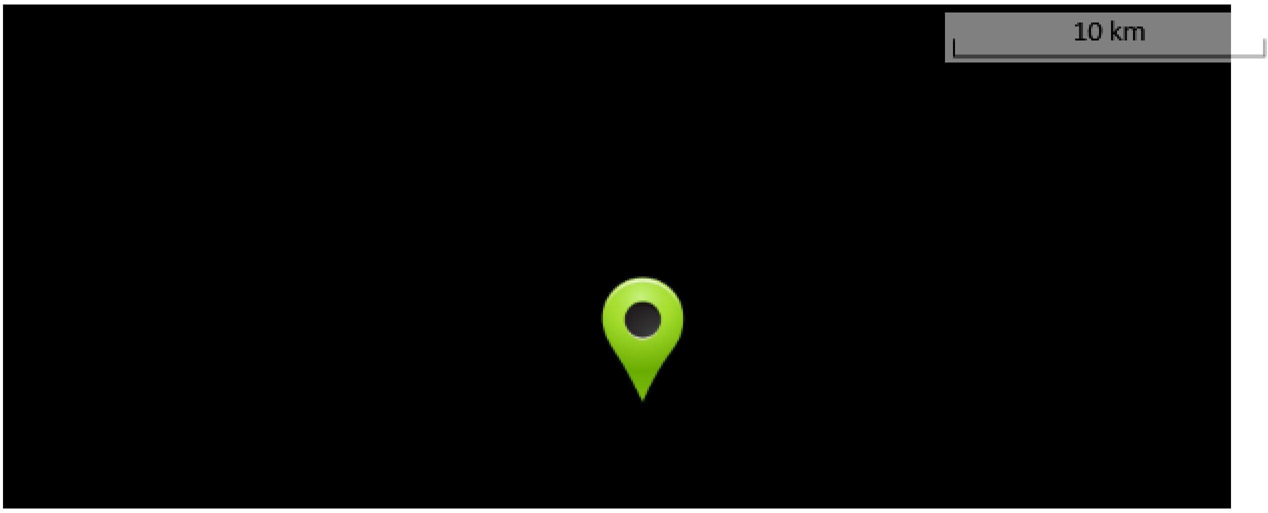
4105_CIA_5_Lot_Subdivision

Scenario details:

RUN_002 (Lot 1, 2, 4, 5): 5-bedroom dwelling (tank water) (0.96kL/d), Zero storage, EDS=480sqm, IRR=SSI, Trigger=Fixed Daily, Application 2.5mm depth fixed.

Map of location:

Note: If the map above appears as a dark box, check that the network is accessible and that the coordinates are not for a location in the ocean.



Description

Climate information

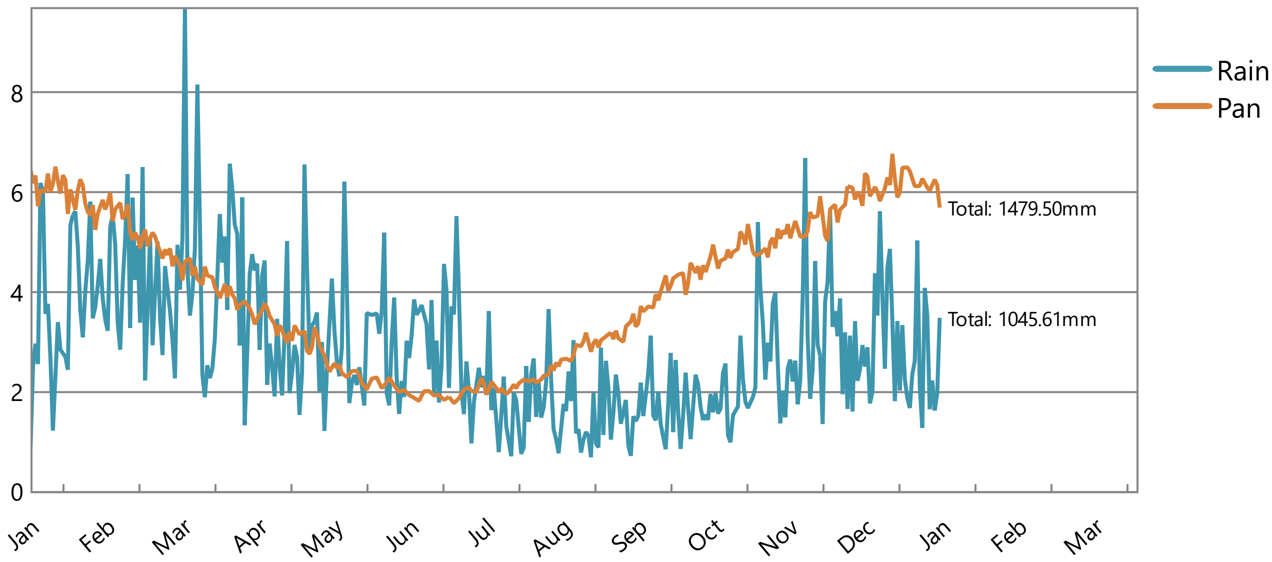
Climate Data Location: Dungog_Clarence_Town_60years, -32.6°, 151.76°
Run Period: 01/01/1965 to 31/12/2025 (61 years)

Climate statistics

	5th Percentile		50th Percentile		95th Percentile	
Rainfall (mm/year)	(Year 2019)	628.2	(Year 1977)	1032.7	(Year 1998)	1434.8
Pan evaporation (mm/year)	(Year 2011)	1278.2	(Year 2001)	1468.5	(Year 2019)	1686.3

Climate data

Daily average across run period:



Description

Wastestream information

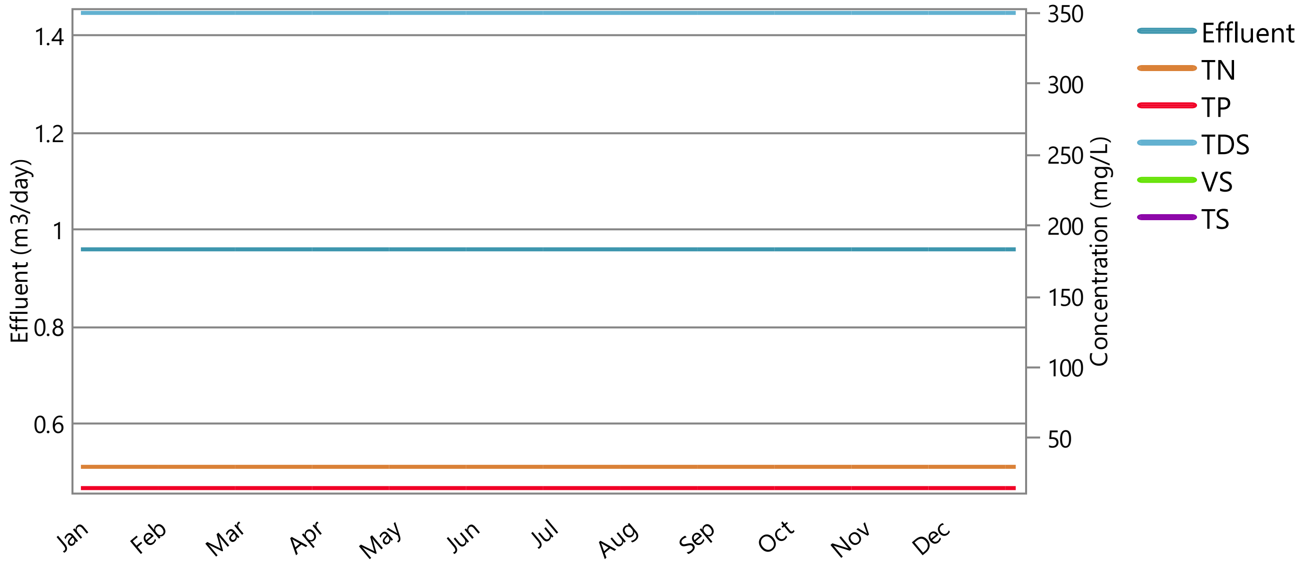
Wastestream Name: - New generic system

Wastestream production description

Daily New generic system data supplied for a representative year. This wastestream is not separately pretreated.

Wastestream

Average Daily Quantity and Flow-Weighted Average Quality:



Wastestream

Effluent Quantity: 350.64 m3/year or 0.96 m3/day (Min-Max 0.96 - 0.96)

Flow-Weighted Average (Min - Max) Daily Effluent Quality Entering the Pond System:

	Concentration (mg/L)	Load (kg/year)
Total nitrogen	30.00 (30.00 - 30.00)	10.52 (10.51 - 10.54)
Total phosphorus	15.00 (15.00 - 15.00)	5.26 (5.26 - 5.27)
Total dissolved salts	350.00 (350.00 - 350.00)	122.72 (122.64 - 122.98)
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)

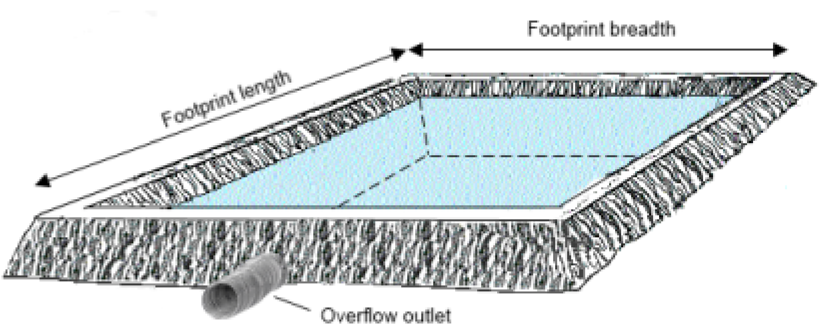
Description

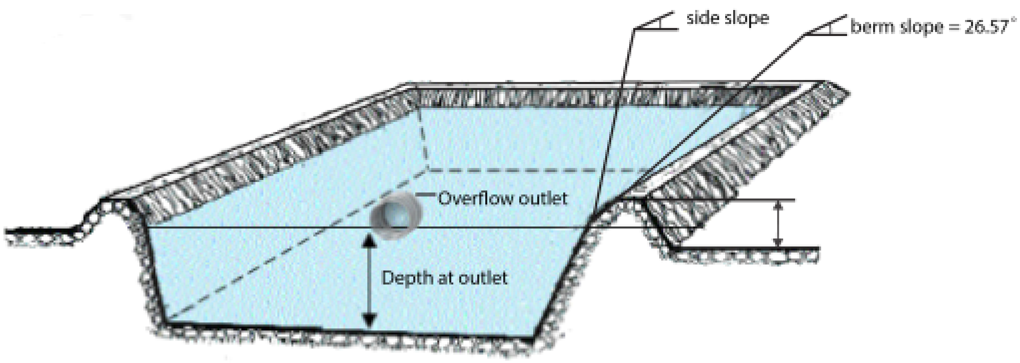
Pond system information

Pond System Configuration: 1 closed (sludge-free) storage tank

Pond system details

	Pond 1
Maximum pond volume (m3)	1.50
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	0.90
Maximum water surface area (m2)	4.64
Pond footprint length (m)	2.15
Pond footprint width (m)	2.15
Pond catchment area (m2)	4.64
Average active volume (m3)	0.00





Irrigation pump limits

Minimum pump rate per area limit (ML/day/m2)	0.00
Maximum pump rate per area limit (ML/day/m2)	0.00

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	No

Description

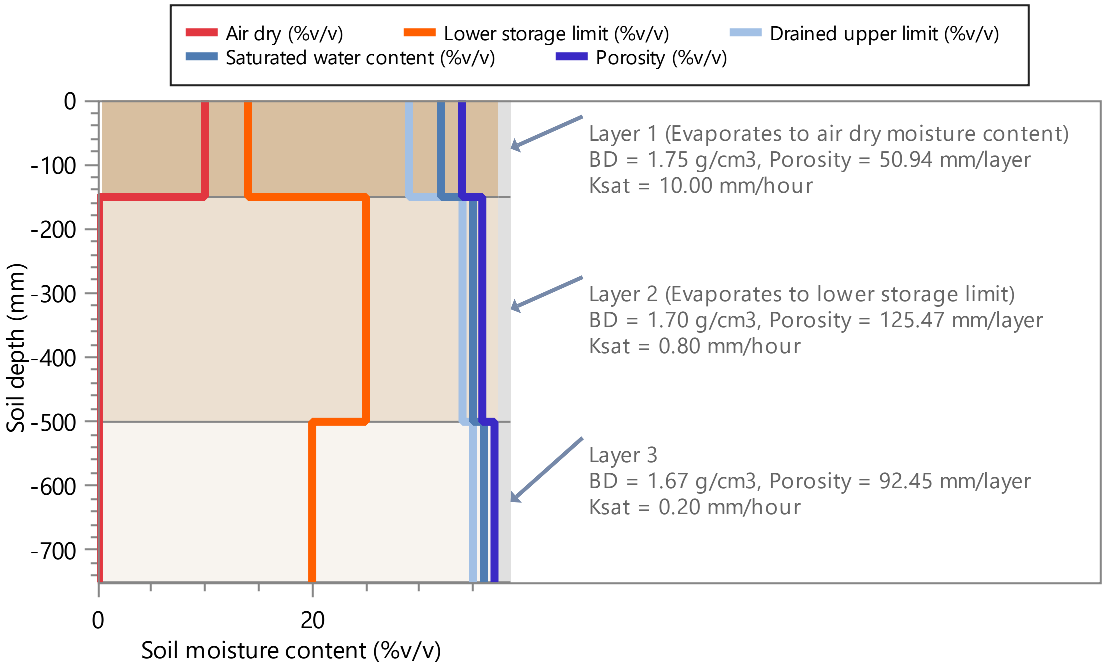
Paddock information

Paddock: 4105 Lot 1, 2, 4, 5, 480 m2

Soil type: 4105_Kurosol 1, 750.00 mm defined profile depth

Profile porosity (mm)	268.87
Profile saturation water content (mm)	260.50
Profile drained upper limit (or field capacity) (mm)	250.00
Profile lower storage limit (or permanent wilting point) (mm)	158.50
Profile available water capacity (mm)	91.50
Profile limiting saturated hydraulic conductivity (mm/hour)	0.20
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

Profile



Planting regime: Continuous Kikuyu 1 pasture

Average monthly cover (fraction) (minimum - maximum)	0.86 (0.83 - 0.90)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Dead cover (if Mthly Covers) or Tot. cover left after harvest (fraction)	1.00
Potential rooting depth in defined soil profile (mm)	750.00
Salt tolerance	Moderately tolerant
Salinity threshold (dS/m soil saturation extract)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03

Irrigation rules: Pressure-compensating SSI

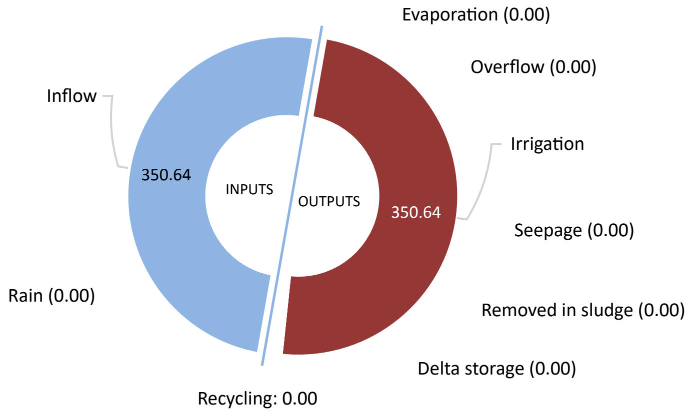
Rule 1. Irrigation triggered every 1 days and rainfall is less than or equal to 10000.00 mm
Rule 2. Irrigate a fixed amount of 2.50 mm each day
Rule 3. Irrigation window from 1/1 to 31/12 including the days specified
Rule 4. A minimum of 0 days must be skipped between irrigation events

Performance

Pond system information

Pond System Configuration: 1 closed (sludge-free) storage tank (wet weather storage pond: 1.5 m3)

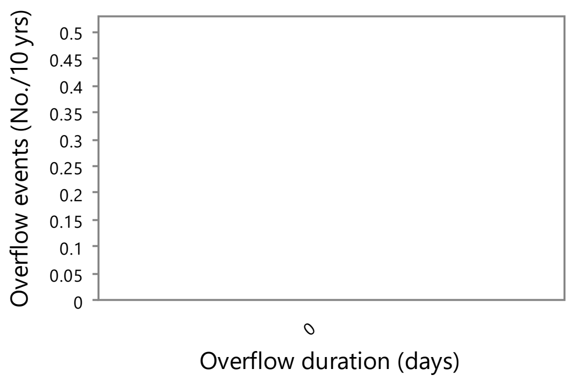
Pond system water balance (m3/year)

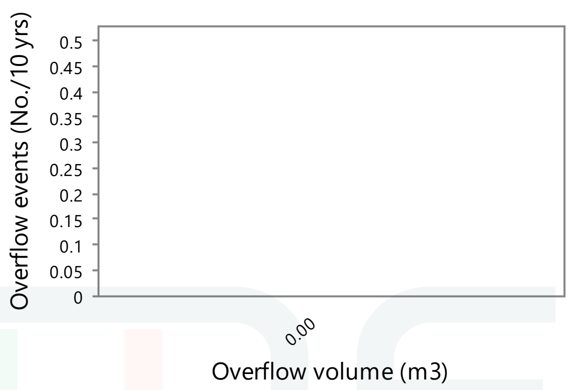


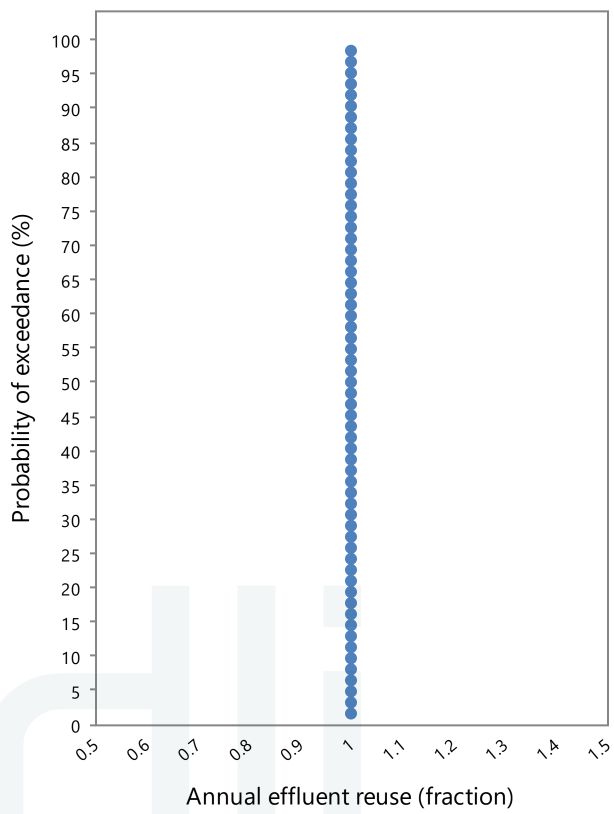
Name	Value
Rain	0.00
Inflow	350.64
Recycling	0.00
Evaporation	0.00
Overflow	0.00
Irrigation	350.64
Seepage	0.00
Removed in sludge	0.00
Delta storage	0.00

Overflow and reuse diagnostics

Metric	Value
Total volume of overflow (m3/10 years)	0.00
Total number of overflow events (events/10 years)	0.00
Total number of pond overflow days (days/10 years)	0.00
Probability of at least 90% effluent reuse (%)	100.00
Effluent reuse (Proportion of inflow + net gain in rain that is irrigated) (fraction)	1.00





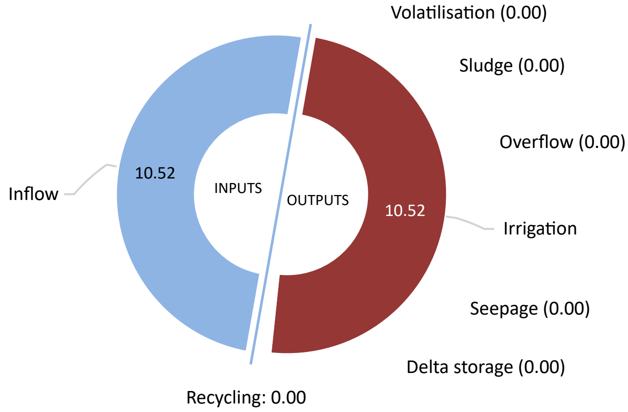


Performance

Pond system information

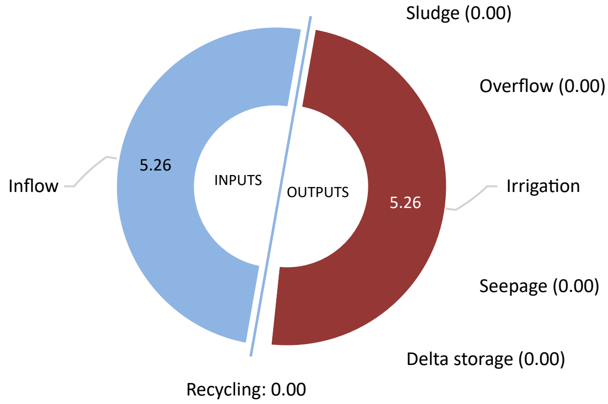
Pond System Configuration: 1 closed (sludge-free) storage tank

Pond system nitrogen balance (kg/year)



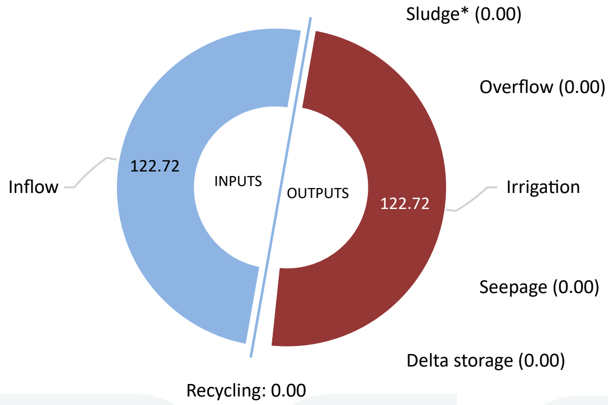
Name	Value
Inflow	10.52
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	10.52
Seepage	0.00
Delta storage	0.00

Pond system phosphorus balance (kg/year)



Name	Value
Inflow	5.26
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	5.26
Seepage	0.00
Delta storage	0.00

Pond system salt balance (kg/year)



Name	Value
Inflow	122.72
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	122.72
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 information

Pond System Configuration: 1 closed (sludge-free) storage tank

Pond nutrient concentrations and salinity

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	30.00
Average phosphorus concentration of pond liquid (mg/L)	15.00
Average salinity of pond liquid (dS/m)	0.55

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	N.D.*
Final phosphorus concentration of pond liquid (mg/L)	N.D.*
Final salinity of pond liquid (dS/m)	N.D.*

* Not determined. Pond is empty.

Performance

Water use (assumes 100% irrigation efficiency)

Metric	Value
Pond water irrigated (m3/year)	350.64
Average shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	350.64
Proportion of irrigation events requiring shandying (fraction of events)	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

Metric	Value
Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	30.00
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	29.40
Average phosphorus concentration of irrigation water (mg/L)	15.00
Average salinity of irrigation water (dS/m)	0.55

Irrigation diagnostics

Metric	Value
No. periods/year without any irrigable effluent in the wet weather storage pond (periods/year)	0.00
Average length of such periods (days)	0.00

Irrigation triggering and application

No. Days without Irrigation Applied per Year: 0.00
No. Days with Irrigation Applied per Year: 365.25 (with supply limited - partial application)
No. Days with Irrigation Triggered per Year: 365.25

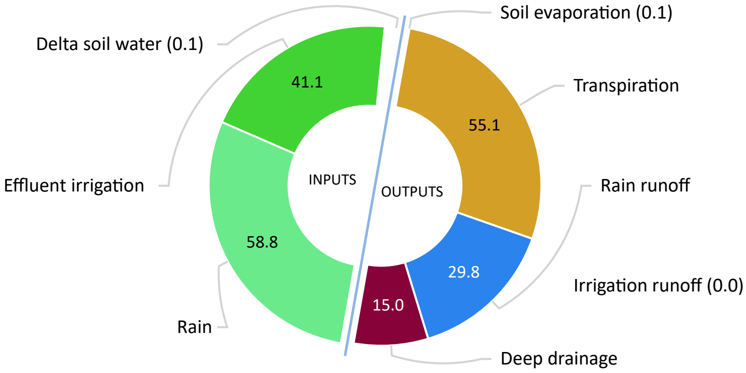
Performance

Paddock information

Paddock: 4105 Lot 1, 2, 4, 5, 480 m2

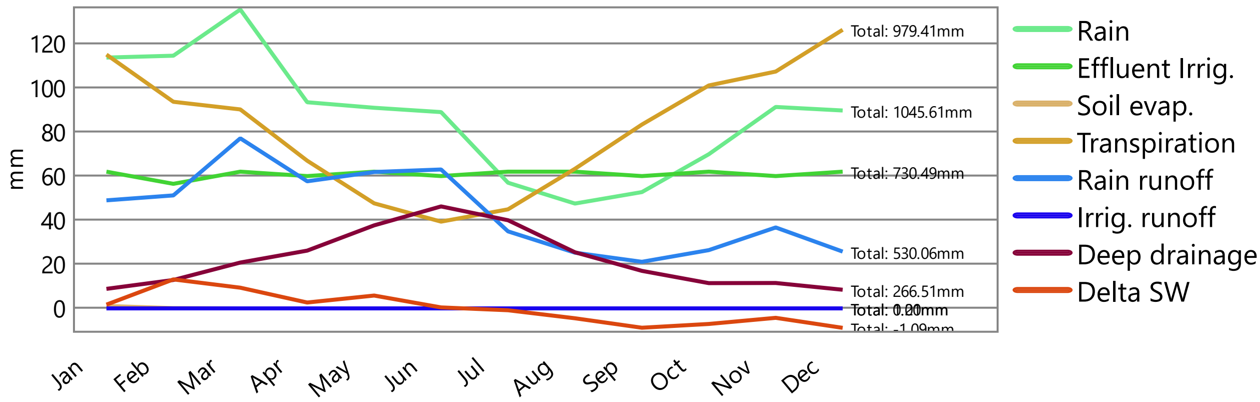
Soil Type: 4105_Kurosol 1, 91.50 mm PAWC at maximum root depth

Soil water balance (%)

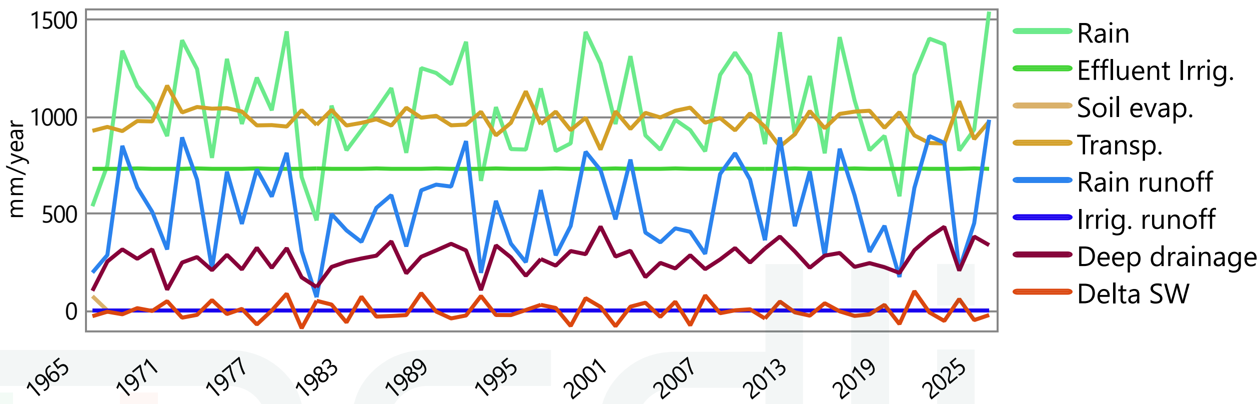


Name	Value
Rain	58.8
Effluent irrigation	41.1
Soil evaporation	0.1
Transpiration	55.1
Rain runoff	29.8
Irrigation runoff	0.0
Deep drainage	15.0
Delta soil water	-0.1

Average monthly totals (mm)



Average annual totals (mm/year)

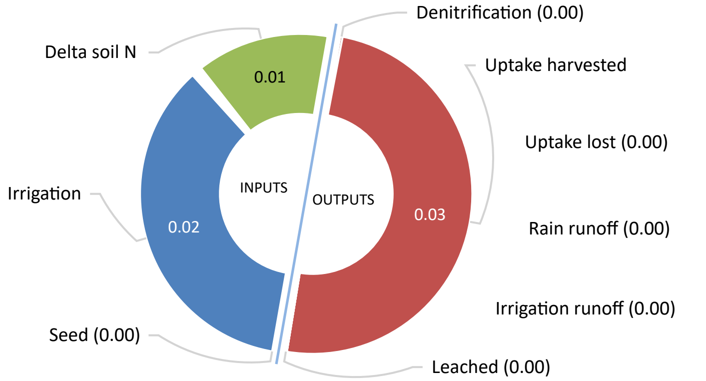


Performance

Paddock information

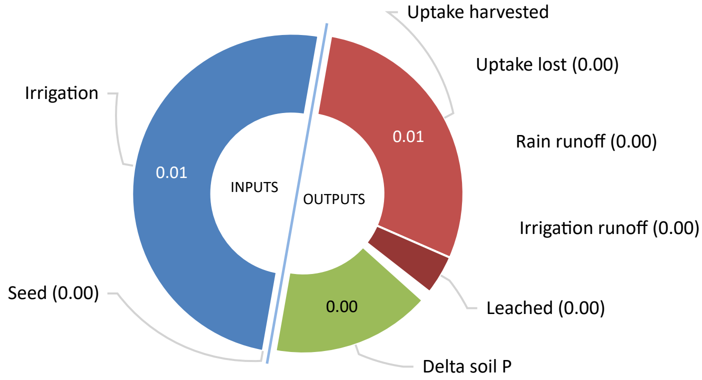
Paddock: 4105 Lot 1, 2, 4, 5, 480 m2
Soil Type: 4105_Kurosol 1
Irrigation Ammonia-N Volatilisation Losses (kg/m2/year): 0.00
Proportion of Total Nitrogen in Irrigated Effluent as Ammonium (fraction): 0.10

Soil nitrogen balance (kg/m2/year)



Name	Value
Seed	1.72E-06
Irrigation	0.02
Denitrification	1.37E-04
Uptake harvested	0.03
Uptake lost	0.00
Rain runoff	0.00
Irrigation runoff	0.00
Leached	1.14E-04
Delta soil N	-0.01

Soil phosphorus balance (kg/m2/year)



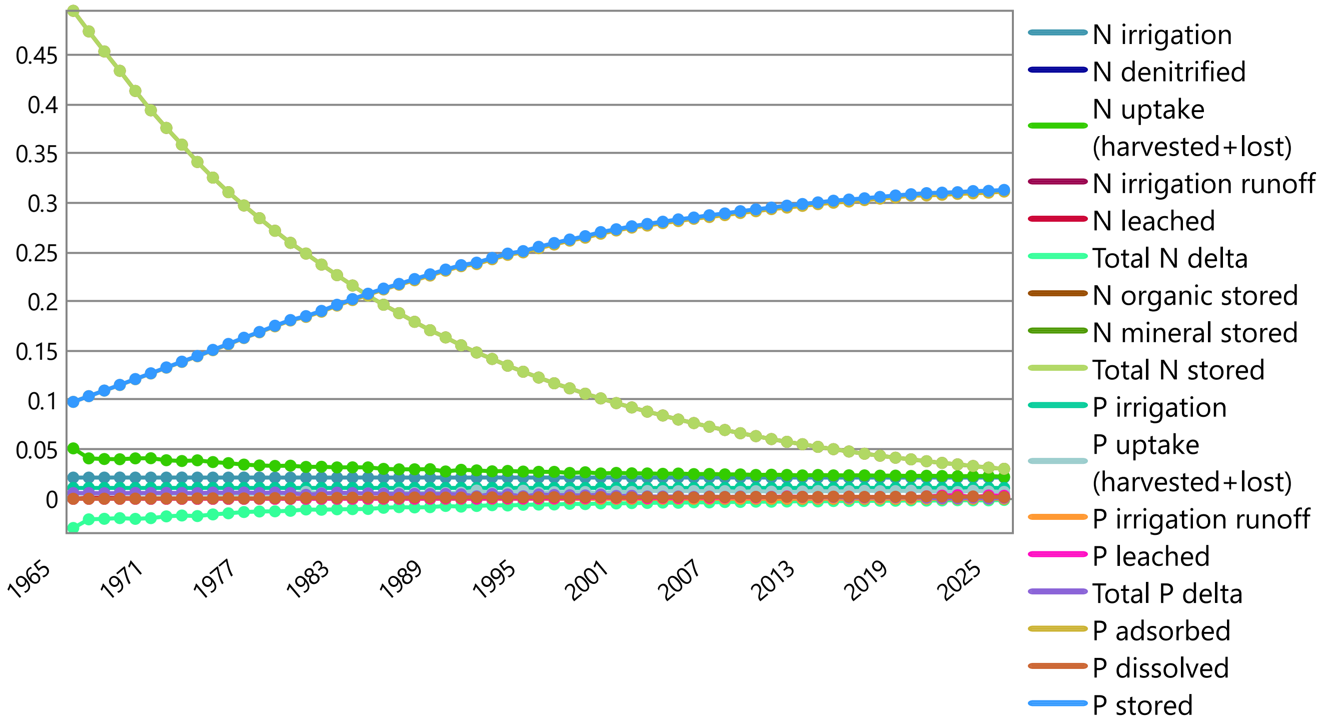
Name	Value
Seed	1.48E-07
Irrigation	0.01
Uptake harvested	0.01
Uptake lost	0.00
Rain runoff	0.00
Irrigation runoff	0.00
Leached	8.89E-04
Delta soil P	3.61E-03

Performance

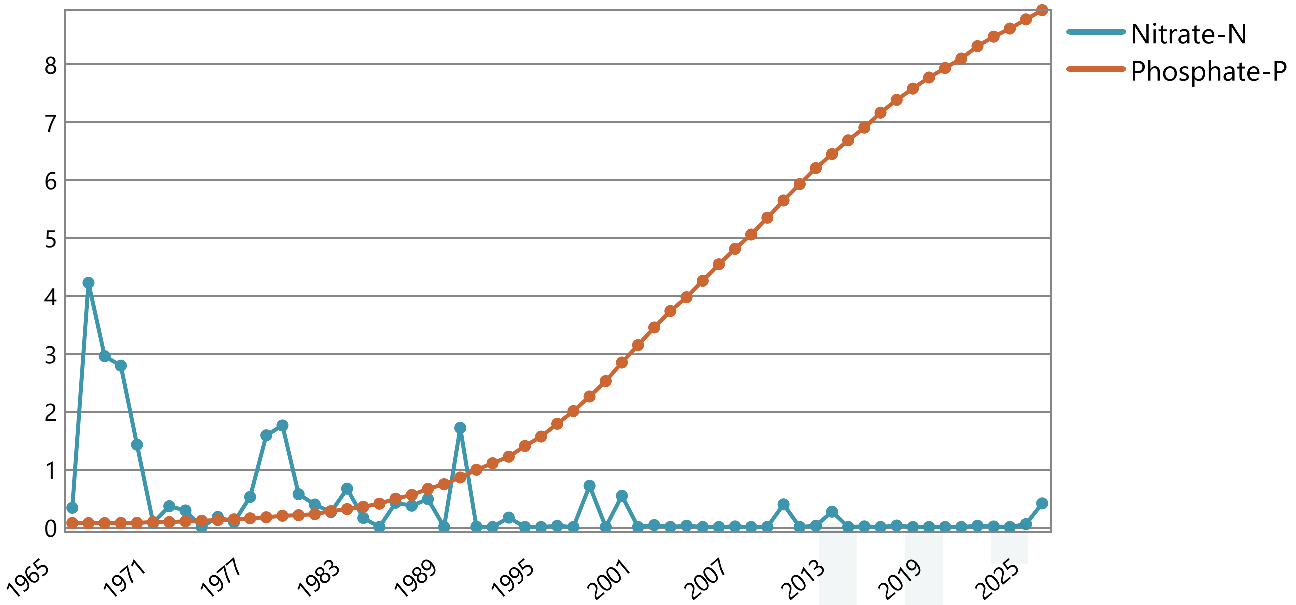
Paddock information

Paddock: 4105 Lot 1, 2, 4, 5, 480 m2
Soil Type: 4105_Kurosol 1

Annual nutrient totals (kg/m2)



Annual nutrient leaching concentration (mg/L)



Performance

Paddock information

Paddock: 4105 Lot 1, 2, 4, 5, 480 m2
Soil Type: 4105_Kurosol 1
Planting Regime: Continuous Kikuyu 1 pasture

Plant growth (minimum - maximum)

Metric	Value
Average annual shoot dry matter harvestable yield* (kg/m2/year)	1.48 (1.20 - 2.01)
Average annual shoot dry matter lost (kg/m2/year)	0.00 (0.00 - 0.00)
Average monthly plant (green) cover (fraction)	0.86 (0.83 - 0.90)
Average monthly root depth (mm)	749.58 (744.99 - 750.00)

Plant nutrient uptake (minimum - maximum)

Metric	Value
Average annual shoot nitrogen in harvestable yield* (kg/m2/year)	0.03 (0.02 - 0.05)
Average annual shoot nitrogen lost (kg/m2/year)	0.00 (0.00 - 0.00)
Average annual shoot phosphorus in harvestable yield* (kg/m2/year)	0.01 (0.00 - 0.01)
Average annual shoot phosphorus lost (kg/m2/year)	0.00 (0.00 - 0.00)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.02 - 0.03)
Average annual shoot phosphorus concentration (fraction dwt)	0.004 (0.003 - 0.006)

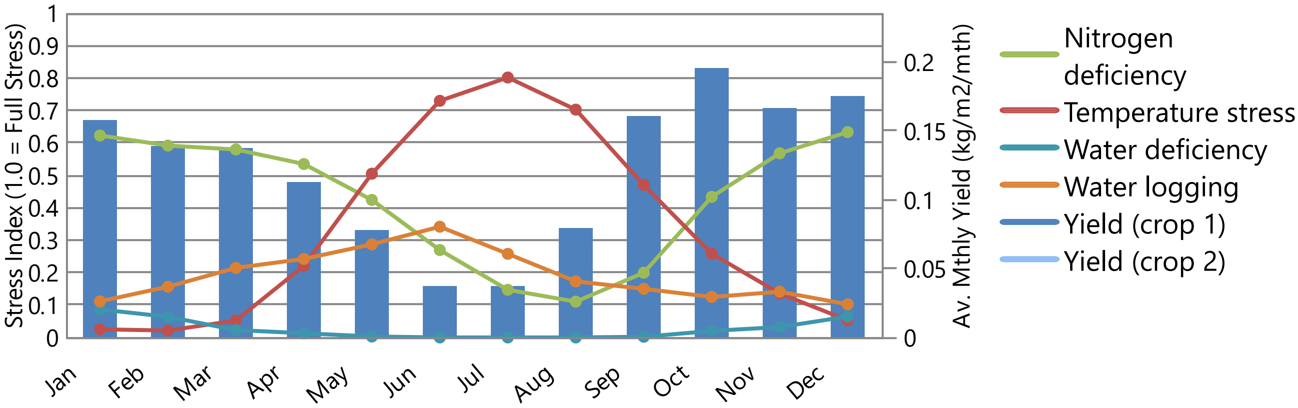
*Harvestable yield is a measure of *net* gain over a nominated period - say monthly. It is the total shoot-dry-matter gain minus any shot-dry-matter loss within a given period. Hence, just like financial investments, negative harvestable yields may occur when the (episodic) losses exceed the gains made within a particular accounting period.

Performance

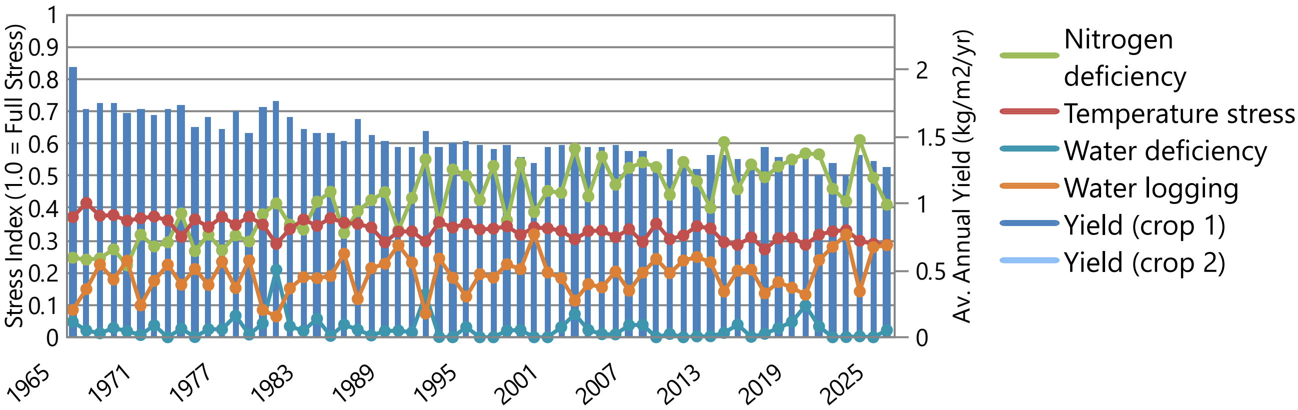
Paddock information

Paddock: 4105 Lot 1, 2, 4, 5, 480 m2
Soil Type: 4105_Kurosol 1
Planting Regime: Continuous Kikuyu 1 pasture

Av. monthly stresses & harvestable yield* (kg/m2/month)



Av. annual stresses & harvestable yield* (kg/m2/year)



*Harvestable yield is a measure of *net* gain over a nominated period - say monthly. It is the total shoot-dry-matter gain minus any shot-dry-matter loss within a given period. Hence, just like financial investments, negative harvestable yields may occur when the (episodic) losses exceed the gains made within a particular accounting period.

Normal and forced harvest information

No. of Harvests per Year: 2.66 (normal).
No. Days without Crop per Year (no./year): 0.00

Performance

Paddock information

Paddock: 4105 Lot 1, 2, 4, 5, 480 m2
Soil Type: 4105_Kurosol 1
Planting Regime: Continuous Kikuyu 1 pasture

Plant salinity tolerance

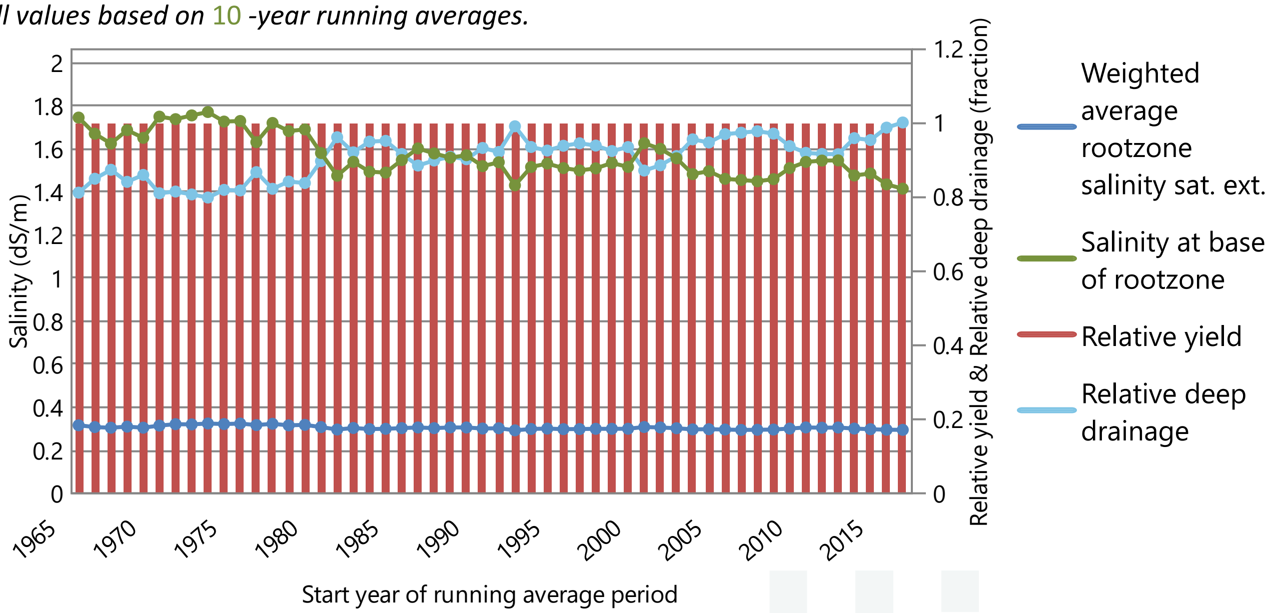
Metric	Value
Salt tolerance	Moderately tolerant
Salinity threshold (dS/m soil saturation extract)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03
No. years assumed for leaching to reach steady-state (years)	10.00

Soil salinity

Metric	Value
Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.33
Salt added by rainfall (kg/m2/year)	0.01
Average annual salt added & leached at steady state (kg/m2/year)	0.27
Average leaching fraction based on 10 -year running averages (fraction)	0.50
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.31
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	1.57
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.

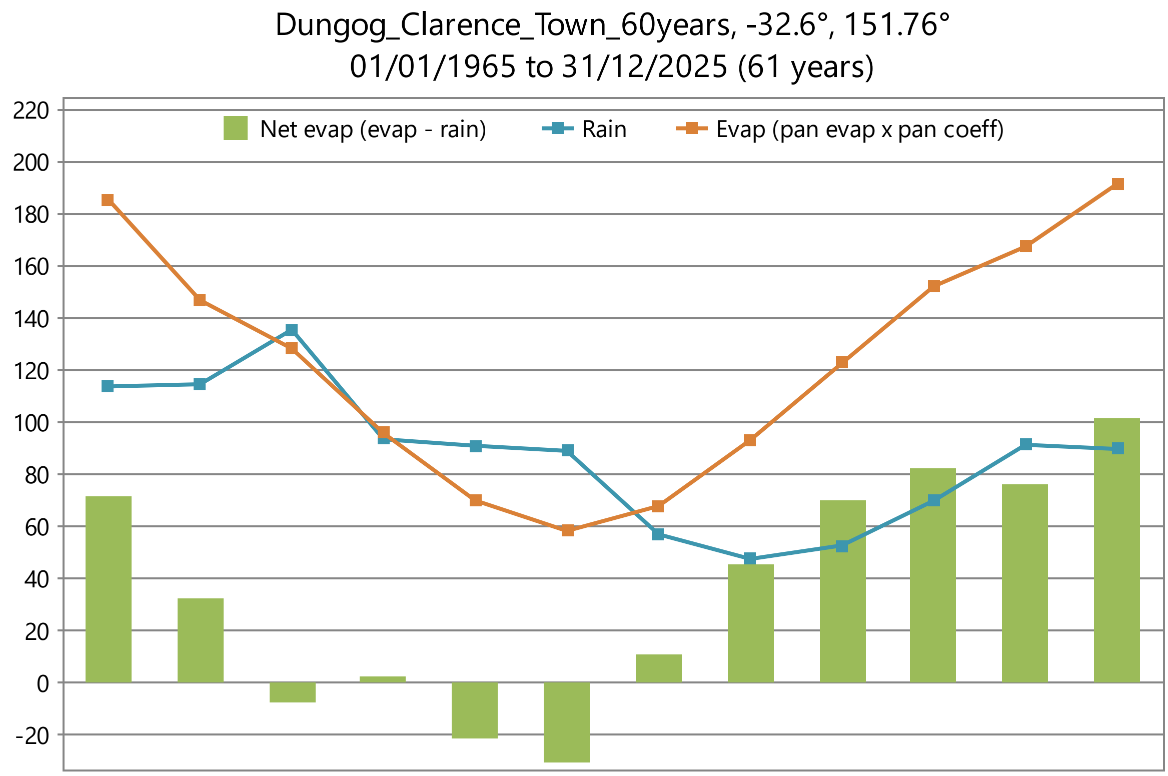


Diagnostics

Scenario information

Enterprise: 206 Fotheringay Road, Clarence Town NSW

Climate long-term monthly averages (mm)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	113.7	114.6	135.5	93.5	91.0	89.0	57.0	47.5	52.7	69.9	91.3	89.7	1045.6
Evap	185.5	146.8	128.3	95.8	70.0	58.3	67.9	93.2	122.7	152.2	167.4	191.5	1479.5
Net evap	71.7	32.2	-7.2	2.3	-21.0	-30.7	10.9	45.6	70.0	82.3	76.1	101.7	433.9
Net evap/day	2.3	1.1	-0.2	0.1	-0.7	-1.0	0.4	1.5	2.3	2.7	2.5	3.3	1.2

Diagnostics

Pond system information

Pond System Configuration: 1 closed (sludge-free) storage tank

Effluent Type: - 350.64 m3/year or 0.96 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/year.

Constituent	Concentration (mg/L)	Load (kg/year)
Total nitrogen	30.00 (30.00 - 30.00)	10.52 (10.51 - 10.54)
Total phosphorus	15.00 (15.00 - 15.00)	5.26 (5.26 - 5.27)
Total dissolved salts	350.00 (350.00 - 350.00)	122.72 (122.64 - 122.98)
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)

Ammonia-N loss from pond system water surface area: 0.00 kg/m2/year

Last pond (wet weather store): 1.50 m3

Metric	Value
Theoretical hydraulic retention time (days)	1.56
Volume of overflow (m3/year) Average (minimum-maximum)	0.00 (0.00 - 0.00)
Volume of overflow per day (m3/day) Average (minimum-maximum)	0.00 (0.00 - 0.00)
No overflow days - Average per year (Total in run period)	0.00 (0)
No. overflow events per 10 years exceeding threshold of 0.005 m3* (events/10 years)	0.00
Average overflow event recurrence interval (years)	0.00
Average duration of overflow (days)	0.00
Probability of at least 90% effluent reuse (%)	100.00
Effluent reuse (proportion of inflow + net rain gain that is irrigated) (fraction)	1.00
Average salinity (dS/m)	0.55
Salinity on final day of simulation (dS/m)	0.55

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

Volume distribution of the overflow events

Overflow volume (m3)	Overflow events (No./10 yrs)
0	0.00

Diagnostics

Scenario information

Area irrigated: 480 m2 total area

Loading to whole irrigation area: (assuming 100% irrigation efficiency)

	Quantity/year	Quantity/m2/year
Total irrigation applied (m3)	350.64	0.73
Total nitrogen applied (kg)	10.31	0.02
Total phosphorus applied (kg)	5.26	0.01
Total salts applied (kg)	122.72	0.26

Shandying

Metric	Value
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)
Minimum shandy water is used	No

Irrigation issues

Metric	Value

Diagnostics

Paddock information

Paddock: - 4105 Lot 1, 2, 4, 5, 480 m2

Irrigation: Pressure-compensating SSI with 0.2% ammonium loss during irrigation

Irrigation Rules
Irrigation triggered every 1 days and rainfall is less than or equal to 10000.00 mm
Irrigate a fixed amount of 2.50 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): 4105_Kurosol 1, 91.50 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	113.7	114.6	135.5	93.5	91.0	89.0	57.0	47.5	52.7	69.9	91.3	89.7	1045.6
Efflt. irrg.	62.0	56.5	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	730.5
Soil evap	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Transpn.	115.1	93.7	90.2	67.0	47.6	39.3	44.9	63.3	83.4	101.1	107.4	126.4	979.4
Rain runoff	49.0	51.2	77.1	57.6	61.8	63.0	34.9	25.3	21.1	26.4	36.7	25.8	530.1
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	8.9	12.9	20.8	26.2	37.7	46.2	40.0	25.5	17.0	11.5	11.5	8.5	266.5
Delta SW	1.7	13.1	9.4	2.7	5.8	0.4	-0.8	-4.5	-8.8	-7.1	-4.3	-8.8	-1.1

Soil nitrogen balance: (Concentrations are flow-weighted)

Metric	Value
Average annual nitrogen added in seed (kg/m2/year)	1.72E-06
Average annual nitrogen added from irrigation (kg/m2/year)	0.02
Av. annual soil N removed by uptake (harvest + lost) (kg/m2/year)	0.03 (0.03, 0.00)
Av. annual soil nitrogen removed by denitrification (kg/m2/year)	1.37E-04
Average annual soil nitrogen leached (kg/m2/year)	1.14E-04
Average annual nitrate-N loading to groundwater (kg/m2/year)	1.14E-04
Soil organic-N kg/m2 (Initial - Final)	0.52 - 0.03
Soil inorganic-N kg/m2 (Initial - Final)	0.01 - 1.83E-06
Average nitrate-N concentration of deep drainage (Max annual concentration)	
Across all years (mg/L)	0.43 (4.23)
Excluding first year of data (mg/L)	0.43 (4.23)

Soil phosphorus balance: (Concentrations are flow-weighted)

Metric	Value
Average annual phosphorus added in seed (kg/m2/year)	1.48E-07
Average annual phosphorus added from irrigation (kg/m2/year)	0.01
Av. annual soil P removed by uptake (harvest + lost) (kg/m2/yr)	0.01 (0.01, 0.00)
Average annual soil phosphorus leached (kg/m2/year)	8.89E-04
Dissolved phosphorus (kg/m2) (Initial - Final)	2.50E-05 - 1.72E-03
Adsorbed phosphorus (kg/m2) (Initial - Final)	0.09 - 0.31
Average phosphate-P concentration in rootzone (mg/L)	5.56
Average phosphate-P concentration of deep drainage (Max annual concentration)	
Across all years (mg/L)	3.34 (8.94)
Last year only (mg/L)	8.94 (N.D.*)
Design soil profile storage life based on average infiltrated water phosphorus concn. of 8.79 mg/L (years)	47.20

* Not determined

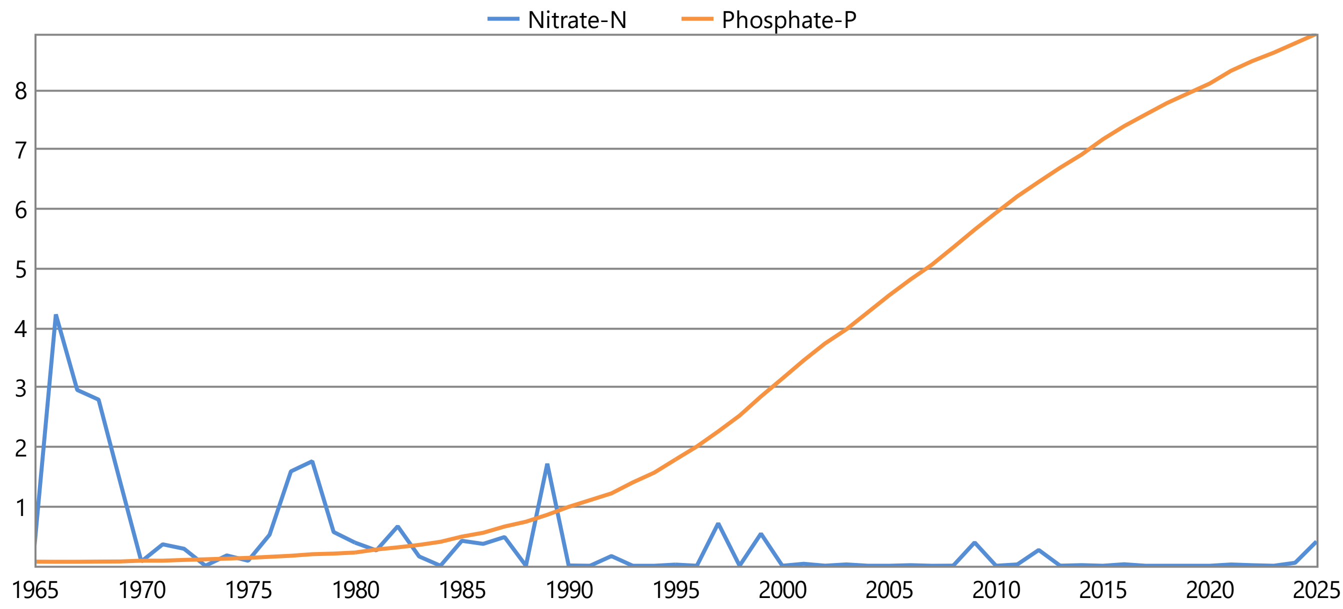
Diagnostics

Paddock information

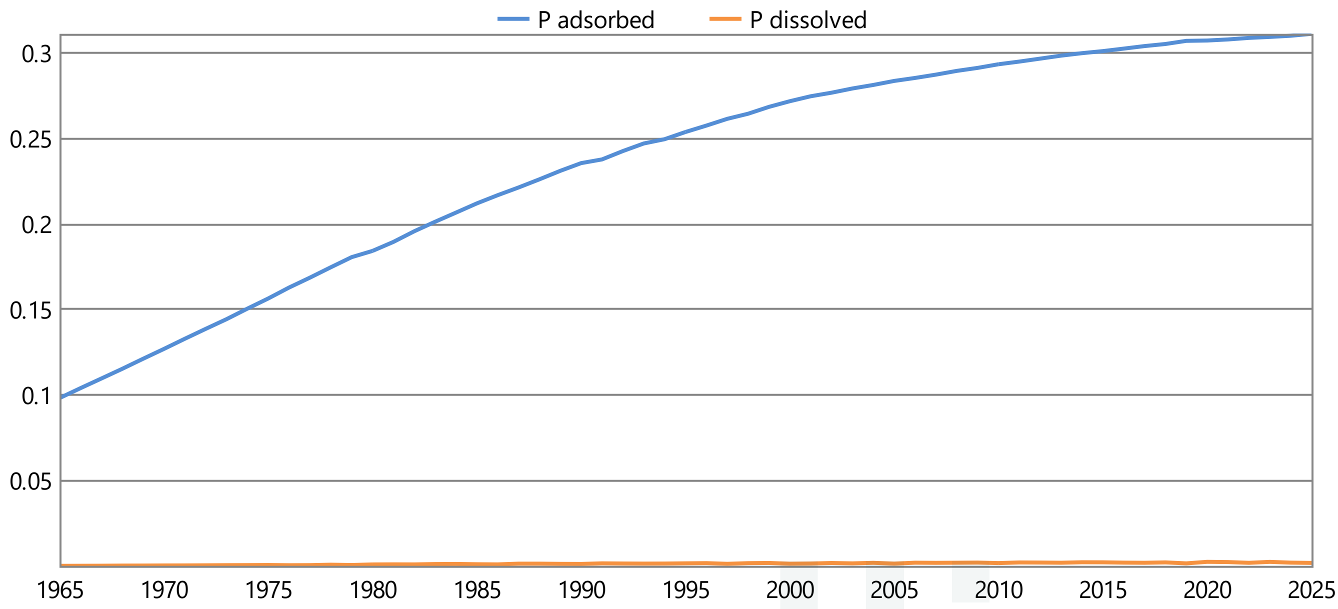
Paddock: 4105 Lot 1, 2, 4, 5, 480 m2

Irrigation: Pressure-compensating SSI with 0.2% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual phosphate-P in soil (kg/m2)



Diagnostics

Paddock information

Paddock: 4105 Lot 1, 2, 4, 5, 480 m2
Planting Regime: Continuous Kikuyu 1 pasture

Average plant performance (minimum - maximum)

Metric	Value
Average annual shoot dry matter harvestable yield (kg/m2/year)	1.48 (1.20 - 2.01)
Average annual shoot dry matter lost (kg/m2/year)	0.00 (0.00 - 0.00)
Average monthly plant (green) cover (fraction)	0.86 (0.83 - 0.90)
Average monthly crop factor (fraction)	0.69 (0.66 - 0.72)
Dead cover (if Mthly Covers) or Tot. cover left after harvest (fraction)	1.00
Average monthly root depth (mm)	749.58 (744.99 - 750.00)
Average number of normal harvests per year (no./year)	2.66 (2.00 - 4.00)
Average number of normal harvests for last five years only (no./year)	2.20
Average number of forced harvests per year (no./year)	0.00 (0.00 - 0.00)
Average number of forced harvests for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.43 (0.22 - 0.61)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.03 (0.00 - 0.09)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.80 (0.68 - 0.93)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.03 (0.00 - 0.09)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.19 (0.10 - 0.34)
No. days without crop per year. Excludes bare fallow days (days)	0.00

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.

Metric	Value
Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.33
Salt added by rainfall (kg/m2/year)	0.01
Average annual salt added & leached at steady state (kg/m2/year)	0.27
Average leaching fraction based on 10 -year running averages (fraction)	0.50
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.31
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	1.57
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 information

Messages generated when the scenario was run
*************************************** WASTESTREAM RESULTS ***************************************
TABLE OF QUANTITY AND QUALITY OF EACH RAINFALL-INDEPENDENT WASTESTREAM (AFTER PRETREATMENT AND BEFORE ENTERING ANY SEDIMENTATION BASIN)
____
Source Volume_m3/yr N conc_mg/L P conc_mg/L TDS conc_mg/L N load_kg/yr P load_kg/yr TDS load_kg/yr
New generic system 350.6 30.0 15.0 350.0 10.5 5.3 122.7
____
*************************************** END WASTESTREAM RESULTS *************************************
UNCONDITIONAL FINISH