



# LINDEMAN GREAT BARRIER REEF RESORT PROJECT ENVIRONMENTAL IMPACT STATEMENT

## APPENDIX O - WATER INFRASTRUCTURE ASSESSMENT

*Addendum:* This EIS was initially prepared assuming that the safe harbour was to be part of the Lindeman Great Barrier Reef Resort Project. With the commencement of the Great Barrier Reef Marine Park Authority's (GBRMPA) Dredging Coral Reef Habitat Policy (2016), further impacts on Great Barrier Reef coral reef habitats from yet more bleaching, and the recent impacts from Tropical Cyclone Debbie, the proponent no longer seeks assessment and approval to construct a safe harbour at Lindeman Island. Instead the proponent seeks assessment and approval for upgrades to the existing jetty and additional moorings in sheltered locations around the island to enable the resort's marine craft to obtain safe shelter under a range of wind and wave conditions. Accordingly, remaining references to, and images of, a safe harbour on various figures and maps in the EIS are no longer current.

# Water Infrastructure Assessment - Supporting Information

Lindeman Great Barrier Reef Resort

Prepared for  
White Horse Australia Lindeman Pty Ltd

13 February 2017



# Water Infrastructure Assessment - Supporting Information

## APPENDIX A MEDLI Modelling Output Reports

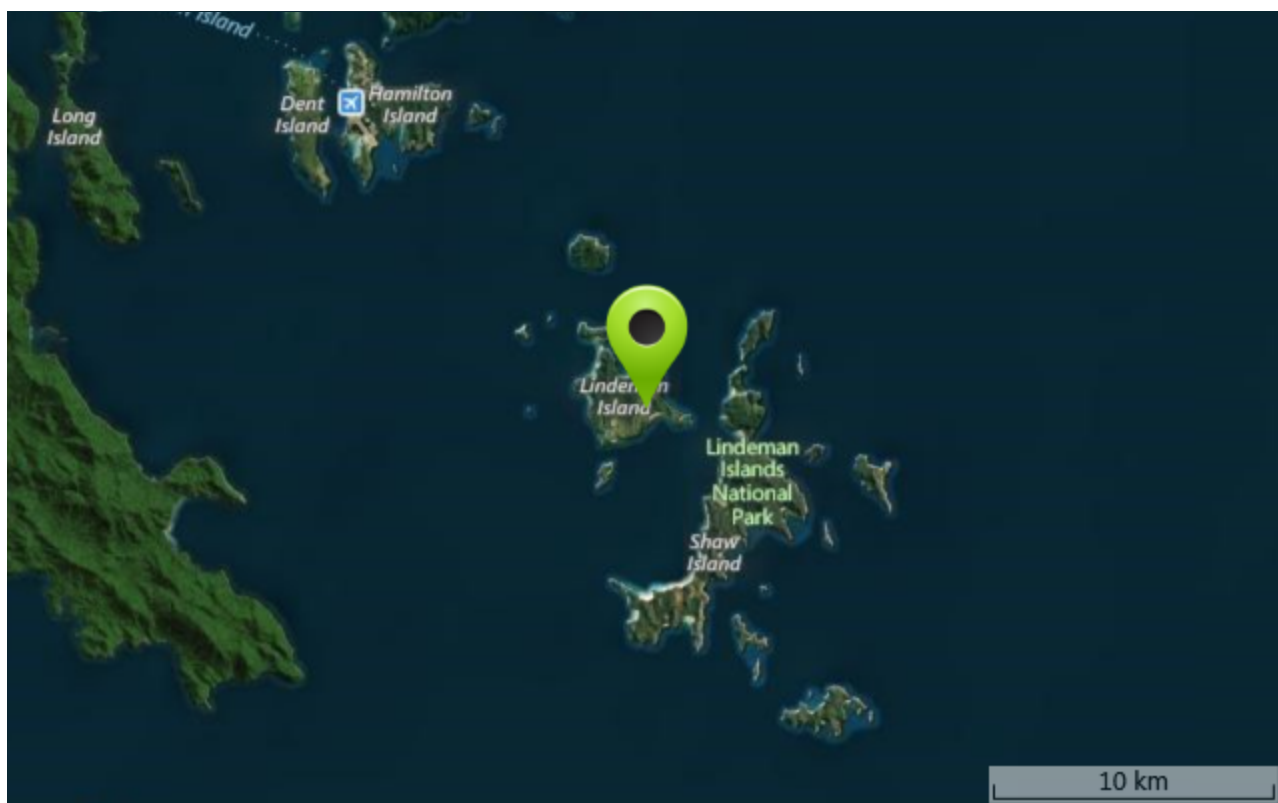
**Enterprise:** Lindeman Island Resort**Description:**

Recycled Water Management Plan

**Client:** White Horse Australia**MEDLI User:** Victoria Haigh**Scenario Details:**

Control Scenario No Irrigation

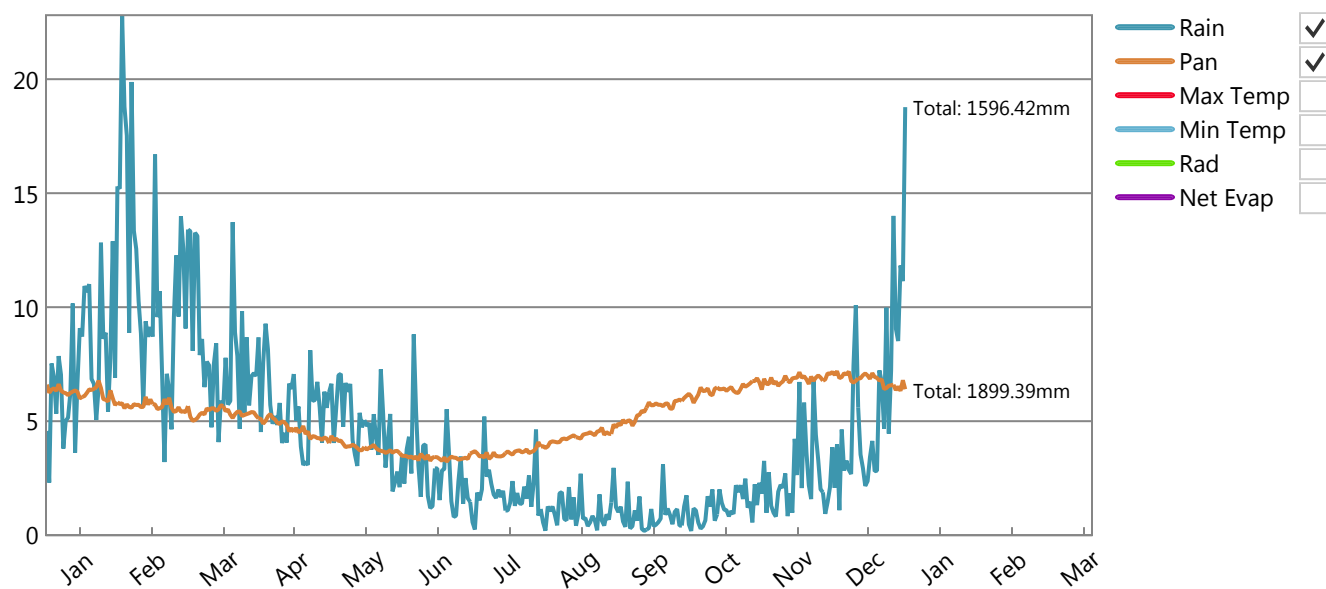
GENERAL INFORMATION - FULL RUN



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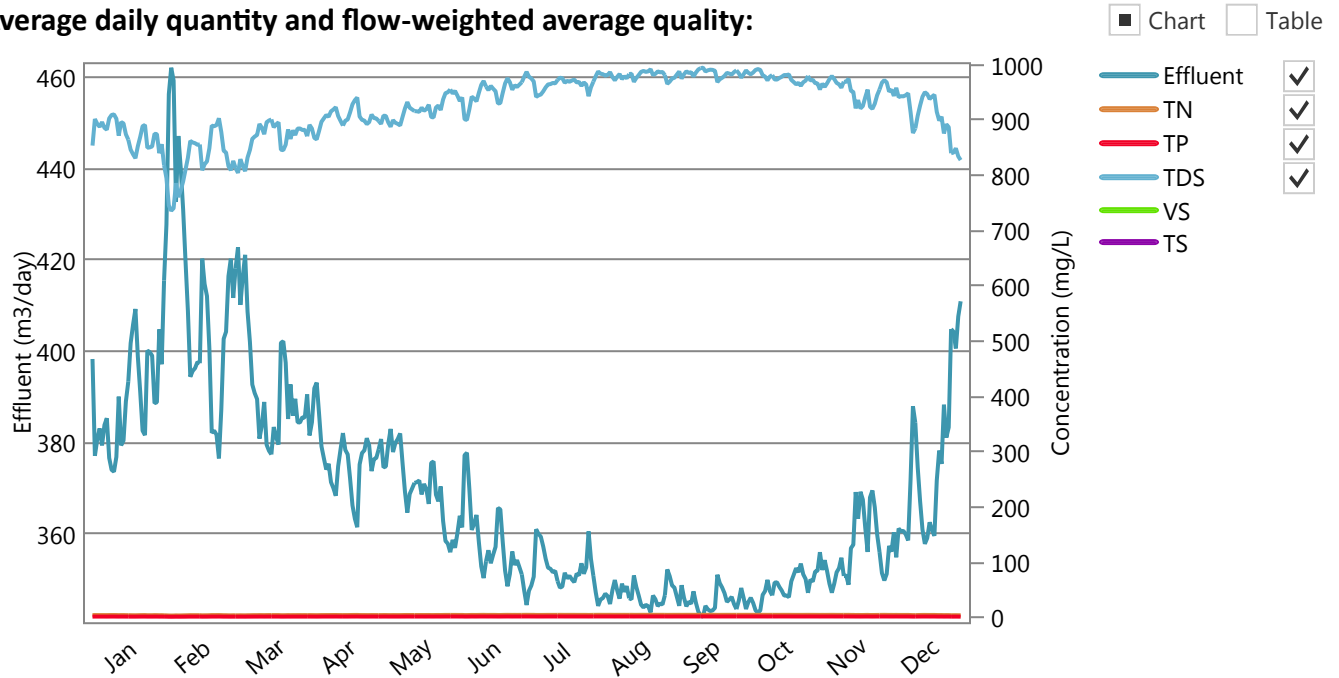
**Climate Data: Lindeman, -20.45°, 149.05°****Run Period: 01/01/1965 to 31/12/2014** 50 years, 0 days**Climate Statistics:**

|                           | 5th ▾ | Percentile | 50th Percentile | 95th ▾ | Percentile |
|---------------------------|-------|------------|-----------------|--------|------------|
| Rainfall (mm/year)        |       | 915        | 1568            |        | 2440       |
| Pan Evaporation (mm/year) |       | 1723       | 1892            |        | 2100       |

**Climate Data:**☒ Chart ☐ Table☐ Monthly ☒ Daily**Daily Average Across Run Period**

DESCRIPTION

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**Effluent type: New Sewage Treatment Plant****Wastestream before any recycling or pretreatment****Average daily quantity and flow-weighted average quality:****Wastestream after any recycling and pretreatment if applicable**

**Effluent quantity:** **134631.74 m3/year** or 368.61 m3/day (Min-Max: 339.94 - 2437.93)

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

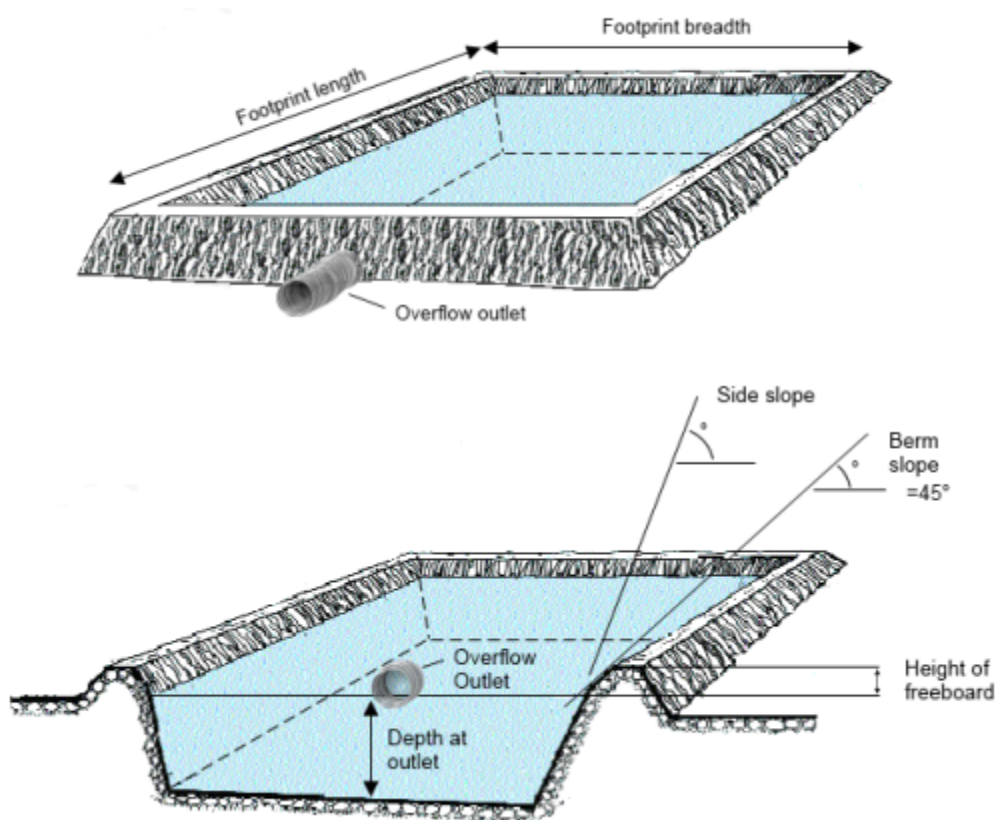
|                       | Concentration (mg/L)      | Load (kg/year)                    |
|-----------------------|---------------------------|-----------------------------------|
| Total Nitrogen        | 4.61 (0.70 - 5.00)        | 620.80 (620.39 - 622.09)          |
| Total Phosphorus      | 1.84 (0.28 - 2.00)        | 248.32 (248.16 - 248.84)          |
| Total Dissolved Salts | 922.22 (139.44 - 1000.00) | 124159.69 (124078.10 - 124418.04) |
| 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

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**Pond system: 1 facultative pond****Pond system details:**

|                                    | Pond 1   |
|------------------------------------|----------|
| Maximum pond volume (m3)           | 15000.00 |
| Minimum allowable pond volume (m3) | 371.41   |
| Pond depth at overflow outlet (m)  | 4.00     |
| Maximum water surface area (m2)    | 3786.92  |
| Pond footprint length (m)          | 87.83    |
| Pond footprint width (m)           | 44.31    |
| Pond catchment area (m2)           | 3891.99  |
| Average active volume (m3)         | 14964.92 |

**Irrigation pump limits:**

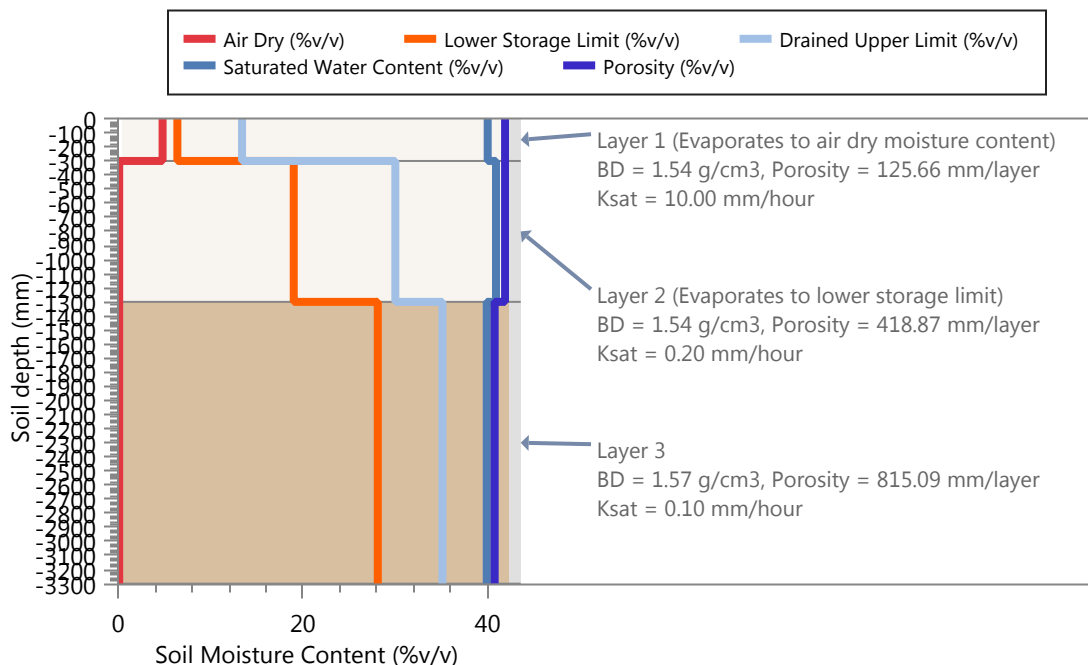
|                                              |      |
|----------------------------------------------|------|
| Minimum pump rate per area limit (ML/day/ha) | 0.00 |
| Maximum pump rate per area limit (ML/day/ha) | 0.00 |

**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                                       | False |

**Land: Nominated Irrigation Areas****Area (ha): 11.40****Soil Type: Duplex 2, 3300.00 mm defined profile depth**

|                                                               |         |
|---------------------------------------------------------------|---------|
| Profile Porosity (mm)                                         | 1359.62 |
| Profile saturation water content (mm)                         | 1327.00 |
| Profile drained upper limit (or field capacity) (mm)          | 1042.20 |
| Profile lower storage limit (or permanent wilting point) (mm) | 771.20  |
| Profile available water capacity (mm)                         | 271.00  |
| Profile limiting saturated hydraulic conductivity (mm/hour)   | 0.10    |
| Surface saturated hydraulic conductivity (mm/hour)            | 10.00   |
| Runoff curve number II (coefficient)                          | 82.00   |
| Soil evaporation U (mm)                                       | 8.00    |
| Soil evaporation Cona (mm/sqrt day)                           | 4.00    |

**Plant Data: Continuous Blady Grass Pasture**

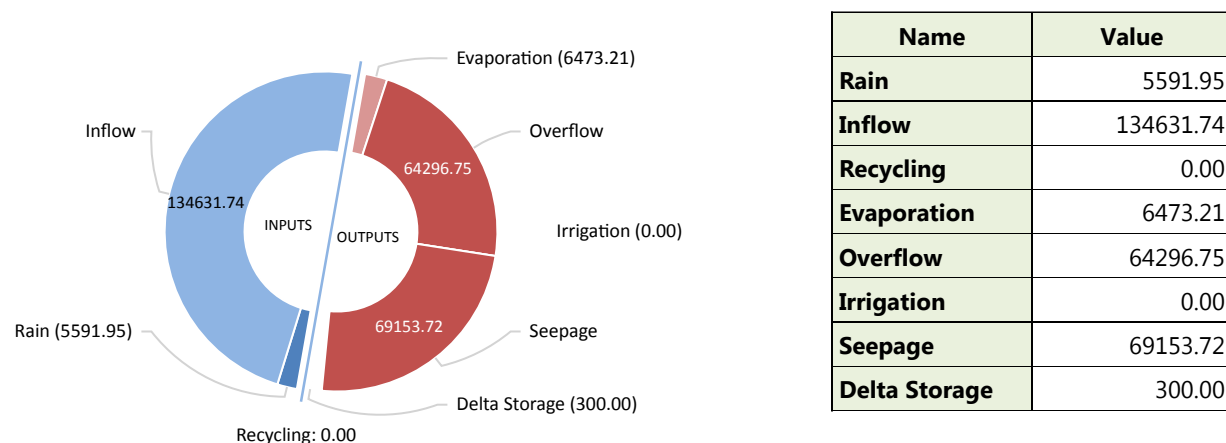
|                                                                                              |                       |
|----------------------------------------------------------------------------------------------|-----------------------|
| Average monthly cover (%) (minimum - maximum)                                                | 26.16 (18.47 - 33.07) |
| Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1) | 0.80                  |
| Non-transpiring Cover Left after Harvest (%)                                                 | 20.00                 |
| Maximum potential root depth in defined soil profile (mm)                                    | 799.88                |
| Salt tolerance                                                                               | Moderately tolerant   |
| Salinity threshold EC sat. ext. (dS/m)                                                       | 1.50                  |
| Proportion of yield decrease per dS/m increase (%/dS/m)                                      | 2.00                  |

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## Pond System Water Performance - Overflow: 1 facultative pond

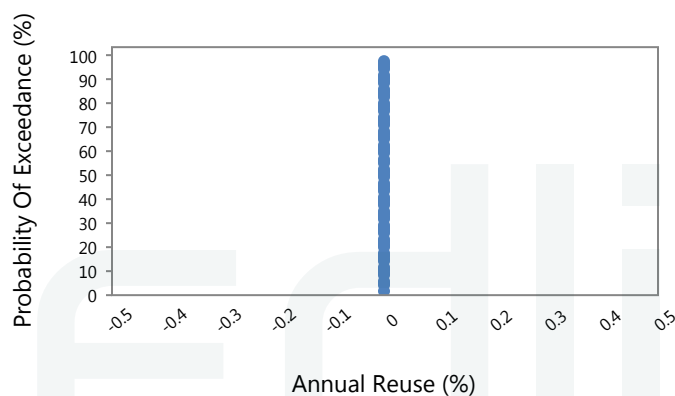
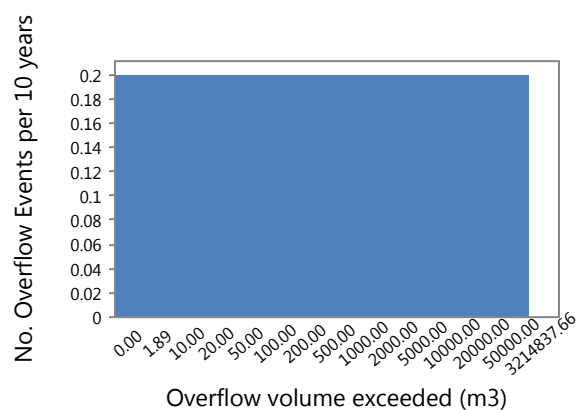
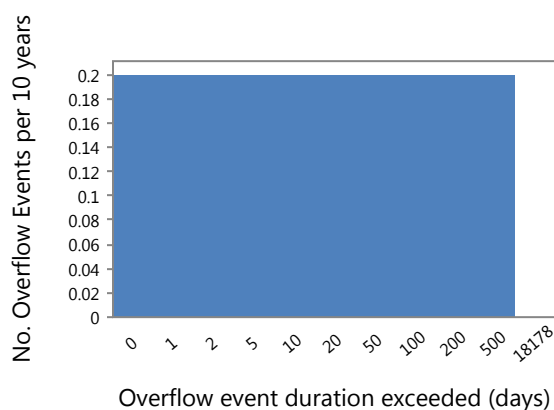
Capacity of wet weather storage pond: **15000 m3**

Pond System Water Balance (m3/year)



### Overflows Diagnostics

|                                                                             |          |
|-----------------------------------------------------------------------------|----------|
| Volume of overflow (m3/year)                                                | 64296.75 |
| No. days pond overflows (days/year)                                         | 363.56   |
| Average duration of overflow (days)                                         | 18178.00 |
| Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (%) | 0.00     |
| Probability of at least 90% reuse (%)                                       | 0.00     |

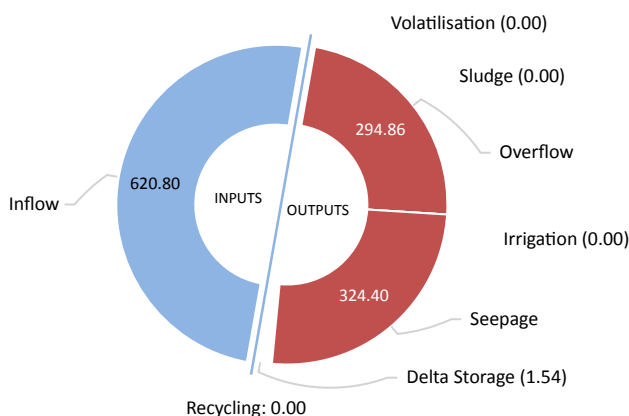


[Export plots](#)

## Pond System Performance - Nutrient: 1 facultative pond

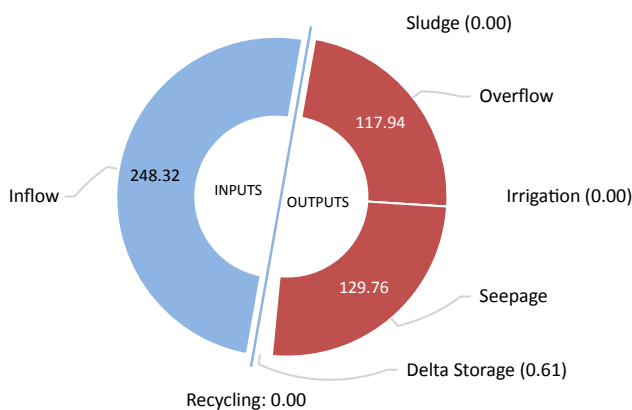
### Pond System Nutrients and salt balance:

#### Nitrogen Balance (kg/year)



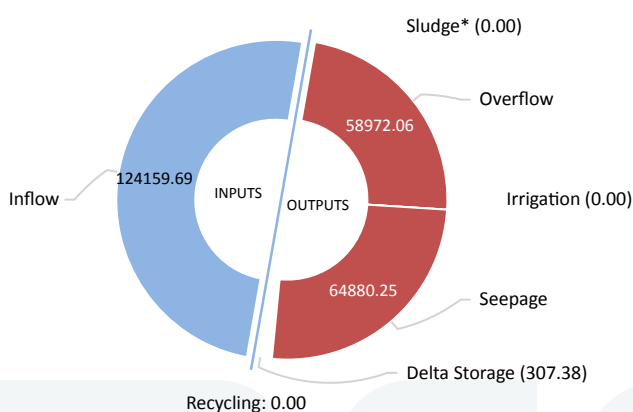
| Name           | Value  |
|----------------|--------|
| Inflow         | 620.80 |
| Recycling      | 0.00   |
| Volatilisation | 0.00   |
| Sludge         | 0.00   |
| Overflow       | 294.86 |
| Irrigation     | 0.00   |
| Seepage        | 324.40 |
| Delta Storage  | 1.54   |

#### Phosphorus Balance (kg/year)



| Name          | Value  |
|---------------|--------|
| Inflow        | 248.32 |
| Recycling     | 0.00   |
| Sludge        | 0.00   |
| Overflow      | 117.94 |
| Irrigation    | 0.00   |
| Seepage       | 129.76 |
| Delta Storage | 0.61   |

#### Salt Balance (kg/year)



| Name          | Value     |
|---------------|-----------|
| Inflow        | 124159.69 |
| Recycling     | 0.00      |
| Sludge*       | 0.00      |
| Overflow      | 58972.06  |
| Irrigation    | 0.00      |
| Seepage       | 64880.25  |
| Delta Storage | 307.38    |

\* 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**

**Pond System Performance - Nutrient: 1 facultative pond****Pond Nutrient Concentrations and Salinity:**

| Average across simulation period                       | Pond 1 |
|--------------------------------------------------------|--------|
| Average nitrogen concentration of pond liquid (mg/L)   | 4.69   |
| Average phosphorus concentration of pond liquid (mg/L) | 1.88   |
| Average salinity of pond liquid (dS/m)                 | 1.47   |

| Value on final day of simulation period              | Pond 1 |
|------------------------------------------------------|--------|
| Final nitrogen concentration of pond liquid (mg/L)   | 5.12   |
| Final phosphorus concentration of pond liquid (mg/L) | 2.05   |
| Final salinity of pond liquid (dS/m)                 | 1.60   |

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**Irrigation Performance:****Water Use: (assumes 100% Irrigation Efficiency)**

|                                                                                                            |                    |
|------------------------------------------------------------------------------------------------------------|--------------------|
| Pond water irrigated (m3/year)                                                                             | 0.00               |
| Average Shandy water irrigation (m3/year) (minimum - maximum)                                              | 0.00 (0.00 - 0.00) |
| Total water irrigated (m3/year)                                                                            | 0.00               |
| Proportion of irrigation events requiring shandying (% of events)                                          | 0.00               |
| Proportion of years shandying water allocation of 0 m3/year is exceeded (% of years)                       | 0.00               |
| Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum) | 0.00 (0.00 - 0.00) |

**Irrigation Quality:**

|                                                                                                   |      |
|---------------------------------------------------------------------------------------------------|------|
| Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L) | 0.00 |
| Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)  | 0.00 |
| Average phosphorus concentration of irrigation water (mg/L)                                       | 0.00 |
| Average salinity of irrigation water (dS/m)                                                       | 0.00 |

**Irrigation Diagnostics (No effluent irrigation occurred!):**

|                                                            |                               |
|------------------------------------------------------------|-------------------------------|
| Proportion Days Irrigation Turned Off (%)                  | 100.00 (Hence no irrigation!) |
| Proportion of days maximum irrigation rate set to zero (%) | 100.00 (Hence no irrigation!) |
| Proportion of Days irrigation occurs (%)                   | 0.00                          |

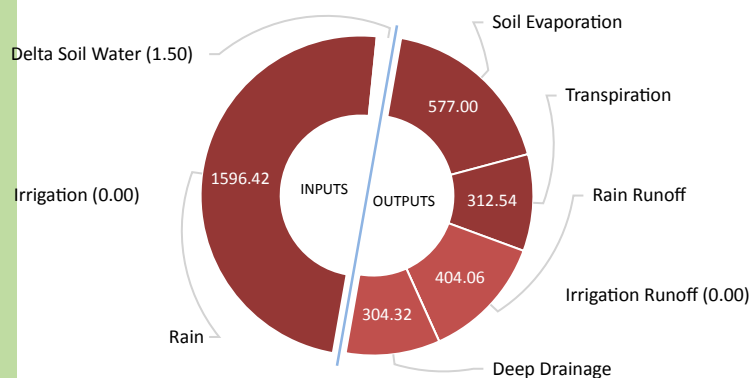
## Land Performance - Soil Water

**Paddock:** Nominated Irrigation Areas, 11.4 ha

**Soil Type:** Duplex 2, 75.99 mm PAWC at maximum root depth

**Water Balance (mm/year):**

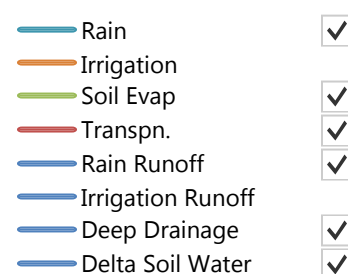
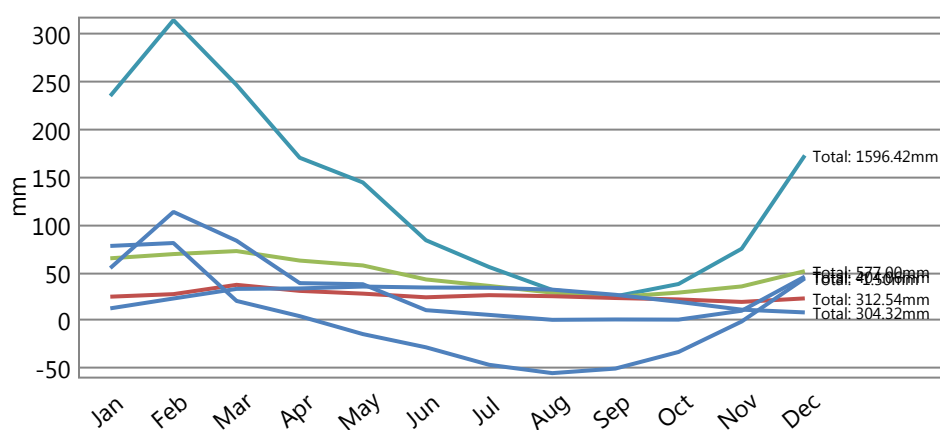
■ mm/year □ % Total inputs



| Name              | Value   |
|-------------------|---------|
| Rain              | 1596.42 |
| Irrigation        | 0.00    |
| Soil Evaporation  | 577.00  |
| Transpiration     | 312.54  |
| Rain Runoff       | 404.06  |
| Irrigation Runoff | 0.00    |
| Deep Drainage     | 304.32  |
| Delta Soil Water  | -1.50   |

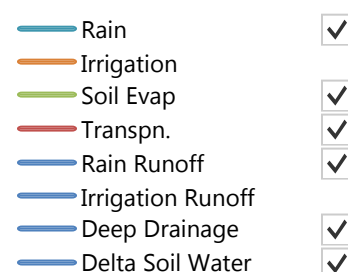
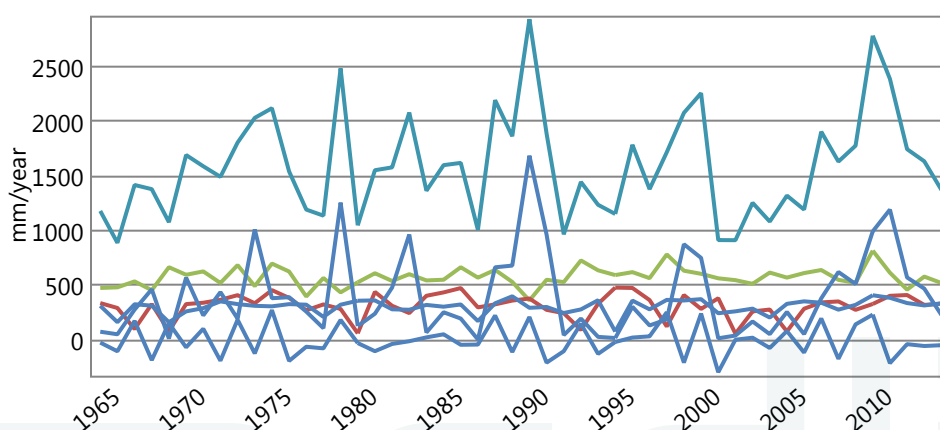
**Average Monthly Totals (mm):**

■ Chart □ Table



**Average Annual Totals (mm/year):**

■ Chart □ Table



PERFORMANCE

Land Performance - Soil Nutrient

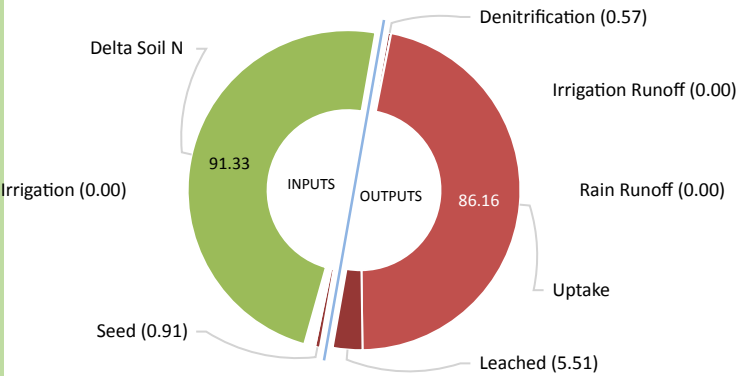
Paddock: **Nominated Irrigation Areas, 11.4 ha**

Soil Type: **Duplex 2**

Irrigation ammonium volatilisation losses (kg/ha/year): 0.00

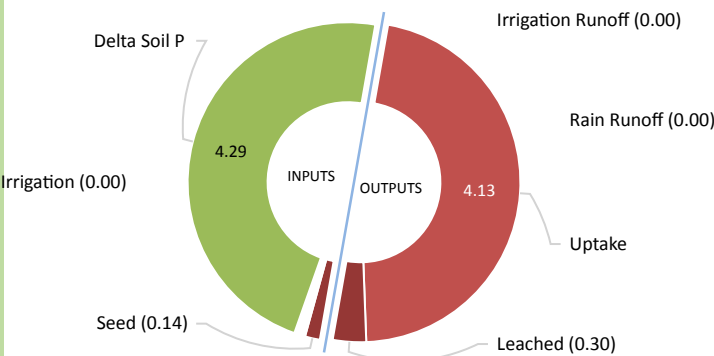
Proportion of total nitrogen in irrigated effluent as ammonium (%): 20.00

Nitrogen Balance (kg/ha/year)



| Name              | Value  |
|-------------------|--------|
| Seed              | 0.91   |
| Irrigation        | 0.00   |
| Denitrification   | 0.57   |
| Irrigation Runoff | 0.00   |
| Rain Runoff       | 0.00   |
| Uptake            | 86.16  |
| Leached           | 5.51   |
| Delta Soil N      | -91.33 |

Phosphorus Balance (kg/ha/year)



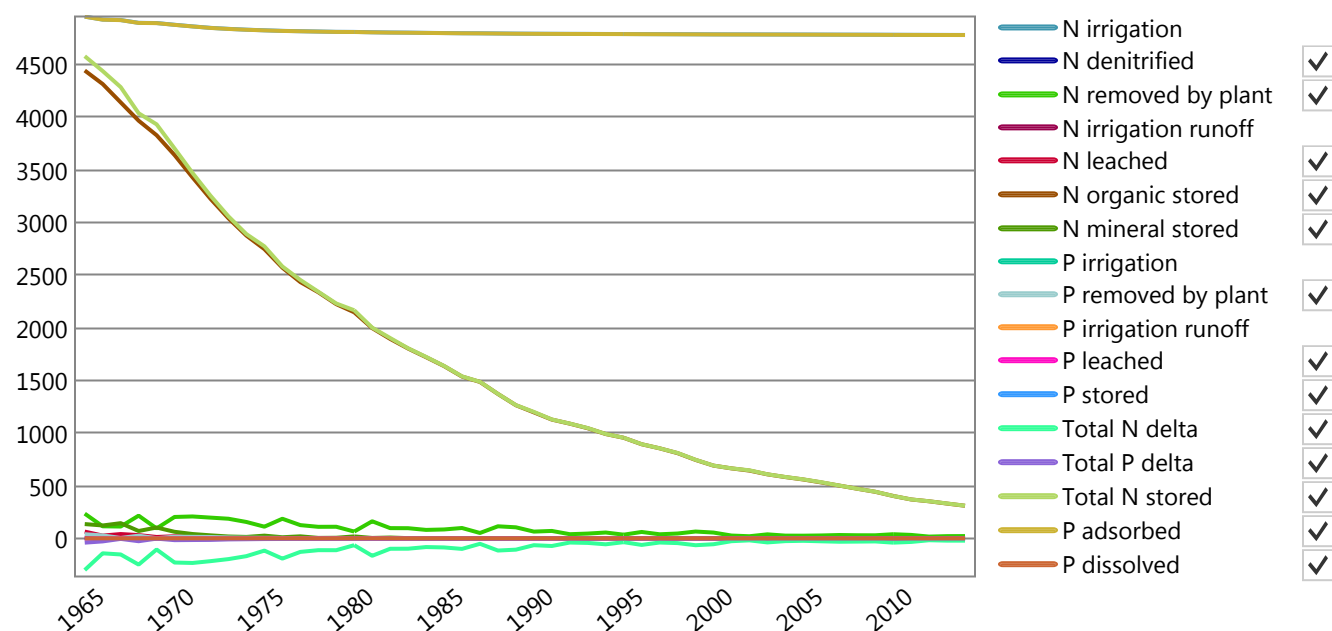
| Name              | Value |
|-------------------|-------|
| Seed              | 0.14  |
| Irrigation        | 0.00  |
| Irrigation Runoff | 0.00  |
| Rain Runoff       | 0.00  |
| Uptake            | 4.13  |
| Leached           | 0.30  |
| Delta Soil P      | -4.29 |

## Land Performance - Soil Nutrient

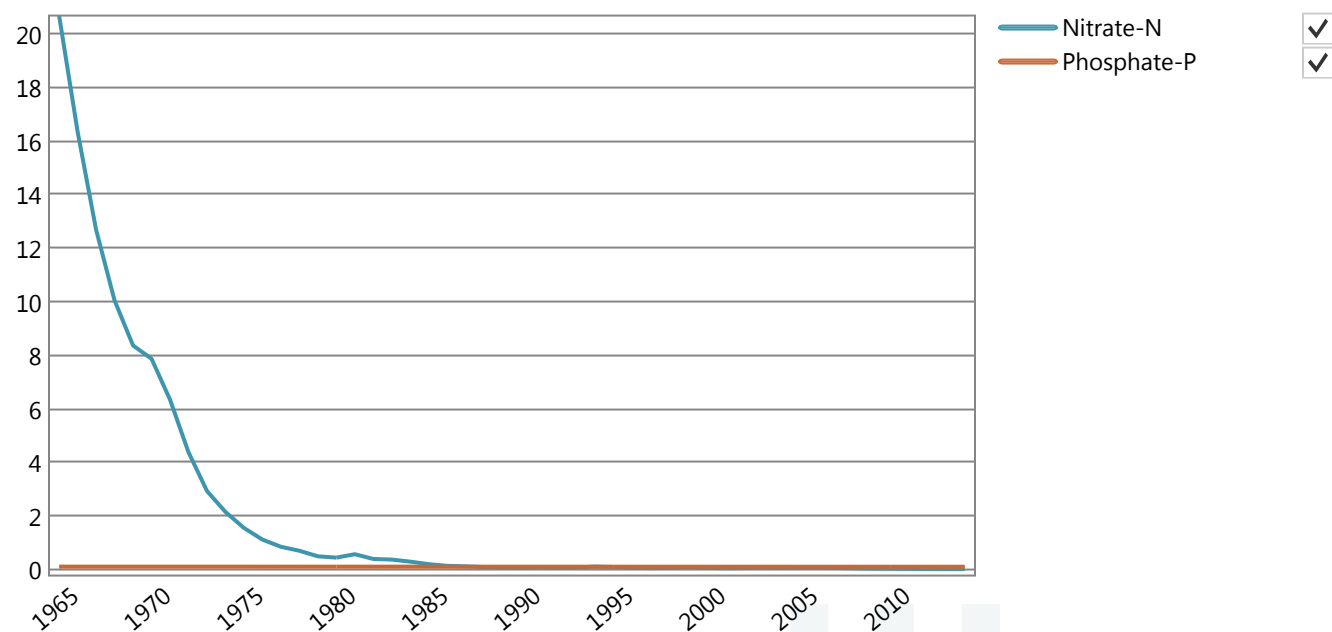
Paddock: **Nominated Irrigation Areas, 11.4 ha**

Soil Type: **Duplex 2**

### Annual Nutrient Totals (kg/ha):



### Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

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## Plant Performance and Nutrients

**Paddock:** Nominated Irrigation Areas, 11.4 ha

**Soil Type:** Duplex 2

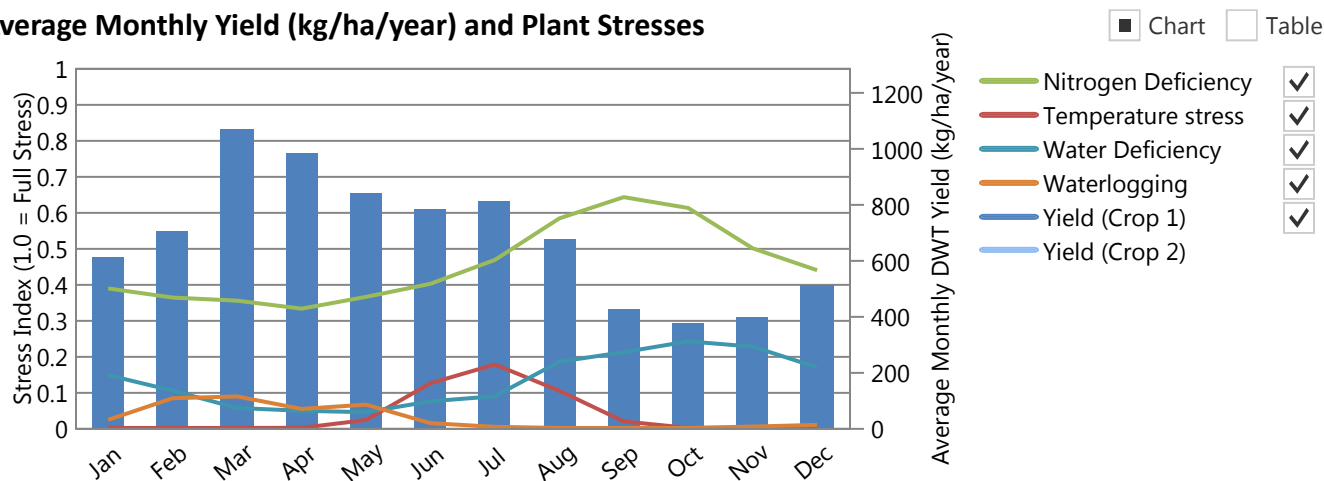
**Plant:** Continuous Blady Grass Pasture

|                                                     |                              |
|-----------------------------------------------------|------------------------------|
| Average annual shoot dry matter yield (kg/ha/year)  | 8221.35 (1976.92 - 15373.35) |
| Average monthly plant cover (%) (minimum - maximum) | 26.16 (18.47 - 33.07)        |
| Average monthly root depth (mm) (minimum - maximum) | 516.80 (410.61 - 603.24)     |

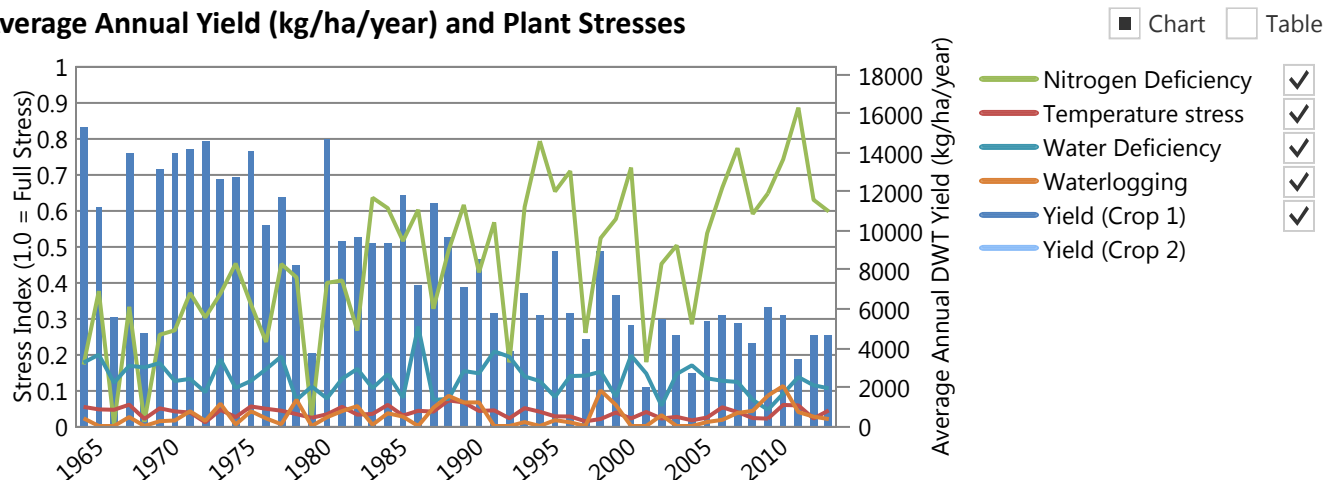
### Nutrient Uptake (minimum - maximum):

|                                                                    |                        |
|--------------------------------------------------------------------|------------------------|
| Average annual net nitrogen removed by plant uptake (kg/ha/year)   | 84.33 (16.01 - 232.87) |
| Average annual net phosphorus removed by plant uptake (kg/ha/year) | 3.85 (-0.48 - 39.71)   |
| Average annual shoot nitrogen concentration (fraction dwt)         | 0.01 (0.01 - 0.02)     |
| Average annual shoot phosphorus concentration (fraction dwt)       | 0.000 (0.000 - 0.003)  |

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



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



**No. of harvests/year:** 1.30 (normal), 1.50 (forced by crop death due to nitrogen stress (0.06), water stress (1.44))

**No. days without crop/year (days/year):** 38.42 due to water stress (38.42)

Land Performance

Paddock: Nominated Irrigation Areas, 11.4 ha                      Soil Type: Duplex 2

Plant: Continuous Blady Grass Pasture

|                                                              |                     |
|--------------------------------------------------------------|---------------------|
| Salt tolerance                                               | Moderately tolerant |
| Salinity threshold EC sat. ext. (dS/m)                       | 1.50                |
| Proportion of yield decrease per dS/m increase (%/dS/m)      | 2.00                |
| No. years assumed for leaching to reach steady-state (years) | 10.00               |

Soil Salinity:

|                                    |      |
|------------------------------------|------|
| Average Infiltrate Salinity (dS/m) | 0.03 |
|------------------------------------|------|

Insufficient deep drainage to run steady state salinity calculations.

PERFORMANCE

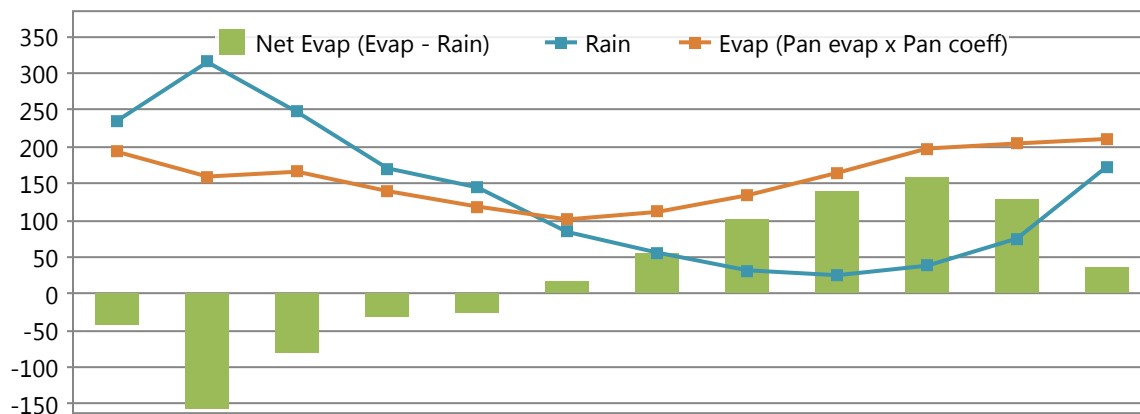


## Sustainability Diagnostics: Lindeman Island Resort

### Averaged Historical Climate Data Used in Simulation (mm)

Location: Lindeman, -20.45°, 149.05°

Run Period: 01/01/1965 to 31/12/2014 50 years, 0 days



|              | Jan   | Feb    | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   | Year   |
|--------------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Rain         | 235.5 | 315.0  | 247.0 | 170.7 | 144.7 | 84.1  | 56.0  | 31.9  | 25.2  | 38.1  | 75.1  | 173.1 | 1596.4 |
| Evap         | 192.9 | 159.4  | 166.0 | 139.6 | 118.6 | 101.1 | 111.3 | 133.8 | 164.4 | 197.5 | 204.4 | 210.5 | 1899.4 |
| Net Evap     | -42.6 | -155.7 | -81.0 | -31.0 | -26.1 | 17.0  | 55.3  | 101.9 | 139.2 | 159.3 | 129.3 | 37.5  | 303.0  |
| Net Evap/day | -1.4  | -5.5   | -2.6  | -1.0  | -0.8  | 0.6   | 1.8   | 3.3   | 4.6   | 5.1   | 4.3   | 1.2   | 0.8    |

DIAGNOSTICS

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**Sustainability Diagnostics: Lindeman Island Resort****Pond System: 1 facultative pond****New Sewage Treatment Plant - 134631.74 m<sup>3</sup>/year or 368.61 m<sup>3</sup>/day generated on average****Effluent entering pond system after any pretreatment and recycling**

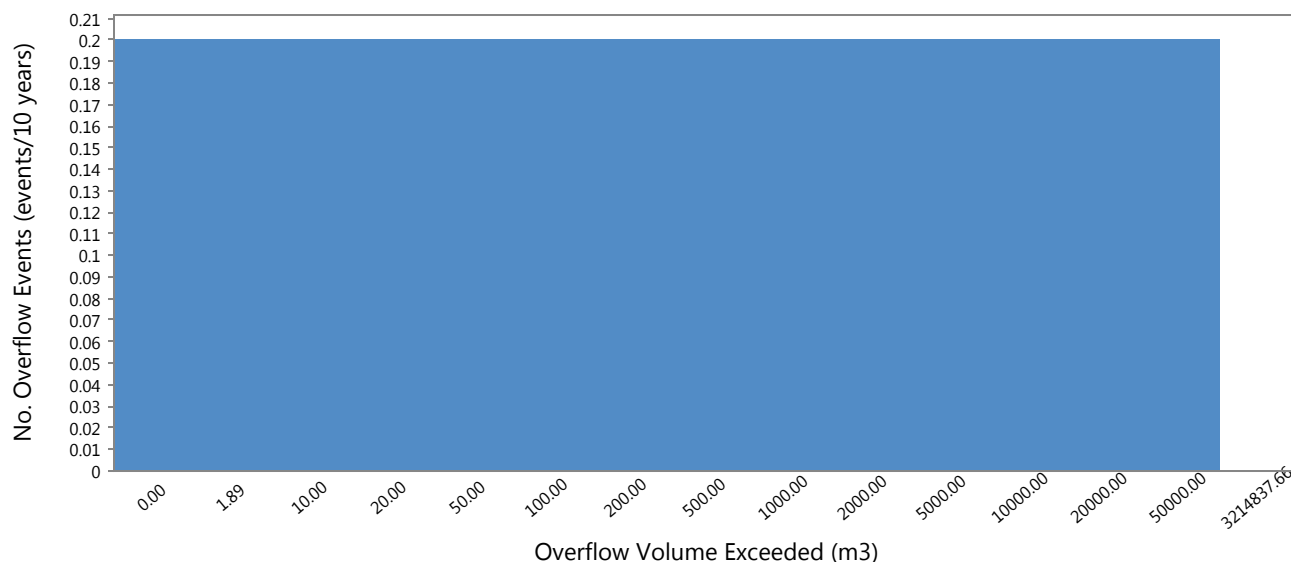
Average (Minimum-Maximum) influent quality calculated for 365.24 non-zero flow days, after any pretreatment and recycling.

| Constituent           | Concentration (mg/L)      | Load (kg/year)                    |
|-----------------------|---------------------------|-----------------------------------|
| Total Nitrogen        | 4.61 (0.70 - 5.00)        | 620.80 (620.39 - 622.09)          |
| Total Phosphorus      | 1.84 (0.28 - 2.00)        | 248.32 (248.16 - 248.84)          |
| Total Dissolved Salts | 922.22 (139.44 - 1000.00) | 124159.69 (124078.10 - 124418.04) |
| Volatile Solids       | 0.00 (0.00 - 0.00)        | 0.00 (0.00 - 0.00)                |
| Total Solids          | 0.00 (0.00 - 0.00)        | 0.00 (0.00 - 0.00)                |

**Last pond (Wet weather store): 15000.00 m<sup>3</sup>**

|                                                                                     |          |
|-------------------------------------------------------------------------------------|----------|
| Theoretical hydraulic retention time (days)                                         | 40.69    |
| Average volume of overflow (m <sup>3</sup> /year)                                   | 64296.75 |
| No. overflow events per year exceeding threshold* of 1.89 m <sup>3</sup> (no./year) | 0.02     |
| Average duration of overflow (days)                                                 | 18178.00 |
| Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (%)         | 0.00     |
| Probability of at least 90% effluent reuse (%)                                      | 0.00     |
| Average salinity of last pond (dS/m)                                                | 1.47     |
| Salinity of last pond on final day of simulation (dS/m)                             | 1.60     |
| Ammonia loss from pond system water area (kg/m <sup>2</sup> /year)                  | 0.00     |

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

**Overflow exceedance:**
☒ Chart
 ☐ Table
[Export plot](#)

**Sustainability Diagnostics: Lindeman Island Resort****Irrigation Information****Irrigation: 11.4 ha total area (assumed 100% irrigation efficiency)**

|                               | Quantity/year | Quantity/ha/year |
|-------------------------------|---------------|------------------|
| Total irrigation applied (m3) | 0.00          | 0.00             |
| Total nitrogen applied (kg)   | 0.00          | 0.00             |
| Total phosphorus applied (kg) | 0.00          | 0.00             |
| Total salts applied (kg)      | 0.00          | 0.00             |

**Shandying**

|                                                                                                            |                    |
|------------------------------------------------------------------------------------------------------------|--------------------|
| Annual allocation of fresh water for shandying (m3/year)                                                   | 0.00               |
| Average Shandy water irrigation (m3/year) (minimum - maximum)                                              | 0.00 (0.00 - 0.00) |
| Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum) | 0.00 (0.00 - 0.00) |
| Proportion of irrigation events requiring shandying (% of events)                                          | 0.00               |
| Minimum shandy water is used                                                                               | False              |

**Irrigation Issues**

|                                                 |        |
|-------------------------------------------------|--------|
| Proportion of Days irrigation is turned off (%) | 100.00 |
|-------------------------------------------------|--------|



## Sustainability Diagnostics: Lindeman Island Resort

**Paddock Land: Nominated Irrigation Areas: 11.4 ha**

**Irrigation: Fixed Sprinkler with 0% ammonium loss during irrigation**

|                                                                  |
|------------------------------------------------------------------|
| Irrigation triggered every 1 days                                |
| Irrigate a fixed amount of 5.00 mm each day                      |
| Irrigation window from 1/1 to 31/12 including the days specified |
| A minimum of 0 days must be skipped between irrigation events    |

**Soil Water Balance (mm): Duplex 2, 75.99 mm PAWC at maximum root depth**

|            | Jan   | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov  | Dec   | Year   |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|--------|
| Rain       | 235.5 | 315.0 | 247.0 | 170.7 | 144.7 | 84.1  | 56.0  | 31.9  | 25.2  | 38.1  | 75.1 | 173.1 | 1596.4 |
| Irrigation | 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    |
| Soil Evap  | 65.1  | 69.6  | 72.7  | 62.7  | 57.6  | 43.0  | 36.2  | 29.1  | 24.6  | 29.1  | 35.6 | 51.7  | 577.0  |
| Transpn.   | 24.8  | 27.5  | 37.3  | 30.9  | 28.1  | 24.2  | 26.5  | 25.4  | 23.4  | 22.0  | 19.4 | 23.1  | 312.5  |
| Runoff     | 54.9  | 113.8 | 83.6  | 39.1  | 37.9  | 10.7  | 5.8   | 0.6   | 0.9   | 0.8   | 10.1 | 45.9  | 404.1  |
| Drainage   | 12.6  | 23.0  | 33.0  | 33.5  | 35.5  | 34.5  | 34.2  | 32.2  | 26.9  | 19.4  | 11.2 | 8.3   | 304.3  |
| Delta      | 78.1  | 81.2  | 20.4  | 4.4   | -14.4 | -28.3 | -46.6 | -55.4 | -50.6 | -33.2 | -1.2 | 44.0  | -1.5   |

### Soil Nitrogen Balance

|                                                                      |                  |
|----------------------------------------------------------------------|------------------|
| Average annual effluent nitrogen added (kg/ha/year)                  | 0.00             |
| Average annual soil nitrogen removed by plant uptake (kg/ha/year)    | 86.16            |
| Average annual soil nitrogen removed by denitrification (kg/ha/year) | 0.57             |
| Average annual soil nitrogen leached (kg/ha/year)                    | 5.51             |
| Average annual nitrate-N loading to groundwater (kg/ha/year)         | 5.51             |
| Soil organic-N kg/ha (Initial - Final)                               | 4620.00 - 310.12 |
| Soil inorganic-N kg/ha (Initial - Final)                             | 257.10 - 0.38    |
| Average nitrate-N concentration of deep drainage (mg/L)              | 1.81             |
| Max. annual nitrate-N concentration of deep drainage (mg/L)          | 20.68            |

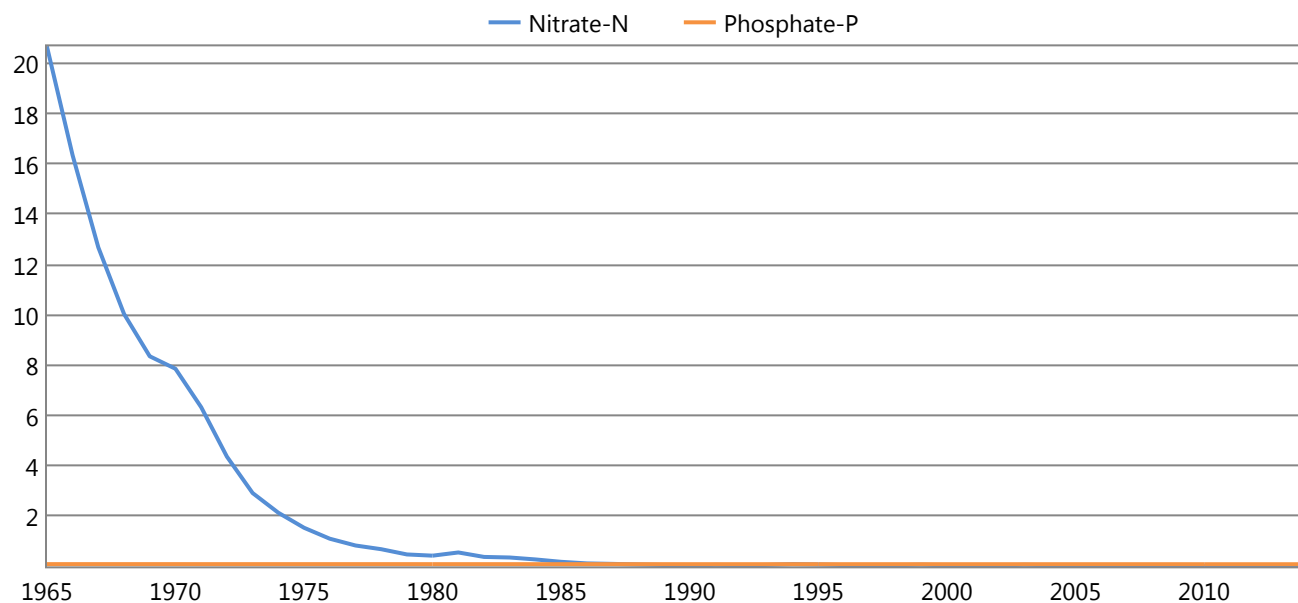
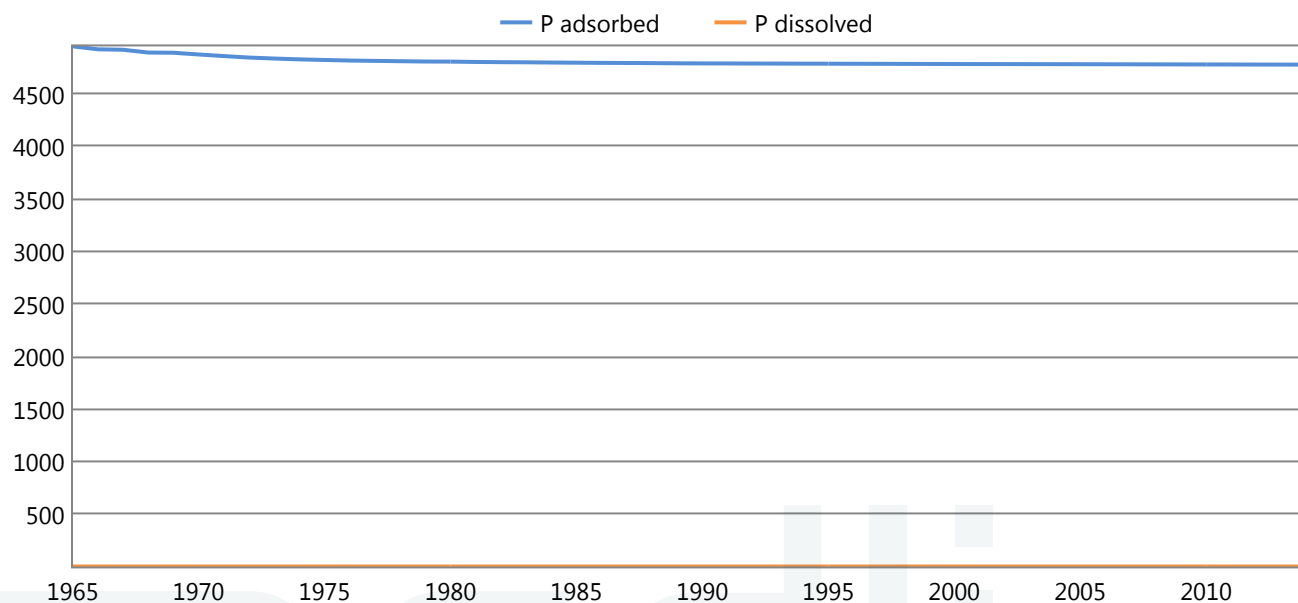
### Soil Phosphorus Balance

|                                                                                                            |                   |
|------------------------------------------------------------------------------------------------------------|-------------------|
| Average annual effluent phosphorus added (kg/ha/year)                                                      | 0.00              |
| Average annual soil phosphorus removed by plant uptake (kg/ha/year)                                        | 4.13              |
| Dissolved phosphorus (kg/ha) (Initial - Final)                                                             | 1.04 - 0.71       |
| Adsorbed phosphorus (kg/ha) (Initial - Final)                                                              | 4991.83 - 4777.74 |
| Average phosphate-P concentration in rootzone (mg/L)                                                       | 0.01              |
| Average phosphate-P concentration of deep drainage (mg/L)                                                  | 0.10              |
| Max. annual phosphate-P concentration of deep drainage (mg/L)                                              | 0.10              |
| Design soil profile storage life based on average infiltrated water phosphorus concn. of 0.00 mg/L (years) | -36990.14         |



**Sustainability Diagnostics: Lindeman Island Resort****Paddock Land: Nominated Irrigation Areas: 11.4 ha****Irrigation: Fixed Sprinkler with 0% ammonium loss during irrigation**

## DIAGNOSTICS

**Annual nutrient leachate concentration (mg/L)****Annual Phosphate-P in soil (kg/ha)**

**Sustainability Diagnostics: Lindeman Island Resort****Paddock Plant Performance: Nominated Irrigation Areas: 11.4 ha****Average Plant Performance (Minimum - Maximum): Continuous Blady Grass Pasture**

|                                                                                         |                              |
|-----------------------------------------------------------------------------------------|------------------------------|
| Average annual shoot dry matter yield (kg/ha/year)                                      | 8221.35 (1976.92 - 15373.35) |
| Average monthly plant cover (%)                                                         | 26.16 (18.47 - 33.07)        |
| Average monthly crop factor (fraction)                                                  | 0.21 (0.15 - 0.26)           |
| Non-transpiring Cover Left after Harvest (%)                                            | 20.00                        |
| Average monthly root depth (mm)                                                         | 516.80 (410.61 - 603.24)     |
| Average number of normal harvests per year (no./year)                                   | 1.30 (0.00 - 3.00)           |
| Average number of normal harvests for last five years only (no./year)                   | 0.60                         |
| Average number of crop deaths per year (no./year)                                       | 1.50 (0.00 - 7.00)           |
| Average number of crop deaths for last five years only (no./year)                       | 0.60                         |
| Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient) | 0.45 (0.01 - 0.88)           |
| Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient) | 0.00 (0.00 - 0.00)           |
| Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)    | 0.18 (0.04 - 0.38)           |
| Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)       | 0.13 (0.04 - 0.24)           |
| Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)       | 0.03 (0.00 - 0.09)           |
| No. days without crop/year (days)                                                       | 38.42                        |

**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*

Insufficient deep drainage to run steady state salinity calculations.



## Run Messages

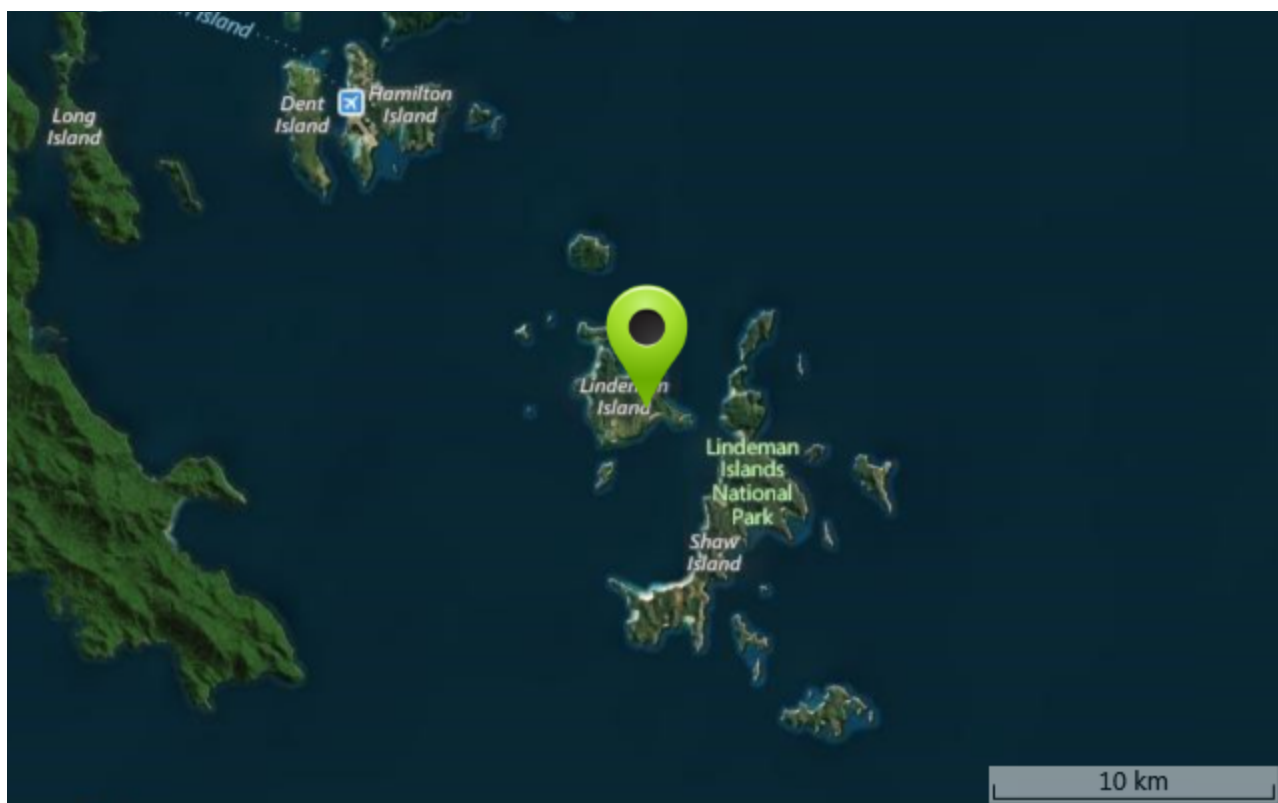
### Messages generated when the scenario was run:

|                                      |
|--------------------------------------|
| This is a Dryland scenario           |
| No effluent irrigation has occurred! |
| Full run chosen                      |



**Enterprise:** Lindeman Island Resort**Description:**

Recycled Water Management Plan

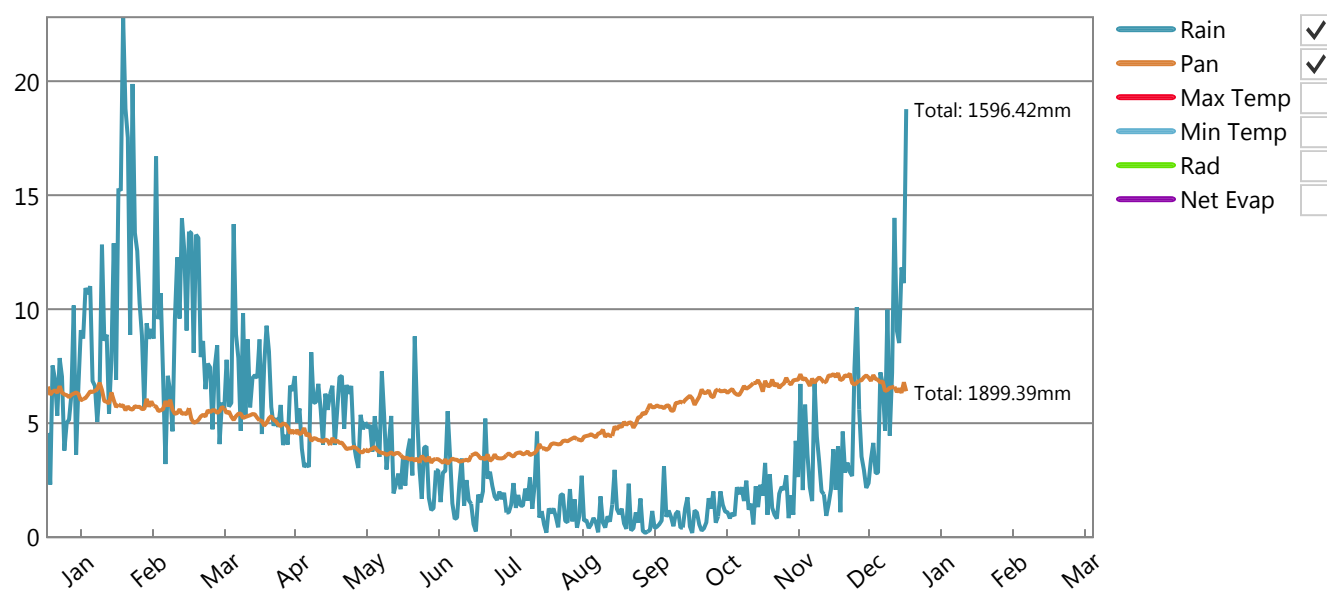
**Client:** White Horse Australia**MEDLI User:** Victoria Haigh**Scenario Details:**

GENERAL INFORMATION - FULL RUN

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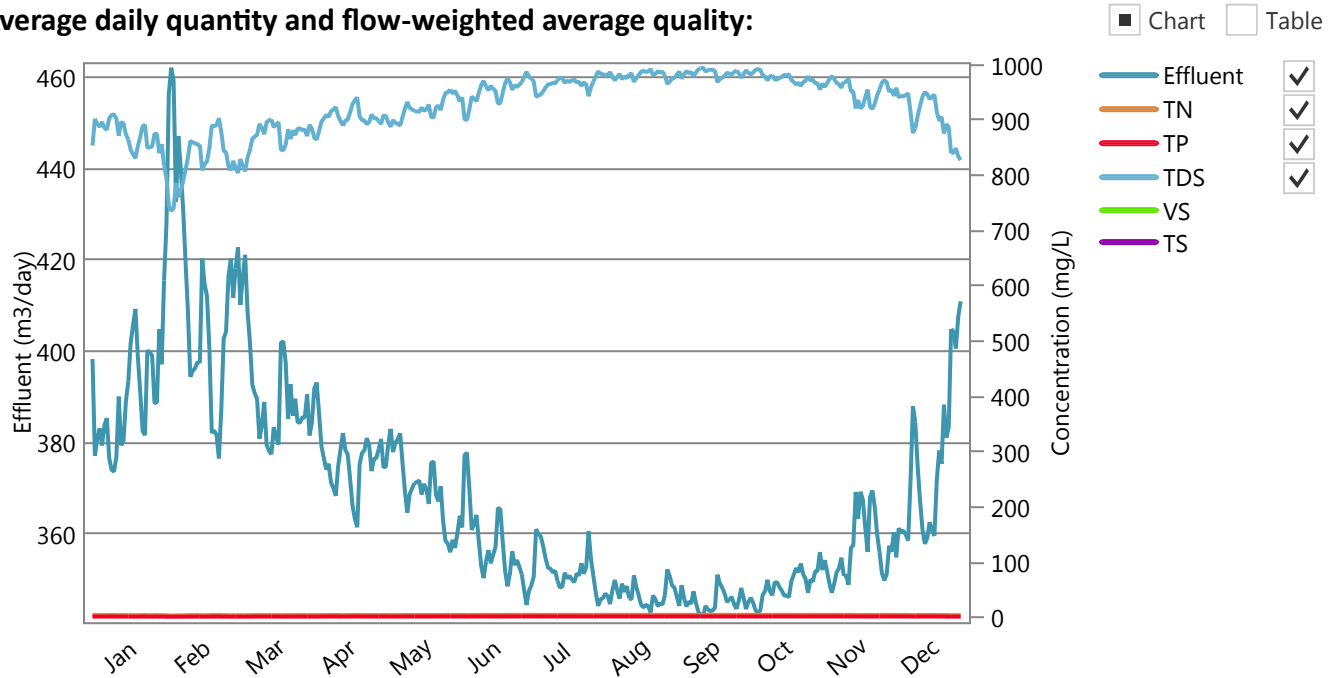
**Climate Data: Lindeman, -20.45°, 149.05°****Run Period: 01/01/1965 to 31/12/2014** 50 years, 0 days**Climate Statistics:**

|                           | 5th ▾ | Percentile | 50th Percentile | 95th ▾ | Percentile |
|---------------------------|-------|------------|-----------------|--------|------------|
| Rainfall (mm/year)        |       | 915        | 1568            |        | 2440       |
| Pan Evaporation (mm/year) |       | 1723       | 1892            |        | 2100       |

**Climate Data:**☒ Chart ☐ Table☐ Monthly ☒ Daily**Daily Average Across Run Period**

DESCRIPTION

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**Effluent type: New Sewage Treatment Plant****Wastestream before any recycling or pretreatment****Average daily quantity and flow-weighted average quality:****Wastestream after any recycling and pretreatment if applicable**

**Effluent quantity:** **134631.74 m3/year** or 368.61 m3/day (Min-Max: 339.94 - 2437.93)

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

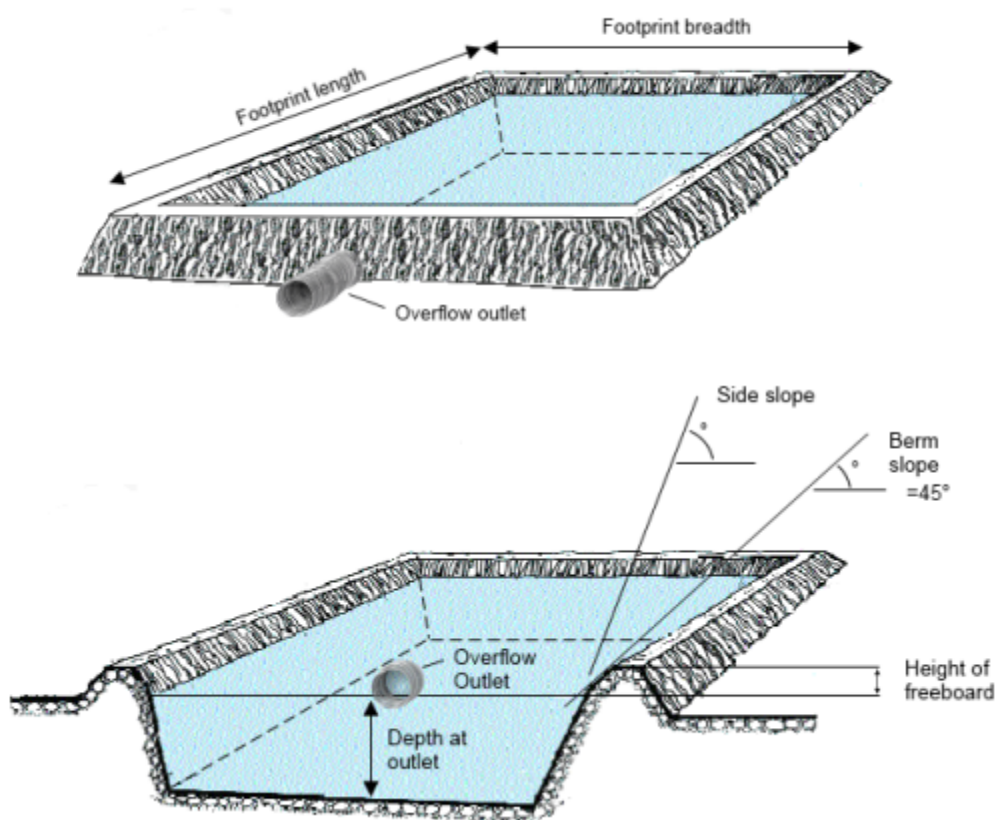
|                       | Concentration (mg/L)      | Load (kg/year)                    |
|-----------------------|---------------------------|-----------------------------------|
| Total Nitrogen        | 4.61 (0.70 - 5.00)        | 620.80 (620.39 - 622.09)          |
| Total Phosphorus      | 1.84 (0.28 - 2.00)        | 248.32 (248.16 - 248.84)          |
| Total Dissolved Salts | 922.22 (139.44 - 1000.00) | 124159.69 (124078.10 - 124418.04) |
| 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

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**Pond system: 1 facultative pond****Pond system details:**

|                                    | Pond 1   |
|------------------------------------|----------|
| Maximum pond volume (m3)           | 15000.00 |
| Minimum allowable pond volume (m3) | 371.41   |
| Pond depth at overflow outlet (m)  | 4.00     |
| Maximum water surface area (m2)    | 3786.92  |
| Pond footprint length (m)          | 87.83    |
| Pond footprint width (m)           | 44.31    |
| Pond catchment area (m2)           | 3891.99  |
| Average active volume (m3)         | 409.49   |

**Irrigation pump limits:**

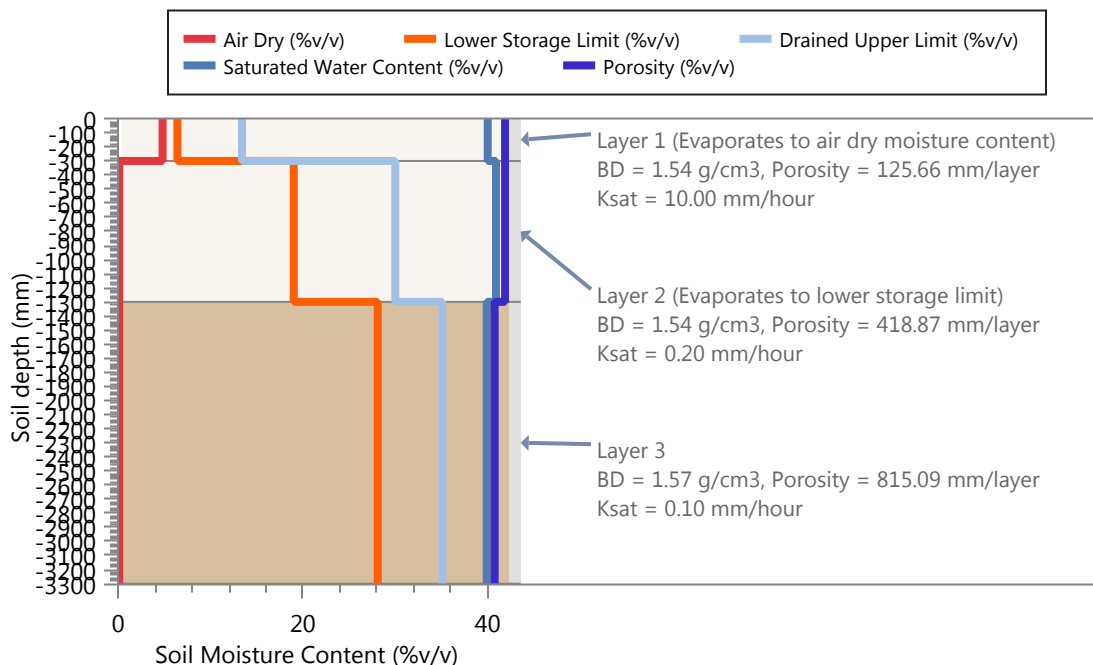
|                                              |       |
|----------------------------------------------|-------|
| Minimum pump rate per area limit (ML/day/ha) | 0.00  |
| Maximum pump rate per area limit (ML/day/ha) | 10.00 |

**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                                       | False |

**Land: Nominated Irrigation Areas****Area (ha): 11.88****Soil Type: Duplex 2, 3300.00 mm defined profile depth**

|                                                               |         |
|---------------------------------------------------------------|---------|
| Profile Porosity (mm)                                         | 1359.62 |
| Profile saturation water content (mm)                         | 1327.00 |
| Profile drained upper limit (or field capacity) (mm)          | 1042.20 |
| Profile lower storage limit (or permanent wilting point) (mm) | 771.20  |
| Profile available water capacity (mm)                         | 271.00  |
| Profile limiting saturated hydraulic conductivity (mm/hour)   | 0.10    |
| Surface saturated hydraulic conductivity (mm/hour)            | 10.00   |
| Runoff curve number II (coefficient)                          | 82.00   |
| Soil evaporation U (mm)                                       | 8.00    |
| Soil evaporation Cona (mm/sqrt day)                           | 4.00    |

**Plant Data: Continuous Blady Grass Pasture**

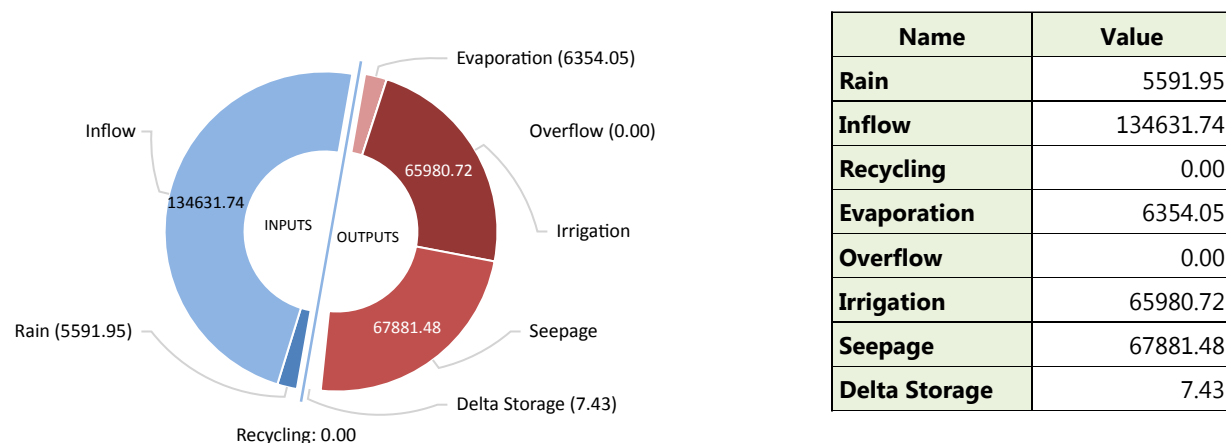
|                                                                                              |                     |
|----------------------------------------------------------------------------------------------|---------------------|
| Average monthly cover (%) (minimum - maximum)                                                | 0.33 (0.31 - 0.37)  |
| Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1) | 0.80                |
| Non-transpiring Cover Left after Harvest (%)                                                 | 0.20                |
| Maximum potential root depth in defined soil profile (mm)                                    | 800.00              |
| Salt tolerance                                                                               | Moderately tolerant |
| Salinity threshold EC sat. ext. (dS/m)                                                       | 1.50                |
| Proportion of yield decrease per dS/m increase (%/dS/m)                                      | 0.02                |

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## Pond System Water Performance - Overflow: 1 facultative pond

Capacity of wet weather storage pond: **15000 m3**

**Pond System Water Balance (m3/year)**



### Overflows Diagnostics

|                                                                             |      |
|-----------------------------------------------------------------------------|------|
| Volume of overflow (m3/year)                                                | 0.00 |
| No. days pond overflows (days/year)                                         | 0.00 |
| Average duration of overflow (days)                                         | 0.00 |
| Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (%) | 0.49 |
| Probability of at least 90% reuse (%)                                       | 0.00 |

No. Overflow Events per 10 years

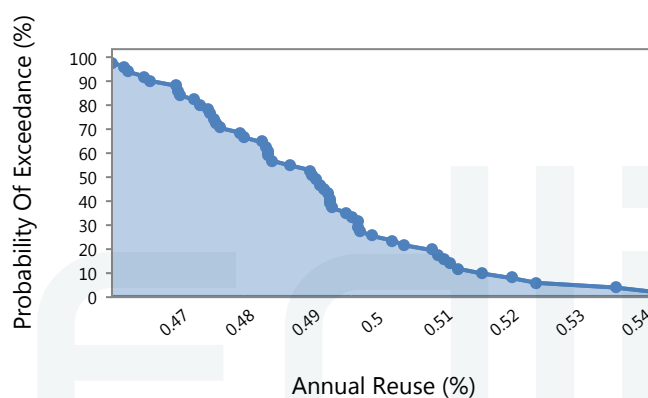


Overflow event duration exceeded (days)

No. Overflow Events per 10 years



Overflow volume exceeded (m3)

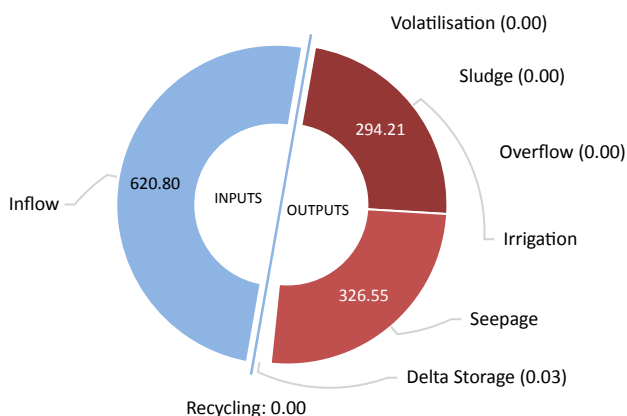


[Export plots](#)

## Pond System Performance - Nutrient: 1 facultative pond

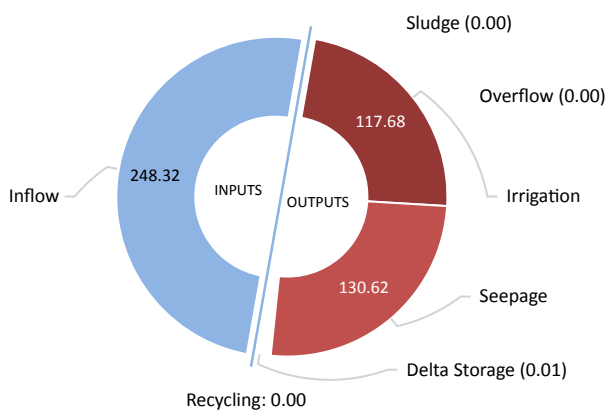
### Pond System Nutrients and salt balance:

#### Nitrogen Balance (kg/year)



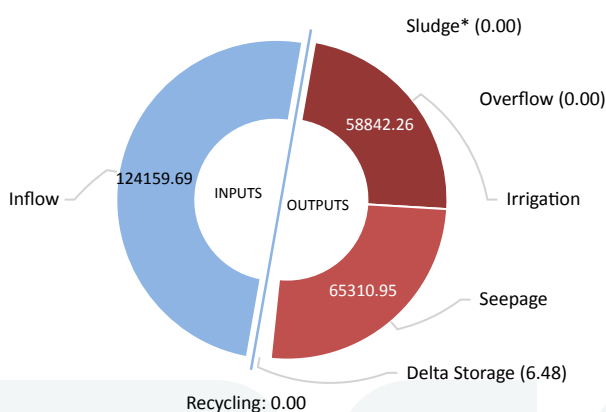
| Name           | Value  |
|----------------|--------|
| Inflow         | 620.80 |
| Recycling      | 0.00   |
| Volatilisation | 0.00   |
| Sludge         | 0.00   |
| Overflow       | 0.00   |
| Irrigation     | 294.21 |
| Seepage        | 326.55 |
| Delta Storage  | 0.03   |

#### Phosphorus Balance (kg/year)



| Name          | Value  |
|---------------|--------|
| Inflow        | 248.32 |
| Recycling     | 0.00   |
| Sludge        | 0.00   |
| Overflow      | 0.00   |
| Irrigation    | 117.68 |
| Seepage       | 130.62 |
| Delta Storage | 0.01   |

#### Salt Balance (kg/year)



| Name          | Value     |
|---------------|-----------|
| Inflow        | 124159.69 |
| Recycling     | 0.00      |
| Sludge*       | 0.00      |
| Overflow      | 0.00      |
| Irrigation    | 58842.26  |
| Seepage       | 65310.95  |
| Delta Storage | 6.48      |

\* 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**

**Pond System Performance - Nutrient: 1 facultative pond****Pond Nutrient Concentrations and Salinity:**

| Average across simulation period                       | Pond 1 |
|--------------------------------------------------------|--------|
| Average nitrogen concentration of pond liquid (mg/L)   | 4.53   |
| Average phosphorus concentration of pond liquid (mg/L) | 1.81   |
| Average salinity of pond liquid (dS/m)                 | 1.42   |

| Value on final day of simulation period              | Pond 1 |
|------------------------------------------------------|--------|
| Final nitrogen concentration of pond liquid (mg/L)   | 4.36   |
| Final phosphorus concentration of pond liquid (mg/L) | 1.74   |
| Final salinity of pond liquid (dS/m)                 | 1.36   |

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**Irrigation Performance:****Water Use: (assumes 100% Irrigation Efficiency)**

|                                                                                                            |                    |
|------------------------------------------------------------------------------------------------------------|--------------------|
| Pond water irrigated (m3/year)                                                                             | 65980.72           |
| Average Shandy water irrigation (m3/year) (minimum - maximum)                                              | 0.00 (0.00 - 0.00) |
| Total water irrigated (m3/year)                                                                            | 65980.72           |
| Proportion of irrigation events requiring shandying (% of events)                                          | 0.00               |
| Proportion of years shandying water allocation of 0 m3/year is exceeded (% of years)                       | 0.00               |
| Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum) | 0.00 (0.00 - 0.00) |

**Irrigation Quality:**

|                                                                                                   |      |
|---------------------------------------------------------------------------------------------------|------|
| Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L) | 4.46 |
| Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)  | 4.46 |
| Average phosphorus concentration of irrigation water (mg/L)                                       | 1.78 |
| Average salinity of irrigation water (dS/m)                                                       | 1.39 |

**Irrigation Diagnostics:**

|                                          |      |
|------------------------------------------|------|
| Proportion of Days irrigation occurs (%) | 1.00 |
|------------------------------------------|------|

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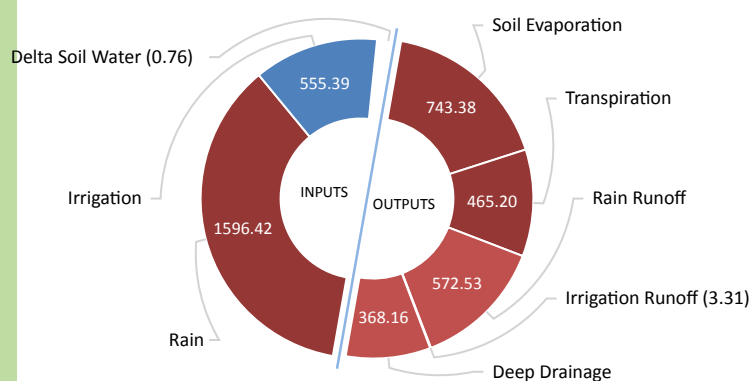
## Land Performance - Soil Water

**Paddock:** Nominated Irrigation Areas, 11.88 ha

**Soil Type:** Duplex 2, 76.00 mm PAWC at maximum root depth

**Water Balance (mm/year):**

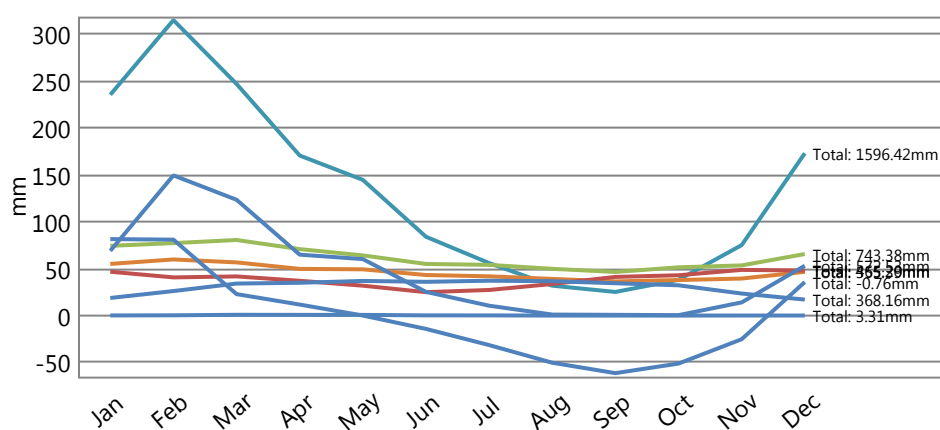
■ mm/year □ % Total inputs



| Name              | Value   |
|-------------------|---------|
| Rain              | 1596.42 |
| Irrigation        | 555.39  |
| Soil Evaporation  | 743.38  |
| Transpiration     | 465.20  |
| Rain Runoff       | 572.53  |
| Irrigation Runoff | 3.31    |
| Deep Drainage     | 368.16  |
| Delta Soil Water  | -0.76   |

**Average Monthly Totals (mm):**

■ Chart □ Table



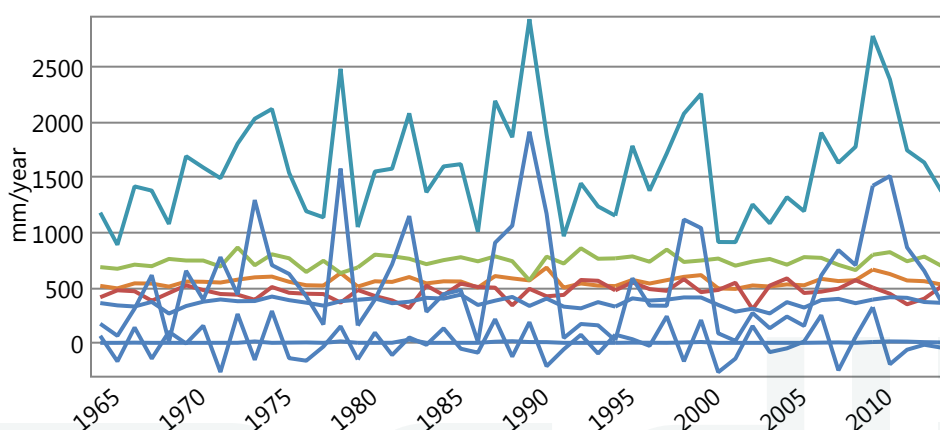
Legend for Average Monthly Totals (mm):

- Rain
- Irrigation
- Soil Evap
- Transpn.
- Rain Runoff
- Irrigation Runoff
- Deep Drainage
- Delta Soil Water



**Average Annual Totals (mm/year):**

■ Chart □ Table



Legend for Average Annual Totals (mm/year):

- Rain
- Irrigation
- Soil Evap
- Transpn.
- Rain Runoff
- Irrigation Runoff
- Deep Drainage
- Delta Soil Water



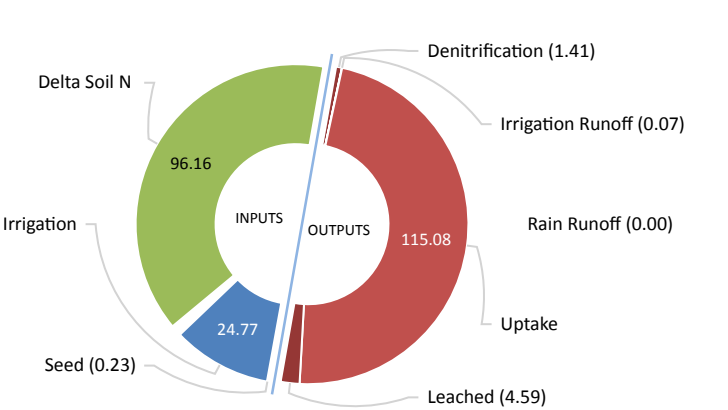
Land Performance - Soil Nutrient

Paddock: **Nominated Irrigation Areas, 11.88 ha**

Soil Type: **Duplex 2**

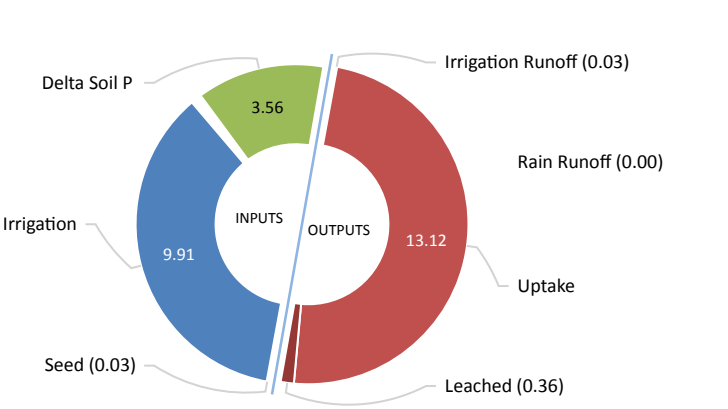
Irrigation ammonium volatilisation losses (kg/ha/year): 0.00  
Proportion of total nitrogen in irrigated effluent as ammonium (%): 0.20

Nitrogen Balance (kg/ha/year)



| Name              | Value  |
|-------------------|--------|
| Seed              | 0.23   |
| Irrigation        | 24.77  |
| Denitrification   | 1.41   |
| Irrigation Runoff | 0.07   |
| Rain Runoff       | 0.00   |
| Uptake            | 115.08 |
| Leached           | 4.59   |
| Delta Soil N      | -96.16 |

Phosphorus Balance (kg/ha/year)



| Name              | Value |
|-------------------|-------|
| Seed              | 0.03  |
| Irrigation        | 9.91  |
| Irrigation Runoff | 0.03  |
| Rain Runoff       | 0.00  |
| Uptake            | 13.12 |
| Leached           | 0.36  |
| Delta Soil P      | -3.56 |

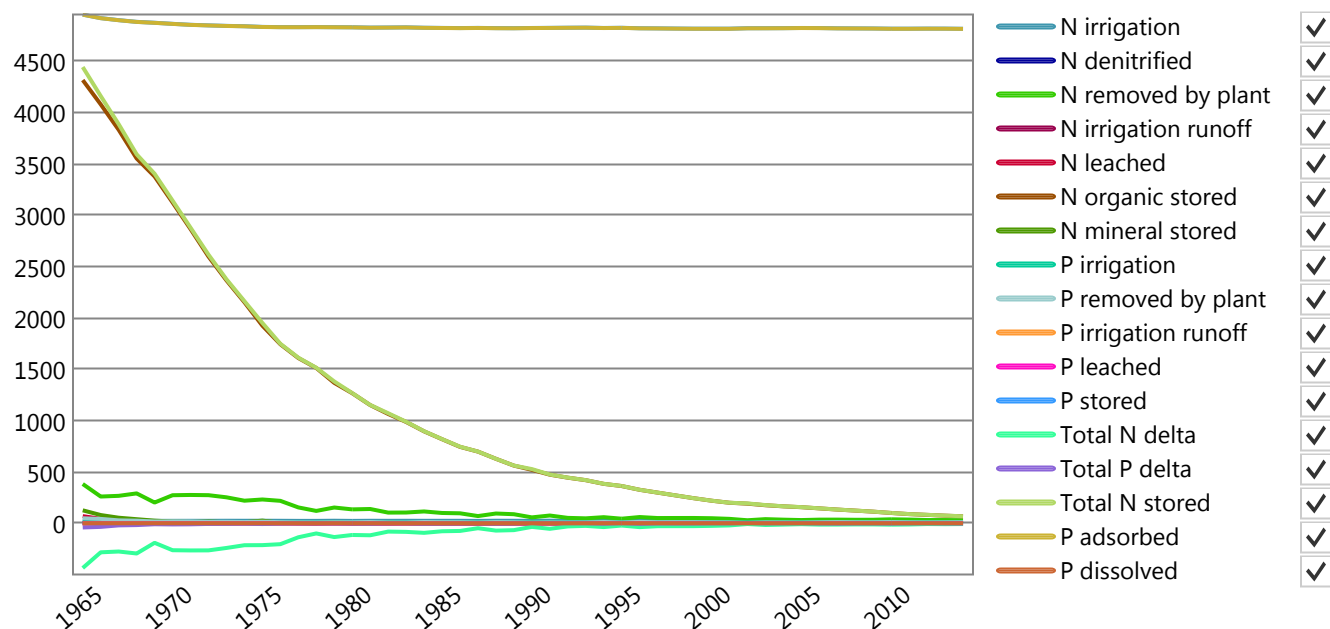
PERFORMANCE



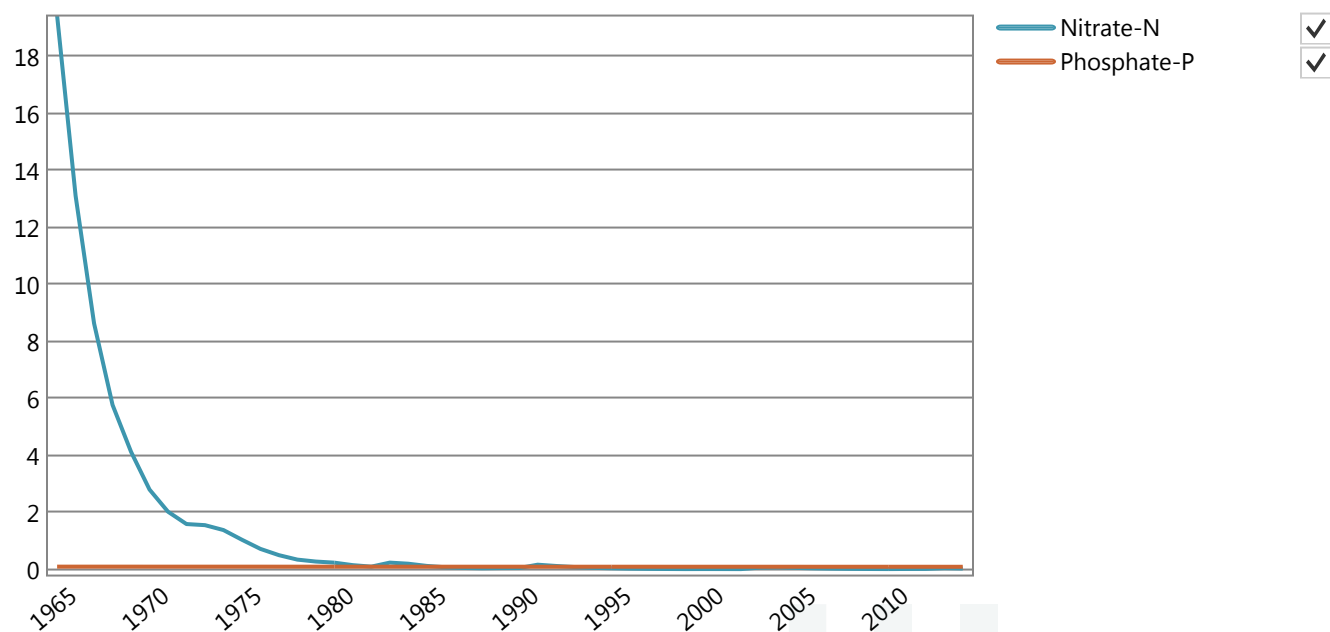
## Land Performance - Soil Nutrient

Paddock: **Nominated Irrigation Areas, 11.88 ha**Soil Type: **Duplex 2**

## Annual Nutrient Totals (kg/ha):



## Annual Nutrient Leaching Concentration (mg/L):



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## Plant Performance and Nutrients

**Paddock:** Nominated Irrigation Areas, 11.88 ha

**Soil Type:** Duplex 2

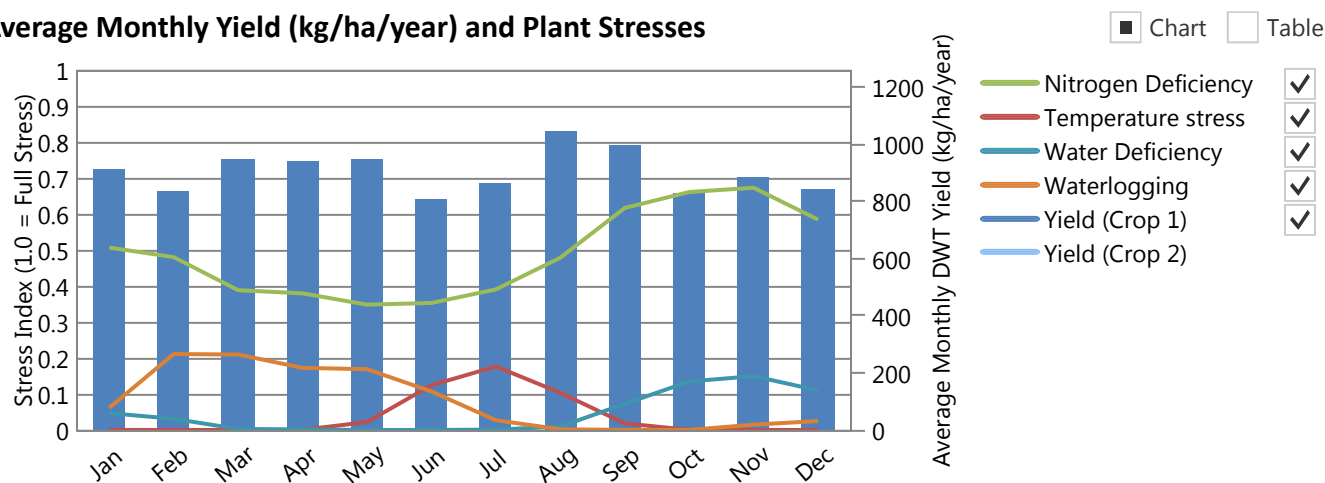
**Plant:** Continuous Blady Grass Pasture

|                                                     |                               |
|-----------------------------------------------------|-------------------------------|
| Average annual shoot dry matter yield (kg/ha/year)  | 10866.83 (5253.54 - 20597.28) |
| Average monthly plant cover (%) (minimum - maximum) | 0.33 (0.31 - 0.37)            |
| Average monthly root depth (mm) (minimum - maximum) | 693.32 (668.82 - 733.90)      |

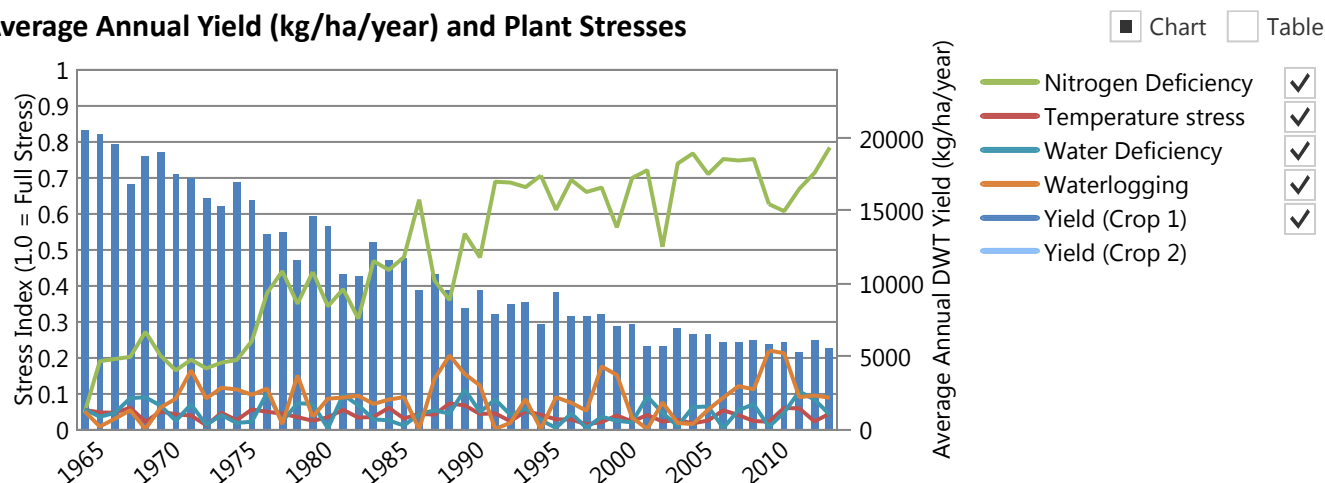
### Nutrient Uptake (minimum - maximum):

|                                                                    |                         |
|--------------------------------------------------------------------|-------------------------|
| Average annual net nitrogen removed by plant uptake (kg/ha/year)   | 114.62 (29.91 - 381.93) |
| Average annual net phosphorus removed by plant uptake (kg/ha/year) | 13.05 (4.94 - 49.16)    |
| Average annual shoot nitrogen concentration (fraction dwt)         | 0.01 (0.01 - 0.02)      |
| Average annual shoot phosphorus concentration (fraction dwt)       | 0.001 (0.001 - 0.003)   |

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



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



**No. of harvests/year:** 2.00 (normal), 0.36 (forced by crop death due to nitrogen stress (0.02), water stress (0.12), waterlogging (0.22))

**No. days without crop/year (days/year):** 4.58 due to water stress (3.38), waterlogging (1.20)

## Land Performance

**Paddock:** Nominated Irrigation Areas, 11.88 ha

**Soil Type:** Duplex 2

**Plant:** Continuous Blady Grass Pasture

|                                                              |                     |
|--------------------------------------------------------------|---------------------|
| Salt tolerance                                               | Moderately tolerant |
| Salinity threshold EC sat. ext. (dS/m)                       | 1.50                |
| Proportion of yield decrease per dS/m increase (%/dS/m)      | 0.02                |
| No. years assumed for leaching to reach steady-state (years) | 10.00               |

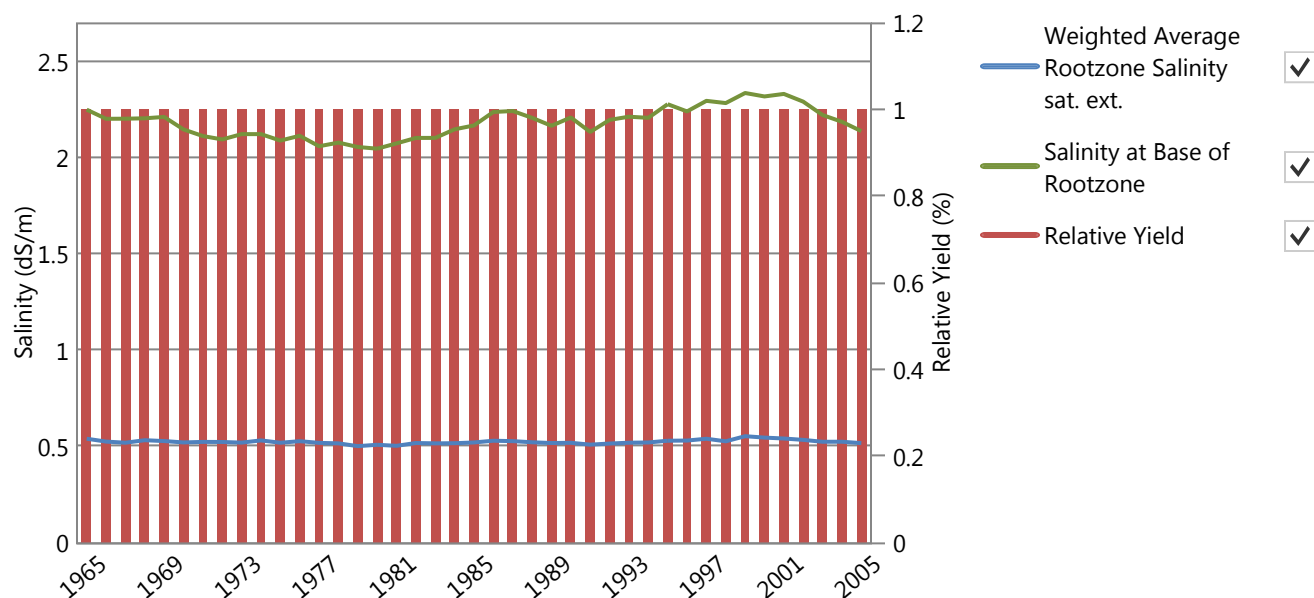
### Soil Salinity:

|                                                                                                           |         |
|-----------------------------------------------------------------------------------------------------------|---------|
| Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)                          | 0.51    |
| Salt added by rainfall (kg/ha/year)                                                                       | 196.59  |
| Average annual effluent salt added & leached at steady state (kg/ha/year)                                 | 5135.33 |
| Average leaching fraction based on 10 year running averages (fraction)                                    | 0.44    |
| Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)                                          | 0.52    |
| Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)                         | 2.18    |
| Relative crop yield expected due to salinity (%)                                                          | 1.00    |
| Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (%) | 0.00    |

### Average Annual Rootzone Salinity and Relative Yield:

☒ Chart ☐ Table

All values based on 10 year running averages



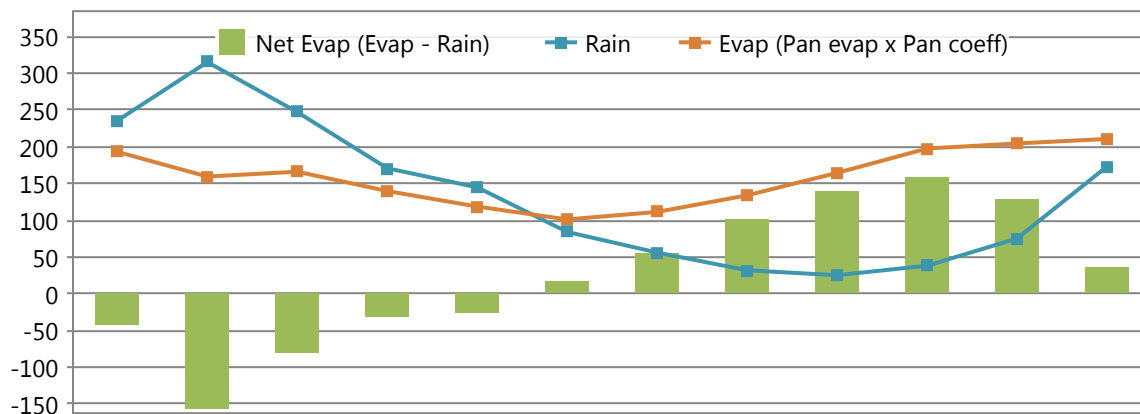
medli

## Sustainability Diagnostics: Lindeman Island Resort

### Averaged Historical Climate Data Used in Simulation (mm)

Location: Lindeman, -20.45°, 149.05°

Run Period: 01/01/1965 to 31/12/2014 50 years, 0 days



|              | Jan   | Feb    | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   | Year   |
|--------------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Rain         | 235.5 | 315.0  | 247.0 | 170.7 | 144.7 | 84.1  | 56.0  | 31.9  | 25.2  | 38.1  | 75.1  | 173.1 | 1596.4 |
| Evap         | 192.9 | 159.4  | 166.0 | 139.6 | 118.6 | 101.1 | 111.3 | 133.8 | 164.4 | 197.5 | 204.4 | 210.5 | 1899.4 |
| Net Evap     | -42.6 | -155.7 | -81.0 | -31.0 | -26.1 | 17.0  | 55.3  | 101.9 | 139.2 | 159.3 | 129.3 | 37.5  | 303.0  |
| Net Evap/day | -1.4  | -5.5   | -2.6  | -1.0  | -0.8  | 0.6   | 1.8   | 3.3   | 4.6   | 5.1   | 4.3   | 1.2   | 0.8    |

DIAGNOSTICS

medli

**Sustainability Diagnostics: Lindeman Island Resort****Pond System: 1 facultative pond****New Sewage Treatment Plant - 134631.74 m3/year or 368.61 m3/day generated on average****Effluent entering pond system after any pretreatment and recycling**

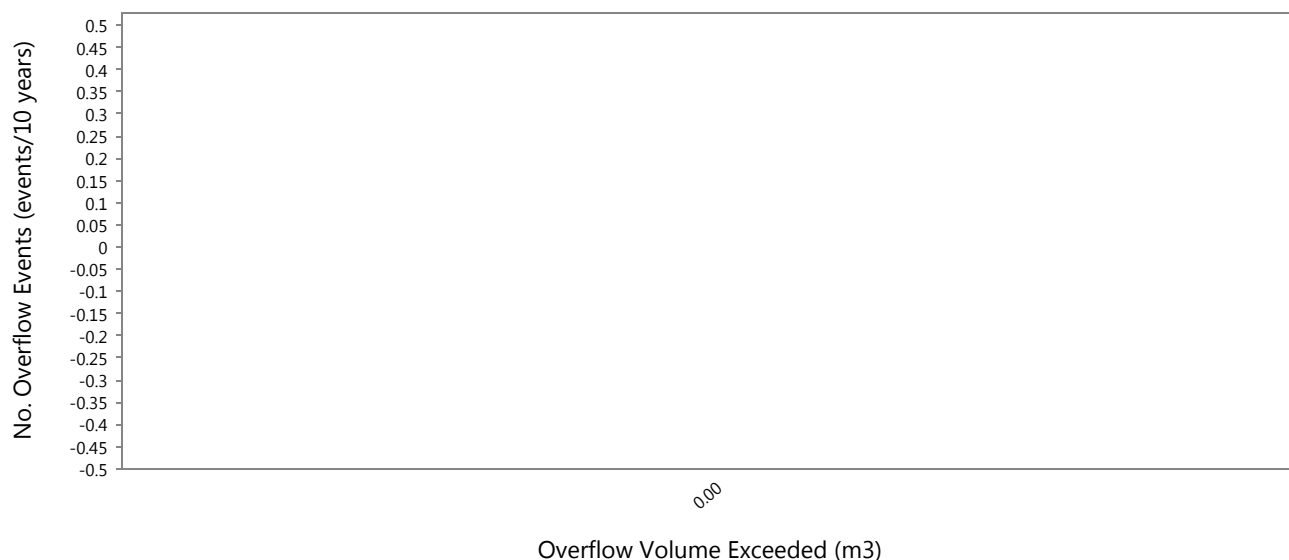
Average (Minimum-Maximum) influent quality calculated for 365.24 non-zero flow days, after any pretreatment and recycling.

| Constituent           | Concentration (mg/L)      | Load (kg/year)                    |
|-----------------------|---------------------------|-----------------------------------|
| Total Nitrogen        | 4.61 (0.70 - 5.00)        | 620.80 (620.39 - 622.09)          |
| Total Phosphorus      | 1.84 (0.28 - 2.00)        | 248.32 (248.16 - 248.84)          |
| Total Dissolved Salts | 922.22 (139.44 - 1000.00) | 124159.69 (124078.10 - 124418.04) |
| Volatile Solids       | 0.00 (0.00 - 0.00)        | 0.00 (0.00 - 0.00)                |
| Total Solids          | 0.00 (0.00 - 0.00)        | 0.00 (0.00 - 0.00)                |

**Last pond (Wet weather store): 15000.00 m3**

|                                                                             |       |
|-----------------------------------------------------------------------------|-------|
| Theoretical hydraulic retention time (days)                                 | 40.69 |
| Average volume of overflow (m3/year)                                        | 0.00  |
| No. overflow events per year exceeding threshold* of 1.89 m3 (no./year)     | 0.00  |
| Average duration of overflow (days)                                         | 0.00  |
| Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (%) | 0.49  |
| Probability of at least 90% effluent reuse (%)                              | 0.00  |
| Average salinity of last pond (dS/m)                                        | 1.42  |
| Salinity of last pond on final day of simulation (dS/m)                     | 1.36  |
| Ammonia loss from pond system water area (kg/m2/year)                       | 0.00  |

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

**Overflow exceedance:**☒ Chart ☐ Table[Export plot](#)

**Sustainability Diagnostics: Lindeman Island Resort****Irrigation Information****Irrigation: 11.88 ha total area (assumed 100% irrigation efficiency)**

|                               | Quantity/year | Quantity/ha/year |
|-------------------------------|---------------|------------------|
| Total irrigation applied (m3) | 65980.72      | 5553.93          |
| Total nitrogen applied (kg)   | 294.21        | 24.77            |
| Total phosphorus applied (kg) | 117.68        | 9.91             |
| Total salts applied (kg)      | 58842.26      | 4953.05          |

**Shandying**

|                                                                                                            |                    |
|------------------------------------------------------------------------------------------------------------|--------------------|
| Annual allocation of fresh water for shandying (m3/year)                                                   | 0.00               |
| Average Shandy water irrigation (m3/year) (minimum - maximum)                                              | 0.00 (0.00 - 0.00) |
| Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum) | 0.00 (0.00 - 0.00) |
| Proportion of irrigation events requiring shandying (% of events)                                          | 0.00               |
| Minimum shandy water is used                                                                               | False              |

**Irrigation Issues**

|                                                               |      |
|---------------------------------------------------------------|------|
| Proportion of Days irrigation is prevented when triggered (%) | 0.00 |
| Proportion of Days irrigation occurs (%)                      | 1.00 |

## Sustainability Diagnostics: Lindeman Island Resort

**Paddock Land: Nominated Irrigation Areas: 11.88 ha**

**Irrigation: Fixed Sprinkler with 0% ammonium loss during irrigation**

|                                                                  |
|------------------------------------------------------------------|
| Irrigation triggered every 1 days                                |
| Irrigate a fixed amount of 5.00 mm each day                      |
| Irrigation window from 1/1 to 31/12 including the days specified |
| A minimum of 0 days must be skipped between irrigation events    |

**Soil Water Balance (mm): Duplex 2, 76.00 mm PAWC at maximum root depth**

|             | Jan   | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   | Year   |
|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Rain        | 235.5 | 315.0 | 247.0 | 170.7 | 144.7 | 84.1  | 56.0  | 31.9  | 25.2  | 38.1  | 75.1  | 173.1 | 1596.4 |
| Irrigation  | 55.1  | 59.8  | 56.7  | 49.8  | 49.3  | 43.2  | 41.9  | 39.1  | 36.4  | 37.9  | 39.5  | 46.6  | 555.4  |
| Soil Evap   | 74.4  | 77.3  | 80.6  | 70.9  | 64.2  | 55.0  | 54.1  | 49.8  | 46.5  | 51.5  | 53.5  | 65.6  | 743.4  |
| Transpn.    | 46.8  | 40.7  | 41.8  | 37.1  | 31.9  | 25.0  | 27.3  | 33.7  | 41.2  | 43.0  | 48.7  | 48.0  | 465.2  |
| Rain Runoff | 69.0  | 149.5 | 123.5 | 65.0  | 60.2  | 25.3  | 10.5  | 1.1   | 0.8   | 0.4   | 14.1  | 53.2  | 572.5  |
| Irr. Runoff | 0.1   | 0.3   | 0.8   | 0.8   | 0.8   | 0.2   | 0.2   | 0.0   | 0.0   | 0.0   | 0.1   | 0.1   | 3.3    |
| Drainage    | 18.8  | 26.1  | 34.1  | 35.0  | 36.9  | 36.0  | 37.2  | 36.7  | 34.5  | 32.3  | 23.5  | 17.1  | 368.2  |
| Delta       | 81.6  | 81.0  | 22.9  | 11.8  | 0.0   | -14.2 | -31.5 | -50.3 | -61.4 | -51.2 | -25.2 | 35.7  | -0.8   |

### Soil Nitrogen Balance

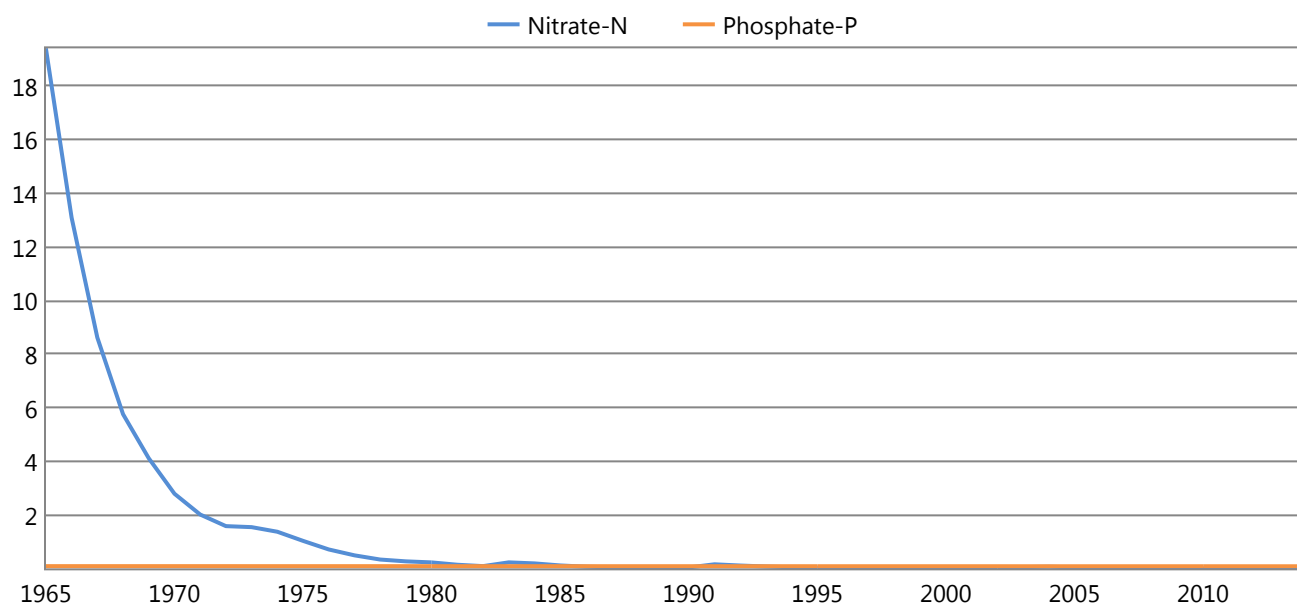
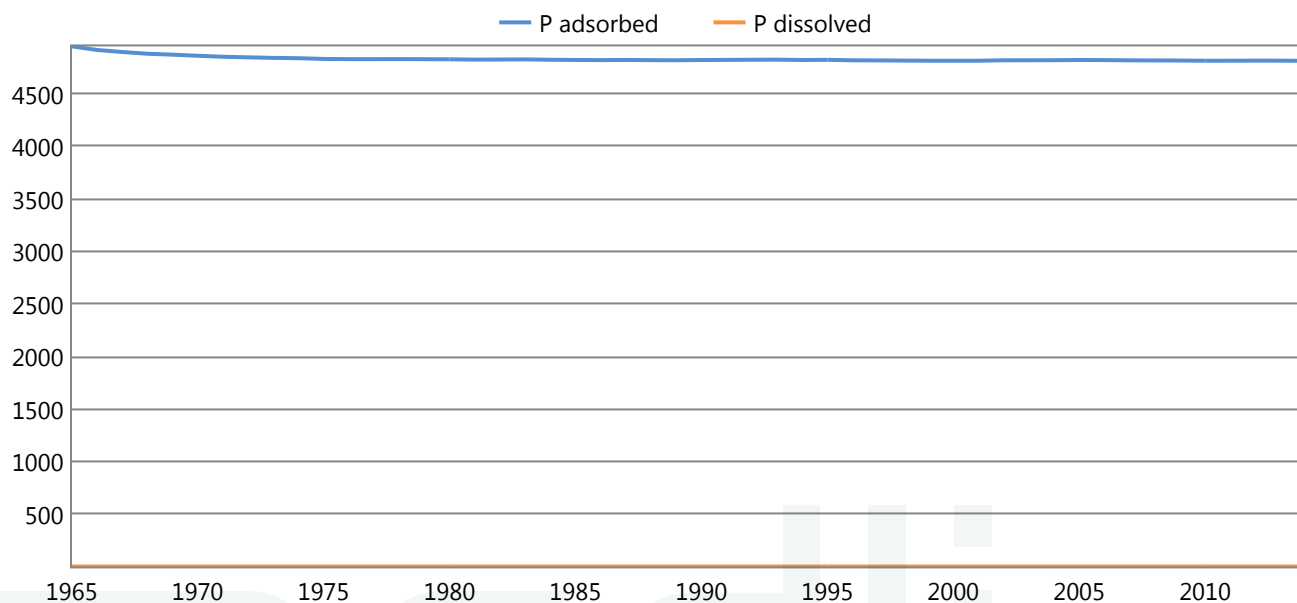
|                                                                      |                 |
|----------------------------------------------------------------------|-----------------|
| Average annual effluent nitrogen added (kg/ha/year)                  | 24.77           |
| Average annual soil nitrogen removed by plant uptake (kg/ha/year)    | 115.08          |
| Average annual soil nitrogen removed by denitrification (kg/ha/year) | 1.41            |
| Average annual soil nitrogen leached (kg/ha/year)                    | 4.59            |
| Average annual nitrate-N loading to groundwater (kg/ha/year)         | 4.59            |
| Soil organic-N kg/ha (Initial - Final)                               | 4620.00 - 68.63 |
| Soil inorganic-N kg/ha (Initial - Final)                             | 257.10 - 0.25   |
| Average nitrate-N concentration of deep drainage (mg/L)              | 1.25            |
| Max. annual nitrate-N concentration of deep drainage (mg/L)          | 19.40           |

### Soil Phosphorus Balance

|                                                                                                            |                   |
|------------------------------------------------------------------------------------------------------------|-------------------|
| Average annual effluent phosphorus added (kg/ha/year)                                                      | 9.91              |
| Average annual soil phosphorus removed by plant uptake (kg/ha/year)                                        | 13.12             |
| Dissolved phosphorus (kg/ha) (Initial - Final)                                                             | 1.04 - 0.71       |
| Adsorbed phosphorus (kg/ha) (Initial - Final)                                                              | 4991.83 - 4814.06 |
| Average phosphate-P concentration in rootzone (mg/L)                                                       | 0.01              |
| Average phosphate-P concentration of deep drainage (mg/L)                                                  | 0.10              |
| Max. annual phosphate-P concentration of deep drainage (mg/L)                                              | 0.10              |
| Design soil profile storage life based on average infiltrated water phosphorus concn. of 0.63 mg/L (years) | 295.74            |

**Sustainability Diagnostics: Lindeman Island Resort****Paddock Land: Nominated Irrigation Areas: 11.88 ha****Irrigation: Fixed Sprinkler with 0% ammonium loss during irrigation**

## DIAGNOSTICS

**Annual nutrient leachate concentration (mg/L)****Annual Phosphate-P in soil (kg/ha)**

## Sustainability Diagnostics: Lindeman Island Resort

**Paddock Plant Performance: Nominated Irrigation Areas: 11.88 ha**

**Average Plant Performance (Minimum - Maximum): Continuous Blady Grass Pasture**

|                                                                                         |                               |
|-----------------------------------------------------------------------------------------|-------------------------------|
| Average annual shoot dry matter yield (kg/ha/year)                                      | 10866.83 (5253.54 - 20597.28) |
| Average monthly plant cover (%)                                                         | 0.33 (0.31 - 0.37)            |
| Average monthly crop factor (fraction)                                                  | 0.26 (0.24 - 0.29)            |
| Non-transpiring Cover Left after Harvest (%)                                            | 0.20                          |
| Average monthly root depth (mm)                                                         | 693.32 (668.82 - 733.90)      |
| Average number of normal harvests per year (no./year)                                   | 2.00 (0.00 - 4.00)            |
| Average number of normal harvests for last five years only (no./year)                   | 0.80                          |
| Average number of crop deaths per year (no./year)                                       | 0.36 (0.00 - 2.00)            |
| Average number of crop deaths for last five years only (no./year)                       | 0.80                          |
| Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient) | 0.49 (0.05 - 0.78)            |
| Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient) | 0.00 (0.00 - 0.00)            |
| Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)    | 0.18 (0.04 - 0.38)            |
| Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)       | 0.05 (0.00 - 0.15)            |
| Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)       | 0.08 (0.00 - 0.21)            |
| No. days without crop/year (days)                                                       | 4.58                          |

**Soil Salinity - Plant salinity tolerance: Moderately tolerant**

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

*All values based on 10 year running averages*

|                                                                                                           |         |
|-----------------------------------------------------------------------------------------------------------|---------|
| Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)                          | 0.51    |
| Salt added by rainfall (kg/ha/year)                                                                       | 196.59  |
| Average annual effluent salt added & leached at steady state (kg/ha/year)                                 | 5135.33 |
| Average leaching fraction based on 10 year running averages (fraction)                                    | 0.44    |
| Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)                                          | 0.52    |
| Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)                         | 2.18    |
| Relative crop yield expected due to salinity (%)                                                          | 1.00    |
| Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (%) | 0.00    |



## Run Messages

### Messages generated when the scenario was run:

Full run chosen

medli

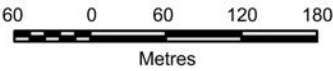
# Water Infrastructure Assessment - Supporting Information

## APPENDIX B

### Nominated Irrigation Areas



Scale: 1:6,000



### LEGEND

 Potential Irrigation Area

Total Areas  
Golf Course 9.1ha  
Spa Resort Entrance 1.6ha  
Airstrip Buffer 0.96ha  
General Landscaping 0.22ha

Lindeman Island

Proposed Irrigation  
Areas

SHEET A3  
Project No: HRP15078  
Date: 21-12-2016  
Revision Number:  
Designed by:  
Client Name:



Cardno (QLD) Pty Ltd | ABN 57 051 074 992  
Level 11, North Tower, 515 St Pauls Terrace  
Locked Bag 4006, Fortitude Valley QLD 4006  
Tel: 07 3369 9822 Fax: 07 3369 9722

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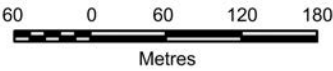
# Water Infrastructure Assessment - Supporting Information

## APPENDIX C

### Recycled Water Service Areas



Scale: 1:6,000



**LEGEND**

 Supplemented with Recycled Water

**Lindeman Island**

**Recycled Water Service Areas**

SHEET A3  
Project No: HRP15078  
Date: 21-12-2016  
Revision Number:  
Designed by:  
Client Name:



Cardno (QLD) Pty Ltd | ABN 57 051 074 992  
Level 11, North Tower, 515 St Pauls Terrace  
Locked Bag 4006, Fortitude Valley QLD 4006  
Tel: 07 3369 9822 Fax: 07 3369 9722

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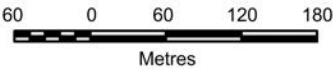
Water Infrastructure Assessment -  
Supporting Information

**APPENDIX D**  
Proposed Water and Sewer Infrastructure



Note: A safe harbour is no longer proposed.

Scale: 1:6,000



**LEGEND**

— Recycled Water Main (Ø100)

**Lindeman Island**

**Recycled Water Network**

SHEET A3  
Project No: HRP15078  
Date: 21-12-2016  
Revision Number:  
Designed by:  
Client Name:



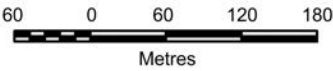
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Scale: 1:6,000



**LEGEND**

- WTP
- Pump Station
- Desalination Plant

- Water Mains (Diameter)
- 50
  - 100
  - 150
  - 200

- Ring Mains
- Ring Main A
  - Ring Main B
  - Ring Main C

**Lindeman Island**

**Proposed Water Supply Infrastructure**

SHEET A3  
Project No: HRP15078  
Date: 21-12-2016  
Revision Number:  
Designed by:  
Client Name:



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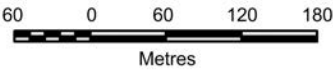
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Scale: 1:6,000



**LEGEND**

- WWTP
- Pump Station

| Sewer Mains (Diameter) |     |
|------------------------|-----|
| 50                     | 110 |
| 63                     | 160 |
| 75                     | 180 |
| 90                     |     |

**Lindeman Island**  
**Proposed Wastewater Infrastructure**

SHEET A3  
Project No: HRP15078  
Date: 21-12-2016  
Revision Number:  
Designed by:  
Client Name:



Cardno (QLD) Pty Ltd | ABN 57 051 074 992  
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