BYRON SHIRE COUNCIL

# USER GUIDE

## FOR BYRON SHIRE COUNCIL'S WASTEWATER MANAGEMENT MODEL

MAY 2025

BYRON SHIRE COUNCIL

# Contents

# 1. INTRODUCTION

This document provides guidance for using the Disposal Field Calculation Model (the model) in alignment with the Byron Shire Council's *Onsite Sewage Management Guidelines* (2023). The model reflects the updates introduced in the latest guidelines, including:

- Changes to the number of people per bedroom to now being 2 people for the first habitable room and 1.5 people for every habitable room thereafter;
- Commercial developments, such as cabins, will require the design based on 2 people, therefore an override is available to input data;
- Rainfall data now from 1980 to 2024 (previous 1980 to 2001)

Other changes that have also been applied to this model are as follows:

- The sizing of the physical disposal field (i.e., the constructed area) is now determined solely by the **hydraulic** area. Previously, the disposal field size was based on the most limiting factor among hydraulic loading, nitrogen, or phosphorus.
- A separate **nutrient** area is also calculated, although this space is not physically constructed. Where required, it may encompass both the constructed hydraulic disposal field and a downgradient buffer, or, depending on the treatment system selected, a nutrient area may not be necessary at all;
- While the nutrient area is not a built feature, it must still be considered in setback calculations and may also serve as a designated reserve where nutrient loading is the limiting factor, and this will be up to the consultant to show on site plans;
- Updating the domestic design flow allowances to be in accordance with Table H3 of AS/NZS 1547:2012;
- In the previous model, a cap of 10 $m^2$/person/day was applied to hydraulic area sizing for highly permeable soils, effectively overriding the Long Term Acceptance Rates (LTAR). This cap has now been removed, with soil-specific design limits used instead;
- AS/NZS 1547:2012 does not provide LTAR values for Category 1 to 3 soils (gravels, sands, and clay loams) when used in evapotranspiration/absorption (ETA) trenches and beds. Councils on the North Coast historically adopted the Standard's LTAR values from absorption trench and bed design in these soil types and used for ETA beds, then constrained the disposal field area using the cap as a general sizing rule;
- The updated model shifts away from this conservative cap, opting instead for reduced permeability rates more representative of appropriate field performance;
- The model now allows wetland cell numbers and sizes to be adjusted to align with commercially available configuration;

- The model still considers the land size limiting factor, to allow for nutrient consideration on smaller, but new allotments where subdivisions are proposed by either choosing 'yes' or 'no' if a subdivision is proposed or not, allowing for a larger nitrogen area if 'yes' a subdivision is proposed, based on the land size of the site. Nutrient sizing is based upon distances to creeks, gullies and water table and dependent upon soil type;

- A default value of nutrient uptake of plants has been used, which is based on grass, as other plants are not encouraged to be grown on disposal fields;

- The model permits lateral seepage of wastewater through the walls of ETA beds to a distance of 0.25 m for selected soil types. In the original 2004 model, a uniform seepage allowance of 0.3 m was applied regardless of soil classification, representing assumed lateral movement from trench walls. The updated approach applies the 0.25 m allowance only where appropriate, and excludes highly permeable soils, where the field sizing is now based on reduced permeability rates rather than seepage assumptions

# 2. GETTING STARTED

The file will need to be unzipped first and depending on the computer or computer network settings, the following additional steps may need to be used to enable the macros for the model to run.

1. Unzip the compressed file and save it to a local folder on your computer
2. Right click the unzipped file and select properties
3. In the General tab, if available, tick the "Unblock" checkbox at the bottom, then click Apply.

## 2.1 Displaying the model

If the model appears misaligned or displays overlapping text, it may be due to a missing font. To resolve this, follow these steps to install the required font:

1. Download the **Aptos Narrow** font from Microsoft:
   https://www.microsoft.com/en-us/download/details.aspx?id=106087
2. Extract the downloaded ZIP file.
3. Double-click the font file and click **Install**.

# 3. MODEL LAYOUT

The model has retained the one-page user interface model as the previous model had with the layout now as A4 portrait. The model has a few colours being:

- Blue – locked cells

- Orange with solid red border – user input required

- Orange with dotted red border – user input optional
- Green – locked cells providing information

The model allows for the disposal field to be calculated on the fly when choosing either a **treatment system** or **disposal field** or when '**calculate hydraulic area'** is pressed. A snap shot of the model is presented in Figure 1.

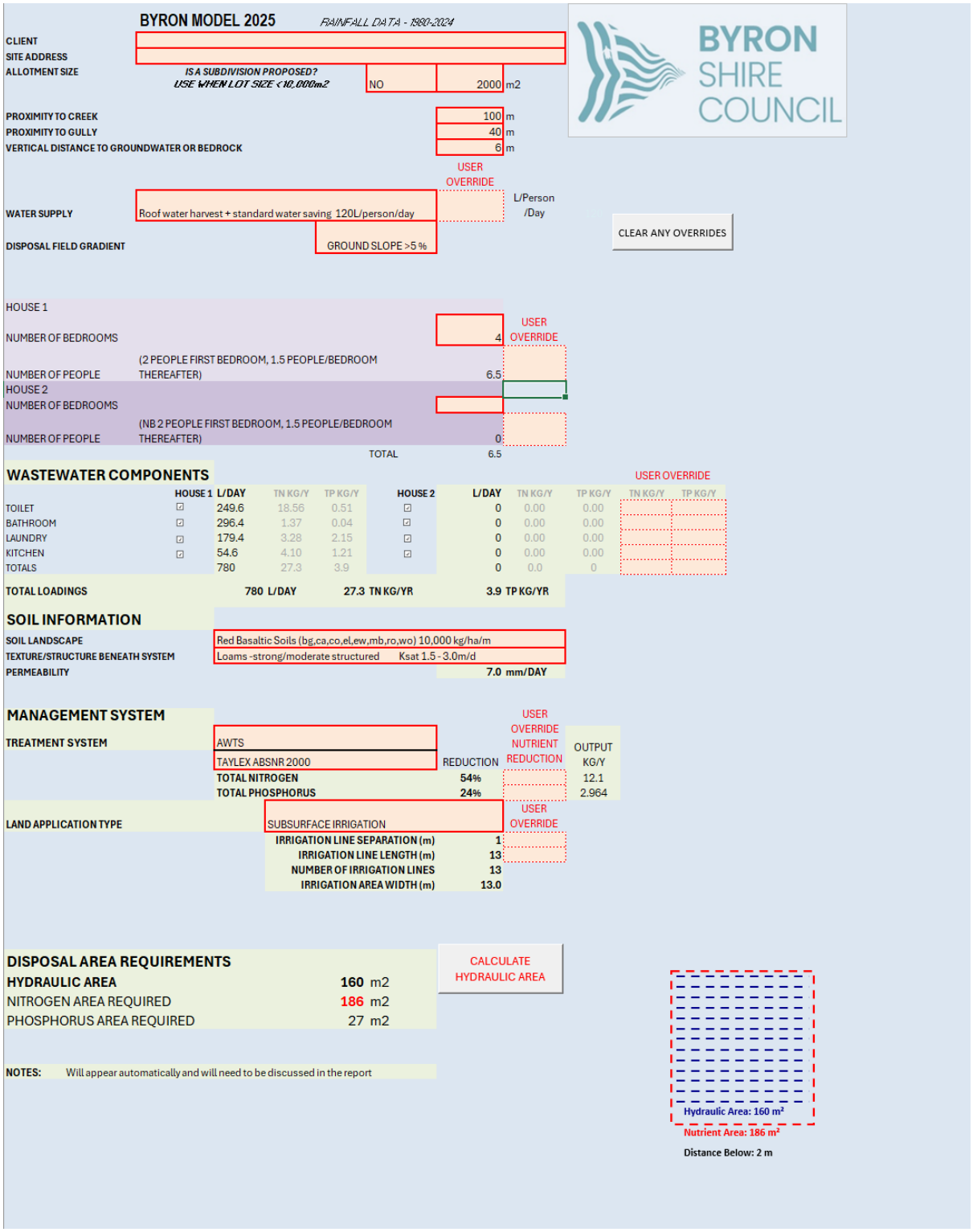


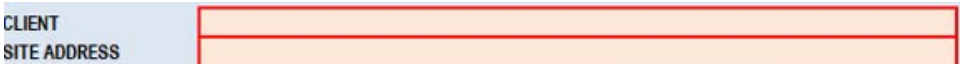

**Figure 1: New design model**

A step-by-step guide on using the model is presented as follows. Each step includes a screen snip of the relevant section of the model to that step, and a description of what is required at each step to complete the modelling process.

## 3.1 Input Cells

The required user input cells are orange with a red border.

### 3.1.1 Client details

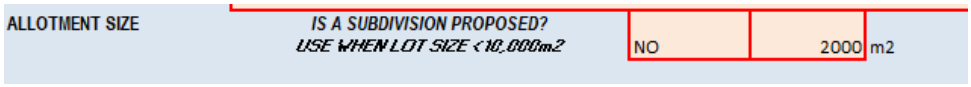



1. Client: note the client for reference (the owner of the site, not the applicant)

2. Site address: note address of property for reference.

### 3.1.2 Allotment Size

This breaks into a question if a subdivision is proposed: yes or no. Land Size is entered directly in the cell to the right.




When **'No'** is selected (i.e. subdivision is *not* proposed), the model operates in site-specific mode. The nitrogen area is primarily determined by the property's nitrogen load, treatment performance, denitrification capacity, and proximity to environmentally sensitive features such as creeks or gullies. For blocks equal to or smaller than 10,000 $m^2$, block size does not affect nitrogen export, maintaining a conservative sizing approach.

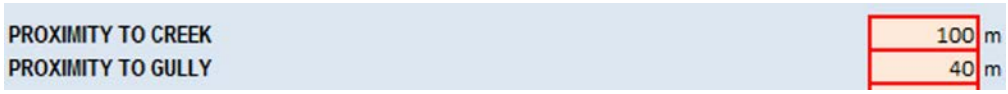
For blocks larger than 10,000 $m^2$ the model applies a scaling factor that recognises the additional assimilative capacity of larger rural lots and allows for an increase in the export of N to the environment, which will match the 'yes' for subdivisions above 10,000$m^2$ lot size also.

When **'Yes'** is selected (ie subdivision is proposed), the model shifts to a catchment-based approach to nutrient management. The block size entered should reflect either the smallest proposed allotment or a representative range of lots if sensitive areas are located near the potential wastewater fields in the other proposed allotments. In this mode, the nitrogen area is scaled based on both block size and proximity to sensitive features. For allotments smaller than 10,000 m2 the model increases the nitrogen area requirement exponentially to reflect the potential for higher cumulative nutrient loads across multiple dwellings within the subdivision.

### 3.1.3 Proximity to creek and gully

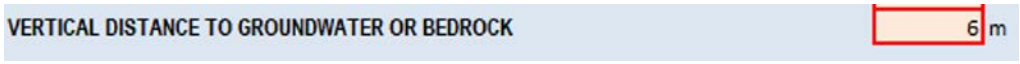
If the land application area (LAA) is located within 100 metres of a creek or 40 metres of a gully, the required nitrogen area may increase in response to the reduced environmental buffer. In such cases, the model dynamically adjusts the nitrogen export allowance using a site-specific calculation based on actual

setback distances. This is based on proximity ratios and modify the export curve accordingly. The TN allowable limit will be affected if the buffer to creek or gully is encroached, which will then require a larger TN field. The TN field must be positioned outside the override distance to the creek, ie if 70 is used, the nitrogen envelope must be 70 m or more from the creek. Further treatment would reduce the TN area required.



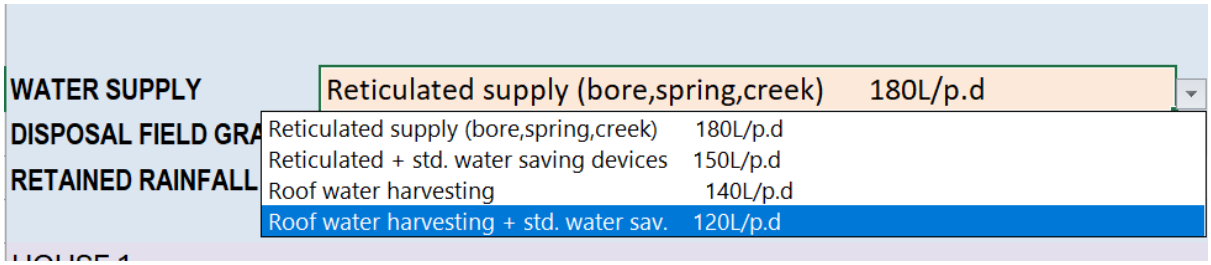

### 3.1.4 Vertical distance to groundwater or bedrock:

This influences the size of the area required for phosphorus management, based on the depth of soil that is available for phosphorus sorption. This input needs to be site specific and will be determined via borehole investigation.




### 3.1.5 Water supply:

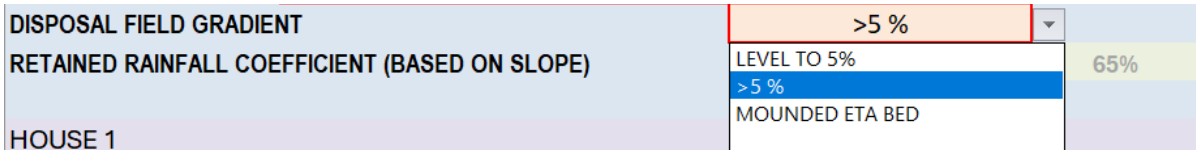
The relevant water supply option is chosen from a drop-down list. The water loading is based on the water supply from standard numbers within Table H3 of AS/NZS 1547:2012. Note, there is a user override option and is discussed in Section 2.5.




### 3.1.6 Land application area gradient

Choose from drop down list. This function allows for the runoff of rainfall from the site (or how much is retained) to be modified, depending on the gradient of the land in the land application area. There are three options:

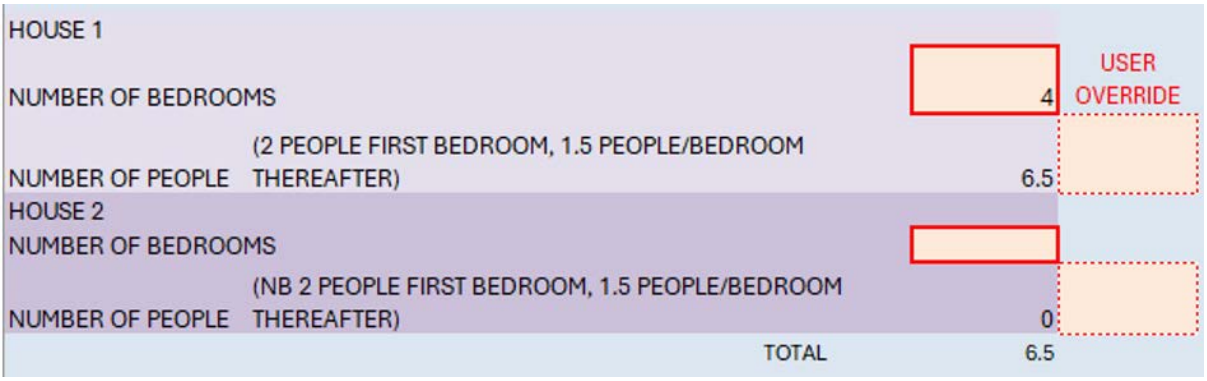
1. Level ground to 5% gradient retains 85% of rainfall. This option is applicable to all land application if the site is relatively flat (ie up to 5 %) and could include ETA beds if no mounding is proposed on the beds, therefore allowing water to enter the LAA
2. > 5% gradient retains 65 % of rainfall. This option would applies to all land application methods apart from ETA beds.
3. Mounded ETA beds, retains 65 % of rainfall. This option applies to ETA beds only.




### 3.1.7 Choosing number of habitable rooms

House 1: manually enter number of bedrooms for 1st house, which will then automatically calculate the number of people, being 2 people 1 bedroom + 1.5 people for bedrooms thereafter.

House 2: leave blank if there is only a single dwelling involved, or manually enter number of bedrooms for the 2nd house which will then calculate the number of people, being 2 people 1 bedroom + 1.5 people for bedrooms thereafter.




The user override fields (located in the adjacent cells to the right) allow for tailored inputs to accommodate site-specific or development-driven design requirements. For example, in cases such as tourist cabins where occupancy is calculated as two persons per habitable room, a two-bedroom cabin would require an override value of 4 persons to reflect peak design load.

It's also important to note that the definition of a *habitable room* is discretionary. Both designers and assessment officers are should apply conservative assumptions as site constraints increase. For instance, a dwelling with four bedrooms, a study, and a rumpus room on a large, well-buffered allotment may reasonably be assessed as a four-bedroom home. However, the same layout on a small, poorly buffered lot should be assessed more cautiously—potentially as six bedrooms—to ensure the wastewater design reflects the site's capacity and environmental limitations

### 3.1.8 Wastewater Components

This Section uses tick boxes for each dwelling and for each fixture to determine the hydraulic, Total Nitrogen (TN) and Total Phosphorus (TP) loadings. **Hydraulic** Loading is determined using a percentage of loading and is based *on Domestic Greywater Reuse: Overseas Practice and Its Applicability to Australia* by Jeppesen & Solley (1994), as per the original model, which is in the absence of AS/NZ 1547-2012 having a breakdown of these components, whereas the overall loading from the standard has been used per person.

The tick boxes provide a running loading rate for hydraulics, TN and TN based on the number of people and theoretical hydraulic load per person per day (either default or user modified).

TN and TP loadings are both from *Rural household wastewater characterisation* within the Proceedings of the National Home Sewage Disposal Symposium, by Witt *et. al.* (1974) using theoretical loadings for each of the fixtures.

No figures will display if there is no number entered into the 'number of bedrooms' cell for the corresponding House in the Section above.

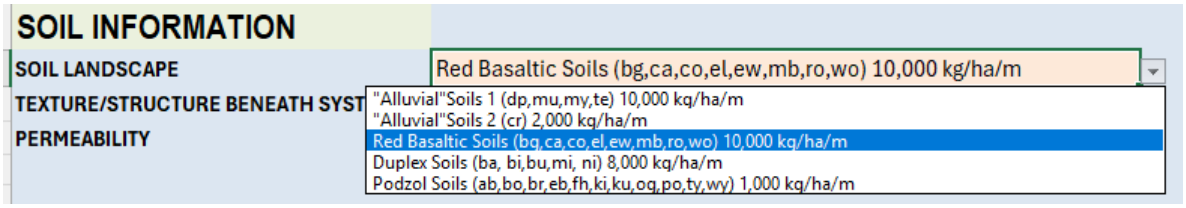
| WASTEWATER COMPONENTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | HOUSE 1 | L/DAY | TN KG/Y | TP KG/Y | HOUSE 2 | L/DAY | TN KG/Y | TP KG/Y |
| TOILET | ☑ | 374.4 | 18.56 | 0.51 | ☑ | 0 | 0.00 | 0.00 |
| BATHROOM | ☑ | 444.6 | 1.37 | 0.04 | ☑ | 0 | 0.00 | 0.00 |
| LAUNDRY | ☑ | 269.1 | 3.28 | 2.15 | ☑ | 0 | 0.00 | 0.00 |
| KITCHEN | ☑ | 81.9 | 4.10 | 1.21 | ☑ | 0 | 0.00 | 0.00 |
| TOTALS | | 1170 | 27.3 | 3.9 | | 0 | 0.0 | 0 |
| TOTALS FOR WASTEWATER | | 1170 L/DAY | | 27.3 TN KG/YR | | 3.9 TP KG/YR | | |

User overrides are available to the right of this table to allow for situations that do not reflect a standard house. The top 4 cells in the TN and TP columns add up to provide a combined total in the bottom (5th) override cell of each column.

### 3.1.9 Soil Information

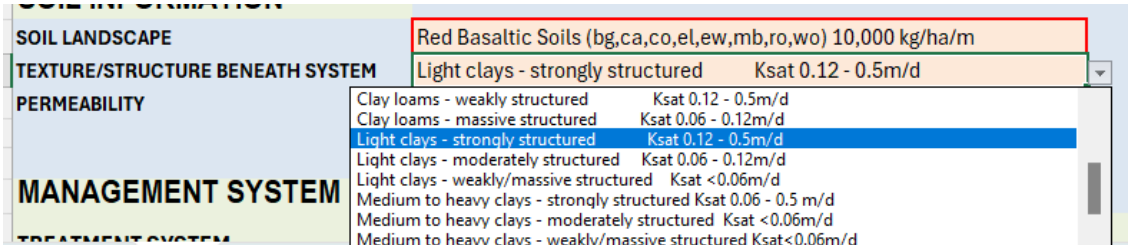
#### 1. Soil Landscape

Choose the soil landscape name for the default phosphorus adsorption rate. Soil landscape categories are those based on the David Morand soil landscape maps, and can be found by accessing the NSW Government eSPADE v2.2 soil mapping https://espade.environment.nsw.gov.au/.




These soil landscape categories are used to calculate the phosphorus area required (in combination with the vertical distance to ground water or bedrock).

#### 2. Soil texture beneath the land application area




Choose the soil texture and structure for the soil below the proposed land application area (generally at 1.0m depth below ground surface) from the drop down box.

This soil texture/structure selection then provides the default permeability rate.

This version of the model includes revised Design Loading Rates (DLR) for highly permeable soils to increase the required land application area (LAA) in these cases. The revised approach replaces the *previous capping method,* which applied a fixed limit of 15 $m^2$ per person, with targeted design limitations instead.

AS/NZS 1547:2012 Table L1 outlines the DLR based on soil texture and category, for systems such as absorption trenches and beds, and evapotranspiration (ETA) trenches and beds. Table L1 presents that ETA beds are not permitted in Category 1to 3 soils (ranging from gravels to clay loams). n the North Coast region, evapotranspiration absorption (ETA) beds are the preferred passive land application area (LAA) type, rather than absorption trenches. To align with this preference, the model uses DLR values from the absorption trench column, for ETA bed applications.

In earlier versions of the model, to mitigate the high DLR values associated with Category 1–3 soils, a hydraulic loading cap was introduced. This cap effectively constrained the disposal field size to prevent under-design. In this updated model, the cap has been removed and design-based limitations have been applied directly to the LTAR values themselves. This ensures that the LAA expands appropriately for high-permeability soils, improving effluent dispersion and reducing the risk of nutrient leaching into the water table.

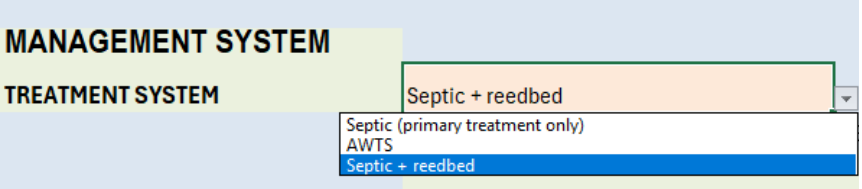
Modifications to the LTAR of high permeability soils are as follows:

| Texture and permeability | | Primary Treatment mm/day | | Secondary Treatment mm/day | |
|---|---|---|---|---|---|
| | | previous | now | previous | now |
| Gravels,Sands | Ksat >3.0m/d | 20 | 12.5 | 50 | 25 |
| Sandy loams - weakly structured | Ksat >3.0m/d | 20 | 12.5 | 50 | 25 |
| Sandy loams - massive | Ksat 1.4 - 3.0m/d | 15 | 10 | 50 | 25 |
| Loams - strong/moderate structured | Ksat 1.5 - 3.0m/d | 15 | 10 | 50 | 20 |
| Loams - weakly structured or massive | Ksat 0.5 - 1.5m/d | | 10 | 30 | 20 |
| Clay loams - strong/mod structured | Ksat 0.5 - 1.5m/d | | 10 | 30 | 18 |

Further reduction to the permeability rate will occur if secondary treatment is not achieved by the chosen number of wetland cells (and their corresponding surface area). The LTAR will also automatically reduce accordingly to the theoretical BOD output from the wetland sizes, that is if secondary treatment is not achieved then the LTAR will be modified per the ratio of treatment – that is relative between the primary and secondary LTAR.

### 3.1.10 Treatment systems

'Treatment systems' has a drop down box, from which other options may then appear further down the model depending on the treatment system choice.

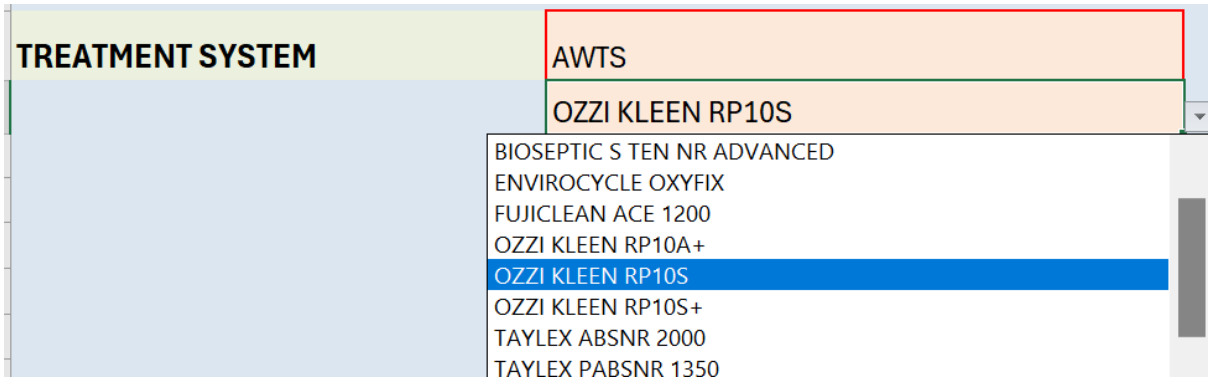



These treatment options are similar to those in the previous model. Default TN and TP values for the septic are as per the previous model using TN and TP loadings are both from *Rural household wastewater characterisation* within the Proceedings of the National Home Sewage Disposal Symposium, by Witt *et. al.* (1974).

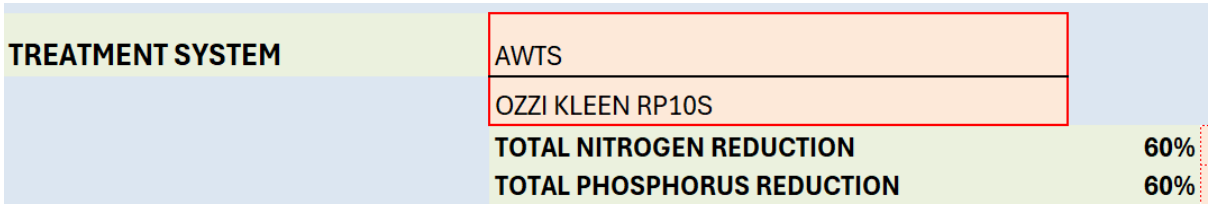
TN and TP loadings for the AWTS and septic + reedbed options are based upon default values for the treatment tank type in regards to AWTS or the number or type of reedbeds chosen

#### *3.1.10.1 AWTS*

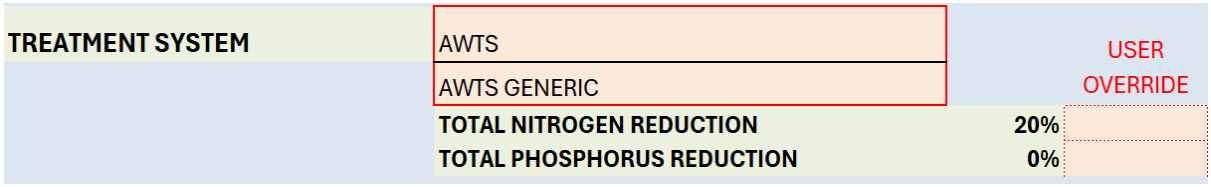
If AWTS is chosen as the treatment option, another drop box will appear below with the values for TN and TP provided for the NSW Health accreditation certificates current at the time this model was developed. A particular AWTS model can be chosen as shown below, or a 'generic' AWTS can be selected for a model not within the list.




Once a particular AWTS is selected, TN and TP treated percentages particular to that AWTS show in cells H38 and H39 respectively. These can be overridden if required as discussed below.

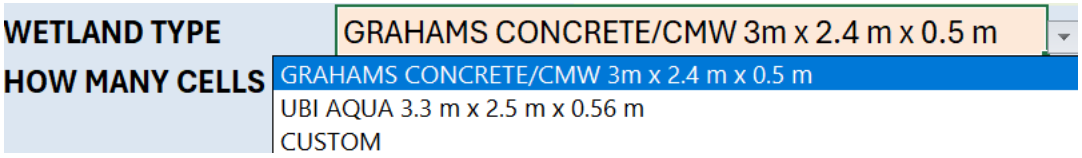



AWTS Generic is used when no TN or TP details are provided on the accreditation or used in conjunction with the override feature adjacent.




### *3.1.10.2 Septic + Reedbed*

If septic + reedbed is chosen, then default sizing for wetland cells have been provided for Grahams Precast or CMW concrete wetland cells; UBI Aqua wetland plastic cell or the user can choose 'custom' and enter in their own sizing based on the particular wetland cell to be utilised.




If the Grahams Precast/CMW or UBI Aqua wetland is chosen from the list, the size specifications pop up and the user can manually enter the number of wetland cells desired to achieve the specific TN and/or BOD reductions. The reedbed calculation is as per the original model and is based on the paper by Headley and Davison (2003) *Design Models for the Removal of BOD and Total Nitrogen in Reed Beds*.

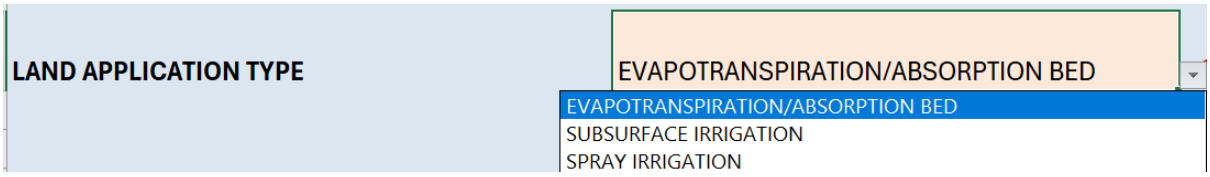
| | | | | |
|---|---|---|---|---|
| **TREATMENT SYSTEM** | Septic + reedbed | | | |
| | | **TOTAL NITROGEN REDUCTION** | **30%** | |
| | | **TOTAL PHOSPHORUS REDUCTION** | **0%** | |
| **WETLAND TYPE** | GRAHAMS CONCRETE/CMW 3m x 2.4 m x 0.5 m | LENGTH | 3 | |
| **HOW MANY CELLS** | 2 | WIDTH | 2.4 | |
| | | DEPTH | 0.5 | |
| | | **AREA** | **7.2** | |
| | | **TOTAL AREA** | **14.4** | |
| | | **TN REMOVAL** | | **30%** |
| | | **BOD achieved** | | 73.56 mg/L |
| | | **Secondary treatment achieved?** | | **NO** |

If 'custom' is chosen for the wetland cell type, new cell inputs are then displayed in where the user must enter in their own cell dimensions. The custom cells are to be used with caution and must be discussed in the accompanying wastewater report.

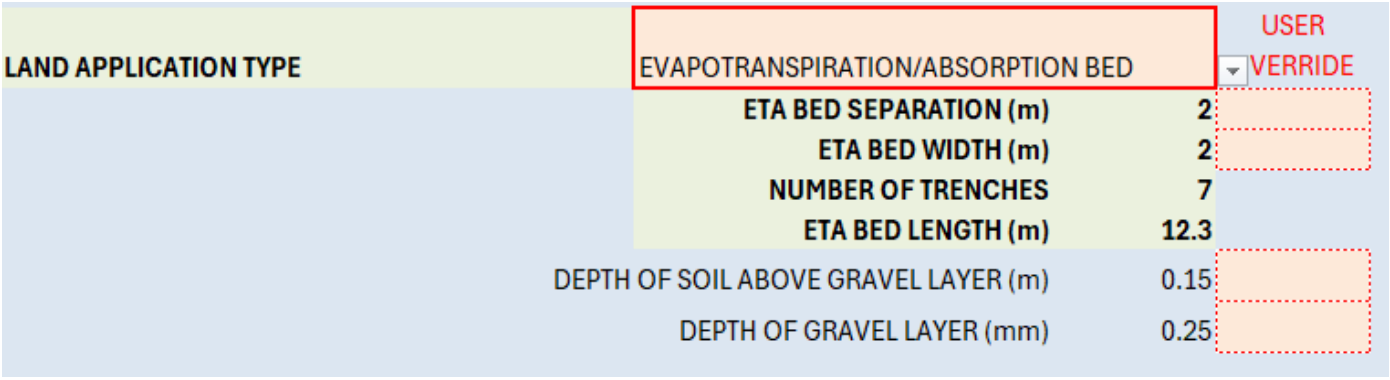
Note, the reedbed section will hide when either Septic or AWTS is chosen.

### 3.1.11 Land Application Area Type

The land application type is chosen from 3 options: ETA bed, subsurface or spray irrigation. There is no difference between the area sizing of the two irrigation options as the same LTAR applies equally to either.




Default sizing values are provided for each of the disposal area options, with the default values displaying based on the land application type chosen. These can be overridden by using the cells for the user override. However, the size of the land application area including ETA beds (trenches) or irrigation length will not alter until 'calculate hydraulic area' is pressed.



## 3.2 Calculate Hydraulic Area

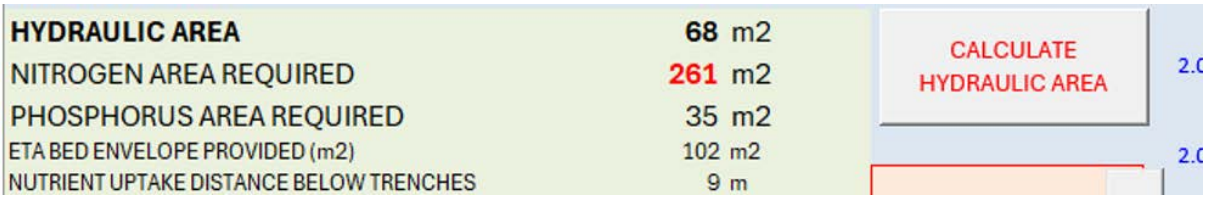
The model determines the minimum disposal field area required to manage daily effluent application without surface runoff on at least 95% of days, using continuous daily rainfall data from 1980 to 2024.

The algorithm operates as follows:

- It targets the 95th percentile of all daily water balance outcomes, ensuring that only 5% of days may produce a positive (excess) water balance.
- Beginning with a small trial area, the model iteratively adjusts the disposal field size and recalculates the 95th percentile result after each step.
- If the result exceeds zero (i.e. the site is too wet), the area is increased; if the result drops below zero, the step size is halved and the area refined.
- This process continues until the model converges on the smallest disposal field area that satisfies the containment threshold—providing reliable effluent absorption in 95% of climatic conditions.
- The resulting land application area represents the minimum field size that can manage effluent loads without overflow on all but the most extreme rainfall days.

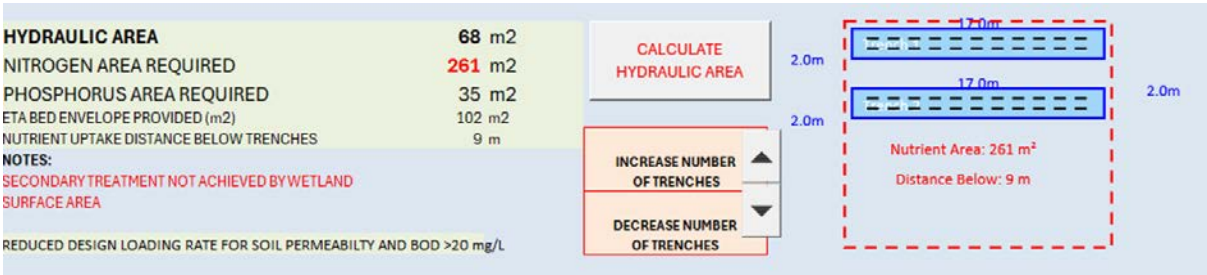
For the remaining 5% of days—those exceeding the soil's short-term capacity—minor effluent runoff may theoretically occur. This exceedance allowance was endorsed under the original 2004 Policy in lieu of wet weather storage, which poses significant design and management challenges in high-rainfall regions such as the Byron Shire. During these rare events, the relative risk is minimal, as any effluent would be heavily diluted by substantial rainfall volumes.

In the model the LAA will update dynamically if a treatment system or a land application type is changed during the process or if the **'calculate hydraulic area'** button is pressed for the land application area to be sized. Every time any changes are made to any of the input cells (with the exception of name and address) the calculate hydraulic area button must be pressed to provide an updated land application area.




## 3.3 Nutrient Areas

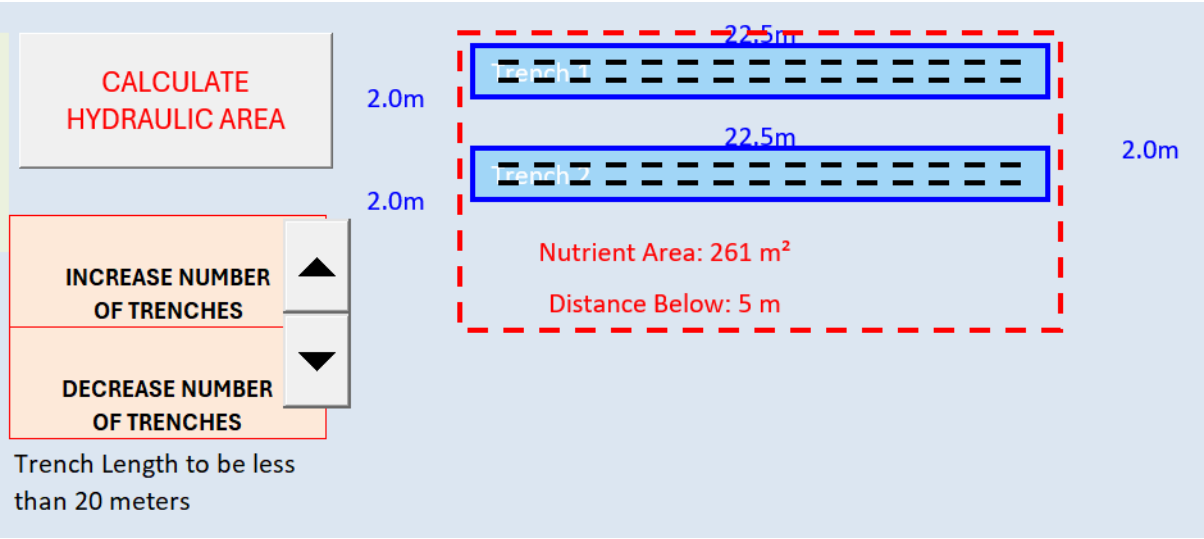
Nutrient areas have now not been incorporated in the sizing of the land application area that is required to be constructed, however, they are still required to be considered for setbacks to boundaries, sensitive areas such as creeks and gullies. The hydraulic area determines the sizing of the land application area to be physically constructed. The display shows the nutrient area required for the LAA and distance below that is required to be considered.




## 3.4 ETA Beds

The number of ETA beds is based on the hydraulic loading as calculated after pressing the 'Calculate Hydraulic Area' button or changing the treatment or land application. The number of trenches (ETA beds) will vary depending on how long a trench is required.

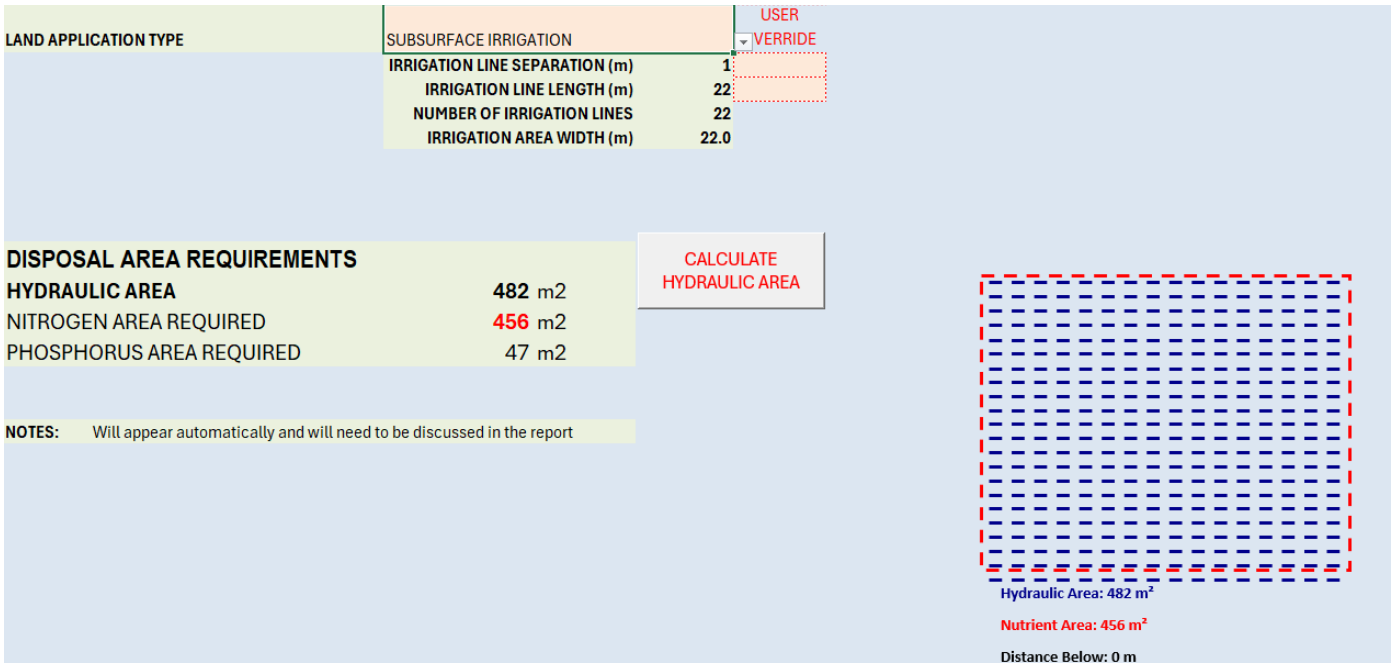
A note will display if the number of trenches proposed are greater than 20 m. Trench length is to be less than 20m unless in specific situations (which will be subject to Council approval).




## 3.5 Irrigation

There is no visual display for the irrigation field, unlike the ETA beds and nutrient area as shown in Section 2.4.

If changing from ETA beds to Irrigation (and vice versa) the 'calculate hydraulic area' button must be pushed to then allow the new series of calculations to be undertaken based on the soil information. The irrigation separation and line length are provided as a guide only, as a detailed irrigation design must accompany any S68 application that proposes irrigation for the LAA.




## 3.6 User Override Cells

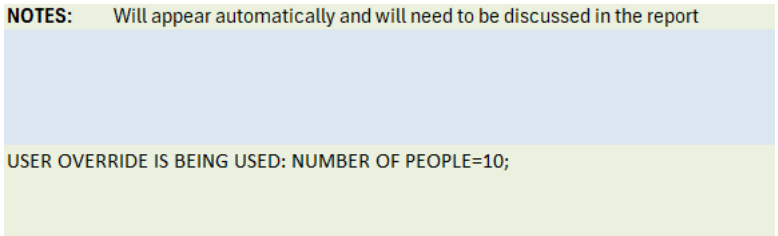
The model has allowed for 'user override' cells, where data can be inputted that will then be read instead the default values that would normally be read. These cells are orange with a dotted red border.


These cells are to be **BLANK** unless the model operator wants to override the defaults. These overrides will need to be discussed within the consultant's report.

Each of these cells allows for the user to enter the following:

- hydraulic loading per person (L/person/day)
- number of people
- nutrient reduction
- For ETA beds the separation and width of trenches

Any override information will be shown in the notes at the bottom of the model. Such as changing the number of people:



To remove any values entered into the 'user override' fields, click the 'CLEAR ANY OVERRIDES' button. This will reset the model to its default distances—100 m to the creek and 40 m to the gully—and revert to the standard input cells.


# 4. SUMMARY

The model is relatively similar to the previous model with an updated user override cells allowing for considered input from the consultant; updated rainfall data; updating the predicted hydraulic loading and removal of the 15 m2/person capping for the hydraulic load whilst reducing LTAR permeability to design loading rates for higher permeable soils.

The model is password protected and as such the user overrides have been provided in the permitted areas that can be manipulated to allow for development specific designs.

# 5. ACKNOWLEDGMENTS

Alderson Associates – for development of the new excel model and user guide

# 6. REFERENCES

Headley, T. & Davison, L. (2003). *Design Models for the Removal of BOD and Total Nitrogen in Reed Beds*. In proceedings of On-site '03 Conference, Future Directions for On-site Systems: Best Management Practice. Lanfax Laboratories, Armidale, NSW, Australia.

Standards Australia & Standards New Zealand. (2012). *AS/NZS 1547:2012 On-site domestic wastewater management.* Sydney, NSW: Standards Australia; Wellington, NZ: Standards New Zealand.

Witt, M.D., Siegrist, R.L., & Boyle, W.C. (1974). *Rural Household Wastewater Characterization.* In: Proceedings of the National Home Sewage Disposal Symposium, ASAE Proc-175, American Society of Agricultural Engineers, St. Joseph, MI, pp. 79–88.

# APPENDIX A - NITROGEN LOADING AND LAND APPLICATION AREA (LAA) CALCULATIONS

The Model estimates the land application area (LAA) required for nitrogen management using a mass balance approach. This accounts for nitrogen reductions through treatment and soil denitrification, a limited export of nitrogen to the surrounding environment being and plant uptake.

The following calculations are performed within locked cells. Unlike previous versions of the model–which included a separate 'nitrogen report' summarising crop uptake and environmental limits–this version integrates that logic directly into the sizing of the disposal field.

### Base Calculation

The base calculation estimates the minimum LAA required when no nitrogen export to the broader environment is assumed:

$$\text{Area } (m^2) = ((\text{Nload} - \text{Ndenit}) / \text{Ncrop}) \times 10{,}000 \quad \text{[Equation 1]}$$

Where:

- Nload = Annual nitrogen load from the dwelling (kg/yr) calculated after treatment
- Ndenit = Soil denitrification capacity (default allowance of 20%)
- Ncrop = Nitrogen uptake capacity of soil and vegetation (default = 200 kg/ha/yr, this is the standard grass uptake)
- 10,000 = Conversion from hectares to square metres

This ensures that nitrogen is only applied to land where it can be safely assimilated. However, Byron Shire Council, as well as other Councils have accepted that there is some export of N into the environment and therefore have provided an allowance for N released into the environment, but based this limit on the size of the allotment, with smaller allotments having a lower allowable nitrogen limit and larger allotments having a larger permitted limit of N to the environment

This model changes this slightly by allowing for smaller allotments, where subdivisions are not proposed, then these sites are treated as if they are 10000$m^2$ for the allowable export to the environment. Whereas, where a subdivision is proposed and then the proposed allotment size would then dictate the allowable nitrogen limit to the site.

### Nitrogen Export Allowance for Low-Density Sites

In larger allotments, which are low-risk, well-buffered to sensitive areas , the model allows a small quantity of nitrogen to be exported to the environment. This acknowledges the assimilative capacity of surrounding land and reduces the LAA requirement. The allowable export (**Nlim**) is determined by:

$$\text{Nlim} = \text{Nmax} \times [1 - \exp(-k \times X)] \quad \text{[Equation 2]}$$

Where:

- Nlim = Allowable nitrogen export (kg/yr)
- Nmax = Maximum permitted export (default = 10 kg/yr)

- k = Curve steepness factor
- X = A scaling factor that adjusts based on site characteristics

The scaling factor used to determine allowable nitrogen limit or export depends on whether subdivision is proposed and the size of the block:

- If subdivision is proposed, the model calculates nitrogen export using both block size and proximity to sensitive features. Larger blocks and greater distances allow a higher level of permissible export.
- If subdivision is not proposed, the model adopts a hybrid approach:
- For blocks larger than 10,000 $m^2$ the same area-weighted calculation is used as in subdivision cases.

**Proximity Factor**

The TN area also takes into account buffers to creeks and gullies, being proximity factors.

The *proximity factor* is a scaling value that reflects how close a proposed LAA is to environmentally sensitive features such as creeks or gullies. It is used to adjust the allowable nitrogen export (Nlim) based on how well-buffered the site is from potential receptors.

For example, a required 100 m buffer reduced to 50 m results in halving the contribution of block size in X, thereby decreasing Nlim and increasing the required LAA..

# APPENDIX B - PHOSPHORUS LOADING AND LAND APPLICATION AREA (LAA) CALCULATIONS

The required land application area for managing phosphorus is calculated using a mass balance approach that considers both long-term soil sorption and annual plant uptake. The general form of the equation is:

Area ($m^2$) = Annual P Load (kg/ha) × 10,000 /[(Soil Sorption Rate × Unsaturated Zone Depth) ÷ Design Life (years) + Annual Plant Uptake (kg/ha/yr)] [Equation 3]

Where:

- Annual P Load is the total phosphorus discharged in the effluent each year, expressed per hectare.
- Soil Sorption Rate is the amount of phosphorus (kg/$m^2$) that the soil can retain over its lifespan.
- Unsaturated Zone Depth is the vertical distance (in metres) from the base of the disposal trench to the seasonal or permanent water table. This defines the active soil depth available for phosphorus retention.
- Design Life is the number of years (50 years default) over which phosphorus accumulation is assessed.
- Annual Plant Uptake represents the phosphorus removed each year through vegetation growth.

The bigger the unsaturated zone (ie deeper water table), the more soil is available to "store" phosphorus, and therefore less disposal field is required. If the watertable is shallow or P uptake is low, the model calculates a larger area to compensate.

# APPENDIX C - EXAMPLES

**Example 1:**

**A subdivision is proposed dividing a 20000 m2 site into four allotments, there are no creeks nearby. All sites have red, light clay soils. The aim is to demonstrate that a passive wastewater management sytem can theoretically be provided on each lot.**

The following data is entered:

- Subdivision proposed: yes
- Allotment size: 5000 m2
- Roof water harvest + standard water saving 120 L/person/day
- Mounded ETA beds
- 5 bedrooms
- All components checked
- Red basaltic soil landscape
- Light clays strongly structured
- Septic + reedbed
- grahams concrete/cmw reedbeds: 5 cells chosen to achieve secondary treatment
- Evapotranspiration/absorption bed

*NB Choosing a new **treatment system** or **land application type** will then calculate the disposal field automatically. Hit CALCULATE HYDRAULIC AREA if not changed.*

Hydraulic Area: 95 m2

Nitrogen Area: 159 m2

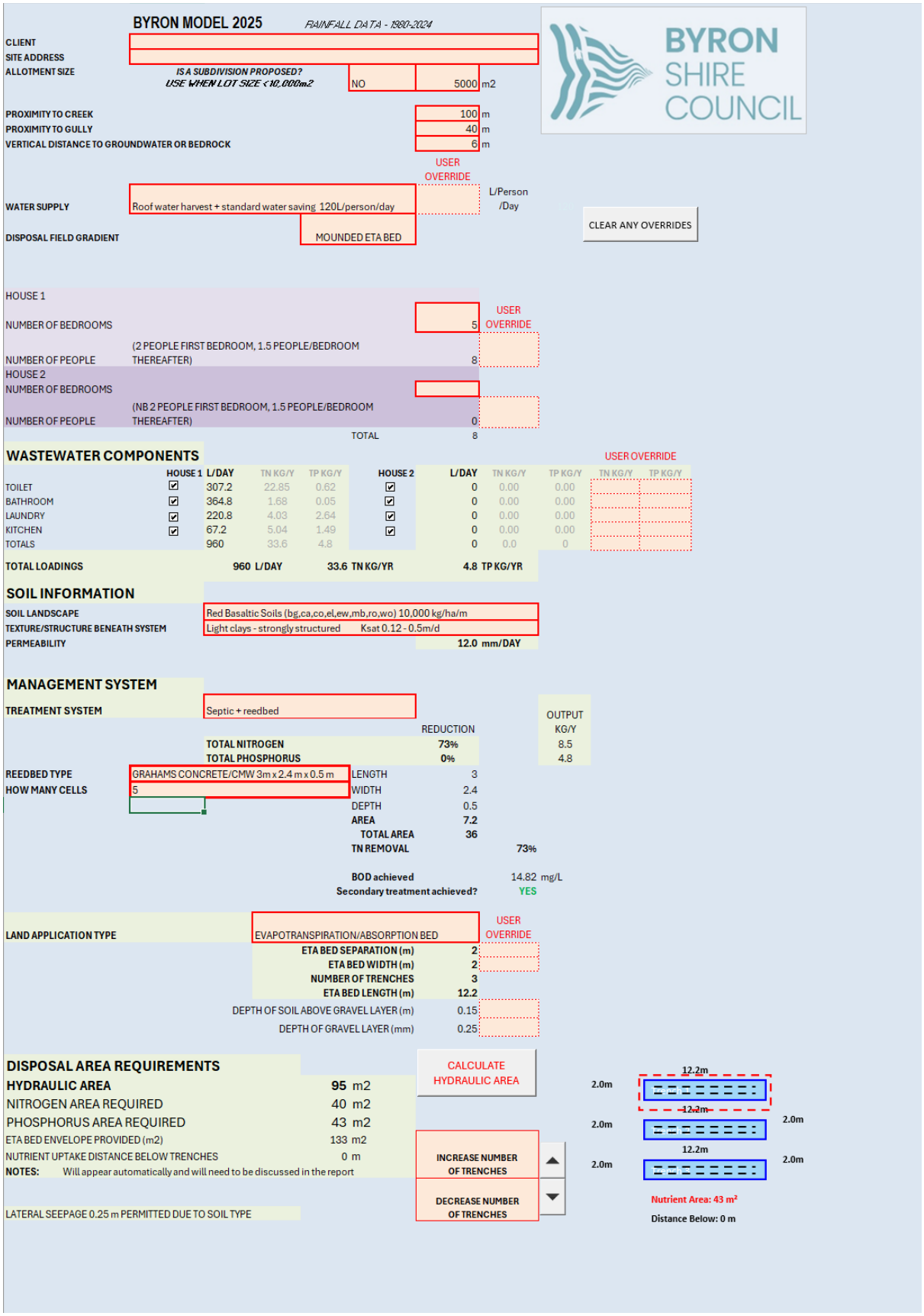
Phosphorus Area: 43 m2

Use the trench number to dynamically provide the desired number of trenches and area below the trenches required for the nutrient limiting factor.

**Construction required:**

3 x 12.7 m x 2 m ETA beds separated by 2 m, which adequately provides area for management of the hydraulic load, this is from the proposed ETA beds to be constructed and an allowance of 0.25 m seepage, that is an allowance of movement of wastewater through the walls of the trench due to soil type.

The constructed area provides for the partial management of the nutrient area due to the high treatment provided, however an additional 2 m below the ETA beds will be required to achieve the TN area of 159 $m^2$ This additional area is required to be considered for setbacks to boundaries and sensitive areas etc.


BYRON MODEL 2025
RAINFALL DATA - 1980-2024
CLIENT
SITE ADDRESS
ALLOTMENT SIZE
IS A SUBDIVISION PROPOSED?
USE WHEN LOT SIZE <10,000m2
NO
5000 m2
PROXIMITY TO CREEK
100 m
PROXIMITY TO GULLY
40 m
VERTICAL DISTANCE TO GROUNDWATER OR BEDROCK
6 m
USER OVERRIDE
WATER SUPPLY
Roof water harvest + standard water saving 120L/person/day
L/Person /Day
DISPOSAL FIELD GRADIENT
MOUNDED ETA BED
CLEAR ANY OVERRIDES
HOUSE 1
NUMBER OF BEDROOMS
5
USER OVERRIDE
(2 PEOPLE FIRST BEDROOM, 1.5 PEOPLE/BEDROOM
NUMBER OF PEOPLE
THEREAFTER)
8
HOUSE 2
NUMBER OF BEDROOMS
(NB 2 PEOPLE FIRST BEDROOM, 1.5 PEOPLE/BEDROOM
NUMBER OF PEOPLE
THEREAFTER)
0
TOTAL
8
WASTEWATER COMPONENTS
USER OVERRIDE
HOUSE 1 L/DAY TN KG/Y TP KG/Y HOUSE 2 L/DAY TN KG/Y TP KG/Y TN KG/Y TP KG/Y
TOILET 307.2 22.85 0.62 0 0.00 0.00
BATHROOM 364.8 1.68 0.05 0 0.00 0.00
LAUNDRY 220.8 4.03 2.64 0 0.00 0.00
KITCHEN 67.2 5.04 1.49 0 0.00 0.00
TOTALS 960 33.6 4.8 0 0.0 0
TOTAL LOADINGS 960 L/DAY 33.6 TN KG/YR 4.8 TP KG/YR
SOIL INFORMATION
SOIL LANDSCAPE
Red Basaltic Soils (bg,ca,co,el,ew,mb,ro,wo) 10,000 kg/ha/m
TEXTURE/STRUCTURE BENEATH SYSTEM
Light clays - strongly structured Ksat 0.12 - 0.5m/d
PERMEABILITY
12.0 mm/DAY
MANAGEMENT SYSTEM
TREATMENT SYSTEM
Septic + reedbed
REDUCTION
OUTPUT KG/Y
TOTAL NITROGEN 73% 8.5
TOTAL PHOSPHORUS 0% 4.8
REEDBED TYPE
GRAHAMS CONCRETE/CMW 3m x 2.4 m x 0.5 m
HOW MANY CELLS
5
LENGTH 3
WIDTH 2.4
DEPTH 0.5
AREA 7.2
TOTAL AREA 36
TN REMOVAL 73%
BOD achieved 14.82 mg/L
Secondary treatment achieved? YES
LAND APPLICATION TYPE
EVAPOTRANSPIRATION/ABSORPTION BED
USER OVERRIDE
ETA BED SEPARATION (m) 2
ETA BED WIDTH (m) 2
NUMBER OF TRENCHES 3
ETA BED LENGTH (m) 12.2
DEPTH OF SOIL ABOVE GRAVEL LAYER (m) 0.15
DEPTH OF GravEL LAYER (mm) 0.25
DISPOSAL AREA REQUIREMENTS
CALCULATE HYDRAULIC AREA
HYDRAULIC AREA 95 m2
NITROGEN AREA REQUIRED 40 m2
PHOSPHORUS AREA REQUIRED 43 m2
ETA BED ENVELOPE PROVIDED (m2) 133 m2
NUTRIENT UPTAKE DISTANCE BELOW TRENCHES 0 m
NOTES: Will appear automatically and will need to be discussed in the report
INCREASE NUMBER OF TRENCHES
DECREASE NUMBER OF TRENCHES
LATERAL SEEPAGE 0.25 m PERMITTED DUE TO SOIL TYPE
12.2m
2.0m
2.0m
Nutrient Area: 43 m²
Distance Below: 0 m

**Example 2: An upgrade is proposed on a relatively small allotment that is close to a creek, therefore treatment should be considered**

The following data is entered:

- Subdivision proposed: no
- Allotment size: 5000 m2
- Roof water harvest + standard water saving 120 L/person/day
- Mounded ETA beds
- 5 bedrooms
- All components checked
- Red basaltic soil landscape
- Light clays strongly structured
- Septic + reed beds
- grahams concrete/cmw reedbeds: 2 cells chosen
- Evapotranspiration/absorption bed

*NB Choosing a new **treatment system** or **land application type** will then calculate the disposal field automatically. Hit CALCULATE HYDRAULIC AREA if not changed.*

*Also note that the reed bed component will be hidden when any treatment system except for reed bed is chosen.*

Hydraulic Area: 125 m2

Nitrogen Area: 512 m2

Phosphorus Area: 43 m2

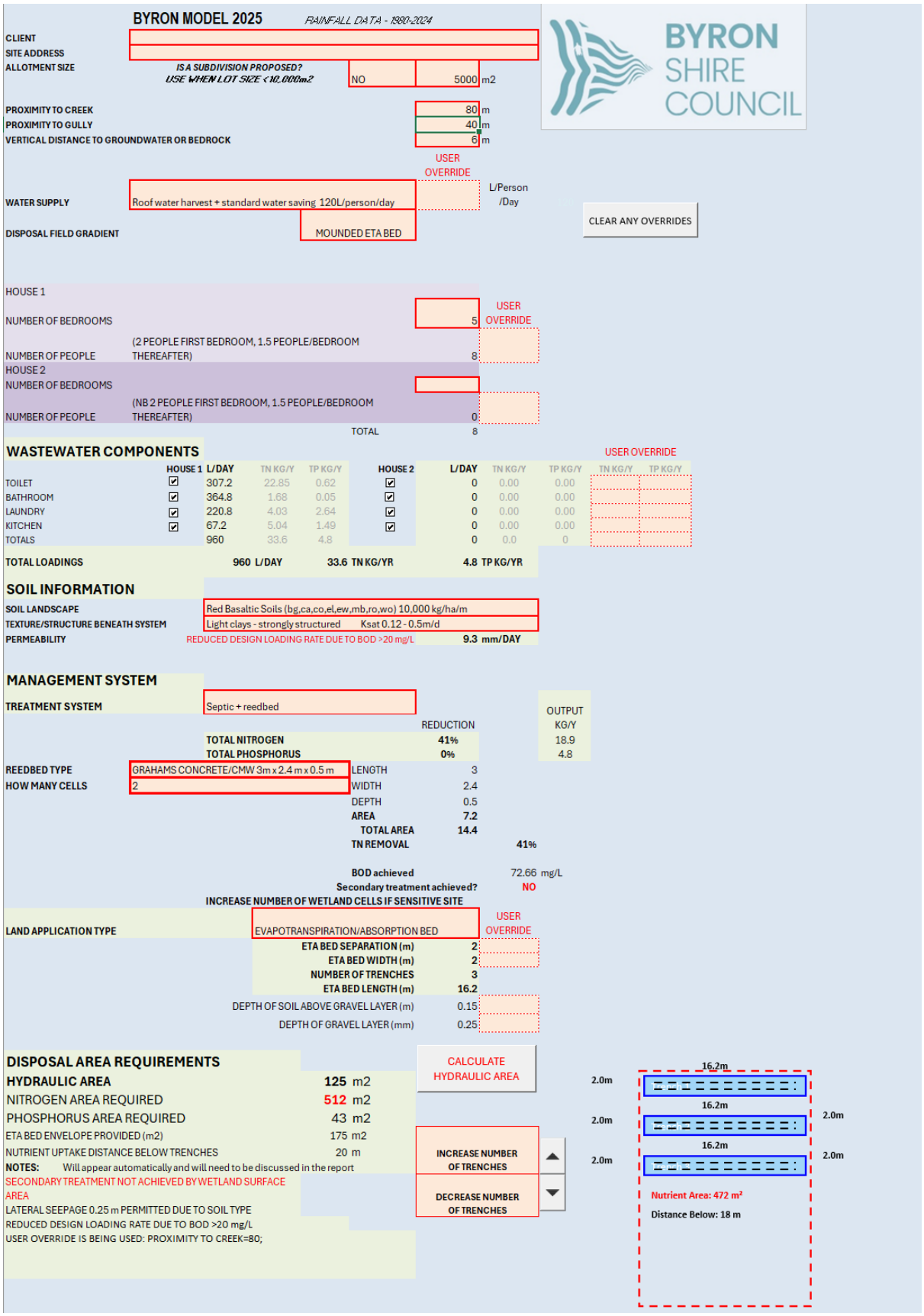
*Use the trench number to dynamically provide the desired number of trenches and area below the trenches required for the nutrient limiting factor*

Construction required:

3 x 16.7 m x 2 m ETA beds separated by 2 m, which adequately provides area for management of the hydraulic load, this is from the proposed ETA beds to be constructed and an allowance of 0.25 m seepage, that is an allowance of movement of wastewater through the walls of the trench due to soil type.

The system is larger than that of Example 1 due to the reduced number of reed bed cells being proposed, which has reduced the DLR automatically.

The number of reedbed influences TN quality and this together with the encroachment to the creek requires a large TN area of 512 $m^2$. This then requires 14 m down gradient to be considered in setbacks to the creek and boundaries. Increasing the number of reedbeds would reduce the size of the LAA required as the wastewater quality improves.


BYRON MODEL 2025
RAINFALL DATA - 1980-2024
CLIENT
SITE ADDRESS
ALLOTMENT SIZE
IS A SUBDIVISION PROPOSED?
USE WHEN LOT SIZE <10,000m2
NO
5000 m2
PROXIMITY TO CREEK
80 m
PROXIMITY TO GULLY
40 m
VERTICAL DISTANCE TO GROUNDWATER OR BEDROCK
6 m
USER OVERRIDE
WATER SUPPLY
Roof water harvest + standard water saving 120L/person/day
L/Person /Day
DISPOSAL FIELD GRADIENT
MOUNDED ETA BED
CLEAR ANY OVERRIDES
HOUSE 1
NUMBER OF BEDROOMS
5
USER OVERRIDE
(2 PEOPLE FIRST BEDROOM, 1.5 PEOPLE/BEDROOM THEREAFTER)
NUMBER OF PEOPLE
8
HOUSE 2
NUMBER OF BEDROOMS
(NB 2 PEOPLE FIRST BEDROOM, 1.5 PEOPLE/BEDROOM THEREAFTER)
NUMBER OF PEOPLE
0
TOTAL
8
WASTEWATER COMPONENTS
USER OVERRIDE
HOUSE 1 L/DAY TN KG/Y TP KG/Y HOUSE 2 L/DAY TN KG/Y TP KG/Y TN KG/Y TP KG/Y
TOILET 307.2 22.85 0.62 0 0.00 0.00
BATHROOM 364.8 1.68 0.05 0 0.00 0.00
LAUNDRY 220.8 4.03 2.64 0 0.00 0.00
KITCHEN 67.2 5.04 1.49 0 0.00 0.00
TOTALS 960 33.6 4.8 0 0.0 0
TOTAL LOADINGS 960 L/DAY 33.6 TN KG/YR 4.8 TP KG/YR
SOIL INFORMATION
SOIL LANDSCAPE
Red Basaltic Soils (bg,ca,co,el,ew,mb,ro,wo) 10,000 kg/ha/m
TEXTURE/STRUCTURE BENEATH SYSTEM
Light clays - strongly structured Ksat 0.12 - 0.5m/d
PERMEABILITY
REDUCED DESIGN LOADING RATE DUE TO BOD >20 mg/L
9.3 mm/DAY
MANAGEMENT SYSTEM
TREATMENT SYSTEM
Septic + reedbed
REDUCTION
OUTPUT KG/Y
TOTAL NITROGEN 41% 18.9
TOTAL PHOSPHORUS 0% 4.8
REEDBED TYPE
GRAHAMS CONCRETE/CMW 3m x 2.4 m x 0.5 m
HOW MANY CELLS
2
LENGTH 3
WIDTH 2.4
DEPTH 0.5
AREA 7.2
TOTAL AREA 14.4
TN REMOVAL 41%
BOD achieved 72.66 mg/L
Secondary treatment achieved? NO
INCREASE NUMBER OF WETLAND CELLS IF SENSITIVE SITE
LAND APPLICATION TYPE
EVAPOTRANSPIRATION/ABSORPTION BED
USER OVERRIDE
ETA BED SEPARATION (m) 2
ETA BED WIDTH (m) 2
NUMBER OF TRENCHES 3
ETA BED LENGTH (m) 16.2
DEPTH OF SOIL ABOVE GRAVEL LAYER (m) 0.15
DEPTH OF GRAVEL LAYER (mm) 0.25
DISPOSAL AREA REQUIREMENTS
CALCULATE HYDRAULIC AREA
HYDRAULIC AREA 125 m2
NITROGEN AREA REQUIRED 512 m2
PHOSPHORUS AREA REQUIRED 43 m2
ETA BED ENVELOPE PROVIDED (m2) 175 m2
NUTRIENT UPTAKE DISTANCE BELOW TRENCHES 20 m
NOTES: Will appear automatically and will need to be discussed in the report
SECONDARY TREATMENT NOT ACHIEVED BY WETLAND SURFACE AREA
LATERAL SEEPAGE 0.25 m PERMITTED DUE TO SOIL TYPE
REDUCED DESIGN LOADING RATE DUE TO BOD >20 mg/L
USER OVERRIDE IS BEING USED: PROXIMITY TO CREEK=80;
INCREASE NUMBER OF TRENCHES
DECREASE NUMBER OF TRENCHES
16.2m
2.0m
16.2m
2.0m
2.0m
16.2m
2.0m
Nutrient Area: 472 m²
Distance Below: 18 m

**Example 3: A dual occupancy using one treatment system is proposed, the site is on heavy clay soils and is close to a creek and the site is relatively flat**

The following data is entered:

- Subdivision proposed: no
- Allotment size: 20000 m2
- Reticulated + standard water saving 150 L/person/day
- Ground slope >5 % [*this allows for some rainfall to shed from the disposal field*]
- 60 m to a creek
- 4 bedrooms house 1
- 3 bedrooms house 2
- All components checked
- Alluvial soil landscape
- Medium to heavy clays strongly structured
- AWTS
- Taylex ABSNR 2000 [*chosen from dropdown box*]
- Subsurface irrigation

*NB Choosing a new* ***treatment system*** *or* ***land application type*** *will then calculate the disposal field automatically. Hit CALCULATE HYDRAULIC AREA if not changed.*

*Also note that the reed bed component will be hidden when any treatment system except for reed bed is chosen.*

Hydraulic Area: 700 $m^2$

Nitrogen Area: 539 $m^2$

Phosphorus Area: 47 m2

*User overrides can be used to enter in irrigation line separation etc, however, an irrigation design is required to be provided with the report, therefore this is used as a guide only.*

Construction required:

An irrigation area required to be constructed is 700 $m^2$, which is larger than the area required for nutrients of 539 $m^2$.

BYRON SHIRE COUNCIL

## BYRON MODEL 2025

*RAINFALL DATA - 1980-2024*

| | | | |
|---|---|---|---|
| CLIENT | | | |
| SITE ADDRESS | | | |
| ALLOTMENT SIZE | *IS A SUBDIVISION PROPOSED? USE WHEN LOT SIZE <10,000m2* | NO | 20000 m2 |
| PROXIMITY TO CREEK | | | 60 m |
| PROXIMITY TO GULLY | | | 40 m |
| VERTICAL DISTANCE TO GROUNDWATER OR BEDROCK | | | 6 m |
| WATER SUPPLY | Reticulated + standard water saving devices 150L/person/day | | USER OVERRIDE L/Person /Day |
| DISPOSAL FIELD GRADIENT | GROUND SLOPE >5 % | | |

CLEAR ANY OVERRIDES

| | | | |
|---|---|---|---|
| HOUSE 1 | | | |
| NUMBER OF BEDROOMS | | 4 | USER OVERRIDE |
| NUMBER OF PEOPLE | (2 PEOPLE FIRST BEDROOM, 1.5 PEOPLE/BEDROOM THEREAFTER) | 6.5 | |
| HOUSE 2 | | | |
| NUMBER OF BEDROOMS | | 3 | |
| NUMBER OF PEOPLE | (NB 2 PEOPLE FIRST BEDROOM, 1.5 PEOPLE/BEDROOM THEREAFTER) | 5 | |
| | TOTAL | 11.5 | |

### WASTEWATER COMPONENTS

| | HOUSE 1 | L/DAY | TN KG/Y | TP KG/Y | HOUSE 2 | L/DAY | TN KG/Y | TP KG/Y | USER OVERRIDE TN KG/Y | USER OVERRIDE TP KG/Y |
|---|---|---|---|---|---|---|---|---|---|---|
| TOILET | ☑ | 312 | 18.56 | 0.51 | ☑ | 240 | 14.28 | 0.39 | | |
| BATHROOM | ☑ | 370.5 | 1.37 | 0.04 | ☑ | 285 | 1.05 | 0.03 | | |
| LAUNDRY | ☑ | 224.25 | 3.28 | 2.15 | ☑ | 172.5 | 2.52 | 1.65 | | |
| KITCHEN | ☑ | 68.25 | 4.10 | 1.21 | ☑ | 52.5 | 3.15 | 0.93 | | |
| TOTALS | | 975 | 27.3 | 3.9 | | 750 | 21.0 | 3 | | |

**TOTAL LOADINGS** **1725 L/DAY** **48.3 TN KG/YR** **6.9 TP KG/YR**

### SOIL INFORMATION

| | |
|---|---|
| SOIL LANDSCAPE | "Alluvial"Soils 1 (dp,mu,my,te) 10,000 kg/ha/m |
| TEXTURE/STRUCTURE BENEATH SYSTEM | Medium to heavy clays - strongly structured Ksat 0.06 - 0.5 m/d |
| PERMEABILITY | 3.9 mm/DAY |

### MANAGEMENT SYSTEM

| | | | USER OVERRIDE NUTRIENT REDUCTION | OUTPUT KG/Y |
|---|---|---|---|---|
| TREATMENT SYSTEM | AWTS | | | |
| | TAYLEX ABSNR 2000 | REDUCTION | | |
| | TOTAL NITROGEN | 54% | | 21.3 |
| | TOTAL PHOSPHORUS | 24% | | 5.244 |
| LAND APPLICATION TYPE | SUBSURFACE IRRIGATION | | USER ERRIDE | |
| | IRRIGATION LINE SEPARATION (m) | 1 | | |
| | IRRIGATION LINE LENGTH (m) | 27 | | |
| | NUMBER OF IRRIGATION LINES | 27 | | |
| | IRRIGATION AREA WIDTH (m) | 27.0 | | |

### DISPOSAL AREA REQUIREMENTS

CALCULATE HYDRAULIC AREA

| | |
|---|---|
| **HYDRAULIC AREA** | **708** m2 |
| NITROGEN AREA REQUIRED | 539 m2 |
| PHOSPHORUS AREA REQUIRED | 47 m2 |

**NOTES:** Will appear automatically and will need to be discussed in the report

Trench Length to be less than 20 meters

USER OVERRIDE IS BEING USED: PROXIMITY TO CREEK=60;