Application form

Environmental Protection Act 1994

Application to amend an environmental authority

This approved form is to be used when applying to amend an environmental authority under sections 222 to 227A of the Environmental Protection Act 1994 (EP Act) for an environmentally relevant activity (ERA).

If you are applying to amend a progressive rehabilitation and closure plan (PRCP) schedule and or applying for a joint PRCP schedule and EA amendment do not use this form. You should instead use the Application to amend a PRCP Schedule or joint PRCP Schedule and environmental form (ESR/2019/4956).

IMPORTANT NOTE:

For applications to the Department of the Environment, Tourism, Science and Innovation, you can apply through Online Services at: https://www.business.qld.gov.au/running-business/environment/online-services**.**

It is recommended that prior to making an amendment application, you read the information on what to provide with an application. This information is located on the Business Queensland website at www.business.qld.gov.au (use the search term "Environmental licence"). This website includes a diagnostic tool called a "Forms and fees finder" which will help identify fees and supporting information you need to make an application.

You are encouraged to have a pre-lodgement meeting before applying to amend your environmental authority (EA). If you would like to have a pre-lodgement meeting:

- for intensive animal industry ERAs (prescribed ERAs 2, 3 and 4)—contact the Department of Primary Industries by email at livestockregulator@dpi.qld.gov.au or by phone on 13 25 23.
- for any other ERAs —prior to lodging this application form, please fill and lodge the form Application for pre-lodgement services (ESR/2015/1664) with the Department of the Environment, Tourism, Science and Innovation.

If you require assistance in answering any part of this form or have any questions about your application, please contact the relevant department. Contact details are at the end of this form (Section 33).

Privacy statement

The Department of the Environment, Tourism, Science and Innovation (the department) is collecting the information on this form in accordance with and as authorised by Chapter 5 of the Environmental Protection Act 1994 *(EP Act). Some of the information may be disclosed to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development and Queensland Treasury for the purpose of processing this application.*

Pursuant to section 540 of the EP Act, the department is required to maintain a register of certain documents and information authorised under the EP Act. A copy of this document will be kept on the public register. The register is available for inspection by members of the public who are able to take extracts, or copies of the documents from the register. Documents that are required to be kept on the register are published in their entirety, unless alteration is required by the EP Act. There is no general discretion allowing the department to withhold documents or information required to be kept on the public register. For more information on the department's public register, search 'public register' at www.qld.gov.au. For queries about privacy matters please email privacy@detsi.qld.gov.au or telephone 13 74 68.

Queensland Government

Section 1 – Environmental authority number	
EA number for this application	EPPR00521513

Section 2 – Applicant details	
Details of the applicant are to be provided in this section.	
NAME / COMPANY NAME CENTRAL SEQ DISTRIBUTOR-RETAILER AUTHORITY	TRADING NAME (IF An organisation) Urban Utilities
REGISTERED BUSINESS ADDRESS / RESIDENTIAL ADDRESS (NOT A POST OFFICE BOX) Level 10 Duncan Street Fortitude Valley	POSTAL ADDRESS (WHERE DIFFERENT) GPO Box 2765 Brisbane QLD 4001
ABN / ACN (IF An organisation) 86673835011	NAME OF APPLICATION CONTACT Monique Gastaldin
EMAIL Monique.Gastaldin@urbanutilities.com.au	TELEPHONE 0477 961 896
☐ INDICATE IF YOU WANT TO RECEIVE CORRESPONDENCE VIA EMAIL ☐ INDICATE IF THERE ARE JOINT HOLDERS OF THE ENVIRONMENTAL AUTHORITY. IF THERE ARE JOINT HOLDERS, PROVIDE THE ADDITIONAL CONTACT DETAILS AS AN ATTACHMENT.	

Section 2.1 – Agent details If there is an agent acting on behalf of the applicant, details of the agent are to be provided. An agent could be a consultant or contactor for the applicant.	
Is this form being completed by an agent for the applicant? * NOTE: If an agent is nominated, please provide evidence of appointment by the authority holder/s.	☐ Yes – Provide details below ☐ No – Go to next section
NAME / COMPANY NAME	TRADING NAME
REGISTERED BUSINESS ADDRESS / RESIDENTIAL ADDRESS (NOT A POST OFFICE BOX)	POSTAL ADDRESS (WHERE DIFFERENT)
ABN / ACN (IF AN ORGANISATION)	CONTACT NAME
EMAIL	TELEPHONE

Section 3 – Checklist questions An application to amend an EA is not appropriate in all circumstances. If you answer **Yes** to any of the preliminary questions below, you cannot use this application form. If you answer **No** to all of the preliminary questions, you may continue to use this application form.	
Is the amendment to correct a clerical or formal error?	☐ Yes ☒ No
If yes, you cannot use this form. This request should be made in writing directly to the administering authority (no fees apply).	
Is the amendment to add an ERA to an amalgamated project authority and the proposed activity does not form part of the single integrated operation conducted under the authority?	☐ Yes ☒ No
If yes, you cannot use this form. You will need to apply for a new EA.	
Is the amendment to add an ERA to the environmental authority and the addition of the ERA would result in the environmental authority not meeting the definition of an 'ERA project'?	☐ Yes ☒ No
If yes, you cannot use this form. You will need to apply for a new EA.	
Is the amendment to amalgamate two or more EA's?	☐ Yes ☒ No
If yes, you cannot use this form. Please use either the form Application to amalgamate two or more environmental authorities into an amalgamated corporate authority (ESR/2015/1734), or Application to amalgamate two or more environmental authorities into an amalgamated project or local government authority (ESR/2015/1735).	
Is the amendment to add an ERA to an amalgamated local government authority and there is not an appropriate degree of integration between the proposed activity and the existing activities on the authority?	☐ Yes ☒ No
If yes, you cannot use this form. You will need to apply for a new EA.	
Is the amendment to amend the financial assurance or estimated rehabilitation cost only?	☐ Yes ☒ No
If yes, you cannot use this form. Please use the form Application to amend or discharge financial assurance held for an environmental authority (ESR/2015/1752) or Application for a decision on the estimated rehabilitation cost (ESR/2018/4426) .	
Is the proposed amendment to add a resource activity to an EA for a prescribed ERA project?	☐ Yes ☒ No
If yes, you cannot add the resource activity to the EA. You will need to apply for a new EA.	
Is the proposed amendment to add a prescribed ERA, other than an ancillary activity, to an EA for a resource project?	☐ Yes ☒ No
If yes, you cannot use this form. You can apply using the standard, variation or site-specific application forms.	
Are you applying to extend the term of an EA that was issued to conduct research into, or test, technology or processes relating to an ERA, and for which information mentioned in section 125(1)(l)(i) and (ii) of the EP Act was not available at the time the authority was applied for?	☐ Yes ☒ No
If yes, you cannot use this form. You will need to apply for a new EA.	

Section 4 – Checklist questions for prescribed ERAs Does the application relate to an EA that is only for prescribed ERAs?	☒ Yes – Answer the questions in this section ☐ No – Go to next section
Does the proposed amendment involve changes to the relevant activity that require a new development application to be lodged under the *Planning Act 2016* and the application for the development application has not been lodged.	☐ Yes ☒ No
If yes, the development application must be lodged before an EA amendment application can be made. Under the EP Act, a development application for a material change of use of premises for an ERA is deemed to be also an application for an environmental authority. In this case, an EA amendment application should not be lodged.	
Is the proposed amendment solely to add or remove vehicles for ERA 57 (Regulated waste transport)?	☐ Yes ☒ No
If yes, you do not need to submit this application form. You can update vehicle details online through Online Services or use the form Details of regulated waste vehicles (ESR/2015/1851).	
Is the amendment for the holder of the EA to transfer all or part of the EA to a person?	☐ Yes ☒ No
If yes, you cannot use this form. Please use the form Request to transfer all or part of an environmental authority (prescribed environmentally relevant activities) (ESR/2015/1718).	
Is the amendment for the surrender of an EA?	☐ Yes ☒ No
If yes, you cannot use this form. Please use the form Application to surrender an environmental authority for a prescribed ERA (ESR/2015/1719) .	

Section 5 – Checklist for resource activities Is the application to amend an EA for a resource activity?	☐ Yes - Answer the questions in this section ☒ No – Go to next section
Is the amendment for a partial surrender of an EA for a mining, geothermal or petroleum resource activity?	☐ Yes ☐ No
If yes, you cannot use this form. Please use the form Application for surrender or partial surrender of an environmental authority (resource activity) (ESR/2015/1751).	
Is the amendment for an EA that has a PRCP schedule and approval of the amendment application would result in the EA to which the application relates being inconsistent with the relevant PRCP schedule?	☐ Yes ☐ No
If yes, you cannot use this form. The amendment to the EA must not be inconsistent with the PRCP Schedule otherwise you must apply to amend your PRCP Schedule. Please use the form Application to amend a progressive rehabilitation and closure plan schedule (PRCP schedule) or joint PRCP schedule and environmental authority (ESR/2019/4956) .	

Section 6 – Major or minor amendment Is the application for a major or minor amendment?
Your application is a minor amendment (condition conversion) if you want to convert all conditions of your EA to the standard conditions for the ERA to which the EA relates. By selecting this amendment type you are certifying that you have a complete and thorough understanding of, and can comply with, the ERA Standard (eligibility criteria and standard conditions).

For applications other than a minor amendment (condition conversion), the administering authority decides if an application is a minor amendment (threshold) or a major amendment and will send you a notice of the decision.

If the application is a major amendment, an assessment fee of 30% of the annual fee for your EA is required to be paid. The assessment of your amendment application will not proceed until the assessment fee is paid.

No additional assessment fees apply if your application is determined to be a minor amendment.

By considering what type of amendment your application is likely to be, you will have a better idea of whether the assessment fee will be payable.

For further information see the Guideline - Major and minor amendments (ESR/2015/1684) and s223 of the EP Act. If you have questions regarding whether your amendment will be a minor or major amendment you are encouraged to arrange a pre-lodgement meeting with the administering authority. Only an indication can be given as to whether the proposed changes are likely to be a minor or major amendment, at a pre-lodgement meeting as this decision can only be made when the actual application is submitted.

☐ Major amendment

☒ Minor amendment (threshold)

☐ Minor amendment (condition conversion)

For minor amendment (condition conversion) go to Section 31 (Payment of fees).

Section 7 – Amendment options

Complete this section for all applications, tick all that apply

I would like to amend the EA:	☐ Activities – includes changes to thresholds ☒ Locations – removal/addition of activity locations ☒ Conditions – includes conversions to standard conditions and variations

Section 8 – Describe the proposed amendment

Provide a detailed description of your proposed amendment.

Include justification of how your proposed amendment meets the criteria for a major or minor amendment and attach any supporting information to this application.

If the amendment is to add or delete a location, tenure or activity, or to change the threshold of an activity, provide details below.

This amendment application is to add parcels of land adjacent to the exisiting ERA to the ERA Activity for the Helidon Resource Recovery Centre (RRC). In addition changes are proposed to the exisiting conditions to streamline and modernise the wording of the General Conditions to make them more in line with model conditions and to change some of the site-specific conditions. For Toogoolawah the same general conditions for Heildon are proposed to be applied to the Toogoolawah RRC as well as Kilcoy and Esk (which currently share general conditions within the exisiting EA. Additionally proposed changes to site-specific conditions for Toogoolawah RRC are inlcuded. The amendment also proposes the adoption of the proposed General conditions across all of the Resource Recovery Centre sites as per the amendment by agreement process (streamlining) that Urban Utilites has been discussing and progressing with the Department for over a year.

☒ I HAVE ATTACHED ADDITIONAL DETAILS FOR THIS SECTION.

Section 9 – Describe the land that will be affected by the proposed amendment

Describe if the activity will be carried out within the existing designated areas of the environmental authority, a new area, or if the activity is mobile or temporary.

The activity at Toogoolawah has not changes and is not being carried out in any additional area, The activity at Helidon has not changed however land parcels have been added which formerly were owned by a third party and are now owned by Urban Utilites and contain infrastructure related to the Sewage Treatment Plant (Effluent storage lagoon and plantation for irrigation).

☒ I HAVE ATTACHED ADDITIONAL DETAILS FOR THIS SECTION.

Section 10 – Development permits and other land use approvals *(Prescribed ERAs only)*

Does the EA only include a prescribed ERA/s?	☐ No – Go to next section ☒ Yes – Provide details below
Are there any development permits or other land use approvals in effect or have any development applications been made under the *Planning Act 2016* to carry out the proposed amendment?	☒ No – Go to next section ☐ Yes – Provide details below

Provide a list of applicable development permits or applications below.

Development permit / application number	Development permit / application name	Assessment manager	Date of application or approval	Expiry date

If a land use approval other than a development permit is in effect, provide details below.

☒ I HAVE ATTACHED ADDITIONAL DETAILS FOR THIS SECTION.

Section 11 – Amend activities	
Do you wish to amend activities under the EA, including removing ERAs, adding ERAs or changes to threshold(s)?	☒ No – Go to next section ☐ Yes – Provide details below
Section 11.1 – Removing ERA(s) Does the proposed amendment remove an ERA from the EA?	☐ No – Go to section 11.2 ☐ Yes – Continue on below

Provide a list of all the ERAs that are to be removed from the EA and identify whether the ERA has commenced.

ERA number	Threshold	Name of ERA	Has the ERA commenced?
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

☐ I HAVE ATTACHED DETAILS OF ADDITIONAL ERA(s) TO BE REMOVED.

Does your EA contain any rehabilitation conditions that are applicable to the ERA(s) that are requested to be removed from the EA?	☐ No – Go to section 11.2 ☐ Yes – Provide details below

A statement addressing compliance with EA conditions is to be completed by, or on behalf of, the EA holder. Attach a separate document to this application form which states the extent to which:

1. The ERAs being removed from the EA have complied with each relevant condition of approval; and
2. The final rehabilitation report is accurate (include the date of the final rehabilitation report).

PROVIDE DETAILS OF THE DATE, METHOD AND EVIDENCE USED TO VERIFY COMPLIANCE:

PROVIDE DETAILS OF THE NAME, POSITION AND CONTACT NUMBER OF THE PERSON SIGNING THE STATEMENT:

DESCRIBE THE QUALIFICATIONS AND EXPERIENCE OF THE PERSON SIGNING THE STATEMENT:

☐ I HAVE ATTACHED THE REQUIRED STATEMENT ADDRESSING COMPLIANCE WITH CONDITIONS.

For guidance on what a rehabilitation report should contain you may use the Final rehabilitation report with landowner statement (ESR/2015/1616). Methods to verify compliance may include a desktop assessment of documentation, an interview with the landowner/holder or a field operator or a site inspection. Evidence used may include photographs, statements and other documents such as maps, plans, approvals, monitoring results etc.

Section 11.2 – Adding ERA(s) Does the proposed amendment add an ERA to the EA?	☒ No – Go to next section ☐ Yes – Continue on below

Provide details of which ERA(s) you wish to add. If the ERA has eligibility criteria and standard conditions[1], identify whether you can comply with them. Select "N/A" where there are no eligibility criteria and standard conditions for that ERA. If you cannot comply with all of the applicable standard conditions, select "no" and attach details of the standard conditions you cannot comply with.

ERA number	Threshold	Name of ERA	I can comply with the eligibility criteria	I can comply with all the standard conditions
			☐ Yes ☐ N/A ☐ No	☐ Yes ☐ No
			☐ Yes ☐ N/A ☐ No	☐ Yes ☐ No
			☐ Yes ☐ N/A ☐ No	☐ Yes ☐ No
			☐ Yes ☐ N/A ☐ No	☐ Yes ☐ No
			☐ Yes ☐ N/A ☐ No	☐ Yes ☐ No
			☐ Yes ☐ N/A ☐ No	☐ Yes ☐ No
			☐ Yes ☐ N/A ☐ No	☐ Yes ☐ No

☐ I HAVE ATTACHED DETAILS OF ADDITIONAL ERA(s) TO BE ADDED.

☐ I HAVE ATTACHED DETAILS OF THE STANDARD CONDITIONS THAT I CANNOT COMPLY WITH.

If you cannot comply with the eligibility criteria as a result of the proposed amendment, then an amendment to the relevant eligibility criteria condition will also be required. The department will only approve an amendment of the eligibility criteria condition if it is a result of factors beyond your control such as residential encroachment, rather than a change to the activity.

[1] ERAs with eligibility criteria and standard conditions are listed at: www.business.qld.gov.au (use the search term "eligibility criteria").

Section 12 – Single integrated operation confirmation

Will the activities be undertaken as a single integrated operation?	☐ No – Go to next section ☒ Yes – Provide details below

PROVIDE DETAILS OF THE ACTIVITIES THAT WILL BE OPERATED AS A SINGLE INTEGRATED OPERATION AND SUPPORTING INFORMATION SHOWING THEY ARE A SINGLE INTEGRATED OPERATION:

The activities carried out are sewage treatment activities at Urban Utilites sewage treatment plant sites (called Resource Recovery Centres). Urban Utilites currently operates 26 sewage treatment plant sites in South East Queensland across five local government areas. Therefore all of the activities which occur on these sites are operationally interrelated. The activities are carried out under the day to day management of our Production Manager Joe Taylor.

Single integrated operation occurs when all of the below criteria are met:

(a) the activities are carried out under the day-to-day management of a single responsible individual, for example, a site or operations manager;
(b) the activities are operationally interrelated;
(c) the activities are, or will be, carried out at one or more places; and
(d) the places where the activities are carried out are separated by distances short enough to make feasible the integrated day-to-day management of the activities.

Section 13– Amend location(s)

Does the proposed amendment relate to the location where the ERA(s) are undertaken, including adding a location, removing a location or changing a location? This section is not applicable to changes in monitoring locations, infrastructure locations ect. unless the new location is outside the currently authorised area for the environmental authority. Amendments to change the location of monitoring or infrastructure where the monitoring or infrastructure location is still within the currently authorised area are considered amendments to vary conditions.	☐ No – Go to Section 14 ☒ Yes – Provide details below

ERA number and threshold	Location (lot on plan(s), tenure(s) or mobile and temporary)	Add or remove
ERA63 1 b ii	Lot 1 RP135445	Add
ERA63 1 b ii	Lot 33 CH31423	Add
ERA63 1 b ii	Lot 3 RP900696	Add
ERA63 1 b ii	Lot 1 SP314208	Add
ERA63 1 b ii	Lot 2 SP314208	Add
ERA63 1 b ii	Lot 17 CH31423	Add

☒ I HAVE ATTACHED DETAILS OF ADDITIONAL LOCATIONS FOR THIS SECTION.

Section 13.1 - Rehabilitation conditions *Are you proposing to remove locations from the EA?*	☒ No – Go to next section ☐ Yes – Continue on below
Does your EA contain any rehabilitation conditions that are applicable to the locations that are requested to be removed from the EA?	☐ No – Go to next section ☐ Yes – Continue on below
Has a statement addressing compliance with EA rehabilitation conditions been attached as per section 11.1?	☐ No – Go to next section ☐ Yes – Continue on below

PROVIDE DETAILS OF THE DATE, METHOD AND EVIDENCE USED TO VERIFY COMPLIANCE:

PROVIDE DETAILS OF THE NAME, POSITION AND CONTACT NUMBER OF THE PERSON SIGNING THE STATEMENT:

DESCRIBE THE QUALIFICATIONS AND EXPERIENCE OF THE PERSON SIGNING THE STATEMENT:

☐ I HAVE ATTACHED THE REQUIRED STATEMENT ADDRESSING COMPLIANCE WITH CONDITIONS.

For guidance on what a rehabilitation report should contain you may use the Final rehabilitation report with landowner statement (ESR/2015/1616). Methods to verify compliance may include a desktop assessment of documentation, an interview with the landowner/holder or a field operator or a site inspection. Evidence used may include photographs, statements and other documents such as maps, plans, approvals, monitoring results etc.

Section 14 – Seek to vary conditions	
Are you looking to vary the condition(s) of the EA?	☐ No – Go to next section ☒ Yes – Provide details below

IMPORTANT NOTE: The administering authority considers what is necessary or desirable when setting the conditions of an EA. Seeking to vary the conditions is likely to change the environmental risk of an activity and will require an assessment of the environmental values. If this is not provided, the application may not be valid.

Provide details of: (a) condition number(s); (b) proposed change; and (c) justification for the change.

See Section 5 of the Reports

☒ I HAVE ATTACHED ADDITIONAL DETAILS FOR THIS SECTION.

If the activities were assessed as part of a coordinated project declared under the State Development and Public Works Organisation Act 1971, you are only able to amend Coordinator General conditions if the Coordinator General's evaluation report for the project has lapsed. If you are unsure if the Coordinator General's evaluation report has lapsed, contact the Department of State Development, Infrastructure and Planning for more information.

Section 15 – Compliance with any eligibility criteria	
Are there any eligibility criteria for the activity(s)?	☐ No – Go to next section ☒ Yes – Provide details below
State whether each relevant activity will, if the amendment is made, comply with any eligibility criteria for the activity.	
ERA 63 activities – Sewage Treatment Works is a prescribed ERA with an ERA standard and eligibility criteria. ERA 63 activities meet the eligibility criteria for a variation application as the activity falls within its currently licensed threshold	
Include a declaration (below) that the above statement is correct	

I Monique Gastaldin - Environmental Specialist at Urban Utilities

(INSERT NAME, POSITION AND COMPANY NAME OF PERSON MAKING THE STATEMENT)

- make the statement by or for the holder of the EA;
- confirm that, to the best of my knowledge, all information provided as part of this statement, including attachments, is true, correct and complete.
- understand that under section 480 of the EP Act, it is an offence to give the administering authority or an authorised person a document that contains information that I know, or ought reasonably know, to be false or misleading in a material particular.
- understand that under section 480A of the EP Act, if I am required to give a document to the administrating authority, it is an offence to give a document that I know, or ought reasonably to know, contains incomplete information in a material particular.
- confirm that, to the best of my knowledge, this statement, including attachments, does not include false, misleading or incomplete information;
- confirm that, to the best of my knowledge, I have not knowingly failed to reveal any relevant information or document to the administering authority;
- confirm that, to the best of my knowledge, all information provided in this statement, including attachments, address the relevant matters and are factually correct;
- confirm that the opinions expressed in this statement, including attachments, are honestly and reasonably held; and
- understand that all information supplied as part of this statement, including attachments, can be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.

SIGNATURE	DATE
Monique Gastaldin	05/08/2025

Only a person with appropriate environmental expertise and/or experience in planning and executing site operations should sign this statement. This person may be the EA holder, a full time employee of the EA holder or a consultant to the EA holder.

Section 16 – Environmental values

Attach a document that provides an assessment of the likely impact of the proposed amendment on environmental values (EVs). Note: All fields below are mandatory, therefore a statement is required where there are no likely impacts to an EV.

Environmental Values

☒ Water	☒ Wetlands	☒ Land use	☒ Acoustic
☒ Groundwater	☒ Land	☒ Air	☒ Waste

☒ I HAVE ATTACHED A DOCUMENT THAT PROVIDES AN ASSESSMENT OF LIKELY IMPACTS ON EVs.

Note that the EP Act, s226A(1)(f) states the information required relating to impacts on EVs which include:

a) a description of the environmental values likely to be affected by the proposed amendment; and
b) details of any emissions or releases likely to be generated by the proposed amendment; and
c) a description of the risk and likely magnitude of impacts on the environmental values; and
d) details of the management practices proposed to be implemented to prevent or minimise adverse impacts; and
e) if a PRCP schedule does not apply for each relevant activity - details of how the land the subject of the application will be rehabilitated after each relevant activity ceases.

Section 17 – Environmental offsets

Will the ERA(s) being applied for cause, or be likely to cause, a significant residual impact to a prescribed environmental matter (other than a matter of local environmental significance)?	☒ No – Go to next section ☐ Yes – Provide details below

☐ Yes - Attach supporting information that:

- details the magnitude and duration of the likely significant residual impact on each prescribed environmental matter (other than matters of local environmental significance) for the entire activity;
- demonstrates that all reasonable measures to avoid and minimise impacts on each of those matters will be undertaken;
- includes a notice of election, if it has not already been submitted; and
- if the activity is to be staged, details of how the activity is proposed to be staged.

An environmental offset may be required for an ERA where despite all reasonable measures to avoid and minimise impacts on certain environmental matters, there is still likely to be a significant residual impact on one or more of those matters. You must verify the presence, whether temporary or permanent, of those environmental matters. For more information refer to the State Significant Impact Guideline at the Queensland Government website, at: www.qld.gov.au/environment/pollution/management/offsets/index.html.

Section 18 – Matters of national environmental significance	
Would the carrying out of the proposed ERA, or where relevant the ERA project, be likely to have a significant impact on any matters of national environmental significance?	☒ No – Go to next section ☐ Yes – Provide details below
Are the impacts covered by transitional provisions for the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)?	☒ No – Go to next section ☐ Yes – Provide details in an attachment
Has the proposal been referred to the Federal Government Environment Minister or a delegate for formal assessment and approval?	☒ No – Go to next section ☐ Yes – Provide details below
If Yes - Has an approval issued under the EPBC Act required an environmental offset for the same, or substantially the same, impact and the same, or substantially the same, matters of national environmental significance?	☐ No – Go to next section ☐ Yes – Provide details below
If Yes - Are there any matters of national environmental significance which are assessed under the EPBC Act which are the same, or substantially the same as any matters of national environmental significance, but that were not conditioned in the approval?	☐ No – Go to next section ☐ Yes – Provide details below

☐ I HAVE ATTACHED DETAILS OF MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE INCLUDING ANY APPLICABLE TRANSITIONAL PROVISIONS.

☐ I HAVE ATTACHED A COPY OF THE EPBC ACT APPROVAL.

There are currently nine matters of national environmental significance (MNES) which have been defined in the *EPBC Act*. To determine whether the proposed ERA(s) will have a significant impact on MNES and for referral requirements, please refer to the guidance provided by the Federal Government's Department of Environment on www.australia.gov.au and www.dcceew.gov.au/.

Section 19 – Waste

Attach a document that provides details of the proposed measures for minimising and managing waste generated by any amendment(s) to the relevant activity.

☒ I have attached a document that provides the required information; or

☒ If waste is to be managed according to an existing waste management plan, provide the name of the plan and the relevant page or section numbers below:

Section 4.1.6

Section 20 – Regional interest areas *(Resource activities only)*	
Is the activity a resource activity?	☒ No - Go to Section 26 ☐ Yes - Continue below
Is the resource activity located anywhere within an area of regional interest?	☐ No – Go to next section ☐ Yes – Provide details below

If yes - Which area of regional interest, has or will require a regional interest development approval (RIDA)?

- ☐ Priority agricultural areas (PAAs)
- ☐ Priority living areas (PLAs)
- ☐ Strategic environmental areas (SEAs)
- ☐ Strategic cropping area (SCA)
- ☐ No RIDA required, I am an exempt activity.

If you have applied or been approved for a RIDA, provide the application reference:	

A regional interests development approval (RIDA) is required when a resource activity is proposed in an area of regional interest under the *Regional Planning Interests Act 2014*. Further information, including application forms, can be found on the Department of State Development, Infrastructure and Planning website at www.planning.qld.gov.au.

Section 21 – ANZSIC code *(Resource activities only)*

Provide the ANZSIC code for the resource activity.

- ☐ 1101 Black coal mining
- ☐ 1102 Brown Coal Mining
- ☐ 1311 Iron ore mining
- ☐ 1312 Bauxite mining
- ☐ 1317 Silver-lead-zinc ore mining
- ☐ 1200 Oil and gas extraction
- ☐ 1313 Copper ore mining
- ☐ 1314 Gold ore mining
- ☐ 1315 Mineral sand mining
- ☐ 1316 Nickel ore mining
- ☐ 1319 Metal ore mining (other metallic mineral ores)
- ☐ Other (provide details): _____

The Australian and New Zealand Industrial Classification (ANZSIC) is used by the Australian Bureau of Statistics. It is required to be displayed in the public register.

Section 22 – Environmental impact statement (EIS)* *(Resource activities only)*	
Has an application been made for a decision on whether an EIS would be required for the proposed amendment activity?	☐ No ☐ Yes
Has a decision been made on the application on whether an EIS would be required for the proposed amendment activity?	☐ Yes, a decision was made that an EIS is required – Attach decision. ☐ Yes, a decision was made that an EIS is **not** required – Attach decision. ☐ No, a decision has not yet been made. ☐ NA – No application has been made.
☐ I HAVE ATTACHED THE DECISION.	
Has an EIS process that includes the proposed amendment been completed?	☐ No - Go to next section ☐ Yes
If yes - Has the EIS assessment report lapsed under section 59A of the EP Act?	☐ No - Provide details below ☐ Yes – Go to next section
I have assessed the environmental risks of the proposed amendment and consider them to be: ☐ The same as was assessed in the EIS process ☐ Different to what was assessed in the EIS process	
☐ I HAVE ATTACHED THE ASSESSMENT OF THE ENVIRONMENTAL RISKS OF THE PROPOSED AMENDMENT.	
* EIS refers to both the EIS process under the *EP Act* and the EIS process under the *State Development and Public Works Organisation Act 1971*. * For further information about the EIS process is available at www.qld.gov.au, using the search term 'environmental impact statements'.	

Section 23 – Environmental impact statement triggers*	
Is the application to amend/alter an existing mine?	☐ No - Continue below ☐ Yes - Answer questions 1-6
Is the application for petroleum and gas activities?	☐ No – Go to next section ☐ Yes – Answer questions 7-9
For proposals to amend/alter an existing mine	
1. Is the proposed amendment for an increase in the annual extraction of more than 100% or 5 million tonnes per year (whichever is the lesser)? *NOTE: Only answer this question if the current ERA project is for an existing mine extracting between 2–10 million tonnes per year of run of mine (ROM) ore or coal; otherwise select N/A.*	☐ Yes ☐ No ☐ N/A
2. Is the proposed amendment for an increase in annual extraction of more than 50% or 10 million tonnes per year (whichever is the lesser)? *NOTE: Only answer this question if the current ERA project is for an existing mine extracting over 10 million tonnes per year of ROM ore or coal; otherwise select N/A.*	☐ Yes ☐ No ☐ N/A

3. Is the proposed amendment for an increase in annual extraction of greater than 25%? *NOTE: Only answer this question if the current ERA project is for an existing mine extracting over 20 million tonnes per year of ROM ore or coal extraction; otherwise select N/A.*	☐ Yes ☐ No ☐ N/A
4. Would the proposed amendment involve an extension into and significant impact on a Category A or B environmentally sensitive area, which is not already authorised by the State?	☐ Yes ☐ No
5. Would the proposed amendment involve a substantial change in mining operations—such as from underground to open cut, or (for underground mining) a change in operations from one causing little subsidence to one likely to cause substantial subsidence?	☐ Yes ☐ No
6. Would the proposed amendment introduce a novel or unproven resource removal process, technology or activity?	☐ Yes ☐ No
For petroleum and gas activities	
7. Would the proposed amendment involve a total disturbance area of greater than 2,000 hectares at any one time during the life of the proposed project? This includes areas occupied by well pads (single or multi-directional), access tracks and roads, water storages, and process plants?	☐ Yes ☐ No
8. Would the proposed amendment involve the construction of a high pressure pipeline over a distance of 300 kilometres or greater?	☐ Yes ☐ No
9. Would the proposed amendment involve the construction of a liquefied natural gas plant?	☐ Yes ☐ No
☐ I HAVE ATTACHED DETAILS OF HOW THE CRITERION IS TRIGGERED INCLUDING DETAILS OF THE IMPACT.	
* EIS refers to both the EIS process under the *EP Act* and the EIS process under the *State Development and Public Works Organisation Act 1971*. * There are numerous criteria used to make the EIS decision, for further information about the EIS process is available at www.qld.gov.au, using the search term 'environmental impact statements'.	

Section 24 – Coal seam gas (CSG) activities *(Resource activities only)*	
Does the application relate to an EA for a CSG activity that is an ineligible ERA?	☐ No – Go to next section ☐ Yes – Provide details below
Does the amendment change the way that CSG water is managed?	☐ No – Go to next section ☐ Yes – Provide details below
If the amendment will change the way that CSG water is managed the following information must be provided with this application.	
☐ I have attached a document that details:	
☐ The quantity of CSG water the applicant reasonably expects will be generated in connection with carrying out each relevant CSG activity.	
☐ The flow rate at which the applicant reasonably expects the water will be generated.	
☐ The quality of the water, including changes in the water quality the applicant reasonably expects will happen while each relevant CSG activity is carried out.	
☐ The proposed management of water including, for example, the use, treatment, storage and disposal of the water.	

☐ The measurable criteria ('management criteria') against which the applicant will monitor and assess the effectiveness of the management of the water, including, for example, criteria for each of the following:
(i) the quantity and quality of the water used, treated, stored or disposed of;
(ii) protection of the environmental values affected by each relevant CSG activity; and
(iii) the disposal of waste, including, for example, salt, generated for the management of the water.

☐ The action proposed to be taken if any of the management criteria are not complied with, to ensure that the criteria will be able to be complied with in the future.

☐ If the application includes a CSG evaporation dam, an evaluation of the following must be provided:
(i) best practice environmental management for managing CSG water;
(ii) alternative ways for managing CSG water; and
(iii) whether there is a feasible alternative to a CSG evaporation dam for managing the water. Note if the evaluation shows that there is a feasible alternative option, the CSG evaporation dam cannot form part of the water management for this amendment application.

Section 25 – Underground water rights *(Resource activities only)*

Is the activity proposed to be undertaken on a mineral development licence (MDL), mining lease (ML) or petroleum lease (PL)?	☐ No – Go to next section ☐ Yes – Provide details below
Does the proposed amendment involve changes to the exercise of underground water rights?	☐ No – Go to next section ☐ Yes – Provide details below

☐ I have attached a document that details:

☐ The areas in which underground water rights are proposed to be exercised.

☐ For each aquifer affected, or likely to be affected, by the exercise of underground water rights:
(i) a description of the aquifer;
(ii) an analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers and surface water; and
(iii) a description of the area of the aquifer where the water level is predicted to decline because of the exercise of underground water rights; and.
(iv) the predicted quantities of water to be taken or interfered with because of the exercise of underground water rights during the period in which resource activities are carried out.

☐ The environmental values that will, or may, be affected by the exercise of underground water rights and the nature and extent of the impacts on the environmental values.

☐ Any impacts on the quality of groundwater that will, or may happen because of the exercise of underground water rights during or after the period in which resource activities are carried out.

☐ Strategies for avoiding, mitigating or managing the predicted impacts on the environmental values of the impacts on the quality of groundwater.

For more information about exercising underground water rights or the associated requirements refer to the guideline Requirements for site-specific and amendment applications—underground water rights (detsi.qld.gov.au)

Section 26 – Financial assurance / estimated rehabilitation cost

Do you currently have financial assurance or scheme assurance held for the approved EA?	☒ No – Go to next section ☐ Yes – Provide details below

☐ I will not need to change the financial assurance or scheme assurance in relation to this amendment.

☐ I will be changing the financial assurance and have attached the form Application to amend or discharge financial assurance held for an environmental authority (ESR/2015/1752).

☐ I will be applying for a new estimated rehabilitation cost decision if this amendment application is approved.

Section 27 – Compliance and enforcement tools or site management plan	
Is this land currently subject to an environmental enforcement order (EEO), environmental protection order (EPO), transitional environmental program (TEP) or a site management plan (SMP)?	☒ No – Go to next section ☐ Yes (EEO) - provide details below ☐ Yes (EPO) - provide details below ☐ Yes (TEP) - provide details below ☐ Yes (SMP) - provide details below
PROVIDE THE REFERENCE NUMBER AND BRIEF DETAILS INCLUDING: DESCRIPTION OF LAND; LOT AND PLAN NUMBERS; AND LOCAL GOVERNMENT AREA.	

Section 28 – Environmental management register	
Is any part of the land currently recorded in, or has previously been removed from, the environmental management register?	☒ No – Go to next section ☐ Yes – Provide details below

☐ The land is currently in the environmental management register.

☐ The land has been removed from the environmental management register.

You must attach evidence (e.g. Notice) advising that the details have been removed.

Section 29 - Website address		
Is the application for a mining activity on a mining lease, or a geothermal, petroleum, or greenhouse gas storage activity?	☒ No – Go to next section ☐ Yes – Provide details below	
Provide the website address for the application notice and application documents.		
Provide details of the contact person if technical assistance is required.	NAME	TELEPHONE
	EMAIL	

Section 30 – Site contact

Would you like to nominate a site contact?	☒ No – Go to next section ☐ Yes – Provide details below

SITE CONTACT NAME	POSITION
EMAIL	TELEPHONE

☐ INDICATE IF YOU WANT THE SITE CONTACT TO RECEIVE CORRESPONDENCE VIA EMAIL

A site contact is an alternative contact nominated by the legal entity which holds, or will in future hold, a relevant authority issued by the department. The department may direct correspondence relating to actual or potential compliance matters to the site contact.

Section 31 – Payment of fees

Application fee:	$

For fees payable to the Department of the Environment, Tourism, Science and Innovation

Preferred

☐ Apply using Online Services – submit the application online and pay by credit card.

Alternatively

☒ Email the completed application with a request to pay the application fee by BPOINT. Please do not email your credit card details – we will send you a link to pay securely by credit card via BPOINT.

For fees payable to the Department of Primary Industries

☐ Payment by cheque or money order made payable to the Department of Primary Industries (attached).

☐ Please contact me (the applicant) for credit card payment:

Phone number: Insert phone no.

An application fee is payable at the time the application is made. Information on the fee can be located on the website Forms and fees for environmental authorities | Business Queensland. Where the proposed amendment is determined by the administering authority to be a major amendment, an assessment fee of 30% of the annual fee for the authority at the time of application, is also payable. The assessment fee is payable once notification of the assessment level decision is issued. The assessment fee must be paid before the assessment of the amendment application can proceed.

The supplementary annual fee is payable where the amendment is approved and results in the aggregate environmental score (and hence the annual fee) for the EA increasing. The supplementary annual fee is a pro-rata adjustment to the annual fee for the period from when the amended EA takes effect to the next anniversary day for the EA. This is payable within 20 business days after the approval date. The supplementary annual fee can be calculated using the Fee calculator (ESR/2015/1731).

Section 32 – Declaration

Note: If you have not told the truth in this application you may be prosecuted.

I declare that:

- I am the holder of the EA, or authorised signatory for the holder of the EA.
- The information provided is true and correct to the best of my knowledge.
- I understand that under section 480 of the EP Act, it is an offence to give the administering authority or an authorised person a document that contains information that I know, or ought reasonably know, to be false or misleading in a material particular.
- I understand that under section 480A of the EP Act, if I am required to give a document to the administrating authority, it is an offence to give a document that I know, or ought reasonably to know contains incomplete information in a material particular.
- I understand that failure to provide sufficient information may result in the application being refused. I understand that an incomplete application may be invalid. Invalid applications will be returned without processing and will only be processed if resubmitted with all invalidating issues addressed.
- I understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.
- If the proposed amendment is made, the relevant activities will continue to comply with the ERA Standard (eligibility criteria and standard conditions) for all eligible ERAs, or where they cannot comply, I have indicated otherwise in my application and provided the required supporting information.
- If the proposed amendment is a minor amendment (condition conversion), I can comply with the ERA Standard (eligibility criteria and standard conditions) for each of the ERAs authorised by the EA.
- If the proposed amendment is made, I will continue to comply with all conditions of my environmental authority as well as any relevant provisions in the EP Act.
- I understand that I am responsible for managing the environmental impacts of these activities, and that approval of this application is not an endorsement by the administering authority of the effectiveness of management practices proposed or implemented.

Where an agreement is in place between all holders of the EA, one holder can sign on behalf of the other joint holders. Please tick the checkbox below.

☒ I HAVE AUTHORITY TO SIGN THIS FORM ON BEHALF OF ALL THE JOINT HOLDERS OF THE EA.

Applicant's or authorised signatory's signature

FULL NAME	POSITION	COMPANY / ORGANISATION
Monique Gastaldin	Environmental Specialist	Urban Utilities

SIGNATURE	DATE
Monique Gastaldin	05/08/2025

Joint holder(s) signature if applicable		
NAME, POSITION AND COMPANY NAME	SIGNATURE	DATE
NAME, POSITION AND COMPANY NAME	SIGNATURE	DATE
NAME, POSITION AND COMPANY NAME	SIGNATURE	DATE
OR ☐ I HAVE ATTACHED A DOCUMENT THAT PROVIDES THE REQUIRED INFORMATION FOR ALL JOINT HOLDERS.		
Where the EA holder is a company, this form must be signed by an authorised person for that company. Where there is more than one holder of the EA, this declaration is to be signed by all holders, unless there is an agreement between all holders that one can sign on behalf of the other(s).		

Section 33 - Submission

Please submit your completed application to:

For ERA 2, ERA 3 or ERA 4:

Post:
Senior Environmental Scientist
Intensive Livestock Unit
Department of Primary Industries
PO Box 102
TOOWOOMBA QLD 4350

Enquiries
Phone: (07) 4688 1374
Fax: (07) 4529 4192
Email: livestockregulator@dpi.qld.gov.au

For a mining ERA where the proposed amendment impacts upon the resource tenure:

Enquiries
Mining Registrar
Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development
The Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development has a list of office locations for mining registrars on its website https://www.nrmmrrd.qld.gov.au.

For all other ERAs:

Post:
Permit and Licence Management
Department of the Environment, Tourism, Science and Innovation
GPO Box 2454
BRISBANE QLD 4001

Enquiries
Website: www.business.qld.gov.au
Email: palm@detsi.qld.gov.au
Phone: 13 QGOV (13 74 68)

Applications and enquiries should not be submitted to individual officers. The latest version of this publication can be found at Application to amend an environmental authority (ESR/2015/1733).

Section 34 - Definitions to terms used in this form

(Where there is inconsistency between the definition of terms used here and the terms used in the EP Act, the terms in the EP Act apply)

Condition conversion	For an EA, means an amendment replacing all the conditions of the authority with the standard conditions for the environmentally relevant activity which the authority relates. The relevant eligibility criteria and standard conditions must be able to be met.
Eligibility criteria	For an environmentally relevant activity, means eligibility criteria that are in effect for the activity under – (a) An ERA standard; or (b) A code of environmental compliance; or (c) A regulation in respect of a mining activity.

Environmentally relevant activity (ERA)	A resource activity or a prescribed ERA.
ERA project	A prescribed ERA project or a resource project.
ERA standard	For an environmentally relevant activity, means the eligibility criteria and/ or the standard conditions set by the administering authority.
Major amendment	For an environmental authority, means an amendment that is not a minor amendment.
Material change of use of premises for an ERA	A category of assessable development requiring a development permit under the *Planning Act 2016*. Refer Schedule 10, Division 2, Item 8 of the Planning Regulation 2017.
Minor amendment	For an environmental authority, means an amendment that is – (a) a condition conversion; or (b) a minor amendment (threshold).
Minor amendment (threshold)	For an environmental authority, means an amendment that the administering authority is satisfied— (a) is not a change to a condition identified in the authority as a standard condition, other than— (i) a change that is a condition conversion; or (ii) a change that is not a condition conversion but that replaces a standard condition of the authority with a standard condition for the environmentally relevant activity to which the authority relates; or (iii) a change that will not result in a change to the impact of the relevant activity on an environmental value; and (b) does not significantly increase the level of environmental harm caused by the relevant activity; and (c) does not change any rehabilitation objectives stated in the authority in a way likely to result in significantly different impacts on environmental values than the impacts previously permitted under the authority; and (d) does not significantly increase the scale or intensity of the relevant activity; and (e) does not relate to a new relevant resource tenure for the authority that is— (i) a new mining lease; or (ii) a new petroleum lease; or (iii) a new geothermal lease under the Geothermal Energy Act; or (iv) a new GHG injection and storage lease under the GHG storage Act; and

	(f) involves an addition to the surface area for the relevant activity of no more than 10% of the existing area; and (g) for an environmental authority for a petroleum activity— (i) if the amendment involves constructing a new pipeline—the new pipeline does not exceed 150km; and (ii) if the amendment involves extending an existing pipeline—the extension does not exceed 10% of the existing length of the pipeline; and (h) if the amendment relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit—the amendment application under section 224 seeks an amended environmental authority that is subject to the standard conditions for the relevant activity or authority, to the extent it relates to the permit.
Mobile and temporary ERA	A prescribed ERA, other than an activity that is dredging material, extracting rock or other material, or the incinerating of waste: (a) carried out at various locations using transportable plant or equipment, including a vehicle (b) that does not result in the building of any permanent structures or any physical change of the landform at the locations (other than minor alterations solely necessary for access and setup including, for example, access ways, footings and temporary storage areas) (c) carried out at any one of the locations: (iii) for less than 28 days in a calendar year, or (iv) for 28 or more days in a calendar year only if the activity is necessarily associated with, and is exclusively used in, the construction or demolition phase of a project.
Prescribed ERA	An environmentally relevant activity that is not a resource activity and is prescribed under section 19 of the EP Act.
Prescribed ERA project	All prescribed ERAs carried out, or proposed to be carried out, as a single integrated operation.
Registered suitable operator	A person who, or a corporation which, under section 318I of the EP Act has been assessed as being suitable to carry out an ERA and has been listed on the suitable operator register.
Resource activity	An activity that is any of the following: (a) a geothermal activity (b) a greenhouse gas (GHG) storage activity (c) a mining activity (d) a petroleum activity.

Resource project	Resource activities carried out, or proposed to be carried out, under 1 or more resource tenures, in any combination, as a single integrated operation.
Single integrated operation	Occurs when all of the below criteria are met: (a) the activities are carried out under the day-to-day management of a single responsible individual, for example, a site or operations manager; (b) the activities are operationally interrelated; (c) the activities are, or will be, carried out at one or more places; and (d) the places where the activities are carried out are separated by distances short enough to make feasible the integrated day-to-day management of the activities.
Underground water rights	Means any of the following: (a) underground water rights within the meaning of the *Mineral Resources Act 1989*; (b) underground water rights within the meaning of the *Petroleum and Gas (Production and Safety) Act 2004*; (c) underground water rights within the meaning of the *Petroleum Act 1923*, section 87(3).

UrbanUtilities

HELIDON RESOURCE RECOVERY CENTRE

Minor Amendment application

EPPR00521513

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1. Introduction

1.1. Purpose of the report

Urban Utilities operates the Helidon Resource Recovery Centre (RRC) under the current Environmental Authority (EA) EPPR00521513 which permits Urban Utilities to operate a number of sewage treatment plants (RRC) under Environmentally Relevant Activity (ERA) 63 including:

- Helidon RRC - ERA 63 (1)(b)(ii) sewage treatment works with a total daily peak design capacity of more than 100 but not more than 1,500EP (no IT or IR).

The current conditions within the EA pertaining to Helidon RRC are largely carried over from the Development Approval conditions from the 1990's and as such many of the conditions as well as the ERA category itself are not suited to the current state of operation of the treatment plant.

Therefore, the purpose of this report is to change the ERA threshold category for the Helidon RRC to ERA 63 (1)(b)(i) sewage treatment works with a total daily peak design capacity of more than 100 but not more than 1,500EP if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme. As such the addition of the Lots and Plans which contain the "farm dam" (as referred to in condition C3J3) and those which contain the plantation for irrigation should be included within the location of the activity, that is:

- Lot 1 RP135445
- Lot 33 CH31423
- Lot 3 RP900696

If the Department consents Urban Utilities would also be happy to include within the activity location the other Lots owned including:

- Lot 1 SP314208
- Lot 2 SP314208
- Lot 17 CH31423

Current conditions which require amending include the quantity and quality characteristics for release to waters as this is no longer the nature of the release. Proposed conditions can be found in Section 5.

1.2. Application particulars

1.2.1. Eligibility Criteria

ERA 63 activities – Sewage Treatment Works is a prescribed ERA with an ERA standard and eligibility criteria. ERA 63 activities at the Helidon Resource Recovery Centre meet the eligibility criteria for a variation application as the activity falls within its currently licensed threshold of 100 to 1,500EP. Although this report proposes a

change in threshold category, that change constitutes a reduction in the Aggregate Environmental Score (AES) of the activity from the existing use of the premises and therefore will not trigger Schedule 10, Part 5, Division 2, Section 8 of the *Planning Regulation 2017* making it a non-concurrence activity under Schedule 2 of the *Environmental Protection Regulation 2019.*

1.2.2. Changes to Standard Conditions

A variation to existing site-specific conditions are being sought by this amendment. Some of these conditions have already been the subject of discussion with the Department and may be included in the amendment by agreement (streamlining to move to model conditions) that is being currently undertaken for EPPR000521513.

Proposed conditions can be found in Section **Error! Reference source not found.**

1.2.3. Impact on Environmental Values

Environmental values for waters are detailed in Section 2.3.
The environmental values which are most likely to be impacted by this application include:

- Land

An assessment of these particular impacts is detailed in Section 4.1.7.

The risk and magnitude of impacts on environmental values has been undertaken and is described in Section 4.1.
Actions proposed to prevent or minimise adverse impacts on the environmental values are described in Section 3.2.

1.2.4. Waste management

Urban Utilities has a Waste Management Plan for all Sewage Treatment Plants (RRCs) across our territory (MP255). Waste management and mitigation measures for waste are included in Section 4.1.6.

1.2.5. Site Management Plans or Environmental Protection Orders

No Site Management Plans or Environmental Protection Orders are in place at the subject site.

1.2.6. Other Approvals Required

This amendment application is to modernise the description of the activity and the wording of existing conditions related to ERA 63 Activities at the Helidon RRC to make them more appropriate. No changes in process or infrastructure at the treatment plant is required therefore no other approvals are required. Written confirmation was received from Lockyer Valley Regional Council on 21/05/2025 confirming that as the site is a continuation of existing activities it does not constitute a Material Change of Use and therefore approval is not required under the *Lockyer*

Valley Planning Scheme. A copy of this correspondence can be found in Appendix 6.1.

1.2.7. Amendment Application Threshold

This amendment application will constitute a minor amendment in accordance with ESR/2015/1684 "*Guideline: Major and Minor Amendments*" on the basis that its inclusion will not meet major amendment thresholds under section 3.1.1. ESR/2015/1684 defines **major amendments** as *'an amendment that is not a minor amendment'* under section 3.2. A summary of the amendment thresholds and responses are provided in Table 1.
The current category for the activity at Helidon RRC is an ERA63 1(b) (ii) which has an Aggregate environmental Score (AES) of 53 whereas the proposed category for the ERA 63 (1) (b) (i) has an AES of 27.

Table 1 Amendment Threshold and Response

Threshold	Response
a) The amendment is not a change to a standard condition identified in the EA as a standard condition, other than a condition conversion or replacing a standard condition with a standard condition for the ERA; and	There are no standard conditions for ERA63 activities. There are however model conditions. The proposed amendment is to vary existing Site-Specific conditions pertaining to the Helidon RRC.
b) The amendment does not significantly increase the level of environmental harm caused by the relevant activity; and	No changes in the current operation of the activity are planned and the AES associated with the reduced ERA63 threshold has less potential to cause environmental harm.
c) The amendment does not change any rehabilitation objectives in the EA in a way likely to result in significantly different impacts on environmental values than the impacts previously permitted under the EA; and	No existing rehabilitative conditions pertain to this EA.
d) The amendment does not significantly increase the scale or intensity of the relevant activity; and	The proposed amendment will not significantly increase the scale and intensity of the relevant activity. Indeed the change of threshold for the activity has a lower AES than the current activity and therefore constitutes a reduction in environmental impact.
e) The amendment does not relate to a new relevant resource tenure for the EA that is— (i) a new mining lease; or (ii) a new petroleum lease; or (iii) a new geothermal lease under the *Geothermal Energy Act 2010*; or	Not applicable.

(iv) a new greenhouse gas injection and storage lease under the *Greenhouse Gas Storage Act 2009*; and	
f) The amendment increases the existing surface area for the relevant activity by 10% or less; and	Although additional land parcels will be added to the ERA Activity the increase does not constitute an increase of surface area for the Environmentally Relevant Activity on EPPR000521513.
g) The amendment for an EA for a petroleum activity: (i) involves constructing a new pipeline that does not exceed 150km in length; and (ii) involves extending an existing pipeline by no more than 10% of the existing length of the pipeline; and	Not applicable

1.3. Declaration

Central SEQ Distributor-Retailer Authority:

- states that if the amendment is made, each relevant activity will comply with the eligibility criteria for the activity; and
- declares that this statement is correct.

1.4. Background information

Helidon RRC has been managed by Urban Utilities (UU) since 01/07/2010. Prior to that date Lockyer Valley Regional Council (LVRC) were the registered operators of the treatment plant.

There have been marginal changes and improvements to the process operations on site during Urban Utilities ownership of the plant including the construction and maintenance of a reed bed filter system and construction and operation of a pilot algae raceway side treatment train system.

More recently Urban Utilities purchased the adjacent land holding and planted two plantations of native trees which are irrigated by recycled water from the plant and provide koala food and habitat.

On 7th April Urban Utilities received a warning notice from DETSI compliance (WARN-E-100787093) for contravening a condition of the environmental authority specifically contravention of condition A3J1 due to treated effluent being used for irrigation activities on site. It should be noted that all treated effluent used for irrigation is currently subject to release to water quality characteristics (see condition C3J7) and undergoes additional treatment (sand filter and chlorination) prior to being used for irrigation on the plantation. Appropriate treatment and release to land is higher up the management hierarchy for an activity that may affect water outlined in

the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (section 14). Therefore, irrigation to land should be the preference over release to waters and presents a lower environmental risk. Despite this, in response to the warning notice Urban Utilities ceased all irrigation activities on site until the EA could be amended to allow for such irrigation. With the cooler dryer weather and sometimes windy conditions Urban Utilities seeks to resume the irrigation of the plantation as soon as practicably possible. The ongoing inactivity of the tertiary treatment system can cause delays in the re-commissioning of these assets and this risk increases over time.

When Urban Utilities took over the management of the Helidon RRC it was understood that the treated effluent from the RRC was always intended for irrigation to land. Unfortunately, the appendices referenced in the Environmental Authority for Helidon (carried over from the preceding Development Application) were not contained within Urban Utilities record management system (as it pre-dated Urban Utilities formation) thus a request for records was sent through to the Department on the 23/04/2025 and a search of the Department's archives located the requested documents. Upon review of these documents it was clear that the original intent was to use the treated effluent for irrigation purposes. This information and explanation was forwarded to the DETSI assessment team on 07/05/2025 and has been attached in Appendix 6.2 for ease of reference.

2. Site characteristics

2.1. Meteorological data

The closest BOM weather station with consistent data is 40829 Helidon TM located at 91 Helendale Drive, Helidon Spa which is approximately 2.8km from the Helidon RRC. A closer BOM station is 40096 Helidon Post Office at 1.6km distance from the RRC however the updating of the data for this station is not as consistent.

2.2. Location and land uses

The existing treatment plant infrastructure is situated on Lot 100 RP900696 on Back Flagstone Road Helidon 4344. In the current Environmental Authority (see condition C3J3) Release Point W1 is located on "the adjacent 120 ML farm dam" which is located on Lot 3 RP900696.

All land parcels owned by Urban Utilities with the tenures as indicated below:

- 100RP900696 (Freehold)
- 3RP900696 (Freehold)
- 1RP135445 (Freehold)
- 33CH31423 (Freehold)
- 17CH31501 (Freehold)
- 1SP314208 (Freehold)

- 2SP314208 (Freehold)



Figure 1 Helidon RRC Land parcel information

Portions of Lot 1 RP135445 and Lot 33 CH31423 have been the site of Urban Utilities plantings of Koala Habitat trees (blue gum, silver leaf ironbark and Moreton Bay ash) in 2019 and 2023. Areas that have been planted, initially with 4 hectares then subsequently with an additional 3 hectares, will be referred to as the "Helidon Plantation" (and can be seen more clearly in Figure 4 below) in this report noting that the Helidon Plantation constitutes a major portion of the "Farm Investigation Area" which is referred to in the Planfuture Reports as seen in Figure 2 below.

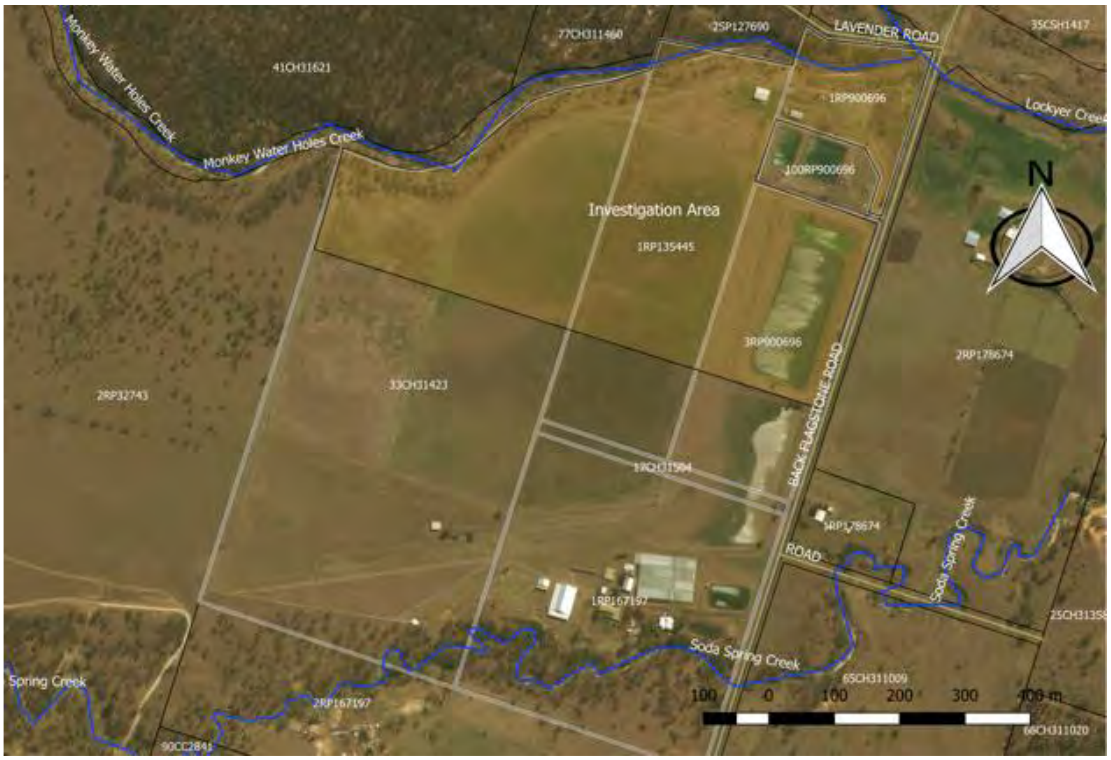


Figure 2 Farm Investigation Area (highlighted in yellow) from Planfuture Reports

Lockyer Valley Planning Scheme denotes Lot 100 RP900696 as a Community Facilities Zone within the surrounding area which is classed as Rural Zone. The Helidon RRC site is broadly bordered by Biodiversity areas, Ecological Corridors and Regulated Vegetation. The proximity of these environmentally significant areas contributed to Urban Utilities decision to revegetate the north-western area of the site with koala habitat trees.

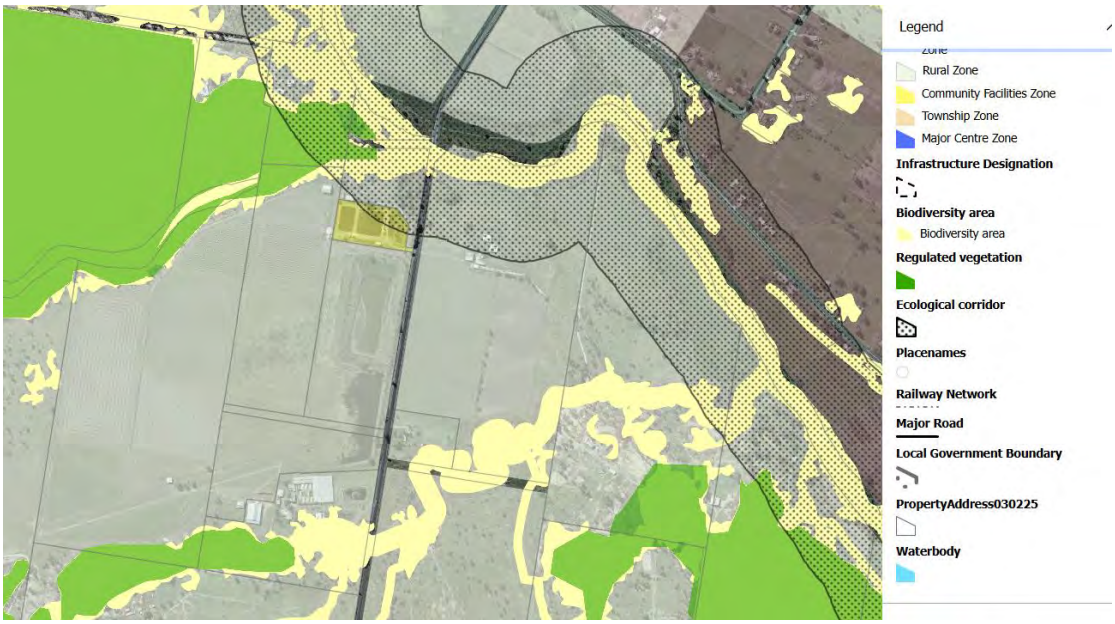


Figure 3 LVRC Planning Scheme Interactive Mapping extracted 14/05/2025

Monkey Water Holes Creek lies to the north of Helidon RRC. The border of the Helidon Plantation lies approximately 65 metres from Monkey Water Holes Creek at its closest point. Figure 4 shows the proximity of the Helidon Plantation to the creek at various points.



Figure 4 Helidon Plantation – Distance to Creek

2.2.1. Cultural Heritage

There is an existing native title claim over the Helidon site (tribunal number QC2017/005) lodged by the Yuggera Ugarapul people. The outcome of this claim has yet to be determined.

GeoResGlobe mapping shows that Monkey Water Holes Creek to the north of Helidon RRC is potentially subject to native title (indicative only) which may indicate native title presence.



Figure 5 Indicative Native Title Mapping (GeoResGlobe 2024)

A search of the DSDSATSIP database returned no cultural heritage site points or polygons within a 2000m radius of the project area. The Cultural Heritage Party for the area are the Yuggera Ugarapul People.

Section 23(1) of the *Aboriginal Cultural Heritage Act 2003* states that a person who carries out an activity must take all reasonable and practical measures to ensure the activity does not harm Aboriginal Cultural Heritage. The Duty of Care Guidelines (Section 28 of ACH Act) identify reasonable and practicable measures for managing activities in order to avoid or minimise harm to Aboriginal Cultural Heritage.

2.3. Surface waters

Under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 the environmental values and water quality objectives for waters are listed under Schedule 1. The project area is within Basin 143 and the Environmental Values and

water quality objectives are contained within the Lockyer River *Environmental Values and Water Quality Objectives*, published by the department in June 2022.

The following Environmental Values are potentially applicable for the Upper Lockyer Creek Environmental Value Zone:

Table 2 Environmental Values for Upper Lockyer Creek

Environmental Value (Aquatic)	Definition
Aquatic Ecosystems 	A community of organisms living within or adjacent to water, including riparian or foreshore area'. (EPP (Water and Wetland Biodiversity), schedule 2) The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways and riparian areas, for example, biodiversity, ecological interactions, plants, animals, key species (such as turtles, platypus, seagrass and dugongs) and their habitat, food and drinking water. Waterways include perennial and intermittent surface waters, groundwaters, tidal and non-tidal waters, lakes, storages, reservoirs, dams, wetlands, swamps, marshes, lagoons, canals, natural and artificial channels and the bed and banks of waterways. (This EV incorporates the 'wildlife habitat' EV used in the South East Queensland Regional Water Quality Management Strategy (SEQRWQMS)). See below for more details on aquatic ecosystems, based on the EPP (Water and Wetland Biodiversity).
Environmental Values (Human)	
Human consumer of aquatic foods 	The suitability of the water for producing aquatic foods for human consumption such as fish, crustaceans and shellfish from natural waterways.
Irrigation 	Suitability of water supply for irrigation, for example, irrigation of crops, pastures, parks, gardens and recreational areas.
Farm supply/use 	Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.
Stock water 	Suitability of water supply for production of healthy livestock.
Primary recreation 	Means a use that involves the following types of contact with the water—full body contact, frequent immersion by the face and trunk, frequent contact with spray by the face where it is likely some water will be swallowed or inhaled, or come into contact with ears, nasal passages, mucous membranes or cuts in the skin. Examples: diving, swimming, surfing (EPP (Water and Wetland Biodiversity), section 6).
Secondary recreation	Means a use that involves the following types of contact with the water—contact in which only the limbs are regularly wet, and

Environmental Value (Aquatic)	Definition
	other contact, including the swallowing of water, is unusual (examples—boating, fishing, wading) or occasional inadvertent immersion resulting from slipping or being swept into the water by a wave. (EPP (Water and Wetland Biodiversity), section 6).
Visual recreation 	Means a use that does not ordinarily involve any contact with the water—for example angling from the shore, sunbathing near water (EPP (Water and Wetland Biodiversity), section 6).
Cultural and spiritual values 	Cultural and spiritual values Means scientific, social or other significance to the present generation or past or future generations, including Aboriginal people or Torres Strait Islanders (EPP (Water and Wetland Biodiversity)), section 6), for example: • custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities • symbols, landmarks and icons (such as waterways, turtles and frogs) • lifestyles (such as agriculture and fishing).

According to the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* the relevant Water Quality Objectives for moderately disturbed fresh waters are

Table 3 Water Quality Objectives Upper Lockyer Creek Freshwaters (Moderately Disturbed)

Quality	High Flow	Low Flow
Ammonia N	10 µg/L	10 µg/L
Oxidised N	10 µg/L	10 µg/L
Total Nitrogen	260 µg/L	340 µg/L
Filterable Reactive Phosphorus (FRP)	10 µg/L	10 µg/L
Total Phosphorus	19 µg/L	25 µg/L
Chlorophyll a	5 µg/L	2 µg/L
Dissolved Oxygen	85 – 110% saturation	85 – 110% saturation
Turbidity	5 NTU	5 NTU
Total Suspended Solids	6 mg/L	6 mg/L
pH	6.5 -8.0	6.5 -8.0
Conductivity	760 µS/cm	950 µS/cm

2.3.1. Flooding

The Lockyer Valley Flood Information Reports for the current Helidon RRC lot and surrounding land parcels can be found in Appendix 6.3.

Lot 100 RP900696 which is the currently listed land parcel for Helidon RRC on EPPR00521513 is not affected by the Defined Flood Event (DFE) or subject to a Flood Investigation Area but is subject to an overland flow path indicated around the perimeter of the lagoons. Lot 3 RP900696, the location of the farm dam referred to in current condition C3J3 as the W1 release point, is similarly described.

Lot 1 RP135445 and Lot33 CH31423 (location of Helidon Plantation) are subject to a Flood Investigation Area, most specifically on the northern most boundaries along the fringes of Monkey Water Holes Creek.

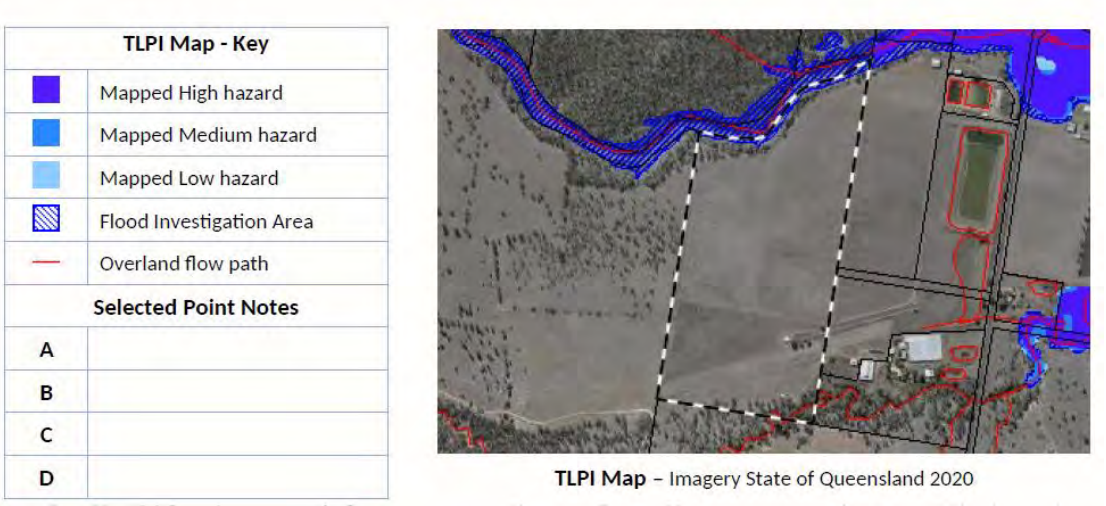


Figure 6 Lockyer Valley Regional Council flood hazard mapping in surrounding areas of Helidon RRC

Floodwaters in Lockyer Creek during the 2011 South-east Queensland floods did not cause any serious inundation at the Helidon Plantation or RRC and was most likely the function of backwater from Lockyer Creek. The Helidon Plantation area is anticipated to experience periodic inundation at an Average Recurrence Interval of 40 years. For more details on perceived flood risk at the plantation area see section 3.1.2c of the report *Helidon STP Reuse Project – Part A Report* (Appendix 6.4)

The Farm Investigation Area (Planfuture Reports) is laser-levelled with a fall at a grade of around 1.5% to direct runoff water to the lagoons and dam. North of this area lies Monkey Water Holes Creek, which on the southern side is marked by a naturally occurring levy (140m ASL) around 10m above the creek bed. The entire Farm Investigation Area lies between the 140m – 145m contour.

Very wet years can be of particular concern for effluent reuse schemes due to the potential for excess effluent that needs to be discharged however this does not present a problem at Helidon due to the capacity of the two treatment lagoons in series with a capacity of ~3,600 m^2 in the first lagoon and ~2,000 m^2 in the second baffled lagoon. Additionally effluent is currently discharged to the "farmers dam" which has a capacity of around 120ML. To provide some context at the current ADWF for the plant which is higher than usual given recent wet weather (115kL/d) it would take approximately 1043 days to fill this dam. With such a significant capacity the effluent lagoon is unlikely to ever overtop and release. The negligible overflow risk of the "turkey nest" dam (farmers dam) is dealt with in further detail in section 3.3.4: Irrigation Overflow of "Helidon STP Effluent Reuse Project – Part B Report" (Appendix 6.5)

2.4. Groundwaters

Groundwater (brackish) is estimated to potentially occur around 10 metres below the surface. This is based on the nearest registered groundwater bore RN 143723 which is a sub-artesian facility located approximately 100 metres north of the Helidon RRC site. The locations of the closest groundwater bores with contours can be seen in Figure 7 below. The complete bore report for RN 143723 and RN14320196 - a current RDMW water level monitoring bore on the other side of Monkey Water Holes Creek can be found in Appendix 6.6.

The upgrade to the MEDLI simulation model (Gardner et al 1996) MEDLI v2 which was used in 2019 to assess the proposed irrigation of the blue-gum plantation integrates groundwater nitrate transport into the analysis (see page 39 of Appendix 6.5).



Figure 7 Location of nearest registered groundwater bores with contours from Queensland Globe 28/05/2025

2.5. Wetlands

No wetlands of high ecological significance occur near the site. As Helidon RRC is a no release site no impacts to downstream wetlands is anticipated.

2.6. Geology, soils and acid sulfate soils

The closest Water Bore (RN 143723) Report (Appendix 6.6) indicates around a metre of sandy topsoil underlain with clayey loam, sand and gravel for around 10-15 metres with a bedrock of sandstone.

For detailed surface geology mapping see Table 4 below.

Table 4 Surface geology description from Queensland Globe

Surface Geology Type	Dominant Rock	Rock Type	Lithological Summary	Age
Qa-QLD	Alluvium	Stratified Unit (including Volcanic and Metamorphic	Clay, silt, sand and gravel, flood-plain alluvium	Quaternary

The 2019 Report produced by PlanFuture entitled *Phase 1 – Farm Investigation Area Assessment* (Appendix 6.7) identifies the dominant soil type over the "Farm Investigation Area", that is, the area upon which the tree plantation occurs, as Blenheim (heavy) black earth with a small amount of Robinson Alluvial Soils along the narrow Monkey Holes Creek levee and immediately adjacent back-slopes to the north.

The Soils and Land Suitability of the Lockyer Valley Alluvial Plains descriptions of both soil types are detailed in Table 5 below.

Table 5 Site suitability parameters at Farm Investigation Area

Suitability parameter	Blenheim (heavy) – Bl(h)	Robinson - Rs
Erosion	<5%	<5%
Soil depth	1.0m – 1.5m	0.6m – 1m
Available water	>100mm	>100mm
Flooding	>40 year frequency	6-9 year frequency
General Irrigation Suitability	Suitable with moderate limitations	Suitable with moderate limitations
Agricultural land class	A	A

Soil sampling was undertaken at 16 sites to confirm soil types with 90% of the area being comprising of 3 soil types as detailed in Table 6. A soil map for the proposed plantation area is included in Figure 8.

Table 6 Representative Soil Types at Proposed Plantation Area

Representative Soils at Project Area	Figure 4 Soil Type
Representative Soil 1 (Sampling Site 1)	Blenheim soil - imperfectly drained black and brown Vertosols with moderate subsoil salinity [Red shading in Figure 4]
Representative Soil 2 (Sampling Site 8	Cavendish/Hooper soils - well drained black and brown Dermosols with low subsoil salinity [Blue shading in Figure 4]
Representative Soil 3 (Sampling Site 11)	Blenheim soil - imperfectly drained black and brown Vertosols with low subsoil salinity [Green shading in Figure 4]

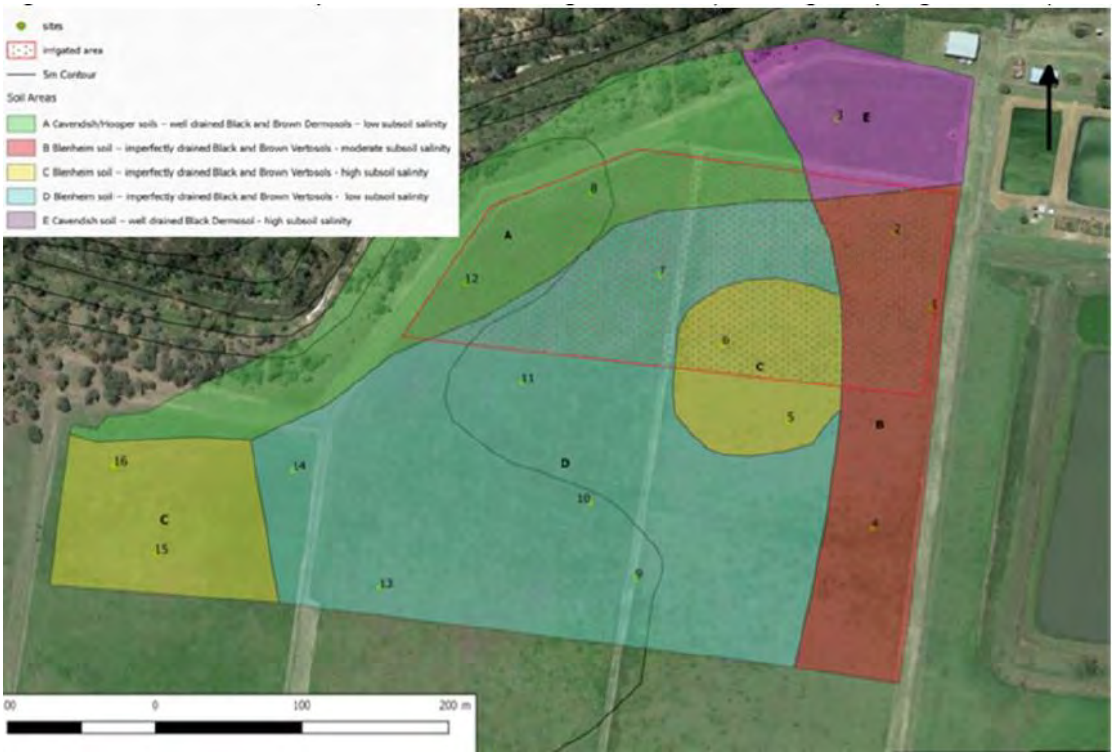


Figure 8 1:10,000 soil map for proposed plantation area

For more details on the soils please seen Section 3.1.2b: Soils in *Phase 1 – Farm Investigation Area Assessment* (Appendix 6.7)

The activity is located well above 20m AHD and is not near any tidal watercourses and does not have the potential to encounter Acid Sulfate Soils (ASS).

2.7. Contaminated land

None of the lots associated with Helidon RRC are listed on the EMR or CLR.

2.8. Flora and fauna

2.8.1. State and Local Flora and Fauna

A Wildlife Online search conducted in July 2025 for the area surrounding Helidon RRC (2km buffer) identified the following species listed as threatened under the NC Act which have been historically recorded in the area:

- *Phascolarctos cinereus* (koala) – Endangered
- *Hirundapus caudacutus* (white-throated needletail) – Vulnerable
- *Erythrotriorchis radiatus* (red goshawk) – Endangered
- *Calyptorhynchus lathami* (glossy black-cockatoo) – Vulnerable
- *Calyptorhynchus lathami lathami* (glossy black-cockatoo (eastern)) – Vulnerable
- *Limosa limosa* (black-tailed godwit) – Endangered
- *Rostratula australis* (Australian painted-snipe) – Endangered
- *Ninox strenua* (powerful owl) - Vulnerable
- *Leuzea australis* – Vulnerable

Additionally, there are also 10 species listed as special least concern under Queensland legislation.

Matters of State Environmental Significance (MSES) are located at the northern and southern end of the Helidon RRC site, associated with existing areas of remnant vegetation. These include:

- MSES Regulated Vegetation (essential habitat)
- MSES Regulated Vegetation (Category C, endangered or of concern)
- MSES Regulated Vegetation (Category B, endangered or of concern)
- MSES Wildlife Habitat (SEQ koala habitat – core)
- MSES Wildlife Habitat (special least concern animal)
- MSES Wildlife Habitat (endangered or vulnerable)
- MSES Regulated Vegetation (defined watercourse)

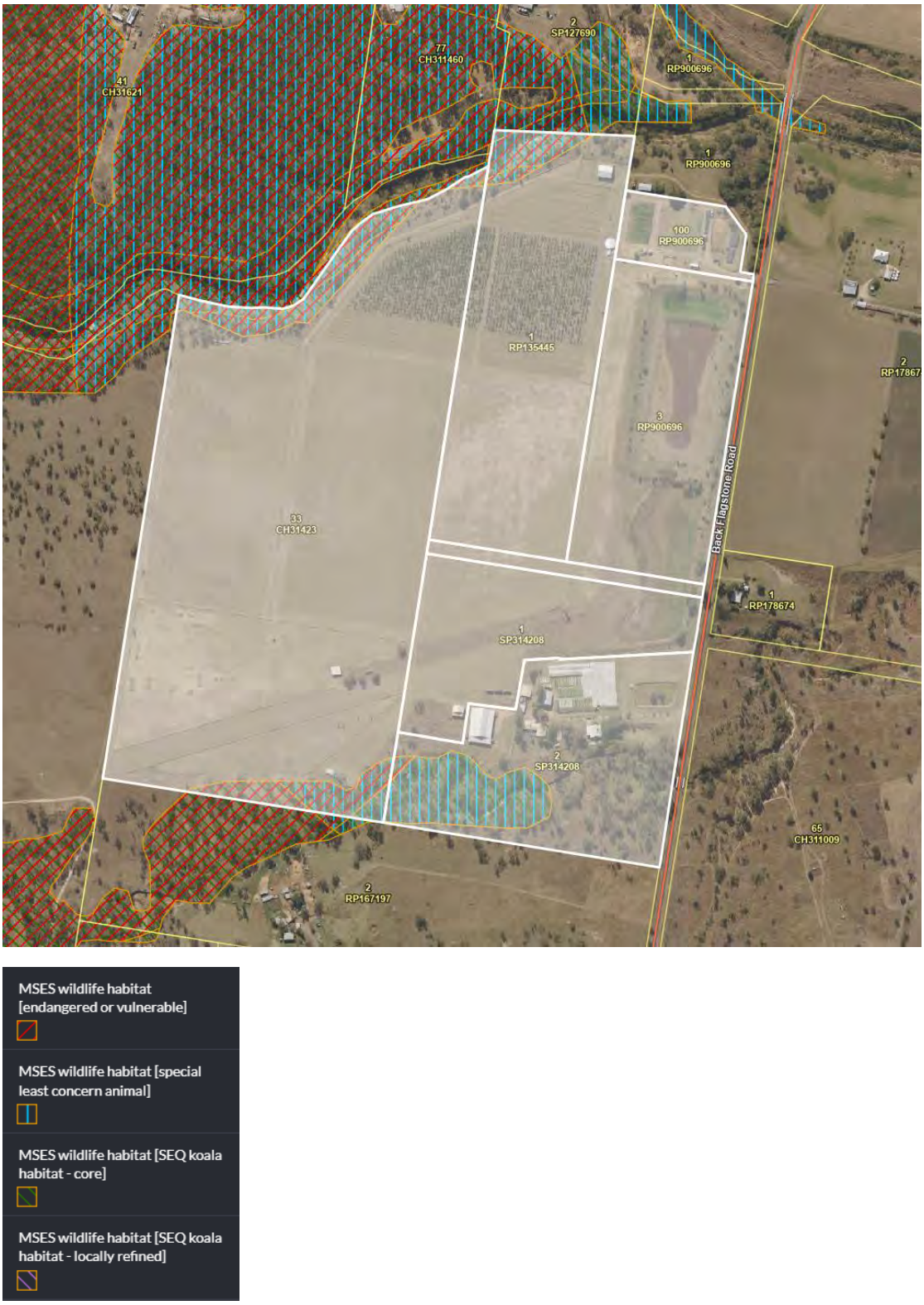


Figure 9 Matters of State Environmental Significance (wildlife habitat), Helidon RRC

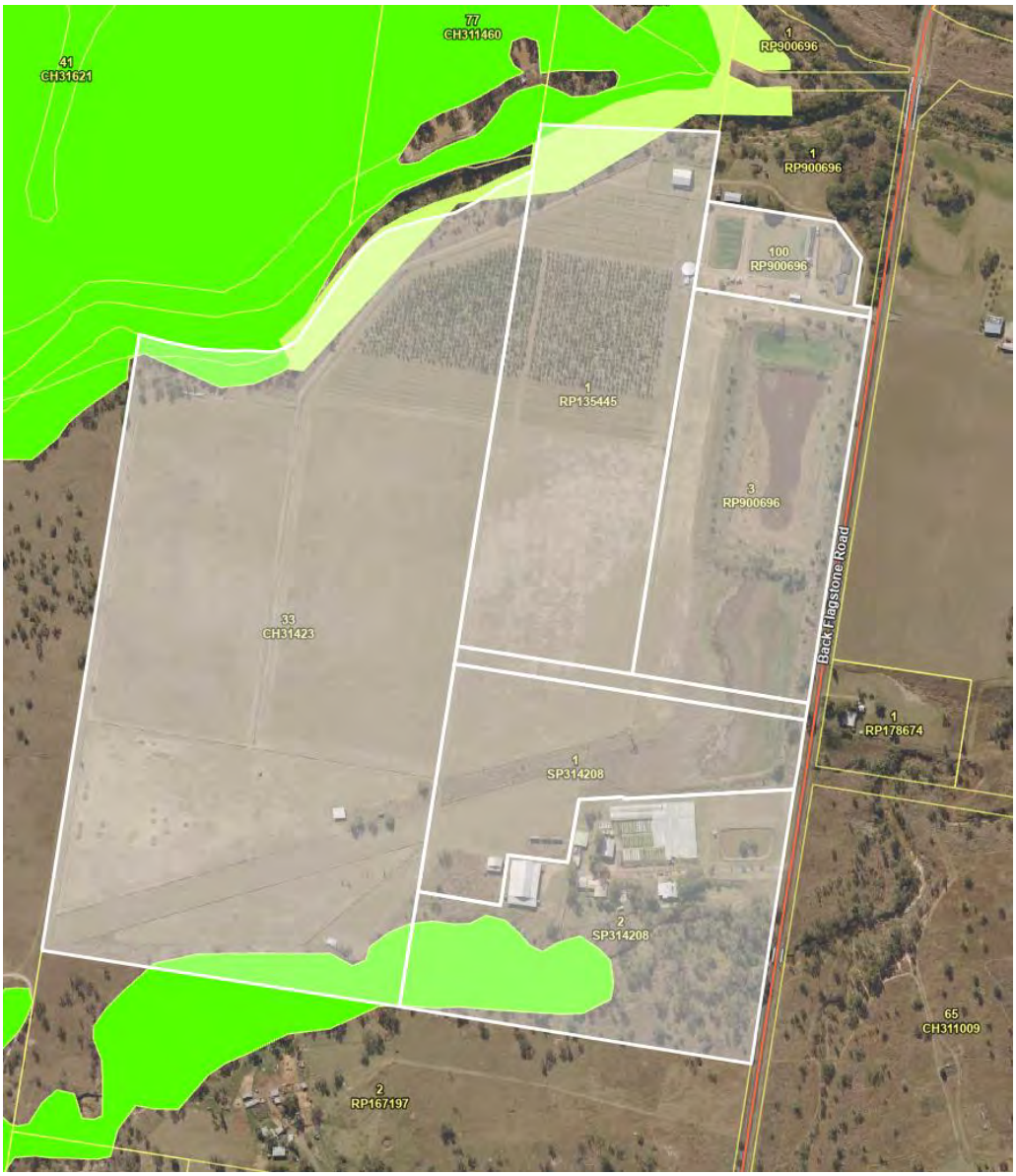


Figure 10 Matters of State Environmental Significance (vegetation and habitat), Helidon RRC

2.8.2. Federally Listed Flora and Fauna

A Matters of National Environmental Significance (MNES) search was completed in July 2025 using the Protected Matters Search Tool (PMST), using a 2km buffer around the Helidon RRC site. This search identified:

- Six listed Threatened Ecological Communities (TECs):
  - Lowland Rainforest of Subtropical Australia (Critically Endangered);
  - Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions (Endangered, likely to occur);
  - Grey box-grey gum wet forest of subtropical eastern Australia (Endangered);
  - White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered)
  - Poplar Box Grassy Woodland on Alluvial Plains (Endangered); and
  - Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland (Endangered)
- 49 listed Threatened Species, including 32 threatened fauna species and 17 threatened flora species; and
- 11 listed Migratory Species

The EPBC Protected Matters Report for the Helidon RRC site and surrounds can be found in Appendix 6.8.

A Wildlife Online Search using an approximate 2km buffer was also completed in July 2025 for the area surrounding Helidon RRC, identifying records of the following threatened species listed under the EPBC Act:

- *Phascolarctos cinereus* (koala) – Endangered
- *Hirundapus caudacutus* (white-throated needletail) – Vulnerable
- *Erythrotriorchis radiatus* (red goshawk) – Endangered
- *Calyptorhynchus lathami lathami* (glossy black-cockatoo (eastern)) – Vulnerable
- *Pteropus poliocephalus* (grey-headed flying-fox) – Vulnerable
- *Limosa limosa* (black-tailed godwit) – Endangered
- *Rostratula australis* (Australian painted-snipe) - Endangered
- *Leuzea australis* – Vulnerable
- *Lepidium peregrinum* - Endangered

There were 23 records of koala within the buffer area, indicating a high likelihood that koala inhabit the site. Koalas have also been sighted at Helidon RRC previously within the tree lots with the originally named K1 appearing in 2023 (news article K1) and K2 in 2024 (news article K2) . The Wildlife Online search can be found in Appendix 6.9.

The pre-clearing native vegetation at the Helidon RRC site is endangered Regional Ecosystem 12.3.3 (RE 12.3.3); tall open blue gum (*Eucalyptus tereticornis*) forest with a grassy understory. The levee along Monkey Water Holes Creek to the North of

the plantation area has a small area of remnant vegetation that is mapped as endangered RE 12.3.10 (*E. populnea* woodland on alluvial plain). The levee is also essential habitat for *Phascolarctos cinereus* (koala), as too is the remnant vegetation to the north of the Creek. Therefore the area was deemed suited to irrigated regeneration of RE 12.3.3. Koala mapping is included in Figure 11.



Figure 11 Koala mapping for Helidon RRC and surrounds

2.9. Sensitive receptors

Helidon RRC is surrounded by lots mapped as part of the rural zone under the Lockyer Valley planning scheme. A map of nearby lot zoning is shown in Figure 12. Note that currently only Lot 100 on RP900696 is mapped as part of the Community Facilities zone (which incorporates the relevant utility use).

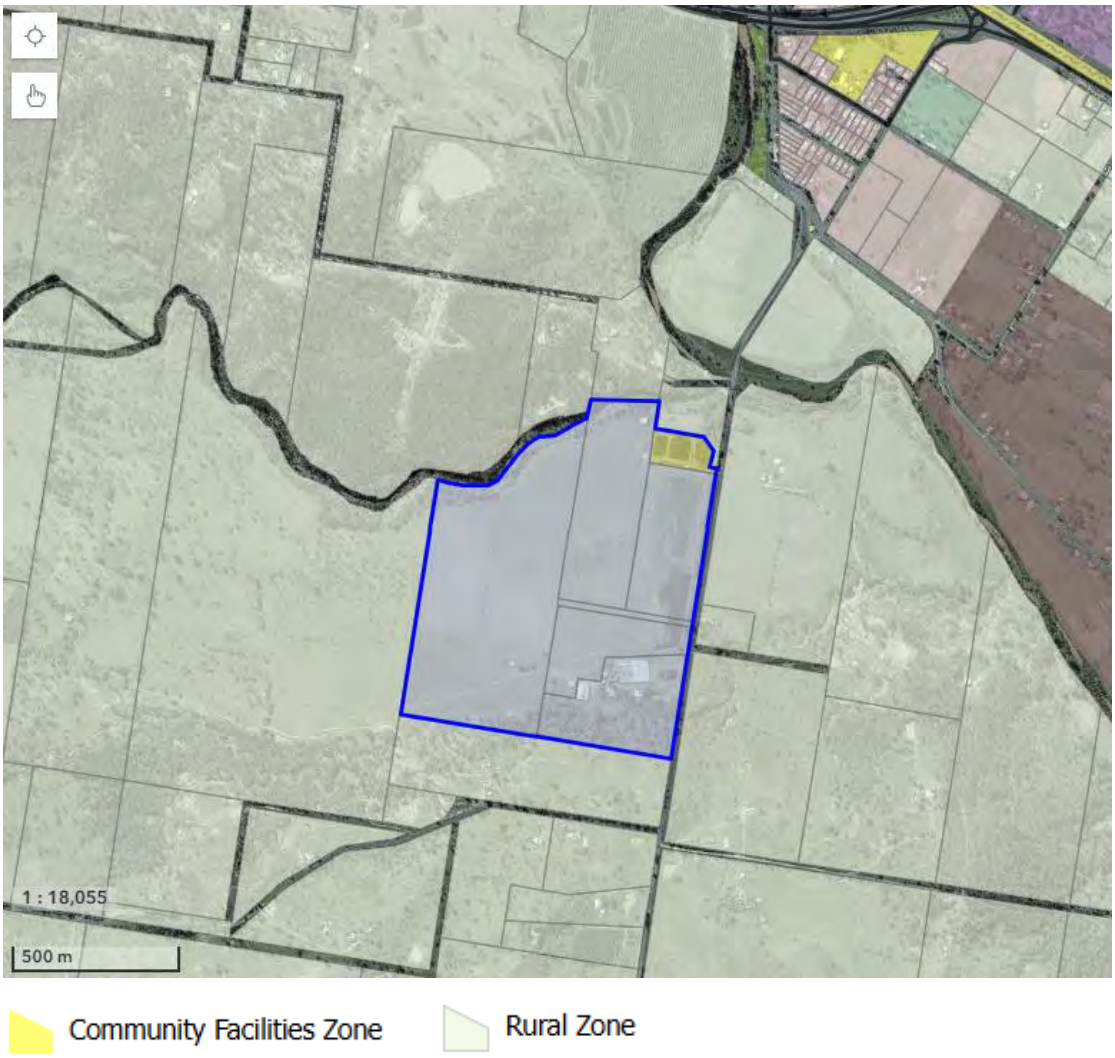


Figure 12 Helidon RRC Zoning

There are sensitive receptors in proximity to Helidon RRC. The nearest private dwelling is located approximately 130m to the east of the Helidon RRC property boundary (and around 300 metres from the Helidon Plantation) as shown in Figure 13 (89 Back Flagstone Road). There are also houses located north of Monkey Water Holes Creek which are approximately 180m from the Helidon RRC property boundary. The house and shed which lies around 400m south of the Helidon RRC is on Lot 2 SP314208 which is owned by Urban Utilities and unoccupied. The main township of Helidon is around 800m to the north of the RRC.



Figure 13 Distance to nearest sensitive receptor – 89 Back Flagstone Road

3. Application details

3.1. Design summary and specification

Helidon RRC is a lagoon treatment plant where influent undergoes biological treatment through two lagoons in series. An offline wetland is available to provide some emergency wet weather storage if required. Some tertiary treatment is provided by 3 reed bed cells and a side train trial algae raceway. The HACCP Process flow diagram for Helidon RRC can be seen in Figure 14 below.

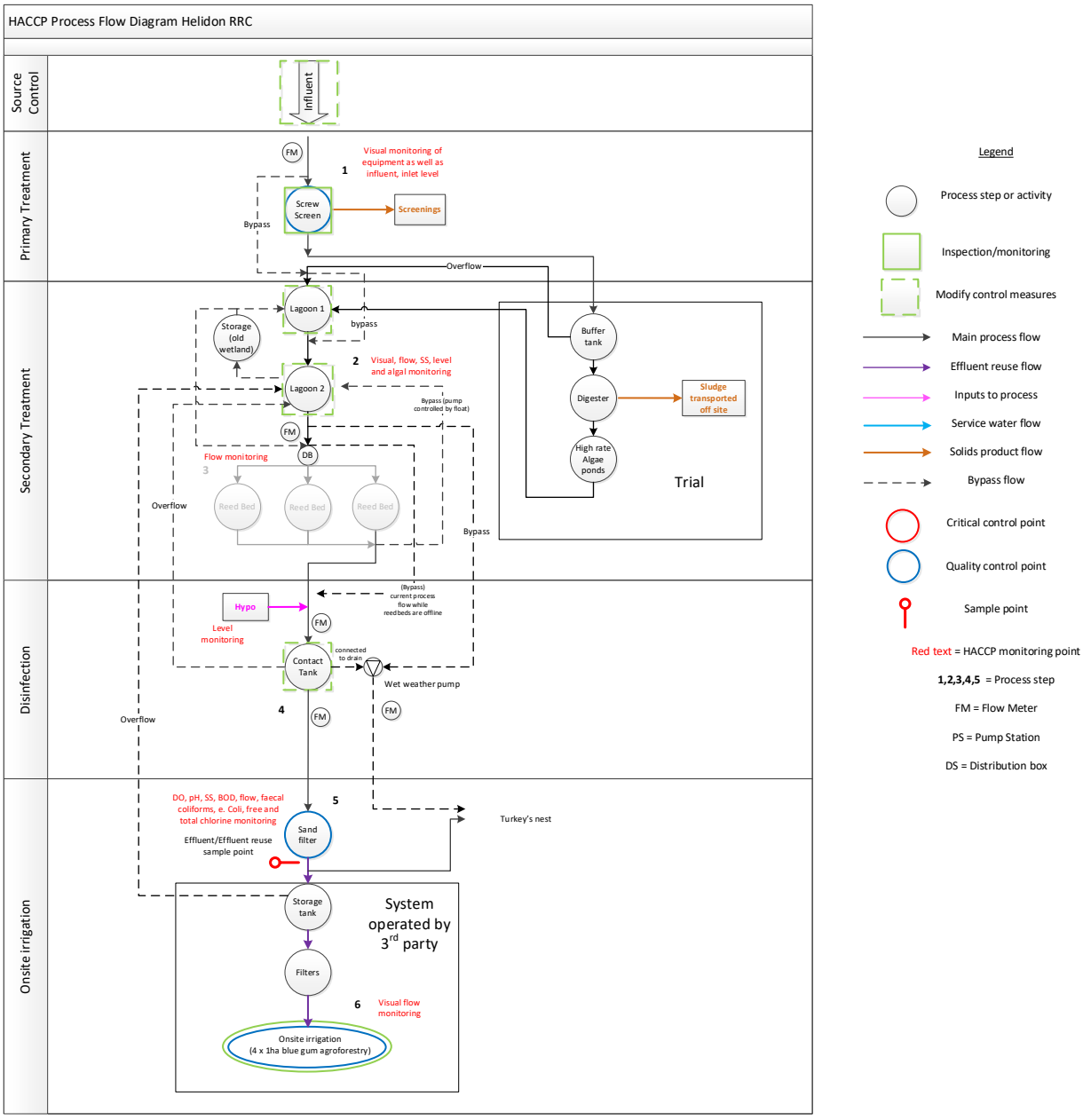


Figure 14 Product Process Flow Diagram for Helidon RRC

3.1.1. Operational overview and control philosophy

The process flow path for the Helidon RRC can be seen in Figure 15 and is described below.

- Inlet works (part flow to Upflow Anaerobic Sludge Blanket (UASB) and then part flow onto algae raceway) to Lagoon 1(~3,600 m^2)
- Lagoon 1 to Lagoon 2 (~2,000 m^2)
- Lagoon 2 to Reed beds
- Reed beds to CCT
- CCT to either irrigation tank (for plantation) or remainder to ("farmers") dam (Effluent Storage Lagoon.).

The wet weather flow path is:

- Lagoon 2 overflows to wetland storage
- Wetland storage to CCT (Lagoon 1 or reed beds), or
- Emergency pumping from lagoon 2 to dam

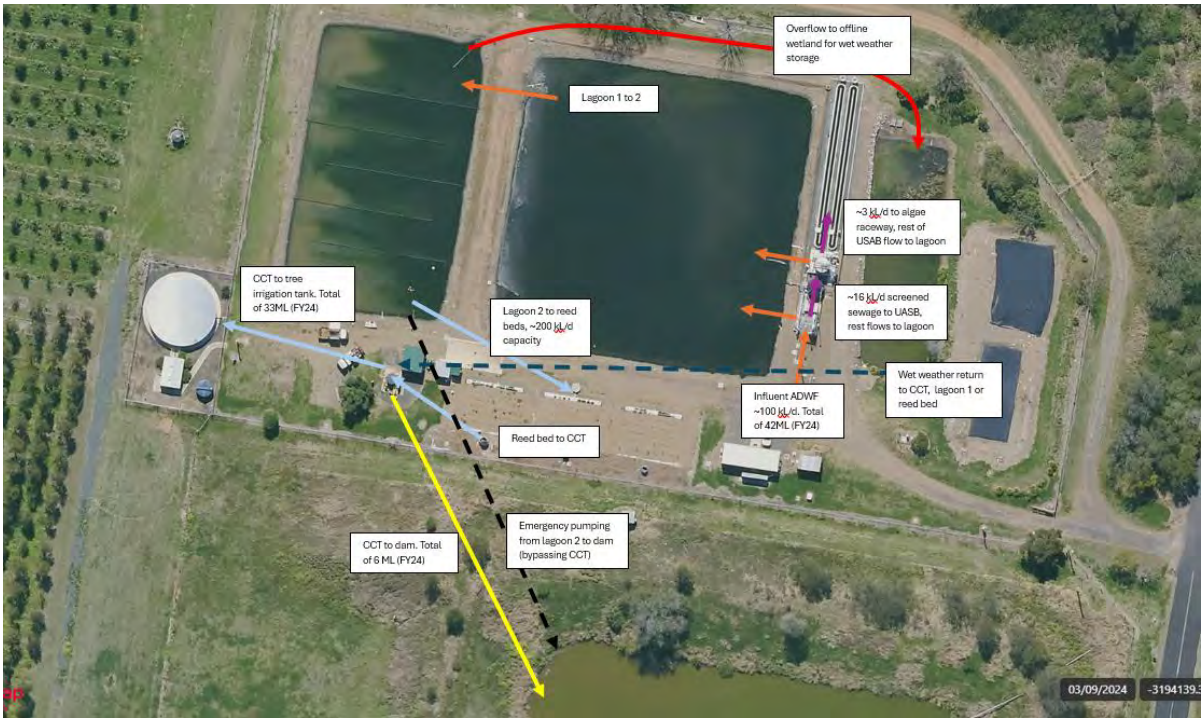


Figure 15 Process flow paths at Helidon RRC

It is worth noting that samples of effluent quality to irrigation area are taken post the first sand filter and chlorination but prior to the second sand filter therefore quality is likely better than what has been historically sampled and recorded.

3.1.2. Emergency protocols and management

In emergency situations Urban Utilities operates in accordance with our Emergency Management Plan (EMP): CER7. In addition to the EMP the Environmental Events Emergency Sub Plan: TCP15 has been developed to outline the triggers for environmental events that have the actual or potential to cause harm.

Urban Utilities has also developed TCP3 Flood Storm Inundation Emergency Management Sub Plan to confirm triggers of a Storm, Flood or High Tide Inundation Event and to outline the preparedness, responsive and recovery activities to minimise impacts to our assets, our people and our customers to ensure continuity of water and sewage services and to minimise impacts to our customers and the environment.

3.2. Mitigations and management measures

3.2.1. Air and odour management

There is no history of odour issues or odour complaints at the Helidon RRC. There are few sensitive receptors in the vicinity although these are a significant distance away. This amendment application does not constitute any notable change in the operation of the treatment plant and is therefore not anticipated to cause any additional risk in air or odour management.

3.2.2. Greenhouse gas emissions management

As operations have not changed at the Helidon RRC and the amendment is to change the ERA threshold category for the Helidon RRC from an ERA 63 (1) (b) (ii) which implies a release to waters to an ERA 63 (1)(b)(i) which discharges through an irrigation scheme and has a lower AES score allocated no impacts to GHG are anticipated.

3.2.3. Water management

The *Environmental Protection (Water and Wetland Biodiversity) Policy* section 14 states the order of preference for release of wastewater or contaminants to waters with appropriate treatment and release to land (s14 (2) (d) (ii)) as the preferred option to release to waters which is the current threshold activity that Helidon RRC is classified as. The release to waters categorisation was determined prior to the site passing to Urban Utilities control and when the surrounding parcels of land, including the one which contained the large storage dam, were owned and the irrigation operated by the farmer. With Urban Utilities purchase of the surrounding parcels of land (approximately 60ha) the opportunity to continue the irrigation and make it even more ecologically sustainable by reinstating remnant vegetation which could be irrigated with treated effluent from the plant was explored. Thus in 2018 Urban Utilities sought a Scope of Works to source experienced effluent reuse specialists to undertake appropriate pedologic investigations to assess, plan and model a sustainable irrigation project for native vegetation regeneration. In response to this

the Planfuture team (Dr Tony Constantini, Professor Ted Gardner and Dr Evan Thomas – the architect of the MEDLI model and hydraulic scientist who worked with the Department to test version 2 of MEDLI) developed a bespoke MEDLI model for blue gum forest and grass understory crop.

MEDLI modelling is a long term water balance integrated with the soil nutrient balance, plant growth and soil salinity. As the water balance is run over multi decade time intervals (usually 50+ years) the irrigation demand will vary from year to year with a maximum in low rainfall years and a minimum in high rainfall years.

MEDLI adjusts for inflow using a leakage algorithm tuned to a low, medium or high inflow sewerage system. Based on the MEDLI modelling undertaken by Planfuture the blocks are irrigated on a sequential system per 1 hectare with approximately 250,000 litres required to apply 25mm of irrigation to 1 hectare. The trigger for irrigation is on an "as needs basis" and uses a 25mm Soil Water Deficit (SWD) trigger, applying 25mm per application. There is an Antecedent Rainfall Trigger and Irrigation Restart Delay with an automated cessation of irrigation trigger at 15mm of rain within a 24 hour period and the automated delay after this trigger is 5 days. This 5 day time frame is far more stringent than the standard 24 hour delay test in the MEDLI modelling. The system can also be managed manually in real time via the GoldTech software system and has been utilised by Urban Utilities to optimise forestry outcomes – for example, in dry summer periods where wet soils do not persist after small rainfall events and where no more significant rain is forecast then this 5 day delay period may be reduced.

For a more detailed analysis of the MEDLI modelling please refer to "*Helidon STP Effluent Reuse Project – Part B Report: Phase 3 MEDLI Modelling*" (Appendix 6.5)

A storage tank of 363kL helps balance the effluent flows prior to irrigation with an overflow into the Sewage Treatment Plant lagoons for reprocessing through the plant. The effluent (post chlorine tank) consistently produces class B effluent quality as defined in the *Public Health Regulation 2005* however as the irrigation is used on a forestry plantation class C quality effluent parameters are deemed appropriate for such use and have been included in the proposed condition for effluent quality limits. Set back distances have been established to mitigate interactions with the irrigated water. The plantation area and associated irrigation system is set back 30 metres from the closest point to the treatment plant security fence (circa 70m from the buildings and work area). Irrigation occurs on lots adjacent to Monkey Water Holes Creek however there is a buffer distance of around 65 metres between the border of the plantation and the waterway (see Figure 4).

Any effluent not required for irrigation can be pumped to the "farmers dam" which serves as an effluent storage lagoon and has a capacity of 120ML (circa 1043 days of current ADWF from Helidon RRC).

3.2.4. Wetland management

No mapped wetlands of high ecological significance occur near the site. As Helidon RRC does not release to waters no impacts to downstream wetlands is anticipated.

3.2.5. Groundwater management

Groundwater is estimated to potentially occur around 10 metres below the surface. With controlled irrigation in line with MEDLI modelling no adverse impacts to groundwater are anticipated. Average nitrate loading to groundwater is considered within the MEDLI modelling.

3.2.6. Noise management

There is no history of noise issues or noise complaints at the Helidon RRC. There are a few sensitive receptors in the vicinity although these are a significant distance away. This amendment application does not constitute any notable change in the operation of the treatment plant and is therefore not anticipated to cause any additional risk in noise management.

3.2.7. Waste management

Urban Utilities has a Waste Management Plan for all Sewage Treatment Plants (RRCs) across our territory (MP255) and an Environmental Waste Standard (STD147). Urban Utilities utilises a waste tracking ID service for the transport of waste. During operation of the activity biosolids will be managed in accordance with Urban Utilities Biosolids Management System. This amendment application does not constitute any notable change in the operation of the treatment plant and is therefore not anticipated to cause any additional risk in waste management.

3.2.8. Land management

MEDLI is a mass balance model that uses existing knowledge of bio-physical nutrient and water balance. Long term sustainability of a disposal system is evaluated using design and location specific effluent, pond, soil and plant parameters with long-term weather data. The water balance of the irrigation area is determined by using inputs of irrigation and rainfall, and outputs of evapotranspiration, runoff and deep drainage. The soil hydraulic properties determine the plant available water capacity, the drainable porosity and the saturated hydraulic conductivity. Plant growth modelling is a critical component of MEDLI as it impacts both water use and nutrient uptake and hence nutrient and water mass balances in irrigation. In MEDLI, plant growth is species specific and moderated by limitations of temperature, leaf nitrogen levels and stresses from water supply, water logging and soil salinity.
A critical performance criterion of a successful effluent irrigation scheme is that the land does not accumulate potentially harmful biological nutrients. MEDLI models soil nitrogen balance by considering denitrification, mineralization of native soil N, plant uptake and leaching below the root zone. Provided leaching losses are low (e.g. < 10mg/L NO3-N in soil. solution below root zone), then the reuse scheme is

considered sustainable. A similar argument applies to phosphorus; but it is often immobilised via soil adsorption reactions.

The bespoke MEDLI modelling undertaken in 2019 investigated nutrient uptake and was based on the average total nitrogen and phosphorus concentrations of irrigation water as 22mg/L and 10mg/L respectively with circa 20ML/year ADWF and an average irrigation rate of 4.6ML/ha/yr (based on the 25mm/ha of effluent irrigated sequentially through the plantation lots). The model suggested that the blue gum forest will sequester around 90% of the irrigation applied nitrogen. The model indicated that around 25kg/ha/year of nitrogen is being mineralised from the soil organic store and leached nitrogen (without mineralisation) was a modest 8kg/ha/year. Half of the applied phosphorus was expected to be taken up by the forest with the remainder adsorbed on the soil.
Ultimately as the blue gum forest crop matures (when trees reach canopy closure and tree leaf biomass plateaus around years 5-6) uptake of applied nitrogen will not reach 100% (predicted around 88%) however the plant root uptake model excludes roots which is understandable for grass crops but conservative for crops such as blue gums where around 15% of biomass might be stored in the roots and is therefore not accounted for within the model. At this time the grass understorey will account for around 51% of the nitrogen uptake and the actual amount of nitrogen leachate will be relatively small and manageable. In August 2024, when the first stage of the forest was 5 years old, a sample of young leafy Rhodes grass regrowth, collected 30 days after slashing, was found to have a dry matter TN concentration of 1.38%, which, consistent with the lack of visual nitrogen enrichment at the plantation, and is at the lower end of observed crude protein content for the species. As such the contracted professional foresters made a decision to not remove the grass from the project area as it is adding benefit to the overall soil health of the project area and likely will for a long time into the future as soil health is still poor from previous agricultural practices on the land. In the future the removal of crops from the irrigation area (such as grass clippings or leaf fall) can reduce nitrogen if testing indicates a need.

The Planfuture irrigation recommendation (circa 4.6ML/ha/year), equated to average nitrogen and phosphorus loading rates of around 85kg/ha/yr and 47kg/ha/year respectively, which are considered to be very low for nitrogen fertilized irrigated pasture, and average for phosphorus fertilizer applications. For phosphorus, the excess of amounts added in irrigation over the amounts sequestered in plants (about 20kg/ha/yr) is available for soil adsorption reactions. Accordingly leached phosphorus is effectively zero. While the likely quantity of nitrogen leachate is 8kg/ha/year, with an average nitrate concentration of ≈ 19mg/L.

The modelling also accounted for an additional 25% increase in ADWF to accommodate potential population growth to 2029 and they concluded that the original 4 hectare plantation could accommodate this and remain sustainable as both the MEDLI and SALF modelling confirmed that salinity was unlikely to be limiting and irrigation of low sodicity effluent is unlikely to have an adverse effect on soil structure.

Early in 2022 Urban Utilities provided Planfuture with a revised estimate of ADWF of around 30ML/year which prompted the recommendation to plant an additional 3

hectares of plantation to accommodate the flows to 2029 in line with the MEDLI modelling. The second 3 hectare plantation was completed and irrigation started in January 2023. In 2024 Planfuture provided Urban Utilities with a report of performance on the 7 hectares of plantation. The report confirmed that irrigated effluent flows to the 7 hectares of irrigated forest of around 32ML were successfully reused in accordance with the MEDLI planning assumptions including:

- No surface runoff of irrigation
- Broadly uniform spray irrigation across the entire irrigated forest and
- Irrigation scheduling such that monthly irrigation is not applied when monthly irrigation + rainfall significantly exceeds evapotranspiration.

For a more detailed breakdown of the performance of the project see Appendix 6.10 *Helidon STP Effluent Reuse Project 2024 - Report of performance.*

As outlined in Section 3.2.3 Water Management MEDLI modelling is a long term model run over multi decade time intervals so it is expected that there could be significant variance of inputs over that time period with individual year's results potentially varying significantly although these are expected to balance out over the long term. As South East Queensland has been experiencing significant wet weather over the last few years, combined with variable effluent quality results Urban Utilities decided to run a basic MEDLI model scenario with higher end values as a sense check using the following parameters.

MEDLI input parameters:

- Total nitrogen = 45 mg/L
- Total phosphorus = 15 mg/L
- Total dissolved salts = 688 mg/L
- Effluent flow = 110 kL/day
- Storage tank = 363 kL
- Soil type = blank vertisol
- Plantation area = 7 hectares
- Crop = Rhodes grass (harvested but not removed)
- Irrigation triggered when the soil water deficit reaches 25 mm and rainfall is less than or equal to 15 mm. There is a minimum of one day withholding period between irrigation events.
- Model run over a 50-year period from 1974 to 2024.

MEDLI outputs:

The model output shows that on an average annual basis, 40 ML of effluent is produced of which 29 ML is supplied as irrigation water to the plantation area and 11 ML will be directed to the overflow dam primarily as a result of wet weather conditions (72 % effluent reuse). The average nitrate leached was determined to 1.44 mg/L across all years of data and 0.51 mg/L when excluding the first year of data. The average phosphorus leached was determined to be 0.01 mg/L across all years

of data. The model outputs also show that there are no impacts on crop yield due to salinity. For details of this MEDLI output see MEDLI report in Appendix 6.11

The Planfuture's original MEDLI modelling (with significant inbuilt conservative factors) and the updated 2024 performance assessment indicated irrigation remained sustainable with increased effluent input. Additionally, the current MEDLI model with higher end values also demonstrated sustainable outcomes. As such parameters proposed for effluent irrigation in condition 4M-L1 are comparable to the probable higher end values that may occur within a given year. For example, the most recent MEDLI model output gives an average result based on all 50 years of weather/rainfall data estimating the number of days irrigation would not occur (due to wet weather trigger values being met and delays in irrigation occurring). Outcomes indicates 10.45 days of no irrigation occurring and 97.76 days where a portion of the irrigation would not occur within an average year. If we assume 50% irrigation on portion days that would give about 60 days a year of no irrigation. If we go back to drier conditions in future years this number of days where irrigation cannot occur may reduce significantly. Thus the value of 5.7 ML/ha has been proposed.

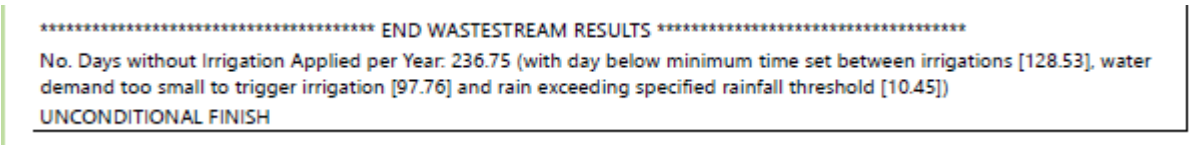


Figure 16 Irrigation days as seen in output from MEDLI Model 01/08/2025

The detailed MEDLI modelling over the long term provides excellent guidance to irrigation practices and provided leaching losses are low, for example NO3-N in soil is < 10mg/L then the reuse scheme is considered sustainable. As such to ensure loading of excess nutrients is not occurring at the plantation Planfuture recommended soil sampling at 6 years (which is late 2025 for the first 4 hectares of plantation and 2028 for the additional 3 hectares) and every 3 years thereafter. As such Urban Utilities is proposing to undertake soil testing later this year at seven (7) sites across the entire plantation with one control site outside of the irrigation area. Urban Utilities is proposing this occurs every three years into the future as per the experts' recommendations (see condition 4M-L7).

If irrigation appears to be having any adverse impacts on the quality of the soil or subsoil then irrigation rates can be varied via the GoldTech software package which is subject to dual control by Urban Utilities and an administrator member of the Planfuture team. Additionally effluent production above the plantation needs will be sent to the effluent storage lagoon (previously referred to as the "farmers dam) which has an enormous capacity of 120ML. Over the last 3 years of operation approximately 10.3 ML/year have been sent to this dam which equates well with the 11ML/year predicted to be released to the dam under the 2025 MEDLI Modelling Scenario.

The risk of adverse impacts to the environmental values of land from irrigation are extremely low and indeed the flourishing plantation represents regeneration of a

small but important area of endangered RE adjacent to Monkey Waterholes Creek and mapped vegetation providing biodiversity benefits including habitat for growing populations of native birds, reptiles and mammals which will only continue to grow as the forest matures and provides enhanced habitat and feeding opportunities (see section 6d of Appendix 6.10).

4. Environmental impact assessment

Environmental aspects, impacts, risk and mitigations

Environmental aspects and impacts for the activity have been detailed in **Error! Reference source not found.**. This includes an assessment of risk and also identified proposed mitigation measures.

4.1. Environmental objectives and treatments

4.1.1. Air management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Air and odour						
The activity will be operated in a way that protects the environmental values of air.	There is no discharge to air of contaminants that may cause an adverse effect on the environment from the operation of the activity.	No historical odour or air issues associated with this plant	If odour or air complaints are received monitoring will be conducted and values compared to air environmental value trigger limits.	Rare	Least significant	Low 1
	Fugitive emissions of contaminants from storage, handling and processing of materials and transporting of materials within the site are prevented or minimised.	Spray drift from irrigation system is minimised	Significant buffer distance to sensitive receptors.	Rare	Least significant	Low 1
	Contingency measures will prevent or minimise adverse effects on the environment due to unplanned emissions and shut down and start up emissions of contaminants to air	Activity will be operated in line with existing procedures and protocols.	Odour loggers can be deployed in the event of a complaint or issue.	Rare	Least significant	Low 1
	Releases of contaminants to the atmosphere for dispersion will be managed to prevent or minimise adverse effects on environmental values	Ecosystem services delivered by plantation include regulation of air quality and amenity.		Rare	Least significant	Low 1

4.1.2. Water management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Water						
The activity will be operated in a way that protects the environmental values of waters.	There is no actual or potential discharge to waters of contaminants that may cause an adverse effect on an environmental value from the operation of the activity.	Discharge to land reduces potential for adverse impacts on the environmental values of water.	Irrigation will occur in line with MEDLI modelling and existing procedures and protocols.	Rare	Least significant	Low 1
	The storage and handling of contaminants will include effective means of secondary containment to prevent or minimise releases to the environment from spillage or leaks;		Hazardous and dangerous materials are stored on site within areas which have secondary containment.	Rare	Minor significance	Low 3
	Contingency measures will prevent or minimise adverse effects on the environment due to unplanned releases or discharges of contaminants to water	Works and activities will be carried out in line with existing procedures and processes to prevent or minimise adverse impacts on the environment due to unplanned releases.	Urban Utilities Environmental Events Emergency Management Sub Plan covers preparedness, response and recovery actions.	Unlikely	Least significant	Low 2
	The activity will be managed so that stormwater contaminated by the activity that may cause an adverse effect on an environmental value will not leave the site without prior treatment	Plantation area is graded to fall and direct any overflow towards treatment plant lagoons and effluent storage dam.		Rare	Least significant	Low 1
	The disturbance of any acid sulfate soil, or potential acid sulfate soil, will be managed to prevent or minimise adverse effects on environmental values	No PASS or ASS are know to occur in the area.		Rare	Least significant	Low 1

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
	Acid producing rock will be managed to ensure that the production and release of acidic waste is prevented or minimised, including impacts during operation and after the environmental authority has been surrendered	Not applicable		Choose a likelihood	Choose a consequence	Choose an item.
	Any discharge to water or a watercourse or wetland will be managed so that there will be no adverse effects due to the altering of existing flow regimes for water or a watercourse or wetland	Helidon RRC does not release to waters therefore no impacts to flow regimes are anticipated.	Irrigation rates are set at sustainable levels as per the MEDLI modelling. Measures are in place to prevent overwatering (including SWD trigger and rainfall cease trigger).	Rare	Least significant	Low 1
	For a petroleum activity, the activity will be managed in a way that is consistent with the coal seam gas water management policy, including the prioritisation hierarchy for managing and using coal seam gas water and the prioritisation hierarchy for managing saline waste			Choose a likelihood	Choose a consequence	Choose an item.
	The activity will be managed so that adverse effects on environmental values are prevented or minimised	Release to land reduces potential for adverse effects on environmental values of water.		Rare	Least significant	Low 1

4.1.3. Wetland management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Wetlands						
The activity will be operated in a way that protects the environmental values of wetlands	There will be no potential or actual adverse effect on a wetland as part of carrying out the activity.	No adverse effects to wetlands are anticipated as a result of this amendment		Rare	Least significant	Low 1
	The activity will be managed in a way that prevents or minimises adverse effects on wetlands	Helidon RRC does not release to waters therefore no impacts to wetlands are anticipated.		Rare	Least significant	Low 1

4.1.4. Groundwater management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Groundwater						
The activity will be operated in a way that protects the environmental values of groundwater and any associated surface ecological systems	There will be no direct or indirect release of contaminants to groundwater from the operation of the activity. There will be no actual or potential adverse effect on groundwater from the operation of the activity.	Vegetation can help support and enhance groundwater environments. Groundwater is predicted to occur at a depth of around 10 metres below the surface.	Irrigation rates are set by MEDLI modelling to prevent deep drainage issues.	Rare	Least significant	Low 1
	The activity will be managed to prevent or minimise adverse effects on groundwater or any associated surface ecological systems.	No adverse effects are anticipated as a result of this amendment.		Rare	Least significant	Low 1

4.1.5. Noise management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Noise						
The activity will be operated in a way that protects the environmental values of the acoustic environment	Sound from the activity is not audible at a sensitive receptor	No sound from the activity is likely to be audible at any sensitive receptor.		Rare	Least significant	Low 1
	The release of sound to the environment from the activity is managed so that adverse effects on environmental values, including health and wellbeing and sensitive ecosystems, are prevented or minimised.	No adverse effects to the acoustic environment have been previously noted or are anticipated at this site.		Rare	Least significant	Low 1

4.1.6. Waste management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Waste						
Any waste generated, transported, or received as part of carrying out the activity is managed in a way that protects all environmental values.	Waste generated, transported or received is managed in accordance with the waste and resource management hierarchy under the Waste Reduction and Recycling Act 2011.		Works and activities will be carried out in line with existing procedures and processes	Rare	Least significant	Low 1
	If waste is disposed of, it is disposed of in a way that prevents or minimises adverse effects on environmental values.		Urban Utilities utilises the Waste Tracking ID system to track the movement of waste products and biosolids	Rare	Least significant	Low 1

4.1.7. Land management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Land						
The activity is operated in a way that protects the environmental values of land, including soils, subsoils, landforms and associated flora and fauna	There is no actual or potential disturbance or adverse effect to the environmental values of land as part of carrying out the activity		Irrigation rates are set at sustainable levels as per the MEDLI modelling.	Unlikely	Minor significance	Low 6
	Activities that disturb land, soils, subsoils, landforms and associated flora and fauna will be managed in a way that prevents or minimises adverse effects on the environmental values of land	Reestablishment of regional ecosystem flora augments environmental values.		Rare	Least significant	Low 1
	Areas disturbed will be rehabilitated or restored to achieve sites— (i) that are safe and stable; and (ii) where no environmental harm is being caused by anything on or in the land; and (iii) that are able to sustain an appropriate land use after rehabilitation or restoration.	Reestablishment of regional ecosystem flora rehabilitates the land that had been previously cleared and degraded from farming.		Rare	Least significant	Low 1
	The activity will be managed to prevent or minimise adverse effects on the environmental values of land due to unplanned releases or discharges, including spills and leaks of contaminants;	Works and activities will be carried out in line with existing procedures and processes to prevent or minimise adverse impacts on the environment due to unplanned releases.	Plantation area is graded to fall back to treatment plant lagoons.	Rare	Least significant	Low 1

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
	The application of water or waste to the land is sustainable and is managed to prevent or minimise adverse effects on the composition or structure of soils and subsoils	Multiple MEDLI models have been run to ensure irrigation is sustainable and minimises adverse effects on soils and subsoils.	Periodic soil testing will be undertaken to ensure no adverse impacts on soils and subsoils.	Unlikely	Minor significance	Low 6

5. Environmental Authority Conditions

The conditions proposed below are separated into General and site specific conditions. The General conditions are largely derived from those that have been proposed and discussed in the ongoing Amendment by Agreement Process (Streamlining) that Urban Utilities has been going through with the Department. The site-specific conditions have been derived from similar land conditions which have been applied to RRC sites within our current Environmental Authority which utilise irrigation to land. In addition consideration was given to a relatively recent (2024) Environmental Authority that the Department granted to Adani for an ERA63 1 (b-i) and an older Environmental Authority from Logan City Council for it's now decommissioned Sewage Treatment Plant at Flagstone which irrigated to land and thus had relevant conditions.

Table 5-1 Proposed changes to standard conditions or existing conditions

New condition	Proposed wording	Justification
	Agency Interest: General	
G1	All reasonable and practicable **measures** must be taken to prevent or minimise environmental harm caused, or likely to be caused by the activities.	As per streamlining
G2	**Contravention of conditions** Unless specifically authorised by a condition of this environmental authority, details of any contravention of a condition of this environmental authority must: a) be reported to the administering authority within 24 hours of becoming aware of the contravention; and include the nature and circumstances of the contravention and any immediate actions taken.	As per streamlining noting this is a new requirement for Helidon
G3	Any monitoring result that indicates an exceedance of or non-compliance with any approval limit must be reported to the administering authority within 20 business days of completion of analysis.	As per streamlining
G4	**Environmental risk management procedures** Written procedures must be developed and implemented by an appropriately qualified person that ensure: a) all potential risks to the environment from the carrying out of the activity are identified and assessed, including: (i) during routine operations; and (ii) outside routine operations (e.g., maintenance, start up and shut down); and (iii) during preparation, rehabilitation, and closure; and (iv) in an emergency (e.g., fire, flood or other natural disaster); and b) for each potential risk identified, any necessary measures to prevent or minimise the potential for environmental harm are implemented; and c) staff understand their obligations under this environmental authority and the Environmental Protection Act 1994; and d) environmental risk management procedures are continually reviewed and improved, based on a reasonable risk-management approach.	As per streamlining noting this is a new requirement for Helidon
G5	**Plant and equipment** An **appropriately qualified person** must install, operate, calibrate, and maintain the plant and equipment required to carry out the activity (including monitoring devices) in a proper and effective manner.	As per streamlining
G6	Records of installation, calibration and maintenance carried out under condition G6 must be kept.	As per streamlining and replaces multiple outdated conditions regarding reporting for Helidon
G7	**Record keeping**	As per streamlining and replaces multiple outdated conditions regarding reporting for Helidon

	Unless otherwise specified by a condition of this environmental authority, records must be: a) kept for the period outlined in *Table 1 – Record keeping requirements*; and b) provided to the administering authority upon request and in the format requested. **Table 1 – Record keeping requirements** Description of records: Retention requirement Monitoring results: Retain for 15 years All other records: Retain for 5 years	
G8	Chemicals and fuels in containers of greater than 15 litres must be stored within a **secondary containment system**.	As per streamlining
G9	**Monitoring and sampling** All monitoring and sampling required by the conditions of this environmental authority must be carried out, interpreted, and recorded by an **appropriately qualified person** in the manner specified by this environmental authority, and in accordance with the methods prescribed in the latest edition of the **administering authority**'s Monitoring and Sampling Manual (available of the Queensland Government website).	As per streamlining
G10	Unless otherwise authorised in writing by the **administering authority**, all laboratory analyses required under this environmental authority must be carried out by a laboratory that has National Association of Testing Authorities (NATA) accreditation for such analyses. The only exception to this condition is for *in situ* **monitoring** of pH, ammonia, dissolved oxygen, electrical conductivity, temperature, turbidity, free and total chlorine.	As per streamlining
G11	An Annual Monitoring Report for each of the locations identified in this environmental authority must be prepared and submitted to the **administering authority** by 30 November each year, for the preceding financial year.	As per streamlining
G12	**Complaints** The following details must be recorded for all complaints received and provided to the administering authority upon request: a. date and time the complaint was received; and b. if authorised by the person making the complaint, their name and contact details; and c. nature and details of the complaint. d. how the complaint was resolved	As per streamlining proposed by Urban Utilities
G13	When required by the administering authority, monitoring must be undertaken in the manner informed by an appropriately qualified person and within a reasonable timeframe agreed to in writing with the administering authority, to investigate any alleged environmental nuisance or environmental harm caused by the activity.	As per streamlining as counter proposed for version 2 noting this is a new requirement for Helidon

	Agency Interest: Air	
A1	Odours or airborne contaminants from the **activity** must not cause environmental nuisance to any sensitive place or commercial place.	As per streamlining
	Agency Interest: Noise	
N1	Noise generated by the **activity** must not cause environmental nuisance to any sensitive place or commercial place.	As per streamlining
	Agency Interest: Water	
WT1	Other than as permitted by this environmental authority, contaminants from the **activity** must not be released to any **waters**.	As per streamlining
	Agency Interest: Waste	
W1	All waste generated by the activity must be lawfully reused or recycled, or removed to a facility that can lawfully accept the waste.	As per streamlining
	Agency Interest: Land	
L1	Other than as permitted within this environmental authority, contaminants must not be released to **land**.	As per streamlining
4M	**HELIDON STP**	Note that 4M was allocated as per alphabetical order of STP sites as proposed in streamlining but may not suit this configuration
	ERA 63 Sewage Treatment (1) (b) (i) operating sewage treatment works with a total daily peak design capacity of more than 100 but not more than 1500EP if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme	Downgrading of threshold for site as discharge is through an irrigation scheme and not to waters.
	Agency Interest: Water	
4M-WT1	Effluent may be removed from the site and provided to a person with the written consent of that person.	Use of recycled water for irrigation of tree plantation is in line with EPPWWB management hierarchy higher preference for an activity that may affect water. Note this was to be considered for inclusion as a general condition applied to all sites for streamlining.
4M-WT2	Records of treated effluent removed from the site and supplied to a person must be made and kept.	
	Agency Interest: Land	
4M- L1	The only contaminants permitted to be released to land is treated sewage effluent in accordance with *Table 2 – Contaminant Release Limits to Land and associated requirements.*	
4M-L2	The release of contaminants to land is permitted within Lot 1 RP900696, Lot 1 RP135445 & Lot 33 CH31423	Re-establishment of Remnant Vegetation has significant positive externalities especially biodiversity benefits.
4M-L3	Treated sewage effluent may be released to land within the boundaries of the site for	

Table 2 – Contaminant Release Limits to Land and associated requirements.

Quality characteristics (units)	Minimum	Median	Maximum	Frequency
Volume sewage treated (ML/hectare)		5.3		Yearly
Total Nitrogen (mg/L as N)		45		Monthly
Total Phosphorus (mg/L as P)		15		Monthly
pH	6.5		9.0	Weekly
E.coli (cfu/100ml)			1000	Monthly
Electrical conductivity (µS/cm)		1600		Weekly
Free Chlorine (mg/L)			0.7	Weekly

Quality characteristic	Justification
Volume	Based on sustainable irrigation as per MEDLI model with inbuilt conservative factors (4.6 ML/ha) plus provision for dry weather year with minimal probable irrigation delay due to wet weather (increase of 16.2%).
TN	Based on most recent MEDLI
TP	Based on most recent MEDLI
pH	6,5 (current) 9.0 consistent with lagoon treatment as per Laidley RRC (see WT3C1 of EPPR000521513)
E.coli	Class C as appropriate for forestry
EC	Based on other non UU EAs
Free Chlorine	Current license limit

	the use of any of the following: a) service water; or b) watering of constructed wetlands and landscaped areas; or c) research and development projects	
4M-L4	Treated effluent releases to land must be done in accordance with documentation that ensures: a) drainage to groundwater and subsurface flows of contaminants to surface waters are prevented; and b) surface pondage and run-off of effluent is prevented; and c) degradation of soil structure is minimised; and d) soil sodicity and the build-up of nutrients and heavy metals in the soil and subsoil are minimised; and e) spray drift or overspray does not carry beyond effluent disposal areas; and f) effluent irrigation areas are maintained with an appropriate crop in a viable state for transpiration and nutrient uptake; and g) sufficient buffer zones are maintained between irrigation sites and sensitive environmental receptors.	
4M-L5	When weather conditions or soil conditions preclude the release of treated sewage effluent to **land**, effluent must not be irrigated to **land**.	
4M-L7	A soil monitoring program must be implemented by appropriately qualified persons to monitor the effects of the activity on land. This monitoring should be undertaken prior to 31 December 2025 and include the taking of top-soil and sub-soil samples from at least 7 representative sites within the plantation and one as a reference site outside of irrigation area for the quality characteristics and at the frequency specified in *Table 3 – Quality characteristics for soil monitoring*	Parameters taken from condition M3Q6 for Toogoolawah RRC in EPPR000521513

Table 3 – Quality characteristics for soil monitoring

Quality characteristics	Units	Monitoring frequency
pH	pH scale	Every 3 years
Exchangeable Sodium Percentage (ESP)	% Na	Every 3 years
Exchangeable Cations	meq/100g	Every 3 years
Total Cations	mg/kg	Every 3 years
Specific Conductance or electrical conductivity	µS/cm	Every 3 years
Total Nitrogen	mg/kg	Every 3 years
Phosphorus (extractable)	mg/kg	Every 3 years
Potassium (exchangeable)	mg/kg	Every 3 years
Total Calcium (exchangeable)	mg/kg	Every 3 years
Total Chloride	mg/kg	Every 3 years
Total Magnesium (exchangeable)	mg/kg	Every 3 years
Total Sodium (exchangeable)	mg/kg	Every 3 years

6. Appendices

6.1. Lockyer Valley Regional Council written advice re MCU requirement

Please note: Printed copies of this document should be verified for currency against online version.

From: Tammee Van Bael
To: Monique Gastaldin
Cc: Tamara Bauld; Environment
Subject: Qdox: RE: Request for Written Advice - Operation of the Helidon Sewage Treatment Plant - Back Flagstone Road Helidon
Date: Wednesday, 21 May 2025 9:13:20 AM
Attachments: image007.png
image009.png
image010.png
image011.png
image012.png
image013.png
image014.png
image015.png
image016.png
image017.jpg
image018.png
image019.gif
image002.png

This Message Is From an External Sender
This message came from outside Urban Utilities.

Report Suspicious

Hi Monique,

Based on the information provided, it is our understanding that the inclusion of the additional lots in the ERA is to reflect existing operations i.e. no changes to operations. This does not constitute a Material change of use and therefore approval is not required under the *Lockyer Valley Planning Scheme*.

Thanks

Tammee Van Bael | Planning Officer
Planning, Policy & Community Wellbeing
Community & Regional Prosperity

P 07 5462 0382
E tvanbael@lvrc.qld.gov.au

Lockyer Valley Regional Council | 26 Railway Street (PO Box 82) Gatton Qld 4343
1300 00 5872 (LVRC) www.lockyervalley.qld.gov.au

I acknowledge the Traditional Custodians of the region, the Yuggera - Ugarapul people and pay my respects to their Elders, past and present, and the Aboriginal and Torres Strait Islander Elders of other communities who may live here.
Lockyer Valley Regional Council is committed to cultivating inclusive environments for all staff, customers, residents and visitors.

From: Monique Gastaldin <Monique.Gastaldin@urbanutilities.com.au>
Sent: Tuesday, 13 May 2025 4:44 PM
To: LVRC General <general@lvrc.qld.gov.au>
Cc: Tamara Bauld <Tamara.Bauld@urbanutilities.com.au>; Environment <Environment@urbanutilities.com.au>
Subject: Development query for Helidon Sewage Treatment Plant

Good afternoon,

I am seeking written advice from Lockyer Valley Regional Council to confirm the category of assessment associated with the operation of the existing Helidon sewage treatment plant located on Back Flagstone Road Helidon.

The Helidon sewage treatment plant was constructed and operated by Lockyer Valley Regional Council (LVRC) up until 01/07/2010 when it was handed over for management to (the then named) Queensland Urban Utilities who became the registered operator for the site from that point. The

infrastructure associated with the treatment activities was confined to one land parcel (now Lot100 RP900696) and apart from some minor changes and improvements to the process operations on site, including the addition of a reed bed and a small pilot trial algae raceway, operational works have had no significant changes since its operation by LVRC. Indeed conditions associated with the Environmental Authority that was granted to the Council of the Shire of Gatton in 1996 (License No: 5080000032) have remained virtually unchanged in the current Environment Authority for the site. A condition within the original Environmental Authority 20.(C3), which is also a current condition of the existing EA, details the Release Point W1 location as an outfall pipe located in waters described as "the adjacent 120 ML farm dam". This dam was located on a land parcel (now Lot 3 RP900696) which was originally owned by a local farmer but was sold to Queensland Urban Utilities in 2017. The release location for the plant remains exactly the same but as the ownership of the land has changed to the registered operator of the Environmentally Relevant Activity (ERA) the Department of Environment, Tourism, Science and Innovation (DETSI) has advised that additional land parcels associated with the sewage treatment activities should be added as location of the ERA. As such Urban Utilities will be submitting an amendment application to DETSI to add additional land parcels.

Currently only Lot100 RP900696 is zoned for community use and all the rest of the land parcels owned by Urban Utilities (see below) are zoned as rural.

- 100RP900696 (Freehold)
- 3RP900696 (Freehold)
- 1RP135445 (Freehold)
- 33CH31423 (Freehold)
- 17CH31501 (Freehold)
- 1SP314208 (Freehold)

Picture 16, Picture

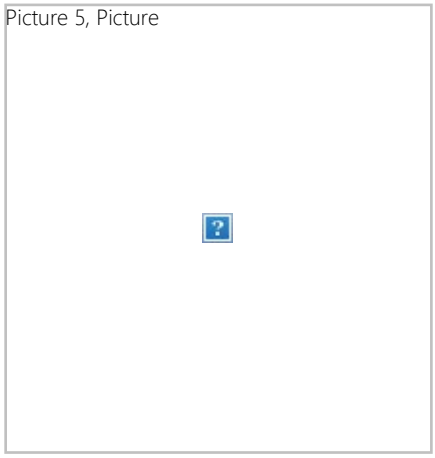
No new works are proposed on the additional lots. The only changes that have occurred to the additional land parcels is the planting and irrigation of trees (reforestation for biodiversity and koala corridor) on parts of Lot1 RP135445 and Lot33 CH31423 which is commensurate with rural use of the land and thus is exempt. And no change has been made to the original release location within the farm dam.

Based on previous advice received from LVRC for the Gatton Planning Scheme (see attached document email trail) the best fit land use definition for an STP is a “local utility” (definition below) as the function of the STP forms a critical part of the conveyance of the sewerage network.



As there are no new works proposed and just a continuation of existing use I believe the planning requirements would not constitute an MCU.
Additionally no overlays affect this category of assessment for a local utility at the site. Flood and biodiversity overlays can be seen below.
The Helidon site is mainly located outside of flood zones, however there are areas listed as “flood investigation” (indicated by hatch in below figure) around Monkey Water Holes Creek to the north of the site. Flood risk would generally be considered as low for this site.

Picture 5, Picture



Biodiversity overlay is as per below which provides context to the decision to replant area of the abovementioned two lots in order to enhance this corridor for the future.



Urban Utilities is aware that the new Lockyer Valley Planning Scheme was introduced in 2024 which replaced the Gatton Planning Scheme and the Laidley Planning Scheme however as the Helidon sewage treatment plant and its works were pre-existing and operation has continued largely unaltered since operations began and no significant building works have been undertaken the old planning scheme is applicable.

Therefore we are seeking written confirmation from LVRC that our interpretation of the planning requirements are correct and that an MCU is not required for the additional lots.

If you have any further questions or wish to discuss this matter further please do not hesitate to contact me.

Kind Regards

Monique Gastaldin
Environmental Specialist
Risk and Resilience

| **M:** 0477961896
E: Monique.Gastaldin@urbanutilities.com.au

www.urbanutilities.com.au



email-sig_82e3359e-c8c9-4fa8-8c26-36d2d7404244.gif

Urban Utilities acknowledges the Traditional Custodians of the land on which we connect, share, and learn and we pay respects to Elders past and present as we work towards a more reconciled Australia.

6.2. Email to DETSI with archived documents referred to in EPPR000521513 re Helidon RRC

Please note: Printed copies of this document should be verified for currency against online version.

From:	Monique Gastaldin
To:	Elise Halliday; Kristen Corkill; Rebecca.Griffiths@des.qld.gov.au
Cc:	Tamara Bauld
Subject:	Qdox: Documents referred to in EPPR000521513 in relation to Helidon RRC
Date:	Wednesday, 7 May 2025 5:17:00 PM
Attachments:	image001.png image002.gif image003.png image004.png image005.png D 25 379525 5080000032 - Gatton Shire Council - Helidon STP - NoD & DA - 16-03-1996.pdf D 25 379524 FAX - Draft Schedule of Conditions - Helidon STP - 23-02-1996.pdf D 25 379523 Letter - Additional Information Provided - 18-11-1995.pdf D 25 379514 Notice to Provide Addition Information - 09-11-1995.pdf

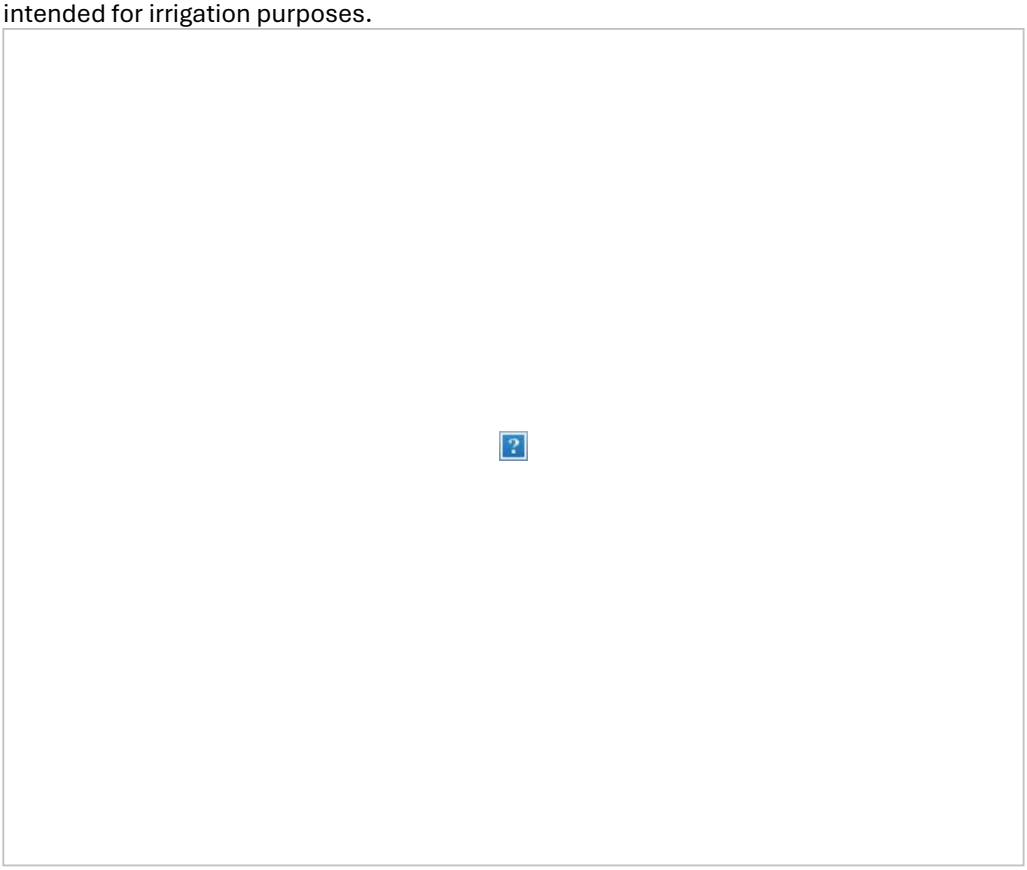
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Good afternoon,

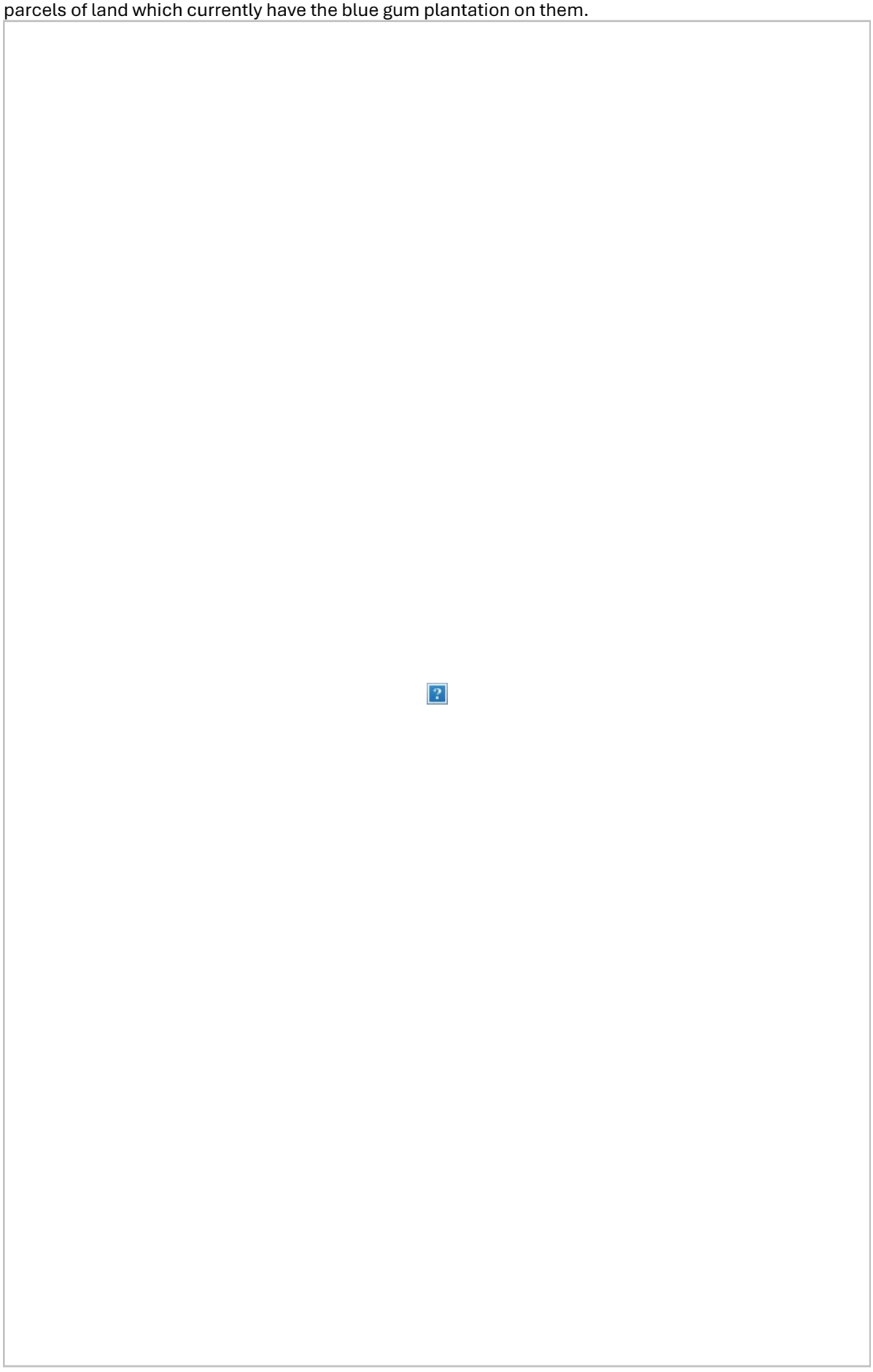
After our recent discussions regarding conditions contained within the Environmental Authority which Urban Utilities holds for its Resource Recovery Centres (also known as STPs) we sought further clarification to support our understanding of the conditions for the Helidon RRC which appear to have been largely retained in our current license from the conditions imposed in 1999. In particular Urban Utilities requested of the Department a records search for documents referred to in Attachment E of EPPR000521513 specifically documents 1,4,6,7 and 8 in order to gain some context on the intent of some of the conditions. One of the Department's Compliance Support Officers were able to locate in the archives some of the relevant documents which I have attached for your reference and record keeping to this email (Please note that the application document will be sent in a subsequent email as the file is too large).

Although the complete records are attached I would like to draw your attention to some specific excerpts of these documents which will be relevant to our discussions in Friday's meeting.

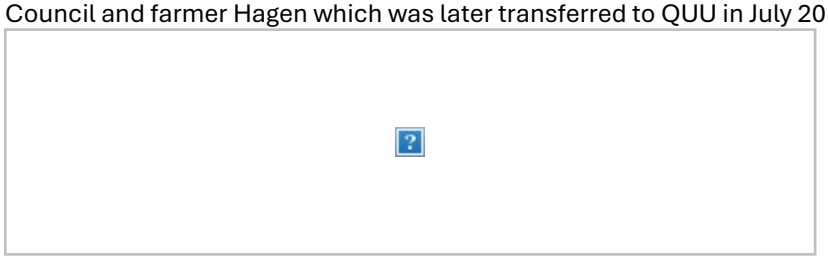
The application document dated 1995 (authored by GHD) clearly outlines that the treated effluent was intended for irrigation purposes.



There is also a map showing the 120ML farm dam and land marked for irrigation (which are the same parcels of land which currently have the blue gum plantation on them.



You will also note that the conditions of 1995 (which align with our current conditions) do not have a category of conditions related to land. Which is the likely reason that that no conditions related to application of effluent to land were included in the 1995 version.
In addition land disposal on the farm was mandatory pursuant to the 1996 deed between Gatton Shire Council and farmer Hagen which was later transferred to QUU in July 2010 (and expired in 2016).



When the farmer put the land up for sale Urban Utilities purchased the land and begun planning for ways to reasonably reduce and prevent sewage generation from the community and evaluate treatment and recycling options.
Appropriate treatment and release to land is higher up the management hierarchy for an activity that may affect water outlined in the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (section 14). Therefore irrigation to land should be the preference over release to waters. The current conditions of the Helidon site include quality characteristics for release to waters for the permitted Release Point (W1) which is the farm dam.

Urban Utilities has recently received (7th April 2025) a formal warning letter from the Department for a contravention of a condition of the environmental authority for the use of treated effluent for irrigation activities which is said to be in contravention of A3J1 of our EA. This seems to be a modern interpretation of outdated condition wording when the evidence obtained from the Department archives clearly indicates that the intention for the site was always to use the treated effluent for irrigation purposes.
Therefore, we feel that the inclusion of modern model conditions to allow for effluent irrigation on site at Helidon should be considered for inclusion in the current amendment by agreement process.

We look forward to our meeting on Friday.

Kind Regards
Monique Gastaldin
Environmental Specialist
Risk and Resilience

| **M:** 0477961896
E: Monique.Gastaldin@urbanutilities.com.au

www.urbanutilities.com.au





Urban Utilities acknowledges the Traditional Custodians of the land on

which we connect, share, and learn and we pay respects to Elders past and present as we work towards a more reconciled Australia.

6.3. Flood Information Reports

Please note: Printed copies of this document should be verified for currency against online version.

LOCKYER VALLEY Flood Information Report

Back Flagstone Road, IREDALE

Report ID: FIP2025/10155
Property: 3RP900696
Date of report: May 14, 2025

This report provides property specific flood level information relevant for development and building work on the identified land and supports the flood requirements of the Lockyer Valley Temporary Local Planning Instrument 2024 Flood Regulation (TLPI). The TLPI is relevant to building and development in areas subject to flooding and should be considered when planning new buildings and developments.
For further information regarding all building and development requirements in flood hazard areas, please refer to the Lockyer Valley Planning Scheme 2024 on Council's ePlan page:
Home - Lockyer Valley Planning Scheme (lvrc.qld.gov.au)



Nearmap – Feb 2024

Planning Trigger	*The property is affected by the Flood hazard overlay as identified in the TLPI.*
Defined Flood Event (DFE)	*The property is not affected by the Defined Flood Event (DFE).*
Flood Investigation Area	*The property is not subject to the Flood Investigation Area.*
Overland flow path	The property is subject to an overland flow path/s[5,14]
Available Flood Data	There is currently no Defined Flood Level (DFL) flood data available within the automatic flood request system for the land. Indicative flood extents are shown overpage. Refer to notes 1, 7, 17 and 9 for guidance.

TLPI Map - Key	
	Mapped High hazard
	Mapped Medium hazard
	Mapped Low hazard
	Flood Investigation Area
	Overland flow path
Selected Point Notes	
A	
B	
C	
D	



TLPI Map – Imagery State of Queensland 2020

Council provides this information as a general reference source only and has taken all reasonable measures to ensure that the material in this report is as accurate as possible at the time of publication. However, the Council makes no representation and gives no warranty about the accuracy, reliability, completeness or suitability of the information for any particular purpose. To the full extent that it is able to do so by law, Council disclaims all liability (including liability in negligence) for the losses or damages (including indirect and consequential loss and damage) caused by or arising from anyone using or relying on the information for any purpose whatsoever. This information can change over time as Council's flood information is periodically updated.

No-Data Mapping

Ground Level[6] **RL** (m) AHD



Subject Property – Imagery State of Queensland 2020

Map Key

Indicative flooding	
Dams	
Undetermined areas	



Indicative extent of flood mapping– contour

There is currently no flood data available within this automatic flood information request system for this parcel. Indicative extent of the flood mapping for the land is shown in the figure above. Refer to Notes 8 and 9 for guidance.

As more information is made available, the system will be updated periodically. Please enquire with Council to determine if further information is available.[10]



Development notes:

1. The flood information in this report:
   a) is limited to that held by Council at the specified date and is not necessarily all the information required to obtain approval for building works or any other development;
   b) depending on the proposed use, may need to be assessed by an experienced and suitably qualified Registered Professional Engineer of Queensland (RPEQ);
   c) does not represent consent by Council for any development. An application to Council for a development approval may be required. Refer to Council's ePlan and Planning Scheme.
2. The ***Temporary Local Planning Instrument 2024 (Flood Regulation)* (TLPI)** specifies the required development response at locations within the ***flood hazard overlay***. Not all areas affected by flooding are captured in the mapping. Mapping may need to be established for a proposed use to satisfy the **TLPI** requirements. See notes 10, 12 and 13.
3. The ***flood hazard overlay*** map***:***
   a) is based on the Lockyer Creek Flood Study and Flood Risk Management Study – Interim Report, June 2012;
   b) is generally the 2012 mapped regional flooding. This event is typically greater than 6 hours, i.e. not local flooding;
   c) does not necessarily capture the effects of local flooding. The local flooding flood hazard may be site specific and may need to be assessed separately by an RPEQ in accordance with the TLPI.
4. The information supplied is limited to the requested locations selected on the land. There may be flood parameters of higher or lower value on the land. Flood parameters that can be provided within mapped flood areas include flood height, flood depth, flood velocity, flood intensity (product of velocity x depth) and hazard vulnerability.
5. Overland flow paths (OLFP) shown in the TLPI maps are generated using an automated process using a digital terrain model 14. Depending on the proposed development, the OLFP may need to be confirmed with Council.

Flood information notes:

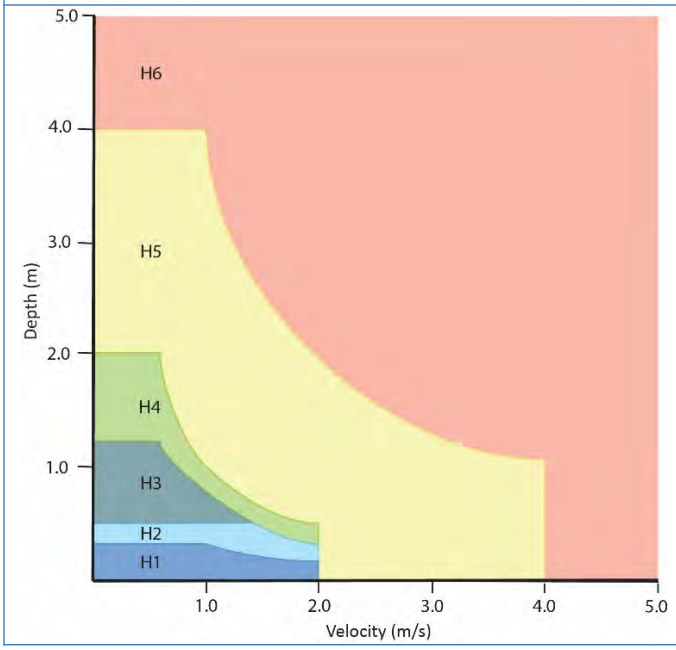
6. For any proposed building:
   a) The ***finished floor level (FFL)*** is the ***defined flood level (DFL)*** plus freeboard.
   b) The given ground levels and nominated flood level/s and depth/s should be verified on site and the maximum outcome used to set the DFL.
7. The flood level nominated for a location is based on flood modelling, ground flood survey and remote survey assessment techniques.
8. The contours and ground levels in the report are based on the remote survey assessment techniques and data available to Council in 2019. The contour and ground levels were accurate at the time of capture. The levels may change over time and with land modification.
9. Photographs used are the latest that can be supplied under license arrangements.
10. Flood mapping extents are generally based on available flood modelling available up to 2021. The information is sometimes updated, so there may be new information available on request from Council.
11. Further or more detailed advice, such as impacts of the 2011 or 2013 flood events, may be requested from Council using a flood information search.
12. In the event flood affected areas of the land are only partially mapped or unmapped, it may be subject to other types of flooding such as local flooding. Further investigations may be required to determine the extent of local flooding.
13. A risk assessment is required to be undertaken by a suitably qualified RPEQ to consider and manage the effect of flooding if:
   a) flood information is required for a critical decision involving public risk, damage to property; or
   b) if there is insufficient flood information to establish the flood depth, velocity and risk for a proposed use.
14. The risk assessment must consider and manage the effect of the water flows arriving on the site at the nominated location to avoid impacts on the proposed use, structure/s or dwelling house. This includes the ***undetermined areas*** nominated in the ***Flood Information Portal (FIP)***. Redirection of water to adjoining properties may result in an actionable nuisance.
15. Other risk factors may need to be considered alongside the flood information, including the frequency of



flooding, risk of isolation, risk to road access, risk to life and risk to property.

Flood advice – interpretation and use:

16. Flood parameters that can be provided within mapped flood areas include flood height, flood depth, flood velocity, flood intensity (product of velocity x depth) and hazard vulnerability.
17. Due to mapping limitations the actual extent of a flood may be beyond that mapped. Interpretation may be required to ascertain applicable levels and operation of flows relating to a chosen point. In this case, use the ***FIP*** tool to understand the depth on the land from adjacent mapping. The ***FIP*** tool also allows a user to select points outside the property boundary when the edge of the closest flood extent is also outside the property boundary.
18. The mapped ***OLFP*** is an indicative centre line. Due to mapping limitations, the line may not be centred on the physical flow path. In some cases, the ***OLFP*** may affect the subject land but may not be physically located on the lot, e.g. on wide floodplains containing small flow channels. In these cases, refer to topographic mapping and/or consult with Council officers. The establishment of a ***TLPI*** trigger will be based on available flood modelling or, in its absence, the actual channel and floodplain configuration (refer to topographic mapping) and flood operations at the point of interest. Development should be located at least 10 metres from the defining bank of an ***OLFP***. (See P10 and AO10.1 – 10.5 of the ***TLPI***).
19. The mapped ***indicative flooding extent*** is a guide only and is based on an automated process and a number of assumptions.
20. The ***dams mapping*** is for information purposes only. This information is general in nature and may not reflect the existing conditions. Property owners with dams have obligations under the *Water Supply (Safety and Reliability) Act 2008*. Refer to the State government's *Small Dam Safety* information.
21. In the event that the ***TLPI*** is not triggered for a proposed use, i.e. a planning application is not required, the ***National Construction Code*** 'deemed to satisfy' solutions may not be sufficient to manage the surface water management requirements for a structure. The appropriate design response depends on the nature of the proposed use, the surface water source/s and typography.

Hazard vulnerability	**Hazard Vulnerability Classification**	
	H6	Unsafe for vehicles and people. All building types consider vulnerable to failure.
	H5	Unsafe for vehicles and people. Buildings require special engineering design and construction
	H4	Unsafe for vehicles and people
	H3	Unsafe for vehicles, children and the elderly
	H2	Unsafe for small vehicles
	H1	Generally safe for vehicles, people and buildings. Relatively benign flood conditions. No vulnerability constraints



Definitions:

AHD or Australian Height Datum - official national vertical datum for Australia used to control vertical mapping.

annual exceedance probability (AEP) the chance of a mapped flood design event occurring or being exceeded in any one year, expressed as a percentage.

defined flood level (DFL) the level to which it is reasonably expected flood waters may rise (see section 8(5) of the *Building Regulation 2021* and the TLPI).

defined flood event (DFE) - a flood event that would result in the extent of flooding shown on the Flood hazard overlay maps in the TLPI.

design event mapping is created from flood model outputs for a particular AEP flood design event. This means that it is a representation of a design event for the mapped locations. There may be no mapping for a locality for this event on this map. The absence of mapping in a locality does not mean that the locality was not affected in this event.

finished floor level (FFL) (or habitable floor level where relevant to a dwelling and/or a habitable room) means the defined flood level plus freeboard (500mm for a dwelling).

Flood Hazard category mapping - based on a "hazard to children" criterion using a combination of the defined flood event, water depth, water velocity (or speed) and velocity-depth.

flood hazard overlay - the area identified on the Flood hazard overlay maps in the TLPI as being a defined flood event, investigation area or overland flow path.

flood investigation area - the area on the Flood hazard overlay maps identified as investigation area. Land within the flood investigation area is known to be, or has the potential to be, affected by a defined flood event, but due to the limits in the modelling process has not yet been quantified. During a defined flood event, land in this area may be exposed to a level of flood risk, although the level of risk has not been determined.

Hazard Vulnerability Classification is the hazard assessment framework from the Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR 2017) Guideline 7-3, Figure 6.

high flood hazard area means the area on the Flood hazard overlay maps identified as high hazard. Development of land in this area may pose unacceptable risks to life and property during a defined flood event. Generally, in this area during a defined flood event:

a) major to extreme risk to life is likely;
b) able bodied adults cannot walk safely; and
c) light frame buildings can structurally fail.

historical event mapping is created as part of the flood model calibration process. This means that it is a representation of flood operations for an actual event for the mapped locations. There may be no mapping for a locality for an event on this map. The absence of mapping in a locality does not mean that the locality was not affected in this event.

low flood hazard area means the area on the Flood hazard overlay maps identified as low hazard. Development of this land, after application of relevant mitigation actions, is not considered to pose any significant risk to life or property during a defined flood event. Generally, in this area during a defined flood event:

a) there is no significant risk to life; and
b) property is only at risk when exposed and in direct contact with flood waters.

medium flood hazard area means the area on the Flood hazard overlay maps identified as medium hazard. Development of land in this area may pose a risk to life and property during a defined flood event. Generally, in this area during a defined flood event:

a) able bodied adults may not be able to walk safely;
b) cars can float and precautions must be taken; and
c) only large vehicles (trucks) may be able to travel safely.

overland flow path means an area on the Flood hazard overlay maps identified as overland flow path.

local or flash flooding means flooding occurring within about six hours of rain, usually the result of intense local rain and characterised by rapid rises in water levels.

regional or creek flooding is when existing water in creeks combined with intense rain over the creek catchment and local run-off from houses and streets results in extensive creek flooding over the flood plain. This type of event is a longer-term event than local flooding and may last for many hours or days.

State Planning Policy (SPP) seeks to protect and deliver State interests. Where there is an inconsistency between the SPP and a Local government planning instrument, the SPP applies instead of the local planning instrument.

Temporary Local Planning Instrument (TLPI) is a local planning instrument that amends the Lockyer Valley Planning Scheme and regulates development in the **flood hazard overlay**. Where there is an inconsistency between the TLPI and SPP, the SPP applies.

Undetermined areas are nominated localities on the FIP engineering mapping that Council has become aware of that may need further investigation to ascertain flood impacts.

LOCKYER VALLEY Flood Information Report

Back Flagstone Road, IREDALE

Report ID: FIP2025/10157
Property: 33CH31423
Date of report: May 14, 2025

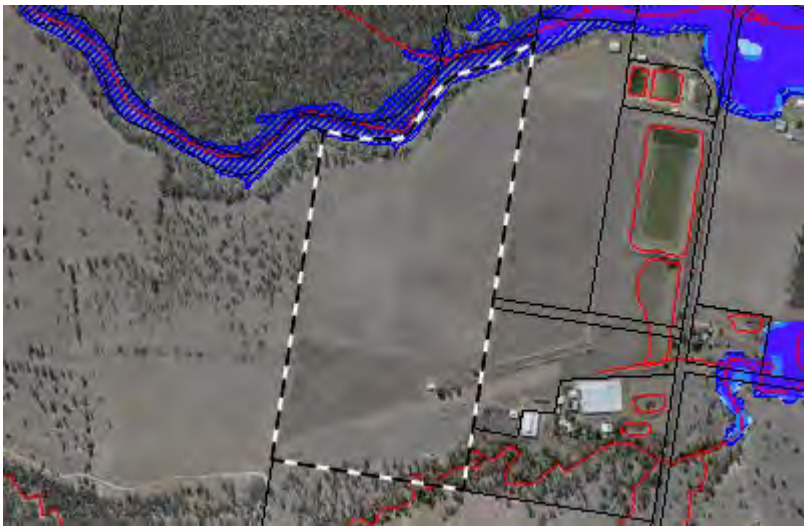
This report provides property specific flood level information relevant for development and building work on the identified land and supports the flood requirements of the Lockyer Valley Temporary Local Planning Instrument 2024 Flood Regulation (TLPI). The TLPI is relevant to building and development in areas subject to flooding and should be considered when planning new buildings and developments.
For further information regarding all building and development requirements in flood hazard areas, please refer to the Lockyer Valley Planning Scheme 2024 on Council's ePlan page:
Home - Lockyer Valley Planning Scheme (lvrc.qld.gov.au)



Nearmap – Feb 2024

Planning Trigger	*The property is affected by the Flood hazard overlay as identified in the TLPI.*
Defined Flood Event (DFE)	*The property is not affected by the Defined Flood Event (DFE).*
Flood Investigation Area	*The property is subject to the Flood Investigation Area.*
Overland flow path	The property is subject to an overland flow path/s[5,14]
Available Flood Data	Based on currently available data and the selected location/s on the land, Defined Flood Level (DFL) flood parameters on the land are shown overpage. To establish a Finished floor level (FFL) refer to notes 6 and 17 for guidance.

TLPI Map - Key	
	Mapped High hazard
	Mapped Medium hazard
	Mapped Low hazard
	Flood Investigation Area
	Overland flow path
Selected Point Notes	
A	
B	
C	
D	

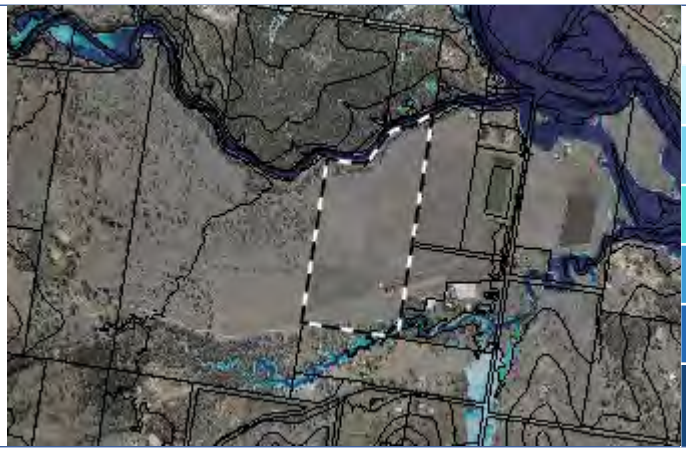


TLPI Map – Imagery State of Queensland 2020

Council provides this information as a general reference source only and has taken all reasonable measures to ensure that the material in this report is as accurate as possible at the time of publication. However, the Council makes no representation and gives no warranty about the accuracy, reliability, completeness or suitability of the information for any particular purpose. To the full extent that it is able to do so by law, Council disclaims all liability (including liability in negligence) for the losses or damages (including indirect and consequential loss and damage) caused by or arising from anyone using or relying on the information for any purpose whatsoever. This information can change over time as Council's flood information is periodically updated.

Flood Event Mapping: DFL

Water Surface Level[13] RL (m) AHD			
A	B	C	D
--	--	--	--
Depth Map (m) AHD			
--	--	--	--
Ground Level[6] RL (m) AHD			
--	--	--	--



Keys
0 – 0.3
0.3 – 0.5
1.5 – 1
1 – 1.2
1.2 – 2
2 – 20

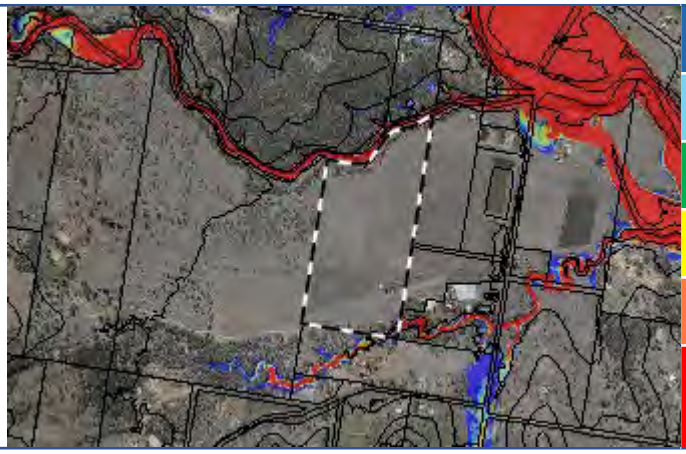
Velocity Map (m/s)[7(e)]			
A	B	C	D
--	--	--	--

Other information - Key	
Indicative flooding	
Dams	
Undetermined areas	



0 – 0.25
0.25 – 0.5
0.5 – 1.0
1.0 – 1.5
1.5 – 2.0
2.0 – 3.0
3.0 – 4.0
4 - 20

Flood Intensity map (m2/s)			
A	B	C	D
--	--	--	--



0 – 0.2
0.2 – 0.4
0.4 – 0.6
0 .6 – 0.8
0.8 – 1.2
1.2 - 20

Hazard vulnerability			
A	B	C	D
--	--	--	--

Refer to the definition of Hazard Vulnerability Classification.



6
5
4
3
2
1



Development notes:

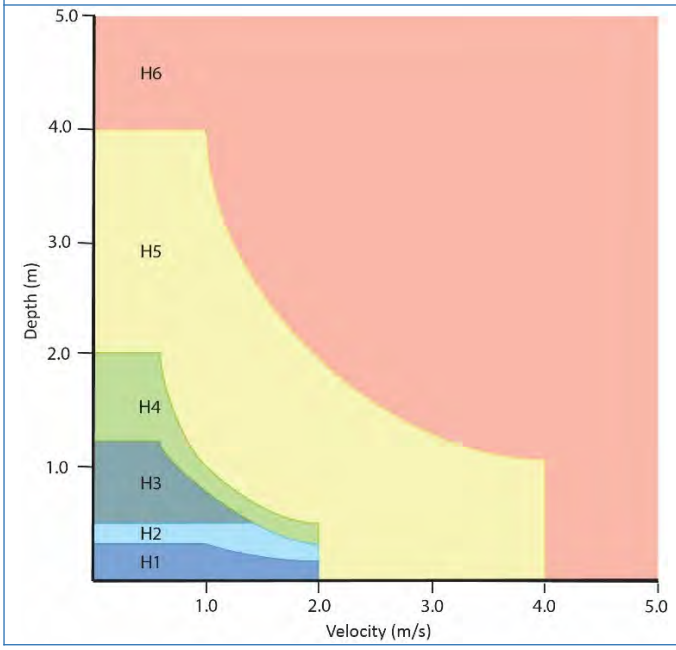
1. The flood information in this report:
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   b) depending on the proposed use, may need to be assessed by an experienced and suitably qualified Registered Professional Engineer of Queensland (RPEQ);
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2. The ***Temporary Local Planning Instrument 2024 (Flood Regulation)* (TLPI)** specifies the required development response at locations within the ***flood hazard overlay***. Not all areas affected by flooding are captured in the mapping. Mapping may need to be established for a proposed use to satisfy the **TLPI** requirements. See notes 10, 12 and 13.
3. The ***flood hazard overlay*** map***:***
   a) is based on the Lockyer Creek Flood Study and Flood Risk Management Study – Interim Report, June 2012;
   b) is generally the 2012 mapped regional flooding. This event is typically greater than 6 hours, i.e. not local flooding;
   c) does not necessarily capture the effects of local flooding. The local flooding flood hazard may be site specific and may need to be assessed separately by an RPEQ in accordance with the TLPI.
4. The information supplied is limited to the requested locations selected on the land. There may be flood parameters of higher or lower value on the land. Flood parameters that can be provided within mapped flood areas include flood height, flood depth, flood velocity, flood intensity (product of velocity x depth) and hazard vulnerability.
5. Overland flow paths (OLFP) shown in the TLPI maps are generated using an automated process using a digital terrain model 14. Depending on the proposed development, the OLFP may need to be confirmed with Council.

Flood information notes:

6. For any proposed building:
   a) The ***finished floor level (FFL)*** is the ***defined flood level (DFL)*** plus freeboard.
   b) The given ground levels and nominated flood level/s and depth/s should be verified on site and the maximum outcome used to set the DFL.
7. The flood level nominated for a location is based on flood modelling, ground flood survey and remote survey assessment techniques.
8. The contours and ground levels in the report are based on the remote survey assessment techniques and data available to Council in 2019. The contour and ground levels were accurate at the time of capture. The levels may change over time and with land modification.
9. Photographs used are the latest that can be supplied under license arrangements.
10. Flood mapping extents are generally based on available flood modelling available up to 2021. The information is sometimes updated, so there may be new information available on request from Council.
11. Further or more detailed advice, such as impacts of the 2011 or 2013 flood events, may be requested from Council using a flood information search.
12. In the event flood affected areas of the land are only partially mapped or unmapped, it may be subject to other types of flooding such as local flooding. Further investigations may be required to determine the extent of local flooding.
13. A risk assessment is required to be undertaken by a suitably qualified RPEQ to consider and manage the effect of flooding if:
    a) flood information is required for a critical decision involving public risk, damage to property; or
    b) if there is insufficient flood information to establish the flood depth, velocity and risk for a proposed use.
14. The risk assessment must consider and manage the effect of the water flows arriving on the site at the nominated location to avoid impacts on the proposed use, structure/s or dwelling house. This includes the ***undetermined areas*** nominated in the ***Flood Information Portal (FIP)***. Redirection of water to adjoining properties may result in an actionable nuisance.
15. Other risk factors may need to be considered alongside the flood information, including the frequency of flooding, risk of isolation, risk to road access, risk to life and risk to property.

Flood advice – interpretation and use:

16. Flood parameters that can be provided within mapped flood areas include flood height, flood depth, flood velocity, flood intensity (product of velocity x depth) and hazard vulnerability.
17. Due to mapping limitations the actual extent of a flood may be beyond that mapped. Interpretation may be required to ascertain applicable levels and operation of flows relating to a chosen point. In this case, use the ***FIP*** tool to understand the depth on the land from adjacent mapping. The ***FIP*** tool also allows a user to select points outside the property boundary when the edge of the closest flood extent is also outside the property boundary.
18. The mapped ***OLFP*** is an indicative centre line. Due to mapping limitations, the line may not be centred on the physical flow path. In some cases, the ***OLFP*** may affect the subject land but may not be physically located on the lot, e.g. on wide floodplains containing small flow channels. In these cases, refer to topographic mapping and/or consult with Council officers. The establishment of a ***TLPI*** trigger will be based on available flood modelling or, in its absence, the actual channel and floodplain configuration (refer to topographic mapping) and flood operations at the point of interest. Development should be located at least 10 metres from the defining bank of an ***OLFP***. (See P10 and AO10.1 – 10.5 of the ***TLPI***).
19. The mapped ***indicative flooding extent*** is a guide only and is based on an automated process and a number of assumptions.
20. The ***dams mapping*** is for information purposes only. This information is general in nature and may not reflect the existing conditions. Property owners with dams have obligations under the *Water Supply (Safety and Reliability) Act 2008*. Refer to the State government's *Small Dam Safety* information.
21. In the event that the ***TLPI*** is not triggered for a proposed use, i.e. a planning application is not required, the ***National Construction Code*** 'deemed to satisfy' solutions may not be sufficient to manage the surface water management requirements for a structure. The appropriate design response depends on the nature of the proposed use, the surface water source/s and typography.

Hazard vulnerability	Hazard Vulnerability Classification	
	H6	Unsafe for vehicles and people. All building types consider vulnerable to failure.
	H5	Unsafe for vehicles and people. Buildings require special engineering design and construction
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	H2	Unsafe for small vehicles
	H1	Generally safe for vehicles, people and buildings. Relatively benign flood conditions. No vulnerability constraints



Definitions:

AHD or Australian Height Datum - official national vertical datum for Australia used to control vertical mapping.

annual exceedance probability (AEP) the chance of a mapped flood design event occurring or being exceeded in any one year, expressed as a percentage.

defined flood level (DFL) the level to which it is reasonably expected flood waters may rise (see section 8(5) of the *Building Regulation 2021* and the TLPI).

defined flood event (DFE) - a flood event that would result in the extent of flooding shown on the Flood hazard overlay maps in the TLPI.

design event mapping is created from flood model outputs for a particular AEP flood design event. This means that it is a representation of a design event for the mapped locations. There may be no mapping for a locality for this event on this map. The absence of mapping in a locality does not mean that the locality was not affected in this event.

finished floor level (FFL) (or habitable floor level where relevant to a dwelling and/or a habitable room) means the defined flood level plus freeboard (500mm for a dwelling).

Flood Hazard category mapping - based on a "hazard to children" criterion using a combination of the defined flood event, water depth, water velocity (or speed) and velocity-depth.

flood hazard overlay - the area identified on the Flood hazard overlay maps in the TLPI as being a defined flood event, investigation area or overland flow path.

flood investigation area - the area on the Flood hazard overlay maps identified as investigation area. Land within the flood investigation area is known to be, or has the potential to be, affected by a defined flood event, but due to the limits in the modelling process has not yet been quantified. During a defined flood event, land in this area may be exposed to a level of flood risk, although the level of risk has not been determined.

Hazard Vulnerability Classification is the hazard assessment framework from the Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR 2017) Guideline 7-3, Figure 6.

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a) major to extreme risk to life is likely;
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a) able bodied adults may not be able to walk safely;
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overland flow path means an area on the Flood hazard overlay maps identified as overland flow path.

local or flash flooding means flooding occurring within about six hours of rain, usually the result of intense local rain and characterised by rapid rises in water levels.

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Temporary Local Planning Instrument (TLPI) is a local planning instrument that amends the Lockyer Valley Planning Scheme and regulates development in the **flood hazard overlay**. Where there is an inconsistency between the TLPI and SPP, the SPP applies.

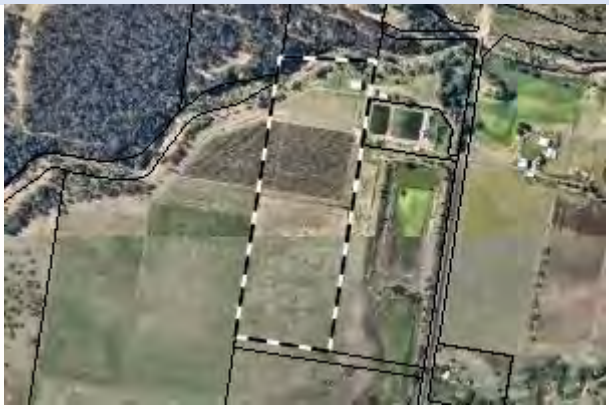
Undetermined areas are nominated localities on the FIP engineering mapping that Council has become aware of that may need further investigation to ascertain flood impacts.

LOCKYER VALLEY Flood Information Report

Back Flagstone Road, IREDALE

Report ID: FIP2025/10156
Property: 1RP135445
Date of report: May 14, 2025

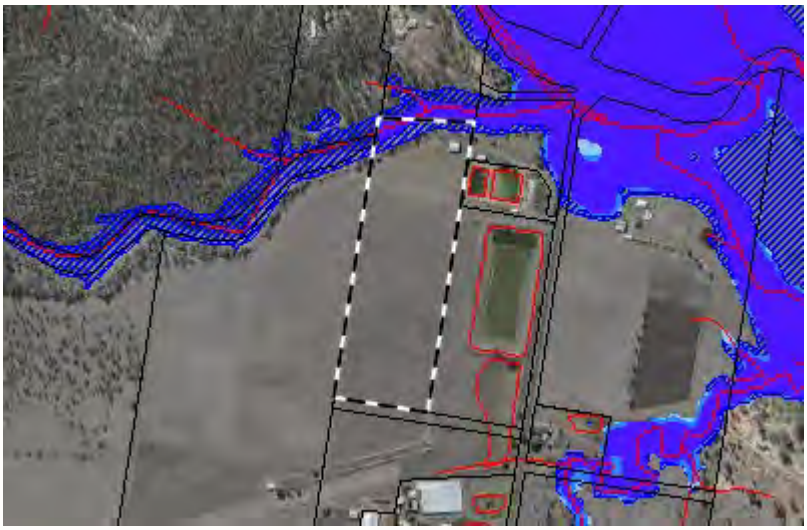
This report provides property specific flood level information relevant for development and building work on the identified land and supports the flood requirements of the Lockyer Valley Temporary Local Planning Instrument 2024 Flood Regulation (TLPI). The TLPI is relevant to building and development in areas subject to flooding and should be considered when planning new buildings and developments.
For further information regarding all building and development requirements in flood hazard areas, please refer to the Lockyer Valley Planning Scheme 2024 on Council's ePlan page:
Home - Lockyer Valley Planning Scheme (lvrc.qld.gov.au)



Nearmap – Feb 2024

Planning Trigger	*The property is affected by the Flood hazard overlay as identified in the TLPI.*
Defined Flood Event (DFE)	*The property is affected by the Defined Flood Event (DFE).*
Flood Investigation Area	*The property is subject to the Flood Investigation Area.*
Overland flow path	The property is subject to an overland flow path/s[5,14]
Available Flood Data	Based on currently available data and the selected location/s on the land, Defined Flood Level (DFL) flood parameters on the land are shown overpage. To establish a Finished floor level (FFL) refer to notes 6 and 17 for guidance.

TLPI Map - Key	
	Mapped High hazard
	Mapped Medium hazard
	Mapped Low hazard
	Flood Investigation Area
	Overland flow path
Selected Point Notes	
A	
B	
C	
D	

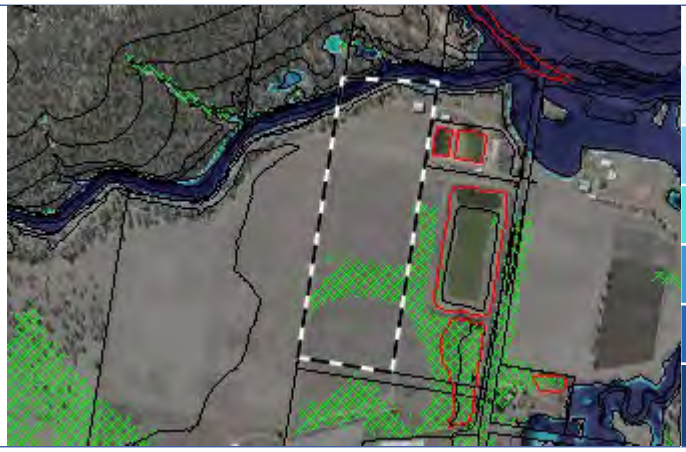


TLPI Map – Imagery State of Queensland 2020

Council provides this information as a general reference source only and has taken all reasonable measures to ensure that the material in this report is as accurate as possible at the time of publication. However, the Council makes no representation and gives no warranty about the accuracy, reliability, completeness or suitability of the information for any particular purpose. To the full extent that it is able to do so by law, Council disclaims all liability (including liability in negligence) for the losses or damages (including indirect and consequential loss and damage) caused by or arising from anyone using or relying on the information for any purpose whatsoever. This information can change over time as Council's flood information is periodically updated.

Flood Event Mapping: DFL

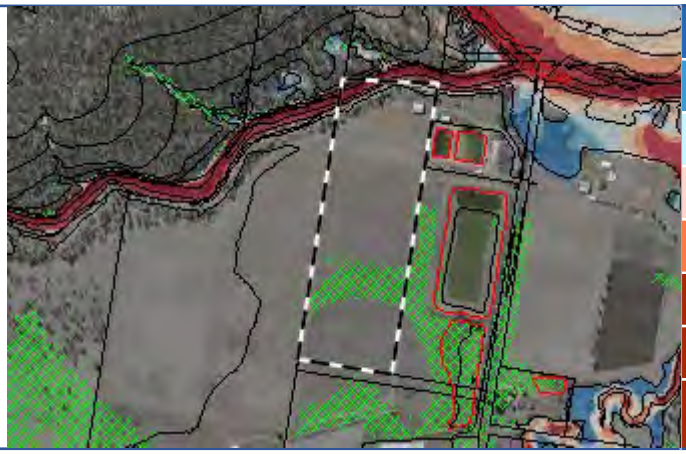
Water Surface Level[13] RL (m) AHD			
A	B	C	D
--	--	--	--
Depth Map (m) AHD			
--	--	--	--
Ground Level[6] RL (m) AHD			
--	--	--	--



Keys
0 – 0.3
0.3 – 0.5
1.5 – 1
1 – 1.2
1.2 – 2
2 – 20

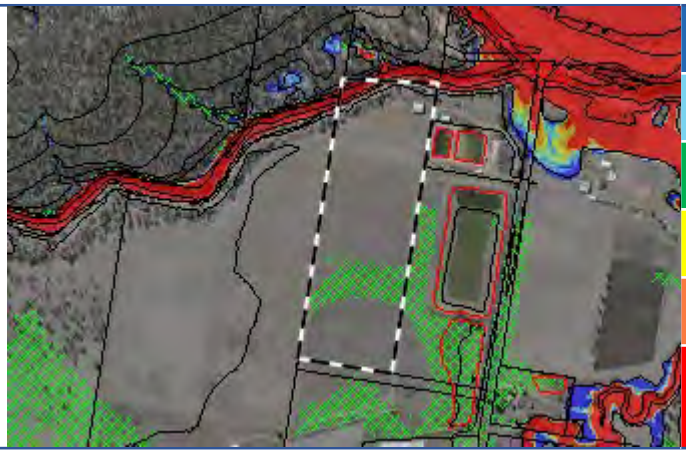
Velocity Map (m/s)[7(e)]			
A	B	C	D
--	--	--	--

Other information - Key	
Indicative flooding	
Dams	
Undetermined areas	



Keys
0 – 0.25
0.25 – 0.5
0.5 – 1.0
1.0 – 1.5
1.5 – 2.0
2.0 – 3.0
3.0 – 4.0
4 - 20

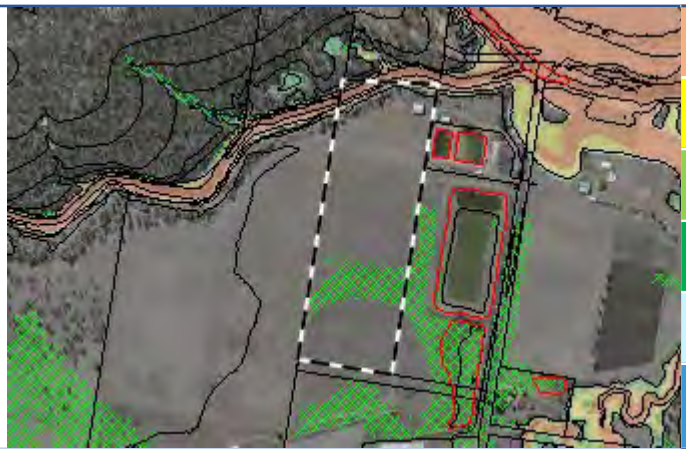
Flood Intensity map (m2/s)			
A	B	C	D
--	--	--	--



Keys
0 – 0.2
0.2 – 0.4
0.4 – 0.6
0 .6 – 0.8
0.8 – 1.2
1.2 - 20

Hazard vulnerability			
A	B	C	D
--	--	--	--

Refer to the definition of Hazard Vulnerability Classification.



Keys
6
5
4
3
2
1



Development notes:

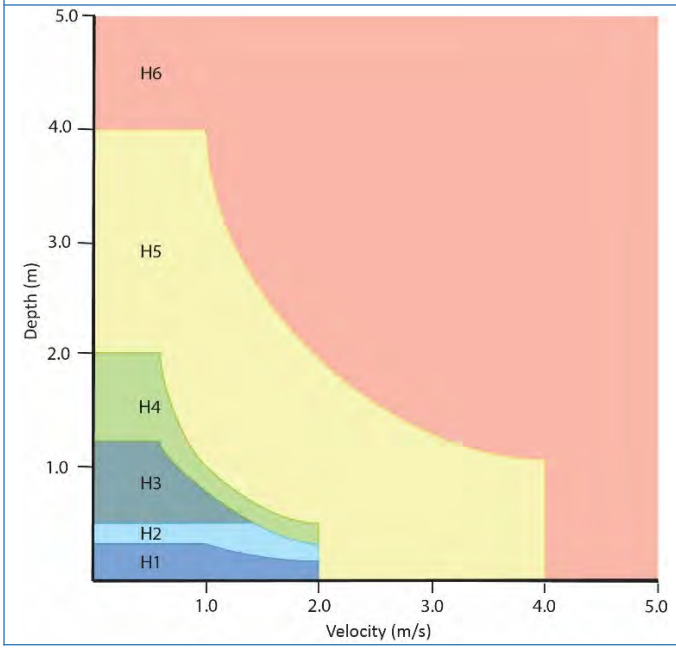
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Undetermined areas are nominated localities on the FIP engineering mapping that Council has become aware of that may need further investigation to ascertain flood impacts.

LOCKYER VALLEY Flood Information Report

Back Flagstone Road, IREDALE

Report ID: FIP2025/10154
Property: 100RP900696
Date of report: May 14, 2025

This report provides property specific flood level information relevant for development and building work on the identified land and supports the flood requirements of the Lockyer Valley Temporary Local Planning Instrument 2024 Flood Regulation (TLPI). The TLPI is relevant to building and development in areas subject to flooding and should be considered when planning new buildings and developments.
For further information regarding all building and development requirements in flood hazard areas, please refer to the Lockyer Valley Planning Scheme 2024 on Council's ePlan page:
Home - Lockyer Valley Planning Scheme (lvrc.qld.gov.au)



Nearmap – Feb 2024

Planning Trigger	*The property is affected by the Flood hazard overlay as identified in the TLPI.*
Defined Flood Event (DFE)	*The property is not affected by the Defined Flood Event (DFE).*
Flood Investigation Area	*The property is not subject to the Flood Investigation Area.*
Overland flow path	The property is subject to an overland flow path/s[5,14]
Available Flood Data	There is currently no Defined Flood Level (DFL) flood data available within the automatic flood request system for the land. Indicative flood extents are shown overpage. Refer to notes 1, 7, 17 and 9 for guidance.

TLPI Map - Key	
	Mapped High hazard
	Mapped Medium hazard
	Mapped Low hazard
	Flood Investigation Area
	Overland flow path
Selected Point Notes	
A	
B	
C	
D	



TLPI Map – Imagery State of Queensland 2020

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No-Data Mapping

Ground Level[6] **RL** (m) AHD



Subject Property – Imagery State of Queensland 2020

Map Key

Indicative flooding	
Dams	
Undetermined areas	



Indicative extent of flood mapping– contour

There is currently no flood data available within this automatic flood information request system for this parcel. Indicative extent of the flood mapping for the land is shown in the figure above. Refer to Notes 8 and 9 for guidance.

As more information is made available, the system will be updated periodically. Please enquire with Council to determine if further information is available.[10]



Development notes:

1. The flood information in this report:
   a) is limited to that held by Council at the specified date and is not necessarily all the information required to obtain approval for building works or any other development;
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   b) is generally the 2012 mapped regional flooding. This event is typically greater than 6 hours, i.e. not local flooding;
   c) does not necessarily capture the effects of local flooding. The local flooding flood hazard may be site specific and may need to be assessed separately by an RPEQ in accordance with the TLPI.
4. The information supplied is limited to the requested locations selected on the land. There may be flood parameters of higher or lower value on the land. Flood parameters that can be provided within mapped flood areas include flood height, flood depth, flood velocity, flood intensity (product of velocity x depth) and hazard vulnerability.
5. Overland flow paths (OLFP) shown in the TLPI maps are generated using an automated process using a digital terrain model 14. Depending on the proposed development, the OLFP may need to be confirmed with Council.

Flood information notes:

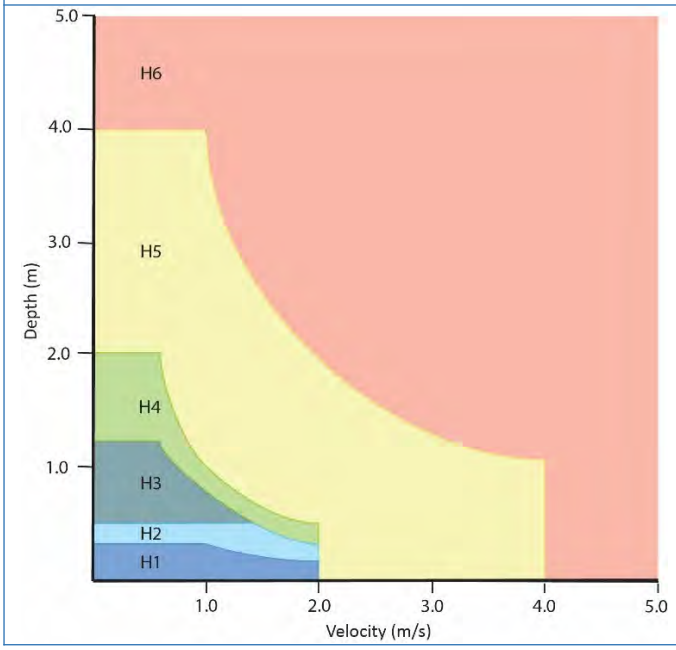
6. For any proposed building:
   a) The ***finished floor level (FFL)*** is the ***defined flood level (DFL)*** plus freeboard.
   b) The given ground levels and nominated flood level/s and depth/s should be verified on site and the maximum outcome used to set the DFL.
7. The flood level nominated for a location is based on flood modelling, ground flood survey and remote survey assessment techniques.
8. The contours and ground levels in the report are based on the remote survey assessment techniques and data available to Council in 2019. The contour and ground levels were accurate at the time of capture. The levels may change over time and with land modification.
9. Photographs used are the latest that can be supplied under license arrangements.
10. Flood mapping extents are generally based on available flood modelling available up to 2021. The information is sometimes updated, so there may be new information available on request from Council.
11. Further or more detailed advice, such as impacts of the 2011 or 2013 flood events, may be requested from Council using a flood information search.
12. In the event flood affected areas of the land are only partially mapped or unmapped, it may be subject to other types of flooding such as local flooding. Further investigations may be required to determine the extent of local flooding.
13. A risk assessment is required to be undertaken by a suitably qualified RPEQ to consider and manage the effect of flooding if:
    a) flood information is required for a critical decision involving public risk, damage to property; or
    b) if there is insufficient flood information to establish the flood depth, velocity and risk for a proposed use.
14. The risk assessment must consider and manage the effect of the water flows arriving on the site at the nominated location to avoid impacts on the proposed use, structure/s or dwelling house. This includes the ***undetermined areas*** nominated in the ***Flood Information Portal (FIP)***. Redirection of water to adjoining properties may result in an actionable nuisance.
15. Other risk factors may need to be considered alongside the flood information, including the frequency of



flooding, risk of isolation, risk to road access, risk to life and risk to property.

Flood advice – interpretation and use:

16. Flood parameters that can be provided within mapped flood areas include flood height, flood depth, flood velocity, flood intensity (product of velocity x depth) and hazard vulnerability.
17. Due to mapping limitations the actual extent of a flood may be beyond that mapped. Interpretation may be required to ascertain applicable levels and operation of flows relating to a chosen point. In this case, use the ***FIP*** tool to understand the depth on the land from adjacent mapping. The ***FIP*** tool also allows a user to select points outside the property boundary when the edge of the closest flood extent is also outside the property boundary.
18. The mapped ***OLFP*** is an indicative centre line. Due to mapping limitations, the line may not be centred on the physical flow path. In some cases, the ***OLFP*** may affect the subject land but may not be physically located on the lot, e.g. on wide floodplains containing small flow channels. In these cases, refer to topographic mapping and/or consult with Council officers. The establishment of a ***TLPI*** trigger will be based on available flood modelling or, in its absence, the actual channel and floodplain configuration (refer to topographic mapping) and flood operations at the point of interest. Development should be located at least 10 metres from the defining bank of an ***OLFP***. (See P10 and AO10.1 – 10.5 of the ***TLPI***).
19. The mapped ***indicative flooding extent*** is a guide only and is based on an automated process and a number of assumptions.
20. The ***dams mapping*** is for information purposes only. This information is general in nature and may not reflect the existing conditions. Property owners with dams have obligations under the *Water Supply (Safety and Reliability) Act 2008*. Refer to the State government's *Small Dam Safety* information.
21. In the event that the ***TLPI*** is not triggered for a proposed use, i.e. a planning application is not required, the ***National Construction Code*** 'deemed to satisfy' solutions may not be sufficient to manage the surface water management requirements for a structure. The appropriate design response depends on the nature of the proposed use, the surface water source/s and typography.

Hazard vulnerability	**Hazard Vulnerability Classification**	
	H6	Unsafe for vehicles and people. All building types consider vulnerable to failure.
	H5	Unsafe for vehicles and people. Buildings require special engineering design and construction
	H4	Unsafe for vehicles and people
	H3	Unsafe for vehicles, children and the elderly
	H2	Unsafe for small vehicles
	H1	Generally safe for vehicles, people and buildings. Relatively benign flood conditions. No vulnerability constraints



Definitions:

AHD or Australian Height Datum - official national vertical datum for Australia used to control vertical mapping.

annual exceedance probability (AEP) the chance of a mapped flood design event occurring or being exceeded in any one year, expressed as a percentage.

defined flood level (DFL) the level to which it is reasonably expected flood waters may rise (see section 8(5) of the *Building Regulation 2021* and the TLPI).

defined flood event (DFE) - a flood event that would result in the extent of flooding shown on the Flood hazard overlay maps in the TLPI.

design event mapping is created from flood model outputs for a particular AEP flood design event. This means that it is a representation of a design event for the mapped locations. There may be no mapping for a locality for this event on this map. The absence of mapping in a locality does not mean that the locality was not affected in this event.

finished floor level (FFL) (or habitable floor level where relevant to a dwelling and/or a habitable room) means the defined flood level plus freeboard (500mm for a dwelling).

Flood Hazard category mapping - based on a "hazard to children" criterion using a combination of the defined flood event, water depth, water velocity (or speed) and velocity-depth.

flood hazard overlay - the area identified on the Flood hazard overlay maps in the TLPI as being a defined flood event, investigation area or overland flow path.

flood investigation area - the area on the Flood hazard overlay maps identified as investigation area. Land within the flood investigation area is known to be, or has the potential to be, affected by a defined flood event, but due to the limits in the modelling process has not yet been quantified. During a defined flood event, land in this area may be exposed to a level of flood risk, although the level of risk has not been determined.

Hazard Vulnerability Classification is the hazard assessment framework from the Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR 2017) Guideline 7-3, Figure 6.

high flood hazard area means the area on the Flood hazard overlay maps identified as high hazard. Development of land in this area may pose unacceptable risks to life and property during a defined flood event. Generally, in this area during a defined flood event:

a) major to extreme risk to life is likely;
b) able bodied adults cannot walk safely; and
c) light frame buildings can structurally fail.

historical event mapping is created as part of the flood model calibration process. This means that it is a representation of flood operations for an actual event for the mapped locations. There may be no mapping for a locality for an event on this map. The absence of mapping in a locality does not mean that the locality was not affected in this event.

low flood hazard area means the area on the Flood hazard overlay maps identified as low hazard. Development of this land, after application of relevant mitigation actions, is not considered to pose any significant risk to life or property during a defined flood event. Generally, in this area during a defined flood event:

a) there is no significant risk to life; and
b) property is only at risk when exposed and in direct contact with flood waters.

medium flood hazard area means the area on the Flood hazard overlay maps identified as medium hazard. Development of land in this area may pose a risk to life and property during a defined flood event. Generally, in this area during a defined flood event:

a) able bodied adults may not be able to walk safely;
b) cars can float and precautions must be taken; and
c) only large vehicles (trucks) may be able to travel safely.

overland flow path means an area on the Flood hazard overlay maps identified as overland flow path.

local or flash flooding means flooding occurring within about six hours of rain, usually the result of intense local rain and characterised by rapid rises in water levels.

regional or creek flooding is when existing water in creeks combined with intense rain over the creek catchment and local run-off from houses and streets results in extensive creek flooding over the flood plain. This type of event is a longer-term event than local flooding and may last for many hours or days.

State Planning Policy (SPP) seeks to protect and deliver State interests. Where there is an inconsistency between the SPP and a Local government planning instrument, the SPP applies instead of the local planning instrument.

Temporary Local Planning Instrument (TLPI) is a local planning instrument that amends the Lockyer Valley Planning Scheme and regulates development in the **flood hazard overlay**. Where there is an inconsistency between the TLPI and SPP, the SPP applies.

Undetermined areas are nominated localities on the FIP engineering mapping that Council has become aware of that may need further investigation to ascertain flood impacts.

6.4. Helidon Effluent Reuse Project – Part A Report: Planfuture

Please note: Printed copies of this document should be verified for currency against online version.

Helidon STP Effluent Reuse Project – Part A Report

QUU Reference	N53536
Project	Helidon STP Effluent Reuse Project – Draft for Discussion
Distribution	Andrew Lawrence, Project Manager Operations & Services QUU
	Cameron Jackson, Leader Water Quality & Environment, QUU
Date	13h MAY 2019
Contact	Tony Costantini, Principal Planfuture

Planfuture is pleased to provide Queensland Urban Utilities (QUU) with its report of findings under QUU Professional Services Agreement, Helidon STP Effluent Reuse Project.

The Report provides findings against the agreed deliverables and recommendations for moving to the next stages of design and implementation for the Helidon STP Effluent Reuse Project.

We understand that QUU encourages and promotes innovation; and are pleased to report that there are a number of innovative features of our work, which have already deepened the relationship between QUU and the Department of Environment & Science (DSE) and Lockyer Valley Regional Council (LVRC).

At QUU's request, the Report has been prepared in two parts: (a) Executive Summary and report against the Phases 1 & 2 Scope of Works (this Report); and (b) report against the Phase 3 Scope of Works (MEDLI). The latter will facilitate discussions with both DSE and LVRC, the former to achieve environmental licensing approvals the latter to achieve planning approvals.

Tony Costantini
Principal Planfuture
Mb: 0400 233 622



Limitations

This report is for use by the Central SEQ Distributor-Retailer Authority, trading as Queensland Urban Utilities (QUU), and should not be used or relied upon by any other person or entity or for any other project. This report has been prepared for the particular project described to Planfuture and its extent is limited to the scope of work agreed between QUU and Planfuture.

In completing this report, Planfuture has relied upon advice provided by QUU including in relation to the Helidon Sewage Treatment Plant (STP), effluent quality and quantity and preferred crop for the effluent reuse project. No responsibility is accepted by Planfuture or its Principal, servants, agents, staff or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.

To the extent that this report contain estimates for future works or services, physical or consulting, those estimates can only be considered current and will only reflect the extent to which the detail of the project is known to the consultant at the time given, details of which are provided in the report.

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Executive Summary

To ensure ongoing compliance with the Helidon STP Environmental Authority, in November 2018 Queensland Urban Utilities (QUU) prepared the Helidon STP Effluent Reuse Scope of Works (Scope of Works) to assess the potential to establish an effluent reuse project on QUU land adjoining the STP (the Farm Investigation Area - Figure 1).

The Scope of Works details six Phases of work required to plan and design an effluent reuse scheme that utilises 100% of Average Dry Weather Flow (ADWF), supports regeneration of native vegetation and provides an affordable and manageable reuse solution. The Scope of Works directed focus to a circa 30ha Farm Investigation Area on the QUU Farm at the Helidon STP.

QUU commissioned Planfuture to undertake components of Phases 1, 2 & 3 of the Scope of Works. This is Part A of our report against the deliverables for each of these three Phases of works. It includes the Executive Summary for all Phases plus the outputs of the Phases 1 & 2 Scope of Works. Part B reports against the Phase 3 Scope of Works (MEDLI).

For Phase 1 of the Scope of Works, we undertook a detailed land assessment of the Farm Investigation Area consistent with best practice soil survey and suitability assessment guidelines. This involved describing 16 soil profiles (to 1,200mm depth) throughout the ≈30ha Farm Investigation Area and undertaking detailed chemical analyses for Representative Soil types.

The Farm Investigation Area is a laser-levelled block (circa 1.5% grade) that has most recently been used for cut-and-carry unimproved pasture production.

We identified five distinct soil types on the Farm Investigation Area, which we used to generate a 1:10,000 soil map. Soil chemical analyses of the three major Representative Soils confirmed that there are no obvious limitations for utilising the site for irrigated crop/tree production.

While it is expected that the Farm Investigation Area will experience periodic inundation (circa 40 year Annual Recurrence Interval), the flooding characteristics of the site will not limit regeneration of native vegetation.

The pre-clearing native vegetation is the endangered Regional Ecosystem 12.3.3 (RE 12.3.3); tall open blue gum (*Eucalyptus tereticornis*) forest with a grassy understory. The Farm Investigation is well suited to effluent irrigation of blue gum regeneration.

It is also noted that the levee along Monkey Water Holes Creek to the North of the Farm Investigation Area has a small area of remnant vegetation that is mapped as endangered RE 12.3.10 (*E. populnea* woodland on alluvial plain). The levee is also essential habitat for *Phascolarctos cinereus* (koala), as too is the remnant vegetation to the north of the Creek.

We conclude that the Farm Investigation Area is suited to irrigated regeneration of RE 12.3.3. There are no mapped environmental or infrastructure impediments to use of the Farm Investigation Area for regeneration. However, it is noted in this context, that the Farm

Investigation Area is a Water Supply Buffer Area and Water Resources Catchment; and that with Seqwater will be required in relation to the intended effluent reuse.

In the Phase 2 schedule of works, we assess the potential to establish native vegetation that could qualify for vegetation, carbon and/or biodiversity offset credits. We conclude that the Project Area has significant potential to generate environmental offsets for both RE 12.3.3 and koala habitat offsets.

The environmental offsets generated at Helidon could be utilised by either QUU, as Proponent driven offsets to meet any offset obligations incurred by QUU (e.g. through unavoidable clearing to lay pipes) or as a supplier of offsets to a third party that has an environmental offset obligation.

Planfuture's recommendation to QUU is to regenerate a pre-clearing blue gum community (RE 12.3.3) at the Project Area, using local genotypes wherever possible. It is recommended that trees be established on a 5m x 5m grid, equivalent to 400 trees/ha, with a species split of 90%, 5% and 5% blue gum, silver-leaf ironbark (*E. melanophloia*) and Moreton Bay ash (*Corymbia tesselaris*) respectively. As the present unimproved pasture includes some native species, including the most commonly occurring small shrub in the RE, *Acacia salicina*, no specific regeneration effort for the understory is recommended.

We worked with QUU to define an area within the Farm Investigation Area (the Project Area) that would optimise the goals of generating environmental offset value, minimising establishment set-up costs (essentially reflecting proximity to the STP and using a regular block design to minimise irrigation infrastructure costs). Based on results from our MEDLI modelling (see below), we recommended a Project Area of 4ha. On these bases, we estimated that regeneration of 4ha of RE12.3.3 and koala habitat at Helidon may offset 1.0ha of RE 12.3.3 clearing and 1.34ha of koala habitat clearing; and have an indicative value of $260,000.

We further recommend that the Project Area be registered as an Advanced Offset under the *Environmental Offsets Act 2014* as soon as possible after QUU commits to the effluent irrigation project. Registering an advanced offset optimises the potential offset value; but does not obligate QUU to either proceed with the offset or to commit to any investments.

In order to proceed with an advanced offset application, QUU will need to undertake a baseline habitat quality assessment of the site, using the Guide to Determining Terrestrial Habitat Quality. The baseline assessment is used to measure improvements in habitat quality. The application for registration should be made using relevant Department of Science forms for a Notice of election, Offset Area Details and Habitat Quality Details.

We also note that the Lockyer Valley Regional Council is extremely supportive of native vegetation regeneration in the Project Area. Council officers have indicated a willingness to work with QUU to strengthen the relatively small area (≈1.9-1.5ha) of the endangered RE 12.3.10 (*E. populnea* woodland on alluvial plain) on the southern levee of Monkey Water Holes Creek. This supplementary project may provide an additional environmental offset value to QUU while strengthening relationships with a key stakeholder in Council.

For Phase 3 of the schedule of works, we development a bespoke MEDLI model for an eucalypt tree/grass crop (blue gum forest model) for the Project Area. We note that this work involved considerable innovation that has benefited from the advice and support of the Department of Environment & Science.

To develop our bespoke blue gum forest model for Helidon, we followed the approach that the Department of Science used to develop the MEDLI Melaleuca module in 1999. To inform this work we undertook a review of the literature and sought expert local knowledge to estimate the likely growth and performance potential for irrigated blue gum and the grass understory (Rhodes grass) at Helidon. We did this at Year 1 (tree sapling stage), when the trees are only modestly shading the grassy understory, and Year 4+ (maturing tree stage), when tree shading reduces growth potential of the grass understory.

MEDLI models were calibrated for the soils at the Farm Investigation Area, historical effluent quality at the Helidon STP (as provided by QUU) and Helidon climate. In this regard, we note that the effluent quality for irrigation is Class B and have designed our Project Area accordingly (Figure 1), with appropriate set-backs. We believe that QUU's approach of installing a storage tank and continuing to disinfect effluent (ensuring appropriate chlorine residuals are maintained in the tank) will minimise costs and risk over the long term.

Our paramatised blue gum forest module competently simulated irrigation, crop growth, water balance, percentage of effluent used, crop nutrient sequestration and soil salinity over the intended 20-year irrigation project.

Based on the MEDLI modelling results, we have recommended:

- establishment of a 4ha irrigation area;
- installation of a minimum 250kL (preferable 500kL) storage tank with an overflow bypass to the existing turkey dam;
- applying 25mm at each irrigation event;
- use of a coarse droplet spray irrigation system, to achieve even irrigation throughout the Planting Area; and
- installation of an irrigation control system that can -
    - irrigate the desired volume to each 1ha of the Project Area on a sequential basis, and
    - incorporate rules for not irrigating given various antecedent daily rainfall (e.g. 10mm).

We confirm that the Planting Area will be sufficient to accommodate the 25% increase in ADWF that was advised by QUU as being required to accommodate potential 2029 population growth.

Using these recommendations, the blue gum forest model simulates irrigation supply of 18.6ML/year over 4 ha, equivalent to 4.6 ML/ha/yr. This irrigation quantum approximates Average Dry Weather Flow for Helidon STP minus the net evaporation loss from the treatment lagoons.

Figure 1: Proposed 4ha Project Area for irrigated native regeneration development at the Helidon STP



We conclude that the recommended effluent reuse is sustainable. Both MEDLI and SALF modelling confirm that salinity is unlikely to be limiting and irrigation of low sodicity effluent is unlikely to have an adverse effect on soil structure. We have also explored the risk of nitrogen leaching using both MEDLI and a mass balance approach; and concluded that it is low: As a matter of prudence, we recommend that QUU sample the soil leachate solution at age 6 years and, if no issues are confirmed, on a tri-annual basis thereafter.

The findings and recommendations in this draft report are sufficient to allow QUU to proceed with Phases 4, 5 & 6 of the Scope of Works. We note that, in moving forward, there will be a need to ensure that:

- the irrigation design and forestry design are integrated;
- the management plan and implementation plan for the effluent reuse project are integrated with the irrigation design, installation and operation and with the goal of optimising the value of the environmental offsets;
- there is early engagement with a local nursery producer to ensure access of suitable planting material (correct genotypes) is available for what would be a desirable planting time in September;
- there are ongoing discussions with Lockyer Valley Regional Council regarding cooperative opportunities for advancing both effluent reuse and enhanced environmental management of the QUU farm; and

- there is early engagement with both the regulator and Seqwater.

Finally, we note that it will be essential for QUU's expert in blue gum forest regeneration to work closely with the specialist engaged to design, install and commission the irrigation system. Planfuture would welcome the opportunity to assist QUU with all of these matters and/or to deliver the remainder of the Scope of Works.

Introduction & Scope

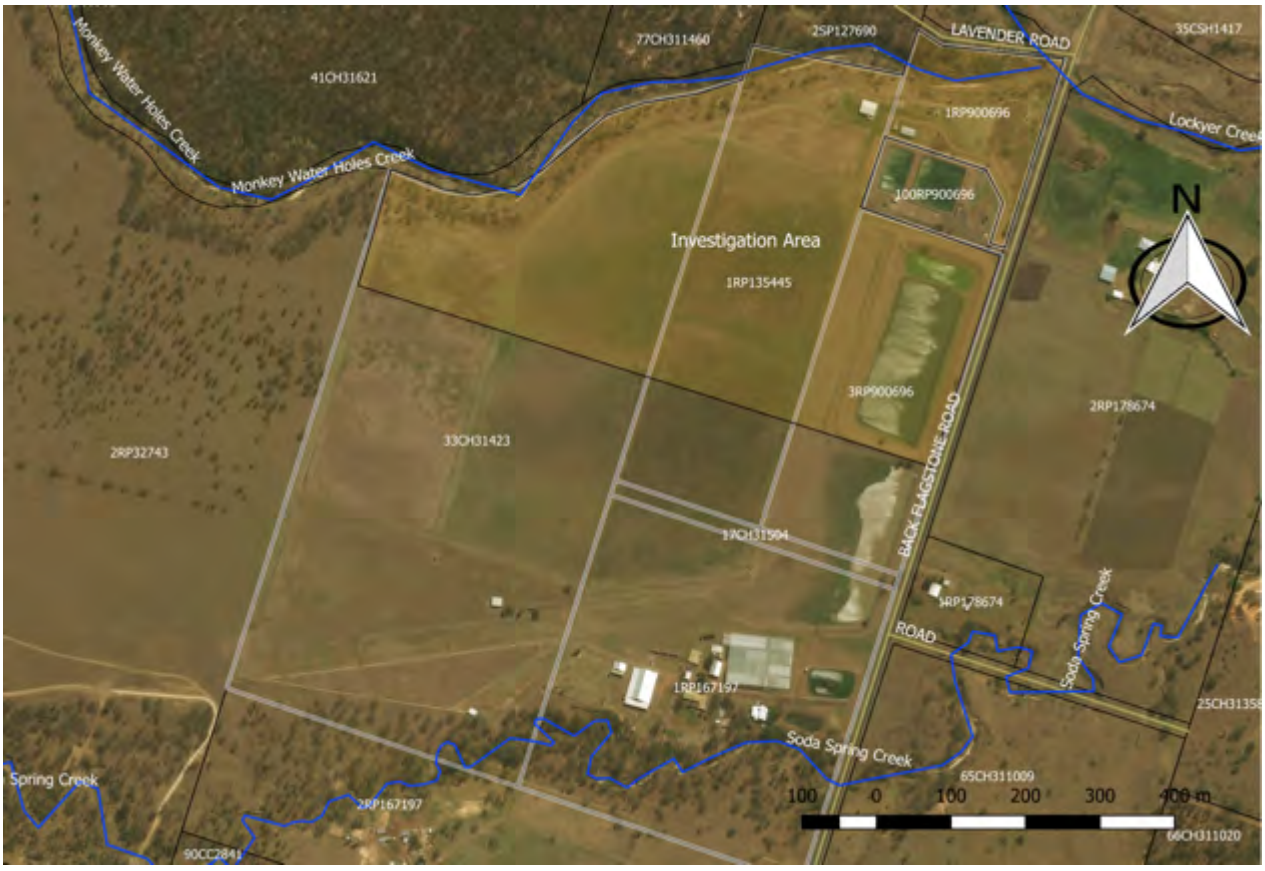
The Helidon Sewage Treatment Plant (STP) services the township of Helidon, approximately 35km west of Ipswich and 105km west of Brisbane in the Lockyer Valley Regional Council Local Government Area. It has an Average Dry Weather Flow (ADWF) of 21ML/yr, which is forecast to grow by 25% over the next decade.

Traditionally, QUU released treated effluent into a large two-chamber Turkey Nest dam to the south of the STP (Figure 2), and the then landowner of the farm surrounding the STP (Figure 2) used the effluent for irrigated pasture production. In 2017, QUU procured the farm and now seeks to utilise establish an effluent reuse scheme on the Farm Investigation Area (highlighted in yellow in Figure 2).

QUU's objectives for the effluent reuse project are:

I. utilise 100% of Average Dry Weather Flow (ADWF);
II. support re-establishment of native vegetation; and
III. provide an affordable and non-resource intensive irrigation solution.

Figure 2: The Helidon STP and surrounding QUU farmland with Monkey Water Holes and Lockyer Creeks to the north and Soda Spring Creek to the south. The Farm Investigation Area is highlighted in yellow



In November 2018, QUU prepared the Helidon STP Effluent Reuse Scope of Works (Scope of Works) to guide planning and implementation of effluent reuse, identifying six Phases of Works:

1. assessment of the Farm Investigation Area;
2. assessing offsetting potential;
3. MEDLI modelling;
4. assessment of STP upgrades;
5. irrigation Design; and
6. development of a Costed Management Plan.

QUU has engaged Planfuture to deliver components of the first three of these Phases of Works, with specific deliverables include including:

a. land suitability assessment of the Farm Investigation Area;
b. selection of suitable species/community for the effluent reuse crop;
c. site and crop specific calibration of an appropriate MEDLI model; and
d. development of species recommendations for the native vegetation crop, effluent storage requirements and irrigation effluent volumes.

This report outlines works undertaken in Phases 1, 2 & 3 of the Scope of.

Terminology

Helidon Effluent Reuse Scope	Queensland Urban Utilities Helidon STP Effluent Reuse Scope of Works November 2018
Farm Investigation Area	The QUU owned Helidon land identified in the Helidon STP Effluent Reuse Scope of Works as requiring investigation
Project Area	The 4ha block within the Farm Investigation Area identified for effluent irrigation and regeneration of native vegetation

Planfuture Team

Planfuture's team of industry experts used to undertake the Phases 1 – 3 Scope of Works include:

- Project conceptualisation design, planning and management (Dr Tony Costantini)
- Effluent reuse strategy (Mr Ted Gardner and Dr Tony Costantini}
- Soil sampling, description and mapping (Mr Bernie Powell);
- Land use assessment (Mr Bernie Powell, Mr Ted Gardner, Mr Simon Brown and Dr Tony Costantini);
- MEDLI modelling (Mr Ted Gardner and Dr Evan Thomas);
- Native vegetation regeneration and offsets (Mr Simon Brown and Dr Tony Costantini); and
- Effluent reuse planning and design (Mr Ted Gardner, Mr Simon Brown Dr Tony Costantini).

Phase 1 Report: Farm Investigation Area Assessment

Summary

Queensland Urban Utilities (QUU) is seeking advice on the potential for effluent reuse at the Helidon STP, "*which supports re-establishment of native vegetation and provides an affordable and non-resource intensive irrigation solution*". To this end, in 2018 QUU prepared the Helidon STP Effluent Reuse Scope of Services[1] (Helidon Effluent Reuse Scope), which defined six Phases of work required to develop and define a reuse project.

This section addresses key components of the first of these Phases of work – the suitability of the Helidon Sewage Treatment Plant (STP) Farm Investigation Area for irrigated crop production. Specifically, it reports upon the matters addressed in Section 3.1.2 of the Helidon Effluent Reuse Scope, which includes topography, soils, flood risk and vegetation; and, while not part of this assignment, provides a high-level summary of a number of matters relevant to Section 3.1.1.

The Farm Investigation Area is a laser-levelled block that has most recently been used for irrigated (unimproved) pasture production and appears to be well suited to effluent irrigation that includes regeneration of natural vegetation.

There are five distinct soil types on the Farm Investigation Area and four distinct soil types in the Project Area. All are suited to irrigated crop production. This has been confirmed in soil chemical analyses of the major Representative Soils at the Project Area, which likewise revealed no obvious limitations for utilising the site for irrigated crop/tree production.

While it is expected that the Farm Investigation Area will experience periodic inundation (circa 40 year Annual Recurrence Interval), the site does not appear to have experienced significant flooding during the 2011 South-east Queensland floods. The flooding characteristics of the site will not limit regeneration of native vegetation.

The pre-clearing native vegetation is the endangered Regional Ecosystem, tall open blue gum (*Eucalyptus tereticornis*) forest with a grassy understory. The Farm Investigation is well suited for effluent irrigation of a blue gum regeneration crop.

[1] Queensland Urban Utilities Helidon STP Effluent Reuse Scope of Works November 2018.

Introduction

QUU is seeking advice on the potential for effluent reuse at the Helidon STP, "*which supports re-establishment of native vegetation and provides an affordable and non-resource intensive irrigation solution*". To this end, in 2018 QUU prepared the Helidon STP Effluent Reuse Scope of Services[2] (Helidon Effluent Reuse Scope), which outlined six Phases of work needed to develop and define a reuse project.

This report addresses key components of the first of these Phases of work – the suitability of the Helidon Sewage Treatment Plant (STP) Farm Investigation Area (Figure 2), the site that QUU has available for effluent irrigated crop production. Specifically, it provides a detailed land suitability assessment of the Helidon STP Farm Investigation Area by addressing the matters detailed in Table 1 to underpin:

- land assessment of the Farm Investigation Area;
- selection of suitable species/community for the effluent reuse crop;
- site specific calibration of necessary MEDLI models; and
- development of recommendations for defining a native vegetation crop, effluent storage requirements and irrigation effluent volumes.

Table 1: Tasks required to undertake land assessment of the Farm Investigation Area

Scope of Works Reference	Phase 1 Tasks sought in this consultancy
3.1.2	Undertake land assessment of the Farm investigation Area as follows: a. Topography: Utilise Queensland Government open-access Lidar data to develop a 50cm topography map, and highlight natural drainage on site; b. Soils: Define major soil types and soil type boundaries at 1:10,000 using recognised Australian soil survey methodology and intensity[3]; c. Flood risk: Assess flood risk and any flood implications for management of effluent during extremely wet periods; and d. Pre-existing vegetation: Assess the likely structure and species composition of the pre-clearing regional ecosystem.

Scope Reference 3.1.2a: Topography

The Farm Investigation Area lies to the south of Monkey Water Holes Creek, which on its southern side is marked by a naturally occurring levy (145m ASL) around 15m above the Creek bed. The entire Farm Investigation Area lies between the 141m – 145m contour and has been laser levelled to fall at a grade of 1.5% to a constructed retention basin to the south of the large Turkey Nest dam. The original intent of the Farm Investigation Area design was to direct runoff water to the retention basis for pumping into the Turkey Nest dam (Figure 3). The State's LiDAR database for this area is not in an accessible form: 5m

[2] Queensland Urban Utilities Helidon STP Effluent Reuse Scope of Works November 2018.

[3] Sampling methodology and intensity must follow:

- McKenzie NJ, Grundy MJ, Webster R and Ringrose-Voase AJ. (2008). (Eds) Guidelines for Surveying Soil and Land Resources (2nd edn) CSIRO Publishing: Melbourne.
- National Committee on Soil and Terrain (2009). 'Australian soil and land survey field handbook (3rd Edition)'. CSIRO Publishing, Melbourne.

contours are however available (Figure 3). Given that the site has been laser levelling, the 5m contours are adequate for the present site suitability assessment and planning.

Figure 3: 5m Contours



Scope Reference 3.1.2b: Soils

The Queensland Government's on line mapping and data resource, the Queensland Globe, provides 1: 50,000 soil mapping for the Farm Investigation Area (Figure 4). It shows the majority of the Farm Investigation Area is Blenheim (heavy) Black Earth[4] (occupying the back plains), with a small amount of Robinson Alluvial Soils along the narrow Monkey Water Holes Creek levee and immediately adjacent back-slopes to the north.

The Soils and Land Suitability of the Lockyer Valley Alluvial Plains[5] descriptions of both soil types are detailed in Table 2.

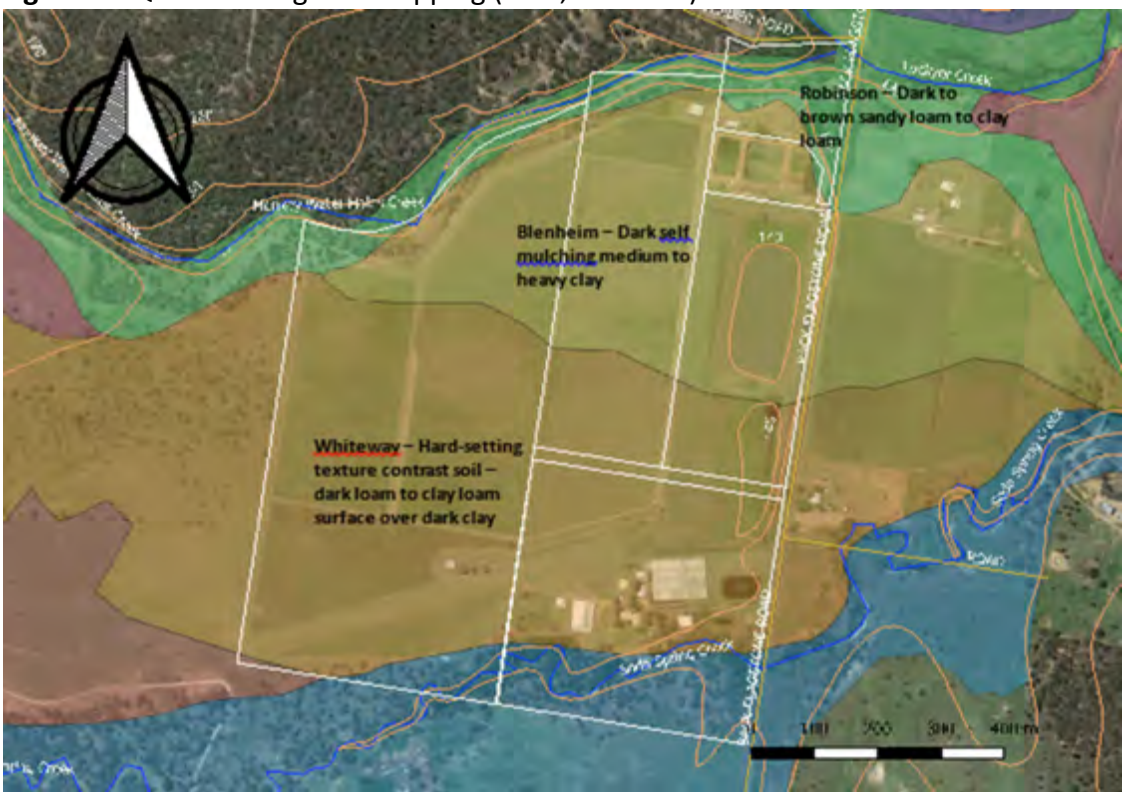
Table 2: Queensland Globe site suitability parameters at the Farm Investigation Area

Suitability parameter	Blenheim (heavy) – Bl(h)	Robinson - Rs
Erosion	<5%	<5%
Soil depth	1.0m – 1.5m	0.6m – 1m
Available water	>100mm	>100mm
Flooding	>40 year frequency	6-9 year frequency
General Irrigation Suitability	Suitable with moderate limitations	Suitable with moderate limitations
Agricultural land class	A	A

[4] Great Soil Group - Stace, H C T , Hubble, G D , Brewer, R , Northcote, K H , Sleeman, J R , Mulcahy, M J , and Hallsworth, E G (1968) 'A Handbook of Australian Soils' (Rellim Tech Publs Glenside, SA)

[5] Powell, Loi and Christianos (2002). The Soils and Land Suitability of the Lockyer Valley Alluvial Plains South-East Queensland

Figure 4: Queensland globe mapping (1:50,000 scale) soil resources at the Helidon STP



Queensland Globe mapping also shows that the entirety of the QUU land, including the Farm Investigation Area, is Class A agricultural land (Figure 5) – *viz*. "*land suitable for current and potential crops with limitations to production which range from none to moderate levels*". While the Queensland Globe data for the Farm Investigation Area is broad-scale, it indicates a general suitability for irrigated crop production and provides the basis for the more detailed soil sampling and analyses needed to frame an effluent reuse recommendation.

Consistent with the *Helidon STP Effluent Reuse Scope of Services,* we designed a soil sampling programme that aligns with best practice soil survey and suitability assessment guidelines[6] and locally defined soil types[7] (Figure 6).

Soils were sampled at each of the sampling locations shown in Figure 6 using a 42mm diameter push tube which delivered an intact core to 1.2m depth. Cores were laid out and described as per the standards of the Handbook of Australian Soils[8], and classified according to the Australian Soil Classification[9], the Factual Key[10] and Great Soil Group[11]. Soil profiles

[6] McKenzie NJ, Grundy MJ, Webster R and Ringrose-Voase AJ. (2008). (Eds) Guidelines for Surveying Soil and Land Resources (2nd edn) CSIRO Publishing: Melbourne & National Committee on Soil and Terrain (2009). 'Australian soil and land survey field handbook (3rd edn)'. CSIRO Publishing, Melbourne

[7] see Powell, B., Loi, J., and Christianos, N.G. (2002). Soils and Land Suitability of the Lockyer Valley Alluvial Plains of South-East Queensland. Queensland Department of Natural Resources and Mines.

8 National Committee on Soils and Terrain, 2009. http://www.clw.csiro.au/aclep/asc_re_on_line/soilhome.htm

[9] Isbell, R.F. (1996). The Australian Soil Classification. CSIRO Publishing: Melbourne

[10] Northcote, K.H. (1979). A Factual Key for the Recognition of Australian Soils. 4th Edition, Rellim Technical Publications: Coffs Harbour NSW

[11] Stace, H.C.T., Hubble, G.D., Brewer, R., Northcote, K.H., Sleeman, J.R., Mulcahy, M.J. and Hallsworth,E.G. (1968). A Handbook of Australian Soils. Rellim Technical Publications

were also field tested for pH, dispersion using a modified Emerson's dispersion test and Electrical Conductivity (1:5 aqueous) using a TPS multi-range conductivity electrode; and then photographed. The descriptions are provided at Attachment 1.

Figure 5: Queensland Globe Agricultural Land Suitability Class

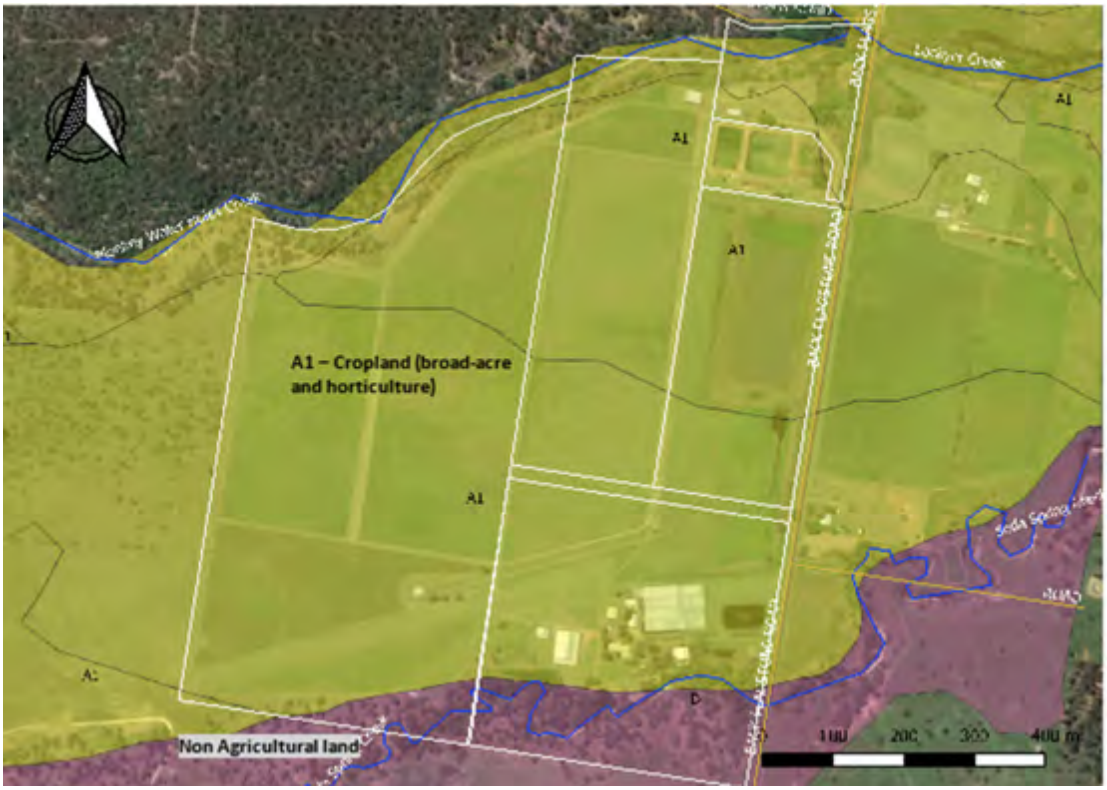
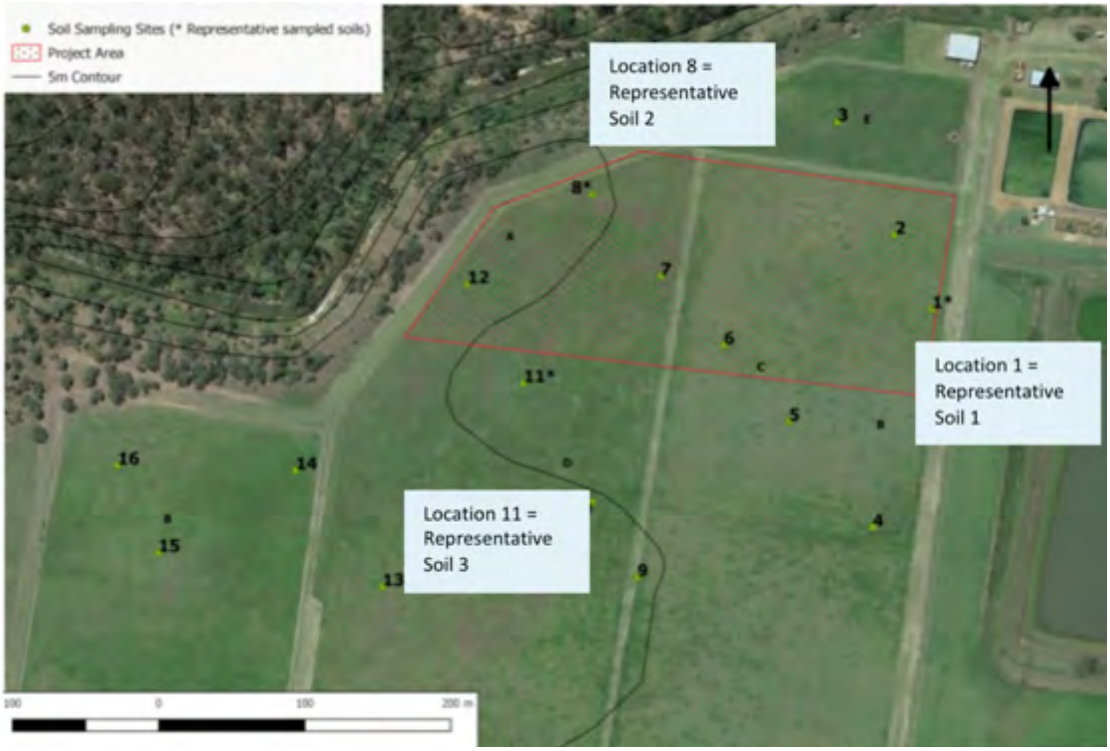


Figure 6: Farm Investigation Area showing soil sampling sites and the proposed 4 ha planting area



Soils at all 16 sampling sites had a number of features in common, including being largely black (or brown or grey equivalents close to black) in colour with calcareous lenticular structure in the deep subsoil B horizons. A number of sites had light gravel at the surface, which is thought to be introduced road material that has been inadvertently distributed during laser levelling.

While the soils share features in common, there are also differences in surface texture, degree of surface cracking and self-mulching, the thickness of the A horizon, the hue colour and depth to subsoil clay containing calcareous accumulations. In addition, the subsoil B horizons varied in their level of salinity. While all soils had low salinity ($EC_{1:5}$ < 0.8dS/m), our soil type classification distinguishes between three relative levels of subsoil salinity derived in **field** $EC_{1:5}$ assessments, which typically are higher than ECs determined in the laboratory:

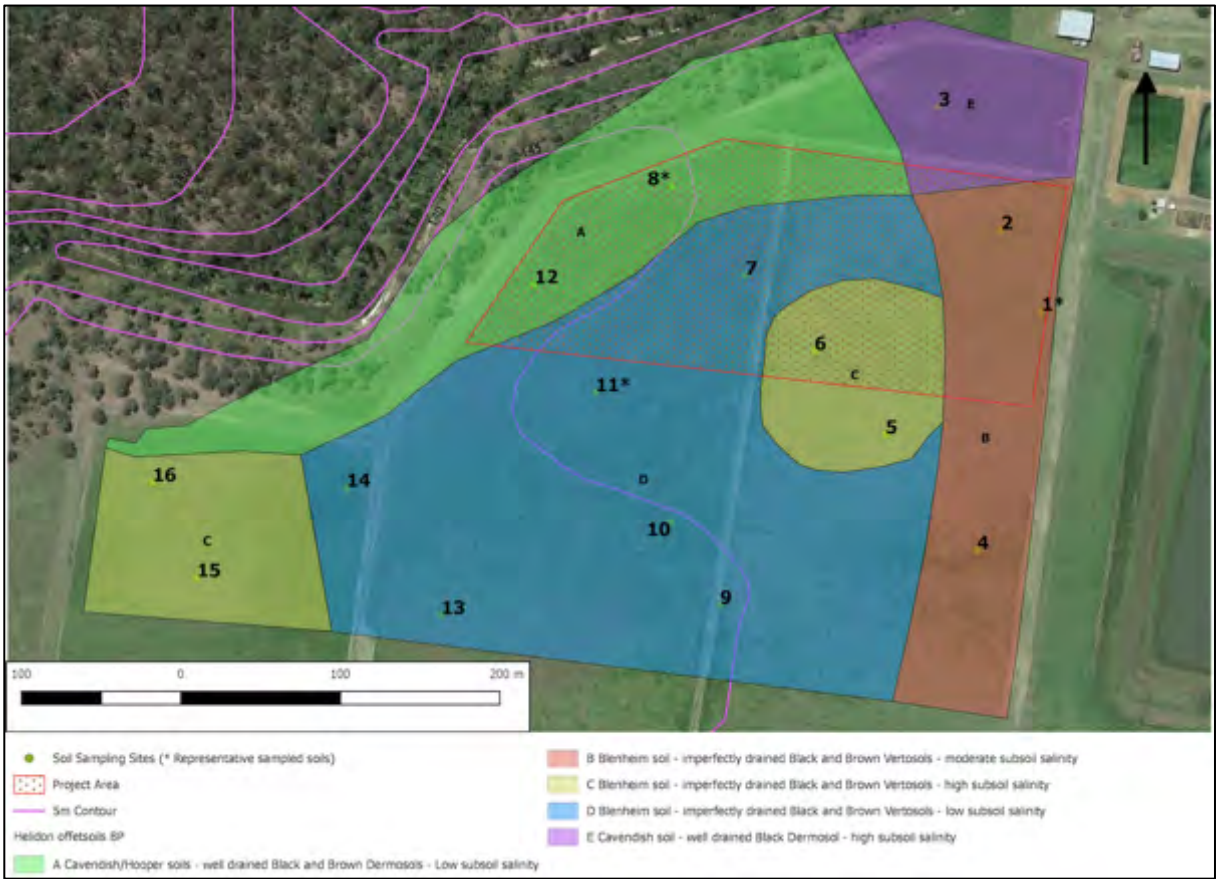
- Low subsoil salinity (field $EC_{1:5}$ < 0.4 dS/m
- Medium subsoil salinity (field $EC_{1:5}$ 0.4 dS/m – 0.8 dS/m
- High subsoil salinity (field $EC_{1:5}$ > 0.8 dS/m

Based on these distinguishing attributes, five key soil types were identified on the Farm Investigation Area (Table 2). A 1:10,000 scale soil map of the Farm Investigation Area is presented in Figure 7.

Table 2. Key distinguishing features of five soil types at the Farm Investigation Area

Soil map unit	Landscape position and site no.	Distinguishing features	Australian Soil Classification	Properties affecting tree selection
Cavendish-high subsoil salinity	Levee (3)	Hard-setting light clay surface, weakly cracking, alkaline black and brown clay subsoils	Brown Dermosol	Moderately well drained, elevated subsoil salinity
Cavendish - Hooper low subsoil salinity	Levee (8, 12)	Hard-setting clay loam to light medium clay surface, weakly cracking, black and brown alkaline clay subsoils	Black and Brown Dermosols and Chromosol	Moderately well drained
Blenheim-low subsoil salinity	Back plain (7, 9 10, 11, 13, 14)	Self-mulching, moderately cracking clay surface, black and brown alkaline clay subsoils	Black Vertosol	Shrink swell can rupture roots, Imperfect drainage
Blenheim-moderate subsoil salinity	Back plain (1, 2, 4, 15, 16)	Self-mulching, moderately to strongly cracking clay surface, black and brown alkaline clay subsoils	Black Vertosol	Shrink swell can rupture roots, Imperfect drainage
Blenheim-high subsoil salinity	Back plain (5, 6)	Self-mulching, moderately cracking clay surface, black and grey brown alkaline clay subsoils	Black Vertosol	Shrink swell can rupture roots, Imperfect drainage, elevated subsoil salinity

Figure 7. 1:10,000 soil map of the Farm Investigation Area (showing sampling locations)



While the 1: 50 000 scale soil map (Figure 4) shows most of the Farm Investigation Area to be a Blenheim soil deep Black Vertosol[12], Figure 7 provides the finer resolution required in site specific soil survey when undertaking land assessment for irrigated crop production.

Figure 7 also shows the preferred area for the effluent irrigation area (Project Area)[13]. The Project Area comprises around:

- 40% Blenheim soil, brown and black vertosol with low subsoil salinity;
- 20% Cavendish soil, brown and black dermosol with low subsoil salinity;
- 20% Blenheim soil, brown and black vertosol with moderate subsoil salinity; and
- 10% Blenheim soil, brown and black vertosol with high subsoil salinity[14].

The first three of these soil types, which collectively comprise ≈90% of the Project Area, are referred to as Representative Soils (Table 3) in the remainder of this report.

[12] Laser levelling may have destroyed evidence of the Whiteway (Ww) soil mapped nearby, which is a deep Black Chromosol with a heavy clay loam surface. Once disturbed by cultivation, and levelling, mixing the topsoil and heavy clay subsoil results, causing this soil to become a Vertosol with Blenheim features.

[13] Definition of the Project Area is discussed further below.

[14] Noting that the terms 'moderate' and 'high' are gradations of a low subsoil salinity used to distinguish soil types and define 'a most sensitive' test for sensitivity testing in modelling.

Table 3: Representative Soil Types at the Project Area

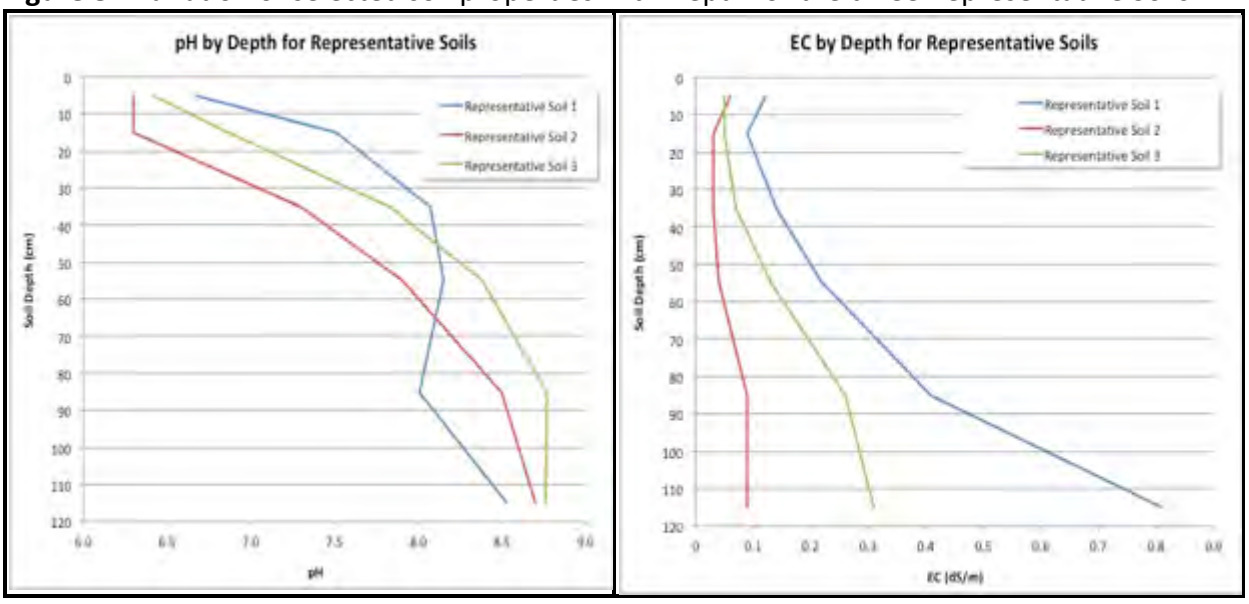
Representative Soils at Project Area	Figure 4 Soil Type
Representative Soil 1 [Sampling Site 1]	Blenheim soil - imperfectly drained black and brown Vertosols with moderate subsoil salinity [Red shading in Figure 4]
Representative Soil 2 [Sampling site 8]	Cavendish/Hooper soils - well drained black and brown Dermosols with low subsoil salinity [Blue shading in Figure 4]
Representative Soil 3 [Sampling Site 11]	Blenheim soil - imperfectly drained black and brown Vertosols with low subsoil salinity [Green shading in Figure 4]

Each of the Representative Soils was further sampled, using a composite of three cores, for analyses of the following by the Queensland Department of Sciences laboratory:

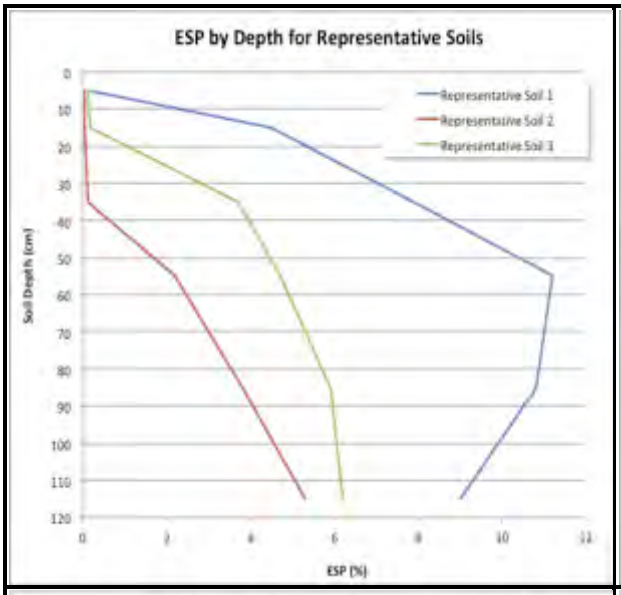
- ADMC, TN%, pH, EC, 15Bar, ECEC (effective CEC), Exchangeable Cations, ESP, PSA, R1, R2 at six depths (0-10cm; 10-20cm; 30-40cm; 50-60cm; 80-90cm; 110-120cm)[15];
- PBI Colwell (indication of max P storage capacity) and Colwell P at four depths (0-10cm; 30-40cm; 80-90cm)[16];
- Fertility - B, Cu, Fe, Mn, Zn, BSES-P, organic C, and Kjeldahl N on the surface samples on the surface samples[17];
- P Adsorption Isotherms at three depths (0-10cm; 30-40cm; 50-60cm); and
- Bulk density[18].

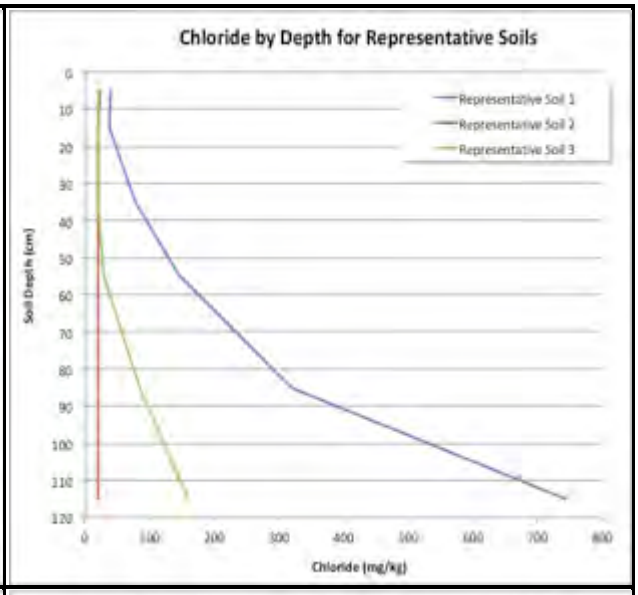
Detailed laboratory data for three sites representative of the area are presented in Attachment 2 and Figure 8.

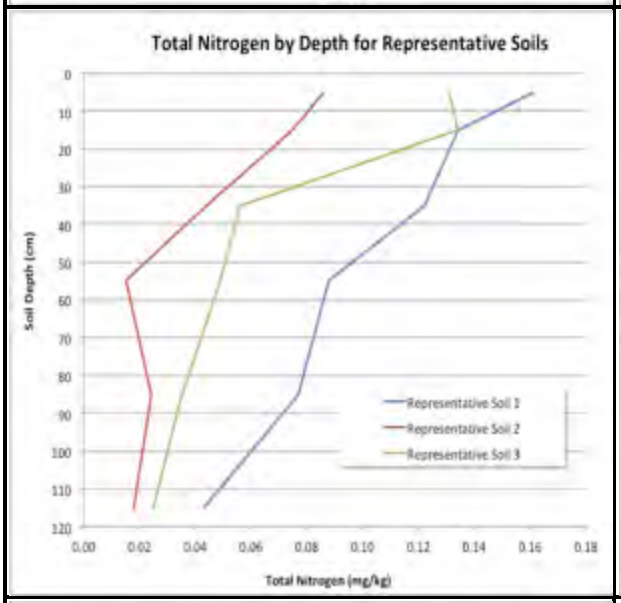
Figure 8: Variation of selected soil properties with Depth for the three Representative Soils

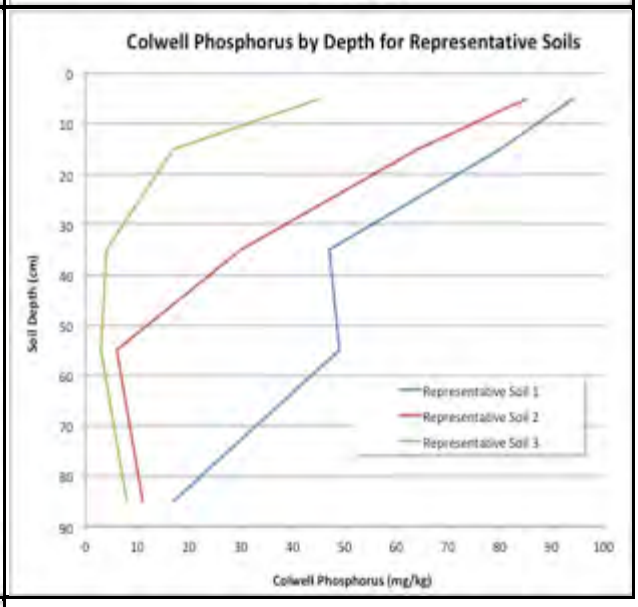


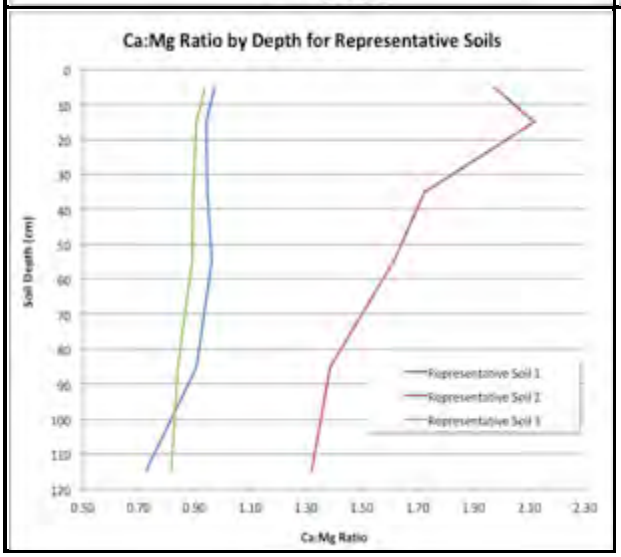
[15] Respectively, Average Dry Moisture Content, Total Nitrogen, Electrical Conductivity (1:5), Exchangeable Sodium percentage, Particle Size Analyses, R1 Dispersion Ratio, R2 Dispersion Ratio
[16] Respectively Phosphorus Buffering Index and Colwell Phosphorus
[17] 0-10cm; 30-40cm and 50-60cm depths
[18] 0-10cm; 20-30cm; 40-50cm; 60-80cm; 90-a00cm











Laboratory analysis shows that the Blenheim soils were high in clay (>45%) throughout the profile, had neutral to alkaline pHs, variable levels of subsoil salinity, slightly elevated

magnesium levels compared to calcium and small increases in Exchangeable Sodium in the subsoil. The soils higher in subsoil salinity have higher levels of Exchangeable Sodium Percentage (ESP>6) and were shown to have higher dispersion. The Blenheim soils exhibited relatively high magnesium concentrations, which may have implications for crop boron availability[19].

The lighter textured Cavendish-Hooper soil differed in that it had lower clay contents in the surface soil, a lower level of Mg relative to Ca and low levels of salinity.

Soil fertility testing in all the soils sampled showed high levels of P in the surface 0-20cm layers, and adequate levels of K, Ca, Mg and trace elements. Nitrogen levels were low and organic carbon levels modest. Measures of water retention showed high Plant Available Water Capacity (PAWC) for these soils.

Using both our field and laboratory analyses we assessed the suitability of the soils for irrigated production of trees native to the locality. All soils on the Project Area are considered to be suitable for irrigating blue gum (*Eucalyptus tereticornis*), the dominant pre-clearing species on both the Blenheim and Cavendish soil types (see next section). A small area of the Blenheim soils (around 10% of the Project Area) was observed in field testing to have higher subsoil salinity: From a precautionary perspective, this area is best suited to the establishment of trees tolerant of soil salinity, sodicity and waterlogging. Blue gum has these qualities[20].

Specifically, there are no obvious limitations to blue gum growth; though supplementary fertilising of nitrogen and boron at establishment may be desirable. Likewise, there are no significant risks with the proposed irrigation for soil structure; and this has been confirmed through SaLF modelling, particularly for the lower profiles of Representative Soil 1, which have marginal ESP at depth (see section on MEDLI modelling).

Scope Reference 3.1.2c: Flood risk

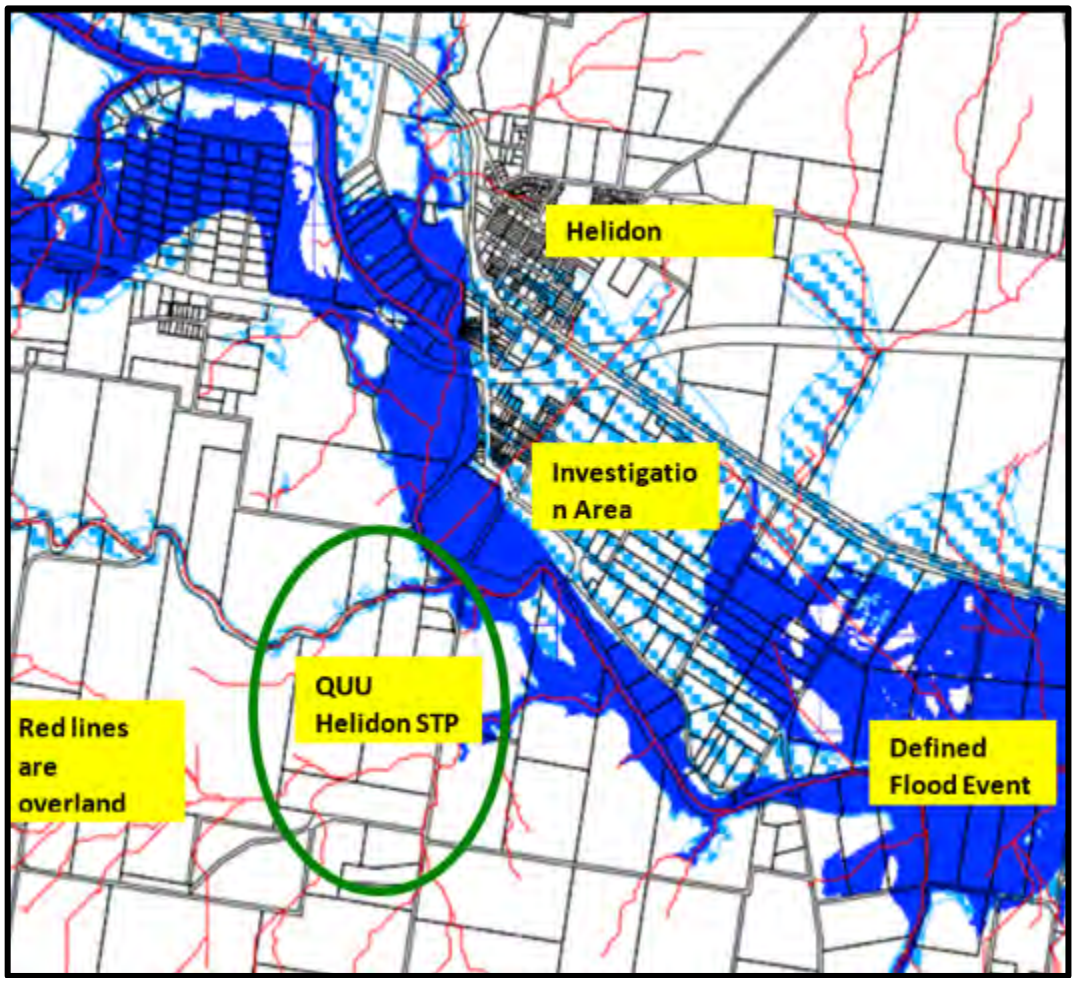
There is no detailed flood mapping of the Farm Investigation Area. Based on the 2011 flood records at Helidon (Insurance Council of Australia Hydrology Panel, 2011) and the mapped relative elevations, it was concluded that the Queensland Globe flood frequency expectations of circa every 40 years was likely to provide the best estimate of flood risk. The finding is consistent with expert eco-physiological interpretation of the site.

Despite this, Lockyer Valley flood mapping of the 2011 South-east Queensland floods does not suggest any serious inundation of the Farm Investigation Area (Figure 9)[21]. Floodwaters in Lockyer Creek during the 2011 event came from Murphys Creek, Fifteen Mile Creek, a number of westerly flowing creeks to the north of Helidon and from Rocky Creek, and that,

[19] A boron response in crops is often observed on more alkaline soils, such as the Blenheim soils at depth – see for example, https://www.jstor.org/stable/42607341?seq=1#page_scan_tab_contents
[20] Salinity management handbook 2nd Edition. Queensland Government 2011
[21] GSC Flood Map F1 - https://www.lockyervalley.qld.gov.au/our-services/strategic-planning/Pages/Flood-Regulation-.aspx

as a result, the limited flooding observed at the Farm Investigation Area would would most likely have been a function of backwater from Lockyer Creek and/or from the various flood lines that traverse the Farm Investigation Area (red lines Figure 9). The Figure 8 flood mapping is also consistent with QUU records, which do not show any significant damage / inundation at the STP during the 2011 Event; though it is recommended that this be tested with locals.

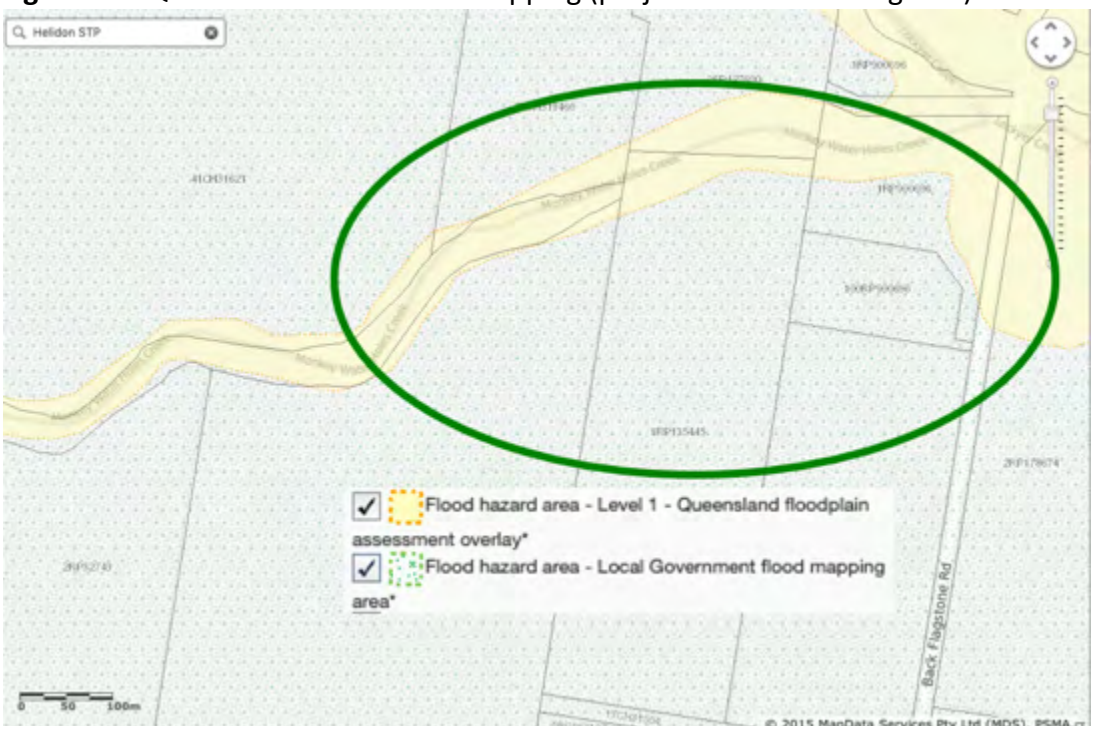
Figure 9: Lockyer Valley Regional Council flood mapping for the 2011 flood event



On balance, we are of the view that the Queensland globe estimate of flood frequency (circa 40 years) is reasonable. This view is also consistent with flood mapping on the Globe (Figure 10). The frequency and level of flooding expected at the Farm Investigation Stage would present no limitations to a regenerating blue gum crop (Salinity Management Handbook). The species is tolerant of waterlogging[22], salinity, sodicity and frost and is suitable for saline discharges.

[22] Blue gum is tolerant of periodic inundation providing the crown remains above the water line

Figure 10. Queensland Globe flood mapping (project area shown in green)



Scope Reference 3.1.2d: Pre clearing vegetation

The Queensland Government defines Regional Ecosystems (RE) as "*communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil*"[23]. The naming convention for RE has numeric codes for bioregion, land zone and vegetation. For the Helidon area, the bioregion is '12', 'South east Queensland' and the land zone is '3', 'recent Quaternary alluvial systems', which includes vertosols and dermosols. The vegetation is defined by the predominant strata.

For the Farm Investigation Area, four separate pieces of evidence indicate that blue gum (*E. teriticornis*) is the dominant strata:

a. Blue gum is recorded as the dominant species on Blenheim soils in the Soil and Land Suitability of the Lockyer Valley Alluvial Plains guide[24];
b. The Salinity Management Handbook details the tolerance of blue gum to the waterlogging and edaphic features of the Lockyer floodplains;
c. Periodic remnant blue gum trees can be still found in the landscape; and
d. Expert opinion of ecologists in the Planfuture team.

The RE type for the site is 12.3.3. The RE is variable, ranging from woodland in drier parts to tall open forest in higher rainfall areas and mono-specific to mixed with other canopy species. Based on the evidence sources detailed above, the pre-clearing RE at the Farm Investigation Area (12.3.3) would be blue gum dominated forests, tending towards mono-specific, but with representation of other tree species, including *Corymbia tessellaris*

[23] https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/framework
[24] Powell, B., Loi, J. and Christianos (2002). Qld Dept. Natural Resources and Mines. QNRM01215

(Moreton Bay Ash) and *E. melanophloia* (silver-leaf ironbark) and, more so on the levees than the floodplain, *E. crebra* (narrow leaf ironbark).

12.3.3 blue gum forests at the Farm Investigation Area would likely have been 20m – 30m, tall open forests, sometimes described as dry sclerophyll forest.

Two broad understory types may develop in open forest south of the Tropic of Capricorn. One is characteristic of the widespread infertile soils in the area and contains a dense assemblage of xeromorphic shrubs to 2 m tall and a ground layer that is poorly developed. The other, found on more fertile soils, is mostly herbaceous grasses, sedges and herbs with a poorly-developed shrub layer that may be absent altogether. Between areas of these extremes there are many places of intermediate soil type where the vegetation can be a mixture of both understory types. The likely understory type at Helidon is mostly herbaceous grasses, with limited understory shrub development. *Acacia salicina* is evident in the landscape and is likely to be the dominant shrub species where shrub existed.

Historically, traditional owners would, most likely, have managed the grassy understory of the tall open blue gum forests using periodic traditional burning practices to encourage grass eating fauna.

While blue gum remains common in the landscape, very few intact stands remain. The RE is an endangered vegetation management class with less than 10% of the pre-clearing RE extent remaining in 2017 (present area circa 40,000ha). It is important koala habitat. Blue gum itself will also develop into very large hollow-forming tree and has a special significance for fauna species, especially in drier area.

Blue gum will regenerate readily but there is a lack of recruitment to replace old trees in stands that are logged, thinned or grazed and regularly burnt. The grasses and herbs associated with intact blue gum communities also persist in the landscape, so there is a potential for re-establishing the RE and increasing its remnant area.

The site is well suited to regeneration of a blue gum dominant forest (see also Table 4 from the Salinity Management Manual.

Table 4. Tolerance of key species to potential growth constraints at the Helidon Farm Investigation Area

Potential Growth Constraint	**Blue Gum (*E. tereticornis*)**	**Moreton Bay Ash (*C. tessellaris*)**	**Sally Acacia (*A. salicina*)**
Soil Salinity	High	High	High
Water logging	High	Low	Low
Soil Sodicity	High	High	High
Frost	High	High	High
Suitability for saline discharge	High	-	Moderate

It is also noted that the levee along Monkey Water Holes Creek to the North of the Project Area has a small area of remnant vegetation and is listed as having a very small area of endangered Regional Ecosystem 12.3.10 (*E. populnea* woodland on alluvial plain). No *E.*

populnea has been observed on the levee. The levee is also essential habitat for *Phascolarctos cinereus* (Koala), as too is the remnant vegetation to the north of the Creek.

Other general land suitability matters

While Section 3.1.1 Scope of Works does not form part of this study, we have included a number of observations that can help inform a general land suitability assessment for the Farm Investigation Area:

- Lockyer Valley Regional Council advises that there are a number of animal (wild dogs) and plant (groundsel) pests that have established in the riparian area of Monkey Water Holes Creek. Council is working with landowners and QUU to control these pests. Neither pest places any constraint on the use of the Project Area for blue gum regeneration.

- The nearest neighbours appear to be circa 300m to the north and 400m to the east and south, with a shed around 150m to the north of the Project Area. This consideration will be relevant to the health assessment to be undertaken as part of the next stage of this project.

- The site is not mapped for State planning purposes as being transport infrastructure development, infrastructure development or economic development.

- The area to the north of Monkey Water Holes Creek is classified as medium potential bushfire risk and the area immediately at the northern boundary of the Project Area is a buffer area. Properly maintained and irrigated, the fire risk at the Project Area should be able to be minimised.

- The Farm Investigation Area is a Water Supply Buffer Area and Water Resources Catchment and, accordingly, the State Planning Policy—state interest guideline Water quality April 2016 applies[25] as follows:

    - Policy 6 (Planning for safe, secure and efficient water supply) and Policy 7 (Including requirements that development in water resource catchments is undertaken in a manner which contributes to the maintenance and enhancement (where possible) of water quality to protect the drinking water and aquatic ecosystem environmental values in those catchments), Item 6/7.4 states –*"Include planning and engineering measures to ensure development in identified water supply buffer areas and water resource buffer areas is planned and designed to manage stormwater and waste water in ways that minimise impacts on water quality. For example, an SEQ local government may reference the Seqwater Development Guidelines: Development guidelines for water quality management in drinking water catchments or include similar provision within relevant assessment codes or planning scheme policies."*

    - Policy 8 (For development in a water supply buffer area), Item 8.1 and Item 8.2 respectively state i*nter alia –"specific outcomes and measures contained in the Seqwater Development Guidelines: Development Guidelines for Water Quality Management in Drinking Water Catchments 2012" and "advice from the Queensland Bulk Water Supply Authority is sought where a reduced separation distance is proposed".*

[25] https://www.dlgrma.qld.gov.au/resources/guideline/spp/spp-guideline-water-quality.pdf

The matters addressed in Seqwater guidelines need to be considered by QUU in the next stage of this project; but with best practice effluent irrigation management should not pose any *a priori* risk.

- Presently all effluent is transferred to the large turkey dam[26] to the south of the STP, providing essentially the only source of water to the dam other than direct rainfall. The dam is frequented by a number of birds. The proposed effluent reuse project will reduce flow to the dam (wet weather flows to the dam will continue).

While QUU will need to investigate these further, none of the matters noted in this supplementary section should limit the suitability of the site to blue gum regeneration.

[26] The large turkey dam has a small nested dam, into which QUU effluent is transferred, with any overflow moving to the larger component of the turkey dam.

Phase 2 – Assessment of Offsetting Potential

Summary

Queensland Urban Utilities (QUU) is seeking advice on the potential for effluent reuse at the Helidon STP, "*which supports re-establishment of native vegetation and provides an affordable and non-resource intensive irrigation solution*". To this end, in 2018 QUU prepared the Helidon STP Effluent Reuse Scope of Services[27] (Helidon Effluent Reuse Scope), which defined six Phases of work required to develop and define a reuse project.

This section addresses the Phase 2 schedule of works – the potential to establish native vegetation that could qualify for vegetation, carbon and/or biodiversity offset credits. Specifically, it reports upon the matters addressed in Section 3.2 of the Helidon Effluent Reuse Scope, which includes undertaking a scan of potential offsets, providing a recommendation regarding the native vegetation crop, providing an indication of offset value and advising upon how to optimise the value of any offset to QUU.

Planfuture has assessed the potential of the Project area to deliver carbon and Queensland and federal environmental offsets.

While the Project will deliver carbon offsets, the value of these offsets is unlikely to offset the transactional costs of dealing with the offsets. Despite this, it may be appropriate for QUU to 'use' these carbon offsets internally to meet any corporate carbon targets.

There is greater potential for the Project Area to realise State environmental offset benefits. There are a number of mapped State Maters of Environmental Significance (SMES) along (and to the north of) Monkey Water Holes Creek, which abut the Project Area. We conclude that the Project Area has significant potential to generate environmental offsets for both Endangered Ecosystem (RE 12.3.3) and koala habitat.

The environmental offsets generated at Helidon could be utilised by either QUU, as Proponent driven offsets to meet any offset obligations incurred by QUU (e.g. through unavoidable clearing to lay pipes) or as a supplier of offsets to a third party that has an environmental offset obligation. We estimate that regeneration of 4ha of RE12.3.3 and koala habitat at Helidon may offset 1.0ha of RE 12.3.3 clearing and 1.34ha of koala habitat clearing may have a value of $260,000.

Planfuture's recommendation to QUU is to regenerate the pre-clearing blue gum community (RE 12.3.3) at the Project Area, using local genotypes wherever possible. It is recommended that trees be established on a 5m x 5m grid, equivalent to 400 trees/ha, with a species split of 90%, 5% and 5% blue gum (*Eucalyptus tereticornis*), silver-leaf ironbark (*E. melanophloia*) and Moreton Bay ash (*Corymbia tesselaris*) respectively. As the present unimproved pasture includes some native species, including the most commonly occurring small shrub in the RE, *Acacia salicina*, no specific regeneration effort for the understory is recommended.

[27] Queensland Urban Utilities Helidon STP Effluent Reuse Scope of Works November 2018.

Planfuture recommends that the Project Area be registered as an advanced offset as soon as practicable after QUU commits to the effluent irrigation project. Registering an area as an advanced offset under the *Environmental Offsets Act 2014* ensures that QUU will benefit from any habitat quality gains made at the Project Area (advanced offset) after the date of registration; rather than from the time of entering into an Agreement to use the Advanced Offset to deliver a specific offset condition. Registering an advanced offset does not obligate QUU to either proceed with the offset or to improve the land in the time between it being registered as an advanced offset and being selected to deliver an offset.

In order to proceed with an advanced offset application, QUU will need to undertake a baseline habitat quality assessment of the site, using the Guide to Determining Terrestrial Habitat Quality. The baseline assessment is used to measure improvements in habitat quality. The application for registration should be made using relevant Department of Science forms for a Notice of election, Offset Area Details and Habitat Quality Details.

We note that the management plan and implementation plan for the Project Area (Helidon Effluent Reuse Scope 3.6 and 3.6.2 respectively), will need to support the offset by contributing to the improvement of habitat quality. To optimise the value of the environmental offsets, management inputs will need to be crafted so that both koala habitat and endangered RE offsets are achieved. It would be prudent to work closely with the Department of Science throughout both the registration stage and in the development of the management and implementation plans.



Introduction

This section deals with the Phase 2 Scope of Works and assesses the potential of the Project Area for offsetting.

QUU is seeking an effluent reuse strategy for the Helidon STP, "*which supports re-establishment of native vegetation and provides an affordable and non-resource intensive irrigation solution*"[28]. In delivering these outcomes, QUU is also seeking to assess the potential to establish native vegetation that could qualify for vegetation, carbon and/or biodiversity credits. Specifically, in this Phase 2 schedule of works, QUU is seeking guidance in relation to the tasks summarised in Table 5.

Table 5: Tasks required to assess offsetting potential

Scope Reference	Task
3.2.1	Undertake a scan of (and summarise) key native vegetation regeneration offsetting opportunities relevant to the Farm Investigation Area, including carbon sequestration, biodiversity, vegetation credits and any other recognised Queensland Government arrangements
3.2.2	Having regard to the findings of 3.1 and 3.2.1, recommend a preferred – – species/community for native vegetation regeneration – location on the Farm Study Area for effluent reuse
3.2.3	Assess the value of the offsetting potential
3.2.4	Provide recommendations for optimising the value of identified offset(s)

Scope Reference 3.2.1: Scan of offsetting opportunities

The key broad offsetting opportunities are summarised below -

i. Carbon offsets

The National Carbon Offset Standard[29] (Standard) details a voluntary framework by which individuals and organisations can manage their greenhouse gas emissions and to achieve carbon neutrality (viz. when nett emissions from a project, process or entire organisation have been reduced to zero).

Business can achieve nett zero emissions through one, or a combination of, reducing energy usage, adopting energy efficiency initiatives and, then, using carbon credits to compensate for any remaining emissions. In Australia the Standard details the different types of carbon credits and activities that can generate these credits.

The most relevant of the carbon credits for QUU's effluent reuse / native vegetation regeneration project at Helidon is the 'carbon farming initiative', which is set up under the Federal Government's Emissions Reduction Fund (Fund), which in turn is administered by

[28] Queensland Urban Utilities Helidon STP Effluent Reuse Scope of Works November 2018.
[29] https://www.environment.gov.au/climate-change/government/carbon-neutral/ncos

the Clean Energy Regulator[30]. The Fund is established by the *Carbon Credits (Carbon Farming Initiative) Regulations 2011* and the Carbon Credits (*Carbon Farming Initiative) Rule 2015* pursuant to the *Carbon Credits (Carbon Farming Initiative) Act 2011*.

Participants in the Fund can earn Australian carbon credit units (ACCUs) for eligible activities leading to emission reductions. One ACCU is earned for each tonne of carbon dioxide equivalent stored or avoided by an eligible activity. ACCUs can be sold to generate income, either to the government through a carbon abatement contract or to third parties in the secondary market.

The rules for quantifying (and monitoring delivery of) carbon credits for each eligible activity are detailed in various 'methods' guidelines; the most applicable of which to the proposed QUU revegetation/forestry project are likely to be the 'reforestation and afforestation 2.0' or 'reforestation by environmental or mallee plantings' methods.

For QUU, there are two possible uses of any carbon offsets that might be generated through the establishment of native vegetation at the Helidon STP: The latter would require that the relevant monitoring protocols in the 'methods' guidelines are incorporated into the scope of works for managing the regenerating forest:

a. Utilising the carbon offset to help achieve any internal policies for either reducing the company's carbon emissions and/or for achieving nett carbon emissions neutrality. This use of the carbon credits could assist QUU in meeting any voluntary carbon targets consistent with its internal carbon accounting policies and rules.

b. Participating in the Fund to sell the carbon offsets as a revenue source.

It is likely that the potential for the second of these will be limited. There are, in addition to any requirements imposed by the relevant applicable method, two specific limitations to the value of carbon offsets at Helidon for use as reforestation-based carbon credits:

a. Uncertainty regarding the long-term availability of the Fund. Over the last 12-15 years, Australian Government carbon policy has been characterised by uncertainty and change. Pubic and corporate concerns about the nation's capacity to meet its Paris Agreement (United Nations Framework Convention on Climate Change) and political disagreement over the efficiency of the present policy milieu pose a risk of future policy instability and uncertainty. While extant arrangements made under the Fund may be grandfathered in any future policy change, policy uncertainty represents a significant unknown for QUU.

b. Limited quantity of credits from Helidon. Given the small scale of the proposed re-establishment area at Helidon (circa 5 ha), carbon sequestration is likely to be modest[31] and unlikely to warrant the transaction costs of participating (selling) in the Fund.

[30] In February 2019, the Australian Government established the Climate Solutions Fund to extend the Emissions Reduction Fund - https://www.environment.gov.au/climate-change/government/emissions-reduction-fund

[31] While the appropriate Fund method details the assessment protocols that QUU would need to use (and evidence standards that would need to be demonstrated) were it to claim ACCU for the project, an *a priori* estimate of carbon sequestered would be say 5-8 tonnes/ha/yr over 25 years, which at the present ACCU value (circa $12/ACCU), would represent a value of ≈$6,000-$10,000 for 4ha of plantings.

In May 2018, the Queensland Government announced a $500 million Land Restoration Fund (LRF) that aims to expand carbon farming in the state by supporting land-sector projects that deliver environmental and economic co-benefits and research and development into emerging areas where Queensland has a comparative advantage to establish new carbon farming methods.

At this stage, the administrative arrangements of the fund are being developed: It is presently in its 'pilot' phase, with a small amount ($4M) of funding being made available for 'catalysing action'. One of the criteria for this funding is "testing the application of innovative funding models to projects or demonstrate how investment barriers may be overcome": The project area may be of interest in this regard (with an emphasis on incentivising small investment).

In preliminary discussions with Planfuture, the Fund administrators has indicated the fund may be interested in the Helidon project; though the relatively small scale may be a challenge. It is suggested that an early discussion is held with the LRF to decide whether further investigation is worthwhile.

ii. Environmental offsets

Queensland

The *Environmental Offsets Act 2014 (Qld)* established a single framework for offsets in Queensland. The Act provides for the development of the Queensland Offsets Policy[32] (Policy) as a statutory instrument[33], which together with the Act and the *Environmental Offsets Regulation 2014* comprise the Framework.

Under the Framework, an environmental offset is used to counterbalance a 'significant residual impact' of a 'prescribed activity 'on a 'prescribed environmental matter', where –

- a prescribed activity is defined by the Act and includes the matters detailed in Schedule 1 of the *Environmental Offsets Regulation 2014* (e.g. development for which an environmental offset may be required under a State Code such as State Code 16 Native Vegetation Clearing[34)];
- a significant residual impact, has or is likely to have, a permanent adverse impact (direct or indirect) on all or part of a prescribed environmental matter; and
- a prescribed environmental matter is any of the following matters prescribed under a regulation to be a prescribed environmental matter of—
  - National environmental significance;
  - State environmental significance; or
  - Local environmental significance.

[32] https://environment.des.qld.gov.au/assets/documents/pollution/management/offsets/offsets-policyv1-6.pdf

[33] The framework also provides scope for reducing duplication of offsets requirements under State, Federal and Local mechanisms enabling a proponent to request removal of Offset requirements if they substantially overlap an offset obligation applied under another power.

[34] https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0010/1258075/state-code-16-veg-clearing-guide.pdf

The Framework may require that an entity needs to provide an offset for a 'prescribed matter' if it is unable to avoid or mitigate impacts on a protected matter and there is a significant residual impact on a protected matter. At the highest level, there are two environmental offset options:

a. direct or proponent driven offsets; or

b. financial payment to a fund administered by the Department of Environment and Science.

With respect to the first of these, the Policy notes that:

- the offset is to be delivered on land that may be –
  - owned by the proponent, or
  - owned by an offset provider who contracts with the proponent for the delivery of the offset;
- in the case of a land-based offset –
  - the most strategic location to achieve a conservation outcome (in order of preference) is the same local government area, the same sub-region and the same bioregion[35], and
  - the suitability of the offset site relative to the impact site and the prescribed environmental matters is measured through undertaking a habitat quality analysis[36]; and
- the proponent may use an advanced offset where it meets the requirements of the policy[37] for the impacted prescribed environmental matter and where it is legally secured by the proponent or a third party for the life of the impact.

For QUU there are two broad environmental offset opportunities:

a. Proponent driven offset where QUU is the proponent. In this instance, the offset meets an obligation incurred by QUU (e.g. in unavoidable clearing needed to lay pipes). To be eligible the Helidon regeneration would need to result in a conservation outcome (equivalent to the value being lost) for the impacted prescribed environmental matters.

b. Supplier of environmental offsets to a third party who may incur an environmental offset obligation (e.g. for impacting prescribed environmental matters) for the conservation outcomes being delivered at the Helidon regeneration area.

Importantly for QUU, both of these opportunities can be realised by registering the Helidon regeneration area as an advanced offset (see Plate 1).

Interrogation of the State's mapping of Matters of State Environmental Significance (MSES) indicates that the site may be suitable for a koala (and other) habitat offset (see discussion below), endangered Regional Ecosystem (RE) types, and other regulated vegetation types prescribed under Schedule 2 of the *Environmental Offsets Regulation 2014* (Attachment 4).

[35] The Policy also notes a preference that offsets be delivered with a designated Strategic Offset Investment Corridor: As yet, these are still being developed.

[36] The Guide to Determining Terrestrial Habitat Quality may be used for regional ecosystems and endangered, vulnerable, near threatened or special least concern species offsets (including advanced offsets) to undertake this analysis. It references a web-based tool, the Land-based Offsets Multiplier Calculator, which compares the habitat quality of an impact and offset site to determine environmental equivalency and can be accessed at - https://www.qld.gov.au/environment/pollution/management/offsets/delivering-proponent.

[37] See Appendix 5 of the Policy

While fauna surveys have not been conducted as part of this work, a desktop analysis highlights that there are a number of Wildnet records for endangered and vulnerable fauna species (Koalas and Glossy Black Cockatoos) within a 2km radius of the site. Additionally, the large block of vegetation to the north of the site is listed as 'essential habitat' for Koalas. In order to optimise the value of any vegetation offsets, the proposed native forest regeneration (and its management) can be designed to maximise the habitat value of the site for endangered and vulnerable fauna[38].

From QUU's perspective, registering the regeneration as an advanced offset and managing the site to provide an environmental offset opportunity may provide future vegetation offset value to QUU. The regeneration plantings (and management) at the Helidon STP have the potential to expand the extent of endangered REs and provide habitat for endangered and vulnerable species. Specifically, the site may have value in meeting environmental offset obligations under the Framework both:

- for endangered regional ecosystems of the same broad vegetation group (as the impacted regional ecosystem) of the same ecosystem status and within the same bioregion; and
- for vulnerable wildlife under the *Nature Conservation Act 1992* that the site will be capable of containing as a sustaining population.

A conceptual process map of how the advanced offset value might be realised is provided at Plate 2.

While it is not possible to guarantee that there will be a demand for offsets, either by QUU or by a third party[39], a proponent with an environmental offset obligation could negotiate with QUU to buy the regenerating environmental values (the subject of the Advanced Offset), thereby entitling QUU to a landholder incentive payment. The quantum of any incentive payment is determined by negotiation. Despite this, the Queensland Government environmental offset calculator[40], which is used to determine the value of an offset if a proponent chooses to make the financial payment, provides a useful guide to value (Plate 3)[41].

The calculations in Plate 3 assume that the regeneration area at Helidon will be 4ha. If the actual regeneration area is 5ha of endangered RE 12.3.3, then the combined Endangered Habitat and Koala Habitat would be circa $322,000, which would offset 1.25ha of RE 12.3.3 clearing and 1.67ha of koala habitat loss.

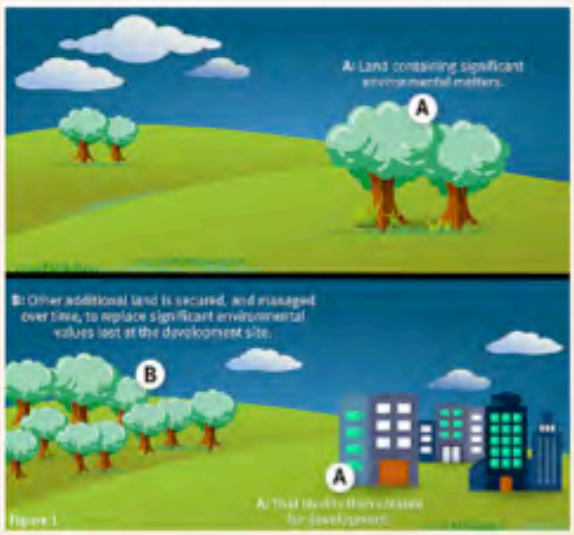
[38] http://qldspatial.information.qld.gov.au/biomaps/

[39] Third parties can comprise developers, brokers or governments

[40] https://apps.des.qld.gov.au/offsets-calculator/

[41] Most entities that are incurring an offset obligation are choosing to make a financial payment rather than deliver a land based offset – https://www.qld.gov.au/environment/pollution/management/offsets/registers. It is likely that this is because the financial payment is less than the total costs of land based offsets: For this reason, the calculator may provide a reasonable guide to the realised value of an offset.

Plate 1: Advanced offsets pursuant to the *Environmental Offsets Act 2014*



Advanced offsets may be used as an offset to compensate for a future significant residual impact on one or more prescribed environmental matters

An *advanced offset* is an area of *land* that has been identified and registered under section 14 of the *Environmental Offsets Regulation 2014* as an *advanced offset*

When establishing an advanced offset, QUU has discretion how the advanced offset is managed to achieve a conservation outcome and does not need to submit an offset delivery plan or legally secure the site – QUU can change its mind

This changes when the advanced offset is identified to deliver a specific offset condition, when the site and management must comply with the Offsets Policy. However, administering agency must consider any conservation outcome achieved for the prescribed environmental matter/s from the date that the advanced offset was recorded in the offsets register

Plate 2: Use of an Advanced Offset

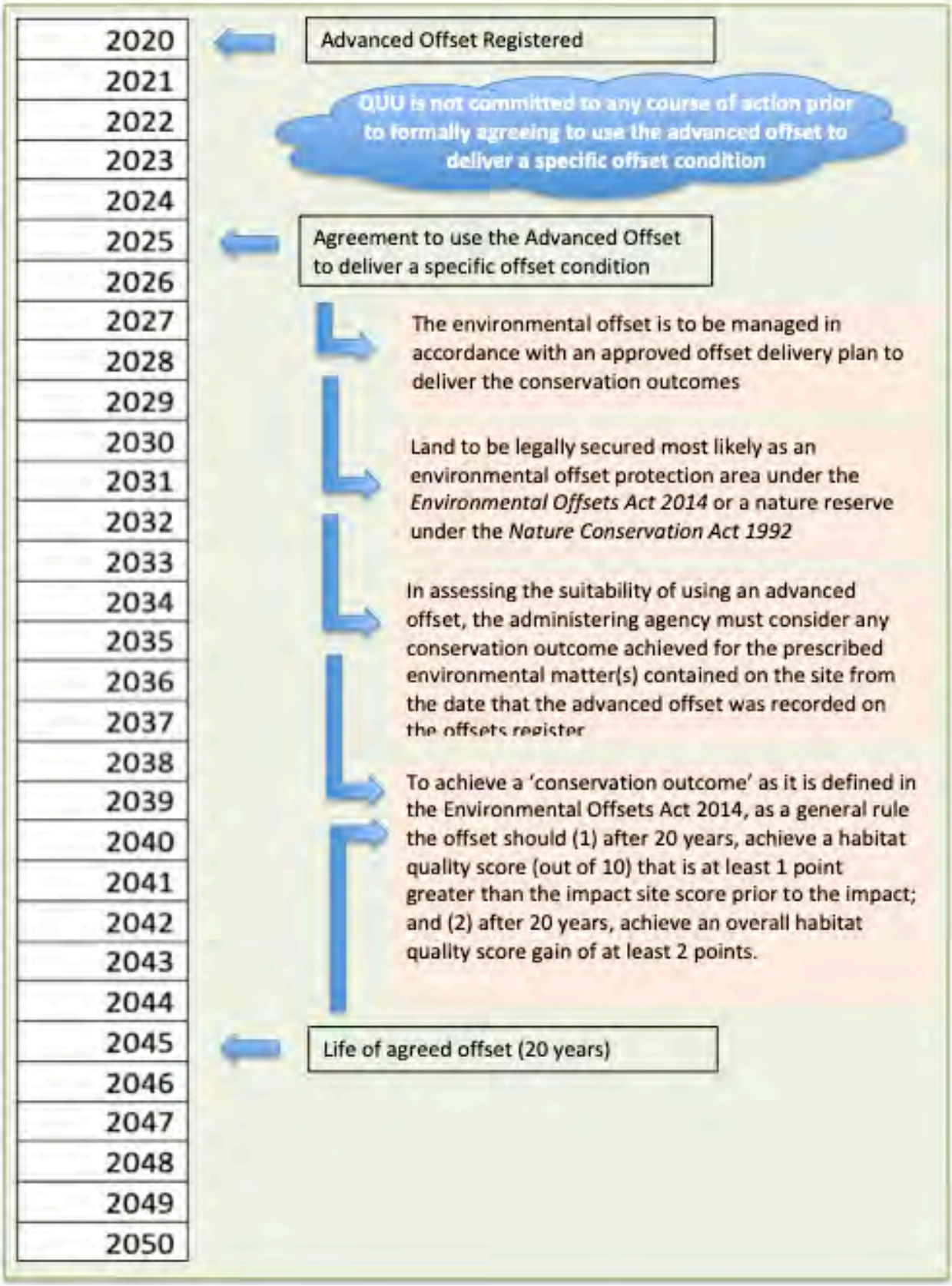
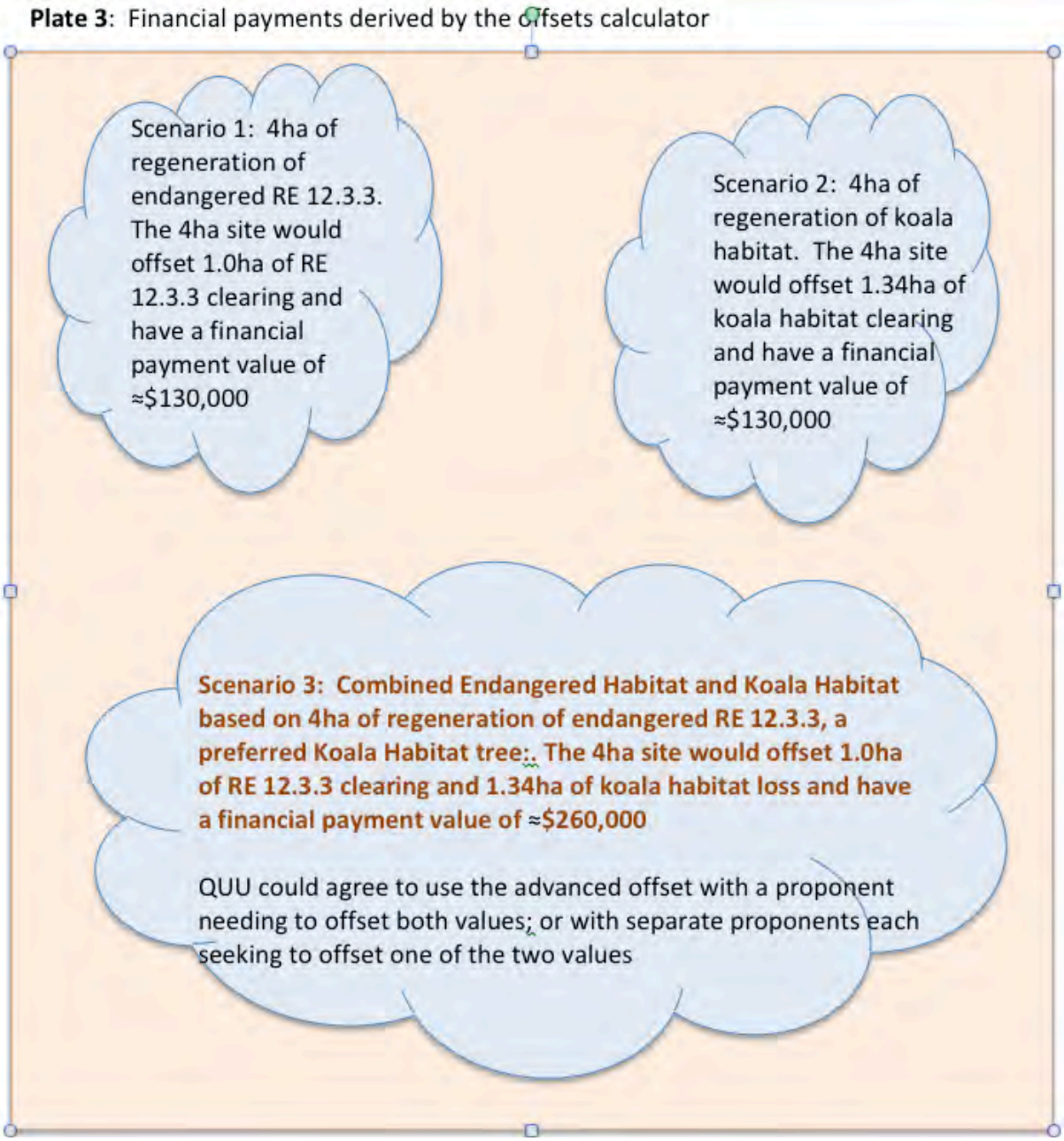


Plate 3: Financial payments derived by the offsets calculator



A rational approach for QUU would be to register the site as an advanced offset for both endangered RE 12.3.3 and for koala habitat. QUU's management plan for the advanced offset would need to include plans and actions that address both of these values.

While environmental offsets represent an opportunity for QUU, it is important to be cognisant of the risks:

a. Demand uncertainty. The demand for land based environmental offsets is unknown, with the key drivers being the relative cost to a developer of making a financial payment for an offset obligation *vis-à-vis* delivering a land-based offset, and the extent of vegetation clearing scenarios that do not attract an offset obligation[42]. In relation to the latter, offset obligations

[42] It is likely that these reasons underpin the relatively low number of registered advanced offsets (presently only eight - https://www.qld.gov.au/environment/pollution/management/offsets/registers.

only arise from the clearing of certain vegetation, not all vegetation. The list of excluded clearings include clearing that does not require approval[43] or clearing conducted pursuant to an accepted development vegetation clearing code[44], an area management plan[45] or a specific development approval[46]. It is unlikely that community preference would support further weakening of environmental offset obligations and, indeed, it may be that the obligations strengthen over time as public concern for vegetation and habitat loss rises[47]; nonetheless, the question of demand uncertainty remains[48].

b. Value for money. As noted in Plate 3, properly designed and managed, the regenerating vegetation at Helidon will have a value. However, to realise the value, QUU will also need to incur (some modest) registration and monitoring costs (Plate 4): Properly managed, the nett benefit to QUU should be in the vicinity of $250,000.

A priori, with the present policy settings, the cost of delivering an Advanced Offset of the nature proposed for the Helidon STP will exceed the potential value of the Advanced Offset. Indeed, it would be difficult for landowners to justify development of advanced offsets unless delivery of the offsets aligns with other priorities of the landowner. This is the case for QUU at the Helidon site: The value of the regeneration as an Advanced Offset is unlikely to counter-balance establishment and management costs. That said, QUU has other obligations for establishing irrigated regeneration at the site, including ensuring compliance with the Environmental Authority and putting effect to the Corporation's recycling vision, which mean that the potential environmental offset values may provide a positive externality that complements other imperatives for undertaking the project (and justifying the native forest crop selection).

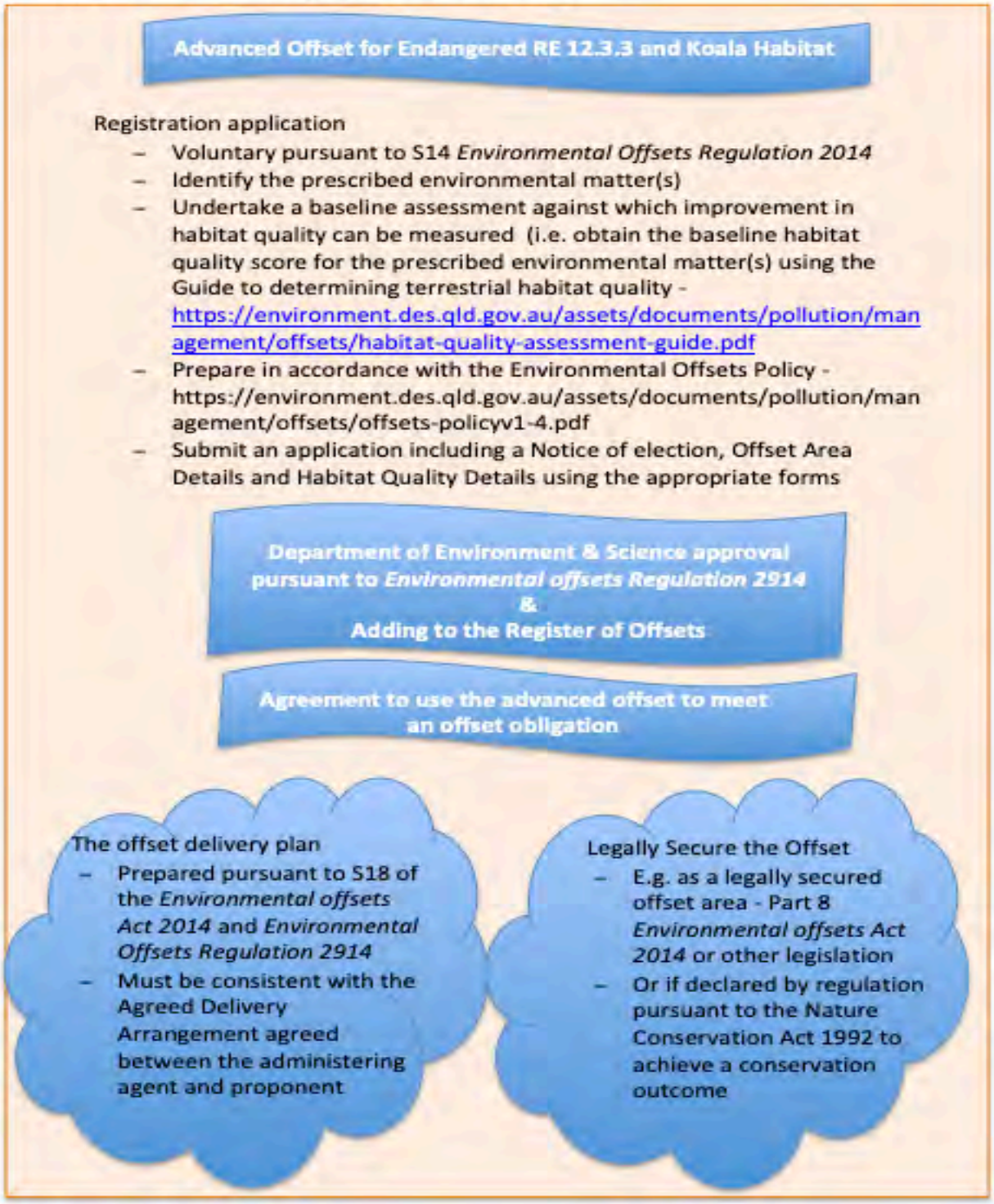
This is particularly the case given that QUU itself may need to clear non-exempt vegetation from time-to-time: If it does and there is an alignment of the environmental values, then QUU could use the Helidon regeneration as a land-based solution to meet its own vegetation offset obligation.

Importantly, as observed in Plate 2, there is a 'dip your toe in the water stage' for QUU. Registration of the advanced offset is relatively straightforward, with few costs[49]. The larger transactional costs would be incurred if (and when) QUU agrees to use the advanced offset to deliver a specific offset obligation – including preparing a management plan, securing the land and managing the land to achieve the desired conservation outcome. QUU would not proceed with such an arrangement, which may happen a number of years after registration (Plate 2), unless the benefits exceeded the transactional costs. In summary, registering the Helidon regeneration site as an advanced offset pursuant to the *Environmental Offsets Act*

[43] https://www.qld.gov.au/environment/land/vegetation/exemptions/
[44] https://www.qld.gov.au/environment/land/vegetation/codes/
[45] https://www.qld.gov.au/environment/land/vegetation/area-plans/
[46] https://www.qld.gov.au/environment/land/vegetation/applying/
[47] See for example - ttps://www.brisbanetimes.com.au/national/queensland/developers-paid-4-6-million-in-koala-offset-payment-to-clear-bushland-20190319-p515ll.html
[48] It is noted in this context that, an offset for koala habitat must be in the same local government area: A value proposition for QUU is that the Helidon advanced offset would be the only advanced offset registered in the Lockyer Valley Regional Council area.
[49] This is particularly case if the site is used to deliver endangered RE 12.3.3 offsets. Habitat quality assessments may need to be more detailed to optimise the value of the site for endangered/vulnerable fauna.

2014 would be strategic, with low risk and cost, and potentially modest benefits (particularly if QUU itself is likely to require offsets in the future).

Plate 4: Comments on managing the advanced offset



It is also noted that, if QUU does not agree to use the advanced offset to deliver a specific offset obligation for a number of years after planting (as in the Plate 2 example, when agreement is shown as happening in 2025), then it may be that a gain in RE/habitat quality

will be evident at that time, providing greater confidence that the offset will succeed in achieving the required conservation outcome[50].

As a final point, advanced offsets are subject to an additionality requirement: They must deliver a conservation benefit for the impacted protected matter that would not have occurred in a business-as-usual scenario (i.e. delivery of the advanced offset cannot be required by an existing obligation). While QUU has an obligation to manage effluent in accordance with its Environmental Authority, it has no existing obligation to re-establish the endangered habitat; and, accordingly, the additionality test is met.

Planfuture recommends that QUU consider registering the Helidon regeneration site for endangered ecosystem RE 12.3.3 and koala habitat. While the Glossy Black Cockatoo has been recorded within the vicinity of the Helidon site, the specific vegetation community at Helidon (RE 12.3.3) does not include Casuarinas, one of the Glossy Black Cockatoo's preferred foods (though they also feed on eucalypt seed): While QUU could revisit this issue in the future, it is recommended that the site not initially be registered for Glossy Black Cockatoo habitat.

QUU's submission for registration the Helidon regeneration site for endangered ecosystem RE 12.3.3 and koala habitat should leverage the Matters of State Environmental Significance (MSES) along Monkey Water Holes Creek and to the north of the Creek (Attachment 4). These include wildlife habitat, remnant vegetation status, regional biodiversity value, essential habitat and intersecting a watercourse. This juxtaposition of significant MSES with the northern boundary of the Farm Investigation Area will enhance the value of any potential offset.

Federal

The Federal Environmental Offsets Framework is defined in the *Environment Protection and Biodiversity Conservation Act 199*9 (EPBC Act) and the EPBC Act Environmental Policy.

The EPBC Act is the Australian Government's principal piece of environmental legislation. It is designed to protect national environmental assets, known as matters of national environmental significance, and other protected matters.

If a proposed development or other action ('proposed action') is likely to have a significant impact upon a protected matter, then it must be referred for assessment under the EPBC Act.

If offsets are required for developments, they are determined having reference to the EPBC Offsets Policy released on October 2012. Under the EPBC Act Environmental Offsets Policy[51], environmental offsets are measures that compensate for the residual adverse impacts of an action. Offsets should counterbalance the residual impacts that remain after avoidance and mitigation measures have been implemented on the site. For assessments under the EPBC Act, offsets are only required if the residual impacts are significant.

[50] This may also reduce the amount of time it takes to acquit an offset management obligation
[51] http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy

An offsets package is defined in the EPBC Offsets Policy as a suite of actions that a proponent undertakes in order to compensate for the residual significant impact of a project. The Federal framework allows for direct offsets (actions that provide a measurable conservation gain such as creating new habitat), other compensatory measures (non direct impacts that will provide a benefit such as research) and Advanced offsets (a supply of offsets for potential future use, transfer or sale)[52].

The operations of the EPBC Act Advanced Environmental Offsets[53] is similar to that detailed above for the State scheme. Like the State scheme, EPBC Act advanced offsets need to be rigorously planned and monitored to demonstrate the conservation benefit that will be delivered for the relevant protected matter, which will be determined using the EPBC Act Offset Policy.

If QUU wished to pursue an EPBC Act Advanced Offset, it could notify the Department of Environment that it is about to commence an advanced offset. The advanced offset is not actually approved until the assessment stage when deciding whether to approve a specific action under the EPBC Act.

If QUU proceeds with registering the Helidon regeneration as an advanced offset under the State scheme, it would also be prudent to notify the federal Department of Environment of the intent to commence an advanced offset at that time.

Scope Reference 3.2.2: Preferred Native Vegetation Regeneration

This section takes the findings of the Phase 1 section (Scope Reference 3.2.2 – site suitability analyses) and Scope Reference 3.2.1 (offset potential) to recommend the species / community for native vegetation regeneration on the Farm Study Area and to recommend the planting area (Project Area).

As noted in the Phase 1 section of this report:

a. The pre -clearing RE for the Helidon site is 12.3.3 – *E. tereticornis* (blue gum) dominated open forest over a largely grassy understory -
   - While blue gum would have been largely mono-specific in the Project Area, especially the floodplains, other species that may have been present as scattered individuals or clumps, particularly associated with the levee, include *Corymbia tessellaris* (Moreton Bay Ash) and *E. melanophloia* (silver-leaf ironbark), and potentially *E. crebra* (narrow-leaf ironbark). Trees are likely to have reached heights of 20+m, and would have been typical of the dry sclerophyll forest type. The understory would have been one of mostly herbaceous, grasses, sedges and herbs with a poorly developed shrub layer

[52] http://www.environment.gov.au/epbc/publications/policy-statement-advanced-environmental-offsets-under-epbc-act
[53] http://www.environment.gov.au/system/files/resources/4f43c926-4b92-4e87-99ce-e44dbe132f6b/files/advanced-offsets-policy-statement.pdf

that may have be absent altogether. To the extent that understory / mid story species were present, it would most likely have been *Acacia salicina*.

- Blue gum is a habitat for the threatened species, *Phascolarctos cinereus* (koala).
- Blue gum may grow into a very large hollow-forming tree and has a special significance for fauna species, especially in drier areas.
- Almost certainly, aboriginal care of the land would have involved traditional burning practices that would have mitigated against the development of a thick shrub layer and promoted development of understory grasses.
- While blue gum remains common in the landscape, very few intact stands remain. The species will regenerate readily; but there is a lack of recruitment to replace old trees throughout much of the landscape due to harvesting, grazing and inappropriate burning. Additionally, the grasses and herbs associated with intact blue gum communities also persist in the landscape, so there is a potential for re-establishing the RE and increasing its remnant area.

b. The site suitability analysis confirms that the Project Area is highly suited to blue gum regeneration. Moreover, the species is well suited to irrigation with slightly saline effluent (Table 6[54]).

Table 6. Tolerance of key species to potential growth constraints at the Helidon Farm Investigation Area

Potential Growth Constraint	**Blue Gum (*E. tereticornis*)**	**Moreton Bay Ash (*C. tessellaris*)**	**Sally Acacia (*A. salicina*)**
Salinity	High	High	High
Water logging	High	Low	Low
Sodicity	High	High	High
Frost	High	High	High
Suitability for saline discharge	high	-	Moderate

Planfuture's recommendation to QUU is to regenerate a pre-clearing blue gum community (RE 12.3.3) at the Project Area, using wherever possible, local genotypes[55]. Specifically, it is recommended that trees be established on a 5m x 5m grid, equivalent to 400 trees/ha, with a species split of 90%, 5% and 5% blue gum, silver-leaf ironbark and Moreton Bay ash respectively. Given the dominance of blue gum in this RE, tree crop modelling is based on blue gum.

Establishment of any understory shrubs is not recommended. *A. salicina* is presently found on the Farm Investigation Area as either scattered individuals or clumps (Plate 5). No specific management for the Acacia is recommended.

[54] Salinity management handbook 2nd Edition. Queensland Government 2011. There is no available data for silver leaf ironbark. MEDLI and SaLF modelling in Phase 3 will confirm the suitability of blue gum for effluent irrigation.

[55] Local genotypes (preferably collected from multiple - > 10 seed trees – will optimise the Project Area's offset and biodiversity value and assist in minimising the risks of establishing genotypes that are poorly suited to the Helidon environment.

Plate 5: Regenerating *Acacia salicina* in the Farm Investigation Area with vegetated land containing Matters of State Environmental Significance to the north of Monkey Waterholes Creek



No specific agronomy is recommended for the existing unimproved grass crop, which includes a number of native species: Specifically, enrichment planting with improved pasture species and/or over-sowing with winter annuals are not recommended. Ultimately, the understory (predominately grassy) will be an important component of the regenerating RE. However, the regenerating tree crop will have a significant and evolving impact on the understory. In essence, understory (grass) biomass will be greatest when the tree crop is juvenile and will decrease as the tree crop reaches canopy closure (leaves of neighbouring trees touching each other). The reduced light penetration and more moderate environment at ground level afforded by shading and the trees acting as a windbreak, will impact upon both understory growth and species composition.

Irrigation will also impact upon understory growth (increasing growth) and species composition (favouring less drought hardy species). An understory more akin to that expected in the pre-clearing RE will emerge after 20 years when irrigation with effluent ceases. [While providing an overview of the forest management required for Helidon is not a component of the present assignment, it is recommended that, at the end of the 20 year irrigation period, irrigation equipment is removed and the tree crops thinned to circa 200

trees/ha (or a little less). At this time, the environment for development of a native grassy understory will be optimised[56].

For MEDLI modelling, these recommendations with result in the Project Area effectively being the composite of two crops, both of which will be irrigated with effluent:

- existing unimproved grass crop[57];
- newly established tree crop of blue gum, silver-leaf ironbark and Moreton Bay ash.

Planfuture investigated a number of areas within the Farm Investigation Area for establishment of the irrigated blue gum and discussed these with QUU. The preferred option (Plate 6) optimises 'contact' with the MSES along (and to the north of) Monkey Water Holes Creek, establishment efficiency and use of existing infrastructure (two sides are already fenced with serviceable road access, location *vis-à-vis* the STP)[58]. It is also adjacent to the STP, reducing pumping costs. The Project Area and Project have the strong support of Lockyer Valley Regional Council.

Plate 6: Recommended Project Area for 4ha planting



[56] The Department of Environment and Science recommends periodic, light burning of this RE, which if practised, will further enhance the environment for native grass / understory development.

[57] As noted in Phase 1 of this report, the RE is essentially tall open blue gum with a native grass understory. Shrubs are largely absent and, to the extent they occur, not a significant long-term component of the understory. *Acacia salicina* is present on the site and can be expected to be present in the understory: As it is not expected to be a significant component of the understory in the long-term, particularly if the grass sward is managed by periodic slashing, the understory is modelled as being a grass crop.

[58] QUU has sufficient land at the Helidon STP to establish a contiguous new blue gum forest at the completion of the 20 year irrigation period, providing a long term effluent reuse solution.

Initial contact with Lockyer Valley Regional Council has elicited significant support for the offset establishment at effluent reuse initiative at Helidon STP; and has resulted in a renewed focus by Council on the value of the remnant forests along (and to the north of) Monkey Water Holes Creek. To date, Council initiatives have included planning for cooperative (with QUU and landowners) weed (groundsel) and pest (wild dog) control along Monkey Water Holes Creek, and engagement with landowners in relation to the value of the remnant forests.

While there are no Matters of Local Environmental Significance (MLES) registered by Lockyer Valley Regional Council along (and to the north of) Monkey Water Holes Creek, Council representatives have also indicated that they would like to work with QUU to enhance the 'regrowth' forest along the levee to the south of Monkey Water Holes Creek, some of which abuts QUU land and some of which is on QUU land (Attachment 4, Figure 1d and Plate 7).

> "*Council is very keen to see an improvement to the native vegetation on the southern bank of Monkey Water Holes creek, in the section identified. We will explore options to facilitate this, including involving community groups – Lockyer Valley Regional Council Catchment Project Officer*"

While there is only a relatively small area of levee land involved (circa 1.0 – 1.5ha), this land could also be registered as an advanced offset. Indeed, as noted in the Phase 1 report, this land may support the endangered RE 12.3.10 (*E. populnea* woodland on alluvial plain), potentially providing another valuable offset asset for QUU. One option for realising this offset opportunity would be for QUU to provide (relatively modest) grant funding to Council, which, in turn, could work with local community groups to undertake enrichment planting and weed control of the area. While this opportunity is beyond the brief of this present assignment, it is recommended that QUU pursue the opportunity with Council: Apart from any positive community / stakeholder engagement outcomes, the value of any potential offset could defray modest QUU contributions to support regeneration.

Scope Reference 3.2.3: Assess the value of the offset potential

As noted in the Scope Reference 3.2.1 section of this report (including Plate 3), the value of the combined Endangered Habitat and Koala Habitat offsets based on 5ha of regeneration of RE 12.33.3, a preferred koala habitat tree, is $260,000. This would offset 1.0ha of RE 12.3.3 clearing and 1.34ha of koala habitat loss.

Scope Reference 3.2.4: Provide recommendations for optimising the value of identified offsets

Planfuture has consulted with the Department of Science in the preparation of this Phase 2 report: The Department provided both assistance and encouragement for the offset project.

Plate 7: Levee area listed as a Matter of State Environmental Significance (regrowth), which could be targeted for additional offset investment with Lockyer Valley Regional Council – showing regenerating *E. tessellaris* and QUU staff member, Cameron Jackson



As noted in the Scope Reference 3.2.1 section of this report (including Plate 4), it is recommended that the Project Area be registered as an advanced offset as soon as possible (*viz*. after QUU commits to the effluent irrigation project). Registering an area as an advanced offset under the *Environmental Offsets Act 2014* ensures that QUU will benefit from any habitat quality gains made at the Project Area (advanced offset) site since the time of registration; rather than from the time of entering into an Agreement to use the Advanced Offset to deliver a specific offset condition. Note that this does not mean that QUU is obligated to improve the land in the time between it being registered as an advanced offset and being selected to deliver an offset (if selected).

Planfuture has reviewed MSES mapping for the Project Area (Attachment 4), highlighting the potential suitability of the Project Area for a koala habitat offset and endangered RE.

In order to proceed with an advanced offset application, QUU will need to undertake a baseline habitat quality assessment of the site, using the Guide to Determining Terrestrial

Habitat Quality[59]. The baseline assessment is used to measure improvements in habitat quality.

The application registration should be made using relevant Department of Science forms[60] for a Notice of election, Offset Area Details and Habitat Quality Details.

It should also be noted that the management plan (Scope Reference 3.6) and implementation plan (Scope Reference 3.6.2) – both of which need to be delivered in the next stage of delivering the effluent reuse project - will need to support the offset by contributing to the improvement of habitat quality. Additionally, management inputs will need to be crafted to be additive to optimise the value of the offset for both koala habitat and endangered RE. It would be prudent to work closely with the Department of Science throughout both the registration stage and in the development of the management and implementation plans.

To achieve a 'conservation outcome' as it is defined in the *Environmental Offsets Act 2014*, as a general rule, the offset should, after 20 years:

a. achieve a higher habitat quality score[61] than the impact site score (quantification of habitat quality affect that gives rise to the offset obligation); and

b. achieve an overall habitat quality score gain[62] at the Project Area.

The Project Area, most likely, will have a habitat quality score of zero at present (see Plate 5). This should make criterion 'b' easy to meet. While meeting criterion 'a' will be more challenging (unless the impact site resulting in the offset obligation had quite a low habitat quality score), the target is imminently achievable providing the Scope Reference 3.6 management and implementation plans support development of habitat quality as well as effluent reuse.

As a final observation, QUU will be well served to maintain detailed records of any management actions undertaken following registration of the Project Area as an advanced offset. These records will be useful for demonstrating management costs, which could be redeemed as part of any agreement to deliver an offset.

59https://environment.des.qld.gov.au/assets/documents/pollution/management/offsets/habitat-quality-assessment-guide.pdf

60https://environment.des.qld.gov.au/assets/documents/pollution/management/offsets/offsets-policyv1-4.pdf

61 Habitat quality is assessed out of 10: At least a 1 point increase is required.

62 Habitat quality gain must be at least a 2 point improvement (out of 10).

Attachment 1: Field Soil Descriptions and Classifications - Helidon Farm Investigation Area

PROJECT Helidon STP Site 01

Location (GDA94): Long. 152.119135 E, Lat. -27.564336 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Self mulching Black Vertosol, clayey, deep **GSG**: Black Earth **PPF**: Ug5.17
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.15	Black 10YR32		Medium heavy clay	Moderate Granular 5-10mm		No segregations	Strong Dry	Clear
2	B21	0.15	0.70	Black 10YR2/1		Heavy clay	Strong angular blocky 20-50mm		No ségrégations	Strong dry	Clear
3	B22k	0.70	1.1+	Black 10YR3/2		Heavy clay	Strong lenticular 20-50mm		Few hard carbonate nodules	Firm Moist	Clear

Notes: Roots to 0.8 m

Field Laboratory Data



Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.110
0.3	7.0	0.137
0.6	7.5	0.154
0.9	8.0	0.626

PROJECT Helidon STP Site 02

Location (GDA94): Long. 152.119527 E, Lat. -27.565038 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. Plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Self mulching Brown Vertosol, clayey, deep **GSG**: Brown Clay **PPF**: Ug5.3
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.20	Black 7.5YR32		Medium heavy clay	Moderate Granular 5-10mm		No segregations	Strong Dry	Clear
2	B1	0.20	0.35	Brown 7.5YR4/3		Medium heavy clay	Strong lenticular 20-50mm		No ségrégations	Strong dry	Clear
3	B21	0.35	0.85	Brown 7.5YR4/4		Medium clay	Strong lenticular 20-50mm	Thin gravel line at 0.5m	No segregations	Strong dry	Clear
4	2B22k	0.85	1.1+	Black 10YR2/1		Medium heavy clay	Strong lenticular 20-50mm		Few hard carbonate nodules	Strong dry	

Notes: Roots to1.15 m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.053
0.3	7.5	0.29
0.6	8.5	0.72
0.9	8.5	0.24

PROJECT Helidon STP Site 03

Location (GDA94): Long. 152.11978 E, Lat. -27.5655 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Moderately permeable **Drainage**: Moderately well drained **Surface Condition**: Firm, weakly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name:** Hooper
Soil Classification ASC: Brown Dermosol, clayey, deep **GSG**: Chernozem **PPF**: Uf6.31
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.10	Black 7.5YR3/2	Nil	Fine sandy light clay	Moderate cloddy 50-100mm	Nil	No segregations	Strong Dry	Abrupt
2	B1	0.10	0.30	Brown 7.5YR4/3	Nil	Light medium clay	Strong subangular blocky 50-100mm	Nil	No ségrégations	Strong dry	Diffuse
3	B21k	0.30	0.60	Brown 7.5YR4/4	Nil	Light medium clay	Strong prismatic 20-50mm	Nil	Few soft carbonate nodules	Strong dry	Diffuse
4	2B22	0.60	1.2+	Black 10YR2/1	Nil	Light medium clay	Strong prismatic 20-50mm	Nil	No ségrégations	Strong dry	

Notes: Roots to1.2 m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.09
0.3	6.7	0.07
0.6	8.0	0.28
0.9	8.0	
1.2	8.0	1.12

PROJECT Helidon STP Site 04

Location (GDA94): Long. 152.11936 E, -27.566847 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, strongly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Vertosol, clayey, deep **GSG**: Black Earth **PPF**: Ug5.17

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A11	0.00	0.10	Black 10YR3/2	Nil	Light medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	A12	0.10	0.30	Black 10YR3/2	Nil	Heavy clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.30	0.95	Black 10YR2/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	No ségrégations	Strong dry	Diffuse
4	2B22k	0.95	1.2+	Brown 3/3	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to 1.0m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.16
0.3	7.0	0.071
0.6	9.0	0.106
0.9	9.0	0.186
1.2	9.0	0.416

PROJECT Helidon STP Site 05

Location (GDA94): 152.118784 -27.566189 **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Black Vertosol, clayey, deep **GSG**: Black Earth **PPF**: Ug5.16

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A11	0.00	0.15	Black 7.5YR3/2	Nil	Light medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	A12	0.10	0.40	Black 7.5YR3/2	Nil	Medium clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.30	0.80	Grey brown 10YR4/2	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	2B22k	0.60	1.1+	Grey brown 10YR4/2	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	Moderate carbonate nodules	Strong dry	

Notes: Roots to1.1m

Field Laboratory Data



Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.086
0.3	7.5	0.246
0.6	8.5	0.750
0.9	8.5	0.966
1.1		0.904

PROJECT Helidon STP Site 06

Location (GDA94): 152.118336 -27.565713 **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Black Vertosol, clayey, deep **GSG**: Black Earth **PPF**: Ug5.16

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.15	Black 10YR3/2	Nil	Medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B1	0.10	0.45	Black 10YR3/2	Nil	Medium clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.450	0.90	Black 10YR3/2	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	2B22k	0.60	1.2+	Grey brown 10YR4/2	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	Moderate carbonate nodules	Strong dry	

Notes: Roots to1.2m

Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	7.0	0.07
0.3	8.5	0.172
0.6	8.5	1.4
0.9	8.5	1.56
1.1	9.0	



PROJECT Helidon STP Site 07

Location (GDA94): 152.117902 -27.565283 **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Moderately permeable **Drainage**: Moderately well drained **Surface Condition**: Self mulching, weak cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Hooper
Soil Classification ASC: Black Dermosol, clayey, deep **GSG**: Chernozem **PPF**: Uf6.32

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.10	Black 10YR3/2	Nil	Light medium clay	Moderate granular 50-100mm	Nil	No segregations	Strong Dry	Abrupt
2	B21	0.10	0.40	Black 10YR3/2	Nil	Medium clay	Strong subangular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B22k	0.30	0.90	Brown 7.5YR4/3	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	Many carbonate nodules	Strong dry	Diffuse
4	B23	0.60	1.1+	Brown 7.5YR4/3	Few brown	Medium heavy clay	Strong angular blocky 20-50mm	Nil	Many carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.077
0.3	7.0	0.176
0.6	8.5	0.229
0.9	8.5	0.214

PROJECT Helidon STP Site 08

Location (GDA94) 152.117434 -27.564774 **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Moderately permeable **Drainage**: Moderately well drained **Surface Condition**: Firm, weakly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Cavendish
Soil Classification ASC: Brown Chromosol, clayey, deep **GSG**: Chernozem **PPF**: Db3.13

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.30	Black 7.5YR32	Nil	Clay loam, fine sandy	Moderate cloddy 20-50mm	Nil	No segregations	Strong Dry	Abrupt
2	B21	0.30	0.80	Brown 7.5YR4/4	Nil	Fine sandy medium clay	Strong prismatic 20-50mm	Nil	No segregations	Strong dry	Diffuse
3	2B22k	0.60	1.2+	Black 10YR2/1	Nil	Fine sandy medium clay	Strong prismatic 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.1m

Field Laboratory Data



Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.056
0.3	7.5	0.040
0.6	8.5	0.063
0.9	8.5	0.058
1.2		

PROJECT Helidon STP Site 09

Location (GDA94): 152.117725 E -27.567146 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim/Flagstone intergrade
Soil Classification ASC: Black Vertosol, clayey, deep **GSG**: Black Earth **PPF**: Ug5.16

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.35	Black 10YR3/2	Nil	Fine sandy medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B21k	0.35	0.95	Grey brown 7.5YR4/2	Nil	Heavy clay	Strong lenticular 50-100mm	Nil	Abundant carbonate nodules	Strong dry	Diffuse
4	2B22k	0.95	1.2+	Grey brown 7.5YR4/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Moderate carbonate nodules	Strong dry	

Notes: Roots to1.1m

Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.054
0.3	7.5	0.154
0.6	9.0	0.247
0.9	8.5	0.200
1.1		0.264



PROJECT Helidon STP Site 10

Location (GDA94): 152.117414 E, -27.56668 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Brown Vertosol, clayey, deep **GSG**: Brown clay **PPF**: Ug5.3

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.10	Black 7.5YR3/2	Nil	Fine sandy light medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B21	0.10	0.50	Brown 7.5YR4/3	Nil	Medium clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B22k	0.50	1.1	Black 10YR3/2	Nil	Medium clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	Diffuse
4	B23	1.1	1.2+	Brown 10YR4/3	Nil	Medium clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.2m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.054
0.3	6.5	0.044
0.6	7.5	0.088
0.9	8.0	0.119

PROJECT Helidon STP Site 11

Location (GDA94): 152.116944 E, -27.565939 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Black Vertosol, clayey, deep **GSG:** Black earth **PPF**: Ug5.15

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.20	Black 7.5YR3/2	Nil	Light medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B21	0.20	0.60	Black 7.5YR3/2	Nil	Medium heavy clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B22k	0.60	0.75	Brown 7.5YR4/3	Nil	Medium clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	B23	0.75	1.2+	Brown 10YR4/3	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.073
0.3	7.0	0.055
0.6	8.0	0.053
0.9	8.5	0.124

PROJECT Helidon STP Site 12

Location (GDA94): 152.11656 E, -27.565325 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Moderately permeable **Drainage**: Moderately well drained **Surface Condition**: Firm, weakly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Hooper
Soil Classification ASC: Black Dermosol, clayey, deep **GSG**: Chernozem **PPF**: Uf6.33

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.40	Black 7.5YR32	Nil	Medium heavy clay	Moderate cloddy 50-100mm	Nil	No segregations	Strong Dry	Abrupt
2	*B1*	*0.40*	*0.60*	*Grey brown 7.5YR4/2*	Nil	*Medium heavy clay*	*Strong subangular blocky 50-100mm*	Nil	*No segregations*	*Strong dry*	*Diffuse*
3	*D1*	*0.30*	*0.75*	*Brown 7.5YR4/3*	Nil	*Coarse sandy clay*	*Massive*	Nil	*No segregations*	*Strong dry*	*Diffuse*
4	*2B21*	*0.75*	*1.05*	*Brown 7.5YR4/3*	Nil	*Fine sandy light medium clay*	*Strong prismatic 20-50mm*	Nil	*No segregations*	*Strong dry*	
5	*2B22k*	*1,05*	*1.20*	*Grey brown 7.5YR4/2*	Nil	*Medium heavy clay*	*Strong lenticular 20-50mm*	Nil	*Few carbonate nodules*		

Notes: Roots to1.2m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.081
0.3	7.0	0.091
0.6	8.0	0.108
0.9	8.5	0.135

PROJECT Helidon STP Site 13

Location (GDA94): 152.115954 E -27.567193 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Hard setting, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim 152.115359 -27.566468
Soil Classification ASC: Black Vertosol, clayey, deep **GSG:** Black earth **PPF**: Ug5.4

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.10	Black 10YR3/2	Nil	Medium heavy clay	Moderate cloddy 50-100mm	Nil	No segregations	Strong Dry	Abrupt
2	B1	0.10	0.50	Black 10YR3/2	Nil	Heavy clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.50	0.90	Black 10YR3/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	B22k	0.90	1.1+	Black 10YR3/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.077
0.3	6.5	0.036
0.6	7.0	0.111
0.9	8.0	0.244

PROJECT Helidon STP Site 14

Location (GDA94): 152.115359 E, -27.566468 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Hooper
Soil Classification ASC: Black Vertosol, clayey, deep **GSG:** Black earth **PPF**: Ug5.15

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.20	Black 7.5YR3/2	Nil	Fine sandy light clay	Massive	Nil	No segregations	Strong Dry	Abrupt
2	B11	0.20	0.40	Black 7.5YR3/2	Nil	Fine sandy light medium clay	Strong granular 20-50mm	Nil	No segregations	Strong dry	Diffuse
3	B21	040	0.80	Brown 7.5YR4/3	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	B22k	0.80	1.1+	Brown 10YR4/3	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.1m

Field Laboratory Data



Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.060
0.3	6.5	0.028
0.6	7.0	0.027
0.9	8.0	0.089

PROJECT Helidon STP Site 15

Location (GDA94): 152.114404 -27.566972 **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Strongly self mulching, Strongly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Black Vertosol, clayey, deep **GSG:** Black earth **PPF**: Ug5.15

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.10	Black 10YR3/2	Nil	Medium heavy clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B1	0.10	0.55	Black 10YR3/1	Nil	Heavy clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.550	0.85	Brown 7.5YR4/3	Few black (down cracks)	Heavy clay	Strong angular blocky 20-50mm	Nil	Very few soft carbonate	Strong dry	Diffuse
4	B22k	0.85	1.1+	Grey brown 10YR4/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.080
0.3	7.0	0.042
0.6	8.0	0.220
0.9	8.5	0.688

PROJECT Helidon STP Site 16

Location (GDA94): 152.114126 E, -27.56643 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Strongly self mulching, Strongly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Black Vertosol, clayey, deep **GSG:** Black earth **PPF**: Ug5.15

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.15	Black 10YR3/2	Nil	Light medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B1	0.15	0.40	Black 10YR3/2	Nil	Medium clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.40	0.60	Black 10YR3/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	B22k	0.60	1.0	Brown 10YR4/3	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	
5	B23	1.0	1.2+	Grey brown 10YR4/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Very few carbonate modules	Strong dry	

Notes: Roots to1.2m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.050
0.3	7.0	0.060
0.6	8.5	0.146
0.9	8.5	0.336

Attachment 2: Soil analytical results – Helidon Farm Investigation Area

Details of the three Representative Soil types are provided in Table 3 of the main Report.

Soil Chemistry

Soils were collected at the Helidon Farm Investigation Area on 16 February 2019. At each of the representative soil sites, composite samples of three cores were combined and bagged; and dispatched to the Department of Science laboratory on 18 February 2019.

Results are summarised in the Tables below. *A priori*, the soils appear to be suitable for blue gum forests irrigated with Helidon STP effluent at the volumes proposed. Specifically, there are no obvious limitations to blue gum growth; though supplementary fertilising of nitrogen and boron at establishment may be desirable. Likewise, there are no significant risks with the proposed irrigation for soil structure; though this will be confirmed through SaLF modelling, particularly for the lower profiles of Representative Soil 1, which have marginal ESP at depth.

Representative Soil	Soil Depth (m)	pH (1:5 water)	$EC_{1:5}$ (dS/m)	Cl (mg/kg)	Clay (%)	CEC cmol_c/kg	ESP (%)
1	0.00-0.10	6.68	0.12	39	44.7	30	0.2
1	0.10-0.20	7.51	0.09	37	48.2	34	4.5
1	0.30-0.40	8.07	0.14	78	59.2	43	7.9
1	0.50-0.60	8.15	0.22	146	59.0	42	11.2
1	0.80-0.90	8.01	0.41	321	59.3	47	10.8
1	1.10-1.20	8.53	0.81	743	58.9	47	9.0
2	0.00-0.10	6.32	0.06	24	22.3	14	0.0
2	0.10-0.20	6.30	0.03	<20	22.3	13	0.1
2	0.30-0.40	7.28	0.03	<20	38.2	27	0.1
2	0.50-0.60	7.90	0.04	<20	34.9	28	2.2
2	0.80-0.90	8.50	0.09	<20	33.1	33	3.8
2	1.10-1.20	8.73	0.09	<20	29.7	34	5.3
3	0.00-0.10	6.42	0.05	<20	39.8	26	0.1
3	0.10-0.20	6.87	0.05	<20	43.8	30	0.2
3	0.30-0.40	7.83	0.07	<20	47.4	36	3.7
3	0.50-0.60	8.38	0.13	29	45.7	42	4.7
3	0.80-0.90	8.77	0.26	85	51.5	51	5.9
3	1.10-1.20	8.76	0.31	160	47.9	49	6.2

- All soils are predominately neutral to moderately alkaline, tending to strongly alkaline below ≈ 90cm
- EC (1:5) is low for all soils (less than 0.8 dS/m)
- Cl levels are high below 1m in Representative Soil 1

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Representative Soil	Soil Depth (cm)	Colwell P (mg/kg)	PBI Colwell	PBI Unadjusted	P (Ext) (mg/kg)	TKP (%)
1	0.00-0.10	94	93	75	131	94
1	0.10-0.20	80	93	78	126	80
1	0.30-0.40	47	130	120	78	47
1	0.50-0.60	49	-----	-----	-----	49
1	0.80-0.90	17	99	96	-----	17
1	1.10-1.20	-----	-----	-----	-----	-----
2	0.00-0.10	85	56	42	116	85
2	0.10-0.20	64	53	42	99	64
2	0.30-0.40	30	86	80	49	30
2	0.50-0.60	6	-----	-----	-----	6
2	0.80-0.90	11	82	80	-----	11
2	1.10-1.20	-----	-----	-----	-----	-----
3	0.00-0.10	45	89	80	80	45
3	0.10-0.20	17	94	91	50	17
3	0.30-0.40	4	103	102	78	4
3	0.50-0.60	3	-----	-----	-----	3
3	0.80-0.90	8	101	99	240	8
3	1.10-1.20	-----	-----	-----	-----	-----

- Surface phosphorus levels are medium, trending low at depth in Representative Soils 2 & 3
- Soils have low phosphorus buffering capacity, implying that a higher component of applied phosphorus will be plant available
- Potassium levels in surface soils are moderate

Representative Soil	Soil Depth (cm)	Total Carbon (%)	Organic Carbon (%)	Total N (%)	TKN (%)	NO3-N (mg/kg)	TKP (%)
1	0.00-0.10	1.90	1.45	0.161	0.148	11	94
1	0.10-0.20	1.57	1.29	0.134	0.122	3	80
1	0.30-0.40	1.63	1.18	0.122	0.108	2	47
1	0.50-0.60	1.21	-----	0.088	-----	<1	49
1	0.80-0.90	1.58	-----	0.077	-----	2	17
1	1.10-1.20	0.82	-----	0.043	-----	2	-----
2	0.00-0.10	1.25	1.03	0.086	0.095	6	85
2	0.10-0.20	0.92	0.86	0.075	0.071	2	64
2	0.30-0.40	0.49	0.44	0.044	0.039	<1	30
2	0.50-0.60	0.39	-----	0.015	-----	<1	6
2	0.80-0.90	0.30	-----	0.024	-----	<1	11
2	1.10-1.20	0.23	-----	0.018	-----	<1	-----
3	0.00-0.10	1.59	1.44	0.131	0.125	5	45
3	0.10-0.20	1.14	0.94	0.134	0.086	1	17
3	0.30-0.40	0.67	0.60	0.056	0.053	<1	4
3	0.50-0.60	0.71	-----	0.049	-----	<1	3
3	0.80-0.90	0.76	0.60	0.035	0.032	<1	8
3	1.10-1.20	0.73	-----	0.025	-----	<1	-----

- Organic carbon levels are low, indicative of laser levelling and cut-and-carry pasture management on a heavier clay. Surface nitrogen levels are low – medium, tending to low-very low at depth

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Representative Soil	Soil Depth (cm)	Ca cmol_c/kg	Mg cmol_c/kg	K cmol_c/kg	Na cmol_c/kg	Base set (%)
1	0.00-0.10	75	131	1.36	0.703	-----
1	0.10-0.20	14.5	15.4	0.688	1.52	95
1	0.30-0.40	18.7	19.8	0.485	3.44	98
1	0.50-0.60	18.5	19.2	0.406	4.73	102
1	0.80-0.90	20.5	22.6	0.332	5.04	104
1	1.10-1.20	18.8	25.9	0.381	4.21	105
2	0.00-0.10	42	116	0.871	0.082	42
2	0.10-0.20	42	99	0.500	0.113	42
2	0.30-0.40	80	49	0.408	0.436	80
2	0.50-0.60	17.6	10.9	0.228	0.613	106
2	0.80-0.90	19.7	14.2	0.241	1.26	106
2	1.10-1.20	19.5	14.8	0.240	1.79	108
3	0.00-0.10	80	80	0.767	0.370	80
3	0.10-0.20	91	50	0.463	0.699	91
3	0.30-0.40	16.7	18.7	0.305	1.33	102
3	0.50-0.60	20.1	22.6	0.320	1.97	108
3	0.80-0.90	23.2	27.6	0.401	3.01	106
3	1.10-1.20	21.2	26.0	0.327	3.02	104

- Representative Soil 1 is slightly sodic at depth. Representative Soils 2 & 3 are non sodic
- Potassium fertility is good

Representative Soil	Soil Depth (cm)	Ca:CEC	Ca:Mg	K:CEC	Mg:CEC	Mg:Ca	Mg:K	Na:K
1	0.00-0.10	-----	-----	-----	-----	-----	-----	-----
1	0.10-0.20	0.427	0.942	0.0203	0.453	1.06	22.3	2.20
1	0.30-0.40	0.431	0.941	0.0112	0.458	1.06	40.8	7.08
1	0.50-0.60	0.438	0.963	0.0096	0.455	1.04	47.3	11.6
1	0.80-0.90	0.438	0.905	0.0070	0.483	1.10	68.2	15.2
1	1.10-1.20	0.400	0.725	0.0081	0.551	1.38	67.8	11.0
2	0.00-0.10	-----	-----	-----	-----	-----	-----	-----
2	0.10-0.20	-----	-----	-----	-----	-----	-----	-----
2	0.30-0.40	-----	-----	-----	-----	-----	-----	-----
2	0.50-0.60	0.633	1.62	0.0082	0.392	0.619	47.6	2.69
2	0.80-0.90	0.591	1.39	0.0072	0.426	0.722	58.9	5.22
2	1.10-1.20	0.580	1.32	0.0071	0.440	0.758	61.7	7.46
3	0.00-0.10	-----	-----	-----	-----	-----	-----	-----
3	0.10-0.20	-----	-----	-----	-----	-----	-----	-----
3	0.30-0.40	0.461	0.892	0.0084	0.517	1.12	61.3	4.36
3	0.50-0.60	0.484	0.891	0.0076	0.543	1.12	70.6	6.16
3	0.80-0.90	0.454	0.839	0.0078	0.541	1.19	68.7	7.51
3	1.10-1.20	0.434	0.815	0.0066	0.533	1.23	79.6	9.24

- CEC for all soils is indicative of high fertility
- Exchangeable calcium is low and exchangeable magnesium high; though not unexpected in the Lockyer alluvial plains

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Representative Soil	Soil Depth (cm)	Cu (mg/kg)	Zn (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	K cmol_c/kg	B (mg/kg)
1	0.00-0.10	2.9	2.2	59.1	29.0	1.30	0.9
1	0.10-0.20	2.6	3.0	39.3	14.1	0.70	1.3
1	0.30-0.40	2.6	2.1	28.8	7.7	0.50	1.5
1	0.50-0.60	-----	-----	-----	-----	-----	-----
1	0.80-0.90	-----	-----	-----	-----	-----	-----
1	1.10-1.20	-----	-----	-----	-----	-----	-----
2	0.00-0.10	1.5	2.4	63.0	23.3	0.88	0.4
2	0.10-0.20	1.5	2.6	69.7	24.0	0.57	0.3
2	0.30-0.40	1.7	1.1	32.3	5.4	0.39	0.5
2	0.50-0.60	-----	-----	-----	-----	-----	-----
2	0.80-0.90	-----	-----	-----	-----	-----	-----
2	1.10-1.20	-----	-----	-----	-----	-----	-----
3	0.00-0.10	3.0	1.6	66.1	24.2	0.76	0.6
3	0.10-0.20	2.6	1.3	46.6	16.7	0.44	0.9
3	0.30-0.40	1.7	0.6	17.3	5.5	0.40	1.2
3	0.50-0.60	-----	-----	-----	-----	-----	-----
3	0.80-0.90	1.7	0.4	13.3	<2.0	0.49	1.3
3	1.10-1.20	-----	-----	-----	-----	-----	-----

- Zinc, copper and manganese levels are medium. Boron levels are medium in Representative Soils 1 & 3, and low in Representative Soil 2. Boron availability may be reduced in the alkaline soils.

Representative Soil	Soil Depth (cm)	ADMC (%)	Coarse sand (%)	Fine Sand (%)	Silt (%)	Clay (%)
1	0.00-0.10	3.9	12.9	27.7	17.3	44.7
1	0.10-0.20	4.7	11.4	28.0	17.7	48.2
1	0.30-0.40	6.9	7.0	19.2	18.8	59.2
1	0.50-0.60	6.7	8.6	18.5	16.7	59.0
1	0.80-0.90	7.6	6.2	17.3	20.7	59.3
1	1.10-1.20	6.7	6.2	16.3	18.8	58.9
2	0.00-0.10	2.1	23.1	45.2	18.0	22.3
2	0.10-0.20	2.0	25.1	39.3	17.9	22.3
2	0.30-0.40	3.7	23.3	29.3	9.6	38.2
2	0.50-0.60	4.1	23.9	30.2	9.6	34.9
2	0.80-0.90	4.7	8.0	45.2	15.1	33.1
2	1.10-1.20	4.9	10.3	48.0	15.2	29.7
3	0.00-0.10	4.2	14.6	28.8	18.5	39.8
3	0.10-0.20	5.2	14.7	29.9	17.0	43.8
3	0.30-0.40	5.4	16.1	26.2	11.8	47.4
3	0.50-0.60	5.6	9.0	28.3	20.5	45.7
3	0.80-0.90	6.6	2.7	18.1	29.6	51.5
3	1.10-1.20	6.7	2.1	19.5	31.4	47.9

- Representative Soils 1 & 3 are clays throughout their profiles typical of Blenheim soil profiles; whereas Representative Soil 2 has a sandy clay loam surface and more variable higher clay layers at depth, reflecting historic episodes of alluvial deposition.

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Soil physical parameters

Representative Soil	Soil Depth (cm)	Disp. Ratio R1	Disp. Ratio R2	1/3 Bar (%)	15 Bar (%)
1	0.00-0.10	0.69	0.38	34.3	18.2
1	0.10-0.20	0.73	0.46	41.7	20.4
1	0.30-0.40	0.71	0.46	49.9	26.3
1	0.50-0.60	0.74	0.49	50.0	26.7
1	0.80-0.90	0.79	0.55	55.1	27.4
1	1.10-1.20	0.67	<0.10	53.8	26.6
2	0.00-0.10	0.60	0.26	32.9	9.7
2	0.10-0.20	0.60	0.30	27.8	9.3
2	0.30-0.40	0.75	0.42	35.1	16.1
2	0.50-0.60	0.65	0.35	37.7	16.4
2	0.80-0.90	0.66	0.31	39.9	17.3
2	1.10-1.20	0.76	0.41	35.2	16.5
3	0.00-0.10	0.51	0.30	30.8	16.3
3	0.10-0.20	0.56	0.33	36.9	18.5
3	0.30-0.40	0.65	0.40	40.5	20.1
3	0.50-0.60	0.62	0.34	45.2	21.8
3	0.80-0.90	0.63	0.34	47.6	25.1
3	1.10-1.20	0.60	0.30	44.3	24.1

Bulk Density

Bulk density samples were collected using a Honda jack hammer soil core sampler with a 42mm diameter bore. Cores were extracted from the steel sampling tube and carefully laid out on a PVC half pipe before being and cut into lengths and paper bagged for oven dry weight assessment. The method is suitable for providing an estimate of bulk density suitable for use in planning operational works and for comparative analyses. As a technique it will typically result in an over-estimate of bulk density and, as a result, both derived values and these values are used in MEDLI modelling.

Soil Depth (cm)	Representative Soil 1	Representative Soil 2	Representative Soil 3
0-10	1.2	1.4	1.3
10-30	1.6	1.4	1.7
40-50	1.4	1.7	1.6
60-80	1.7	1.8	1.6
90-100	1.7	1.7	1.7

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Attachment 3: P Sorption Curves

Representative Soil 1: 0-10cm

1. Colwell P

Colwell P mg/kg
94.00

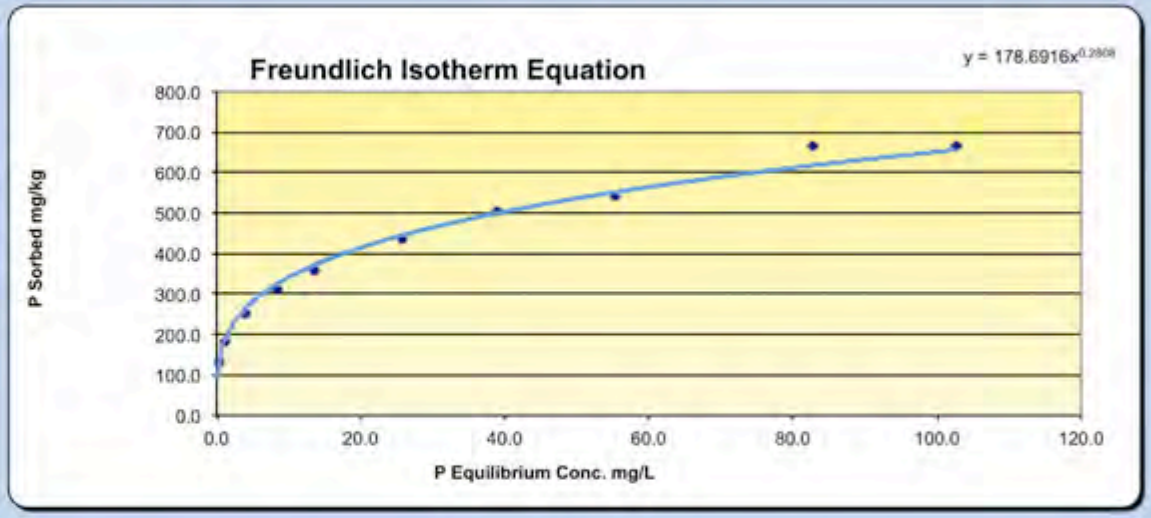
2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.2719	131.28
10.00	1.088	183.12
20.00	4.068	253.32
30.00	8.388	310.12
40.00	13.6	358.00
60.00	25.65	437.50
80.00	38.98	504.20
100.00	55.17	542.30
140.00	82.67	667.30
160.00	102.7	667.00

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph

with an R-Square value of 0.9942



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	94.00
Adsorption Coefficient (A)	178.69
Adsorption Exponent (B)	0.2808
Desorption Exponent	0.2668

Representative Soil 1: 30-40cm

1. Colwell P

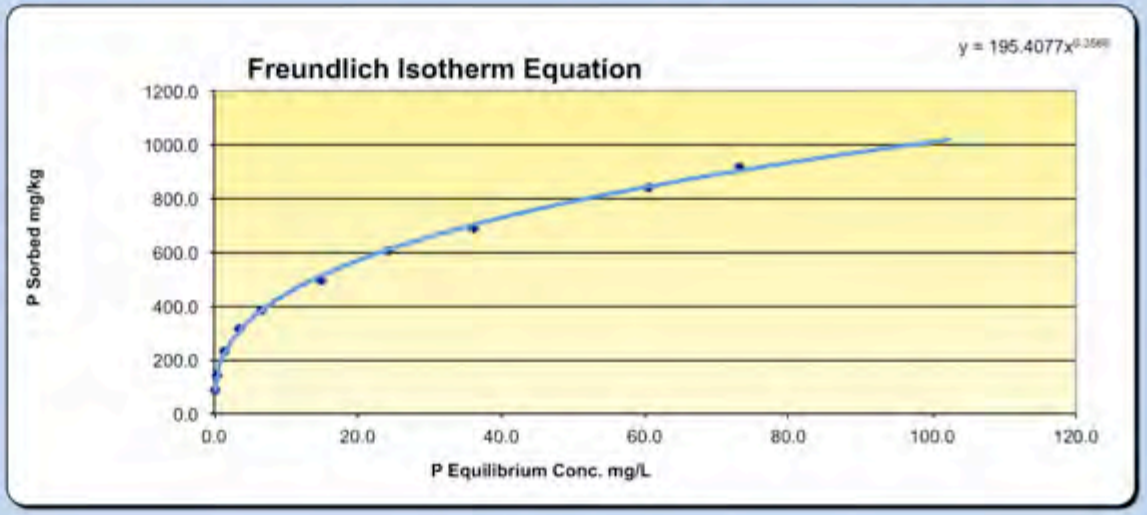
Colwell P mg/kg
47.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.1227	85.77
10.00	0.3622	143.38
20.00	1.398	233.02
30.00	3.532	311.68
40.00	6.516	381.84
60.00	14.99	497.10
80.00	24.31	603.90
100.00	36.06	686.40
140.00	60.52	841.80
160.00	73.16	915.40

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9975



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	47.00
Adsorption Coefficient (A)	195.41
Adsorption Exponent (B)	0.3566
Desorption Exponent	0.3388

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Representative Soil 1: 50-60cm

1. Colwell P

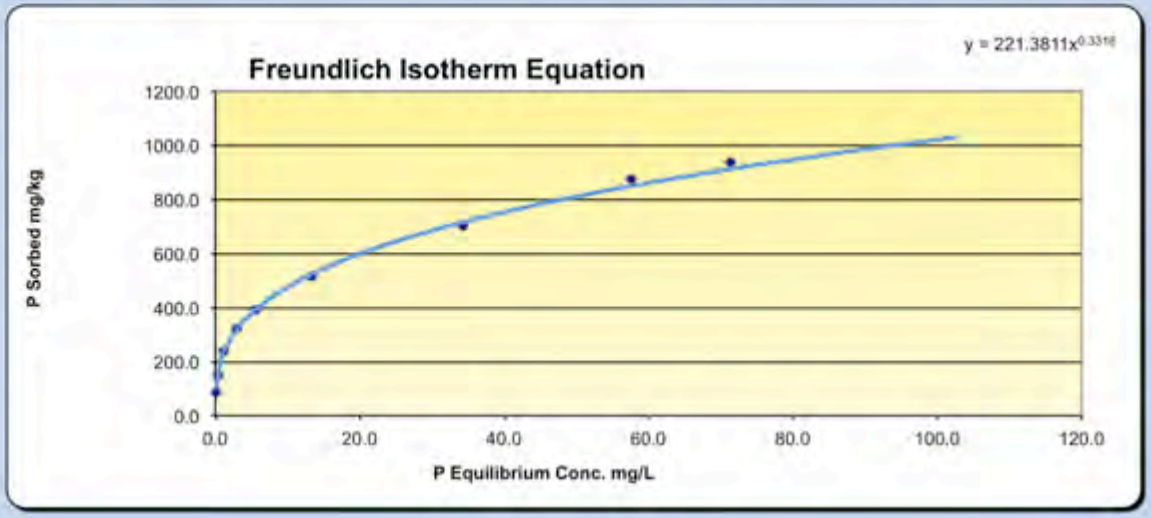
Colwell P mg/kg
49.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.06343	88.37
10.00	0.2901	146.10
20.00	1.191	237.09
30.00	2.989	319.11
40.00	5.51	393.90
60.00	13.35	515.50
100.00	34.44	704.60
140.00	57.7	872.00
160.00	71.3	936.00

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9998



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	49.00
Adsorption Coefficient (A)	221.38
Adsorption Exponent (B)	0.3318
Desorption Exponent	0.3152

CE
CO

Representative Soil 2: 0-10cm

1. Colwell P

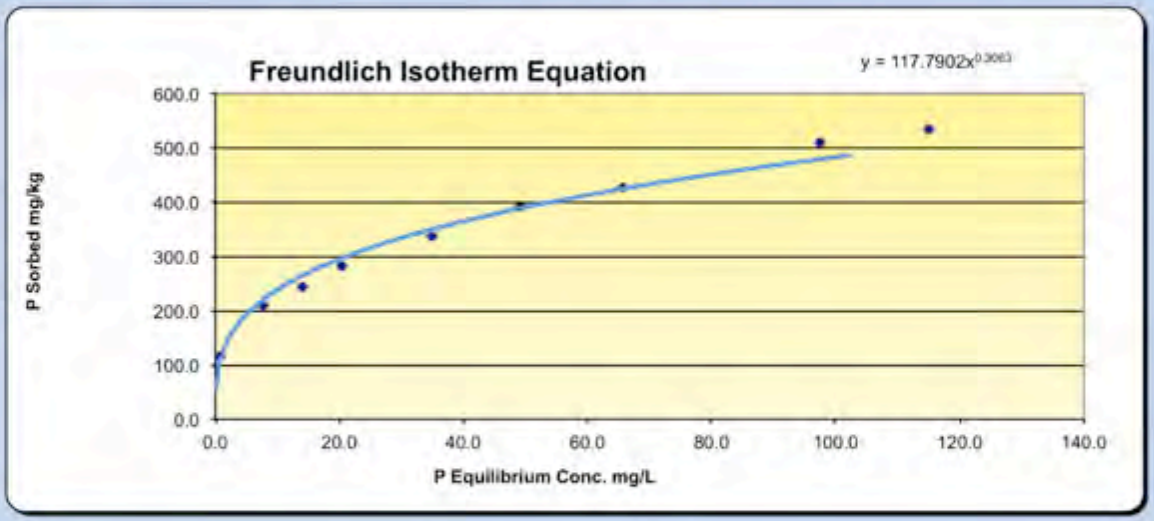
Colwell P mg/kg
85.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.7486	117.51
20.00	7.732	207.65
30.00	14.09	244.10
40.00	20.29	282.10
60.00	34.81	336.90
80.00	49.21	392.90
100.00	65.7	428.00
140.00	97.55	509.50
160.00	115.1	534.00

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9847



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	85.00
Adsorption Coefficient (A)	117.79
Adsorption Exponent (B)	0.3063
Desorption Exponent	0.2910

CE
CO

Representative Soil 2: 30-40cm

1. Colwell P

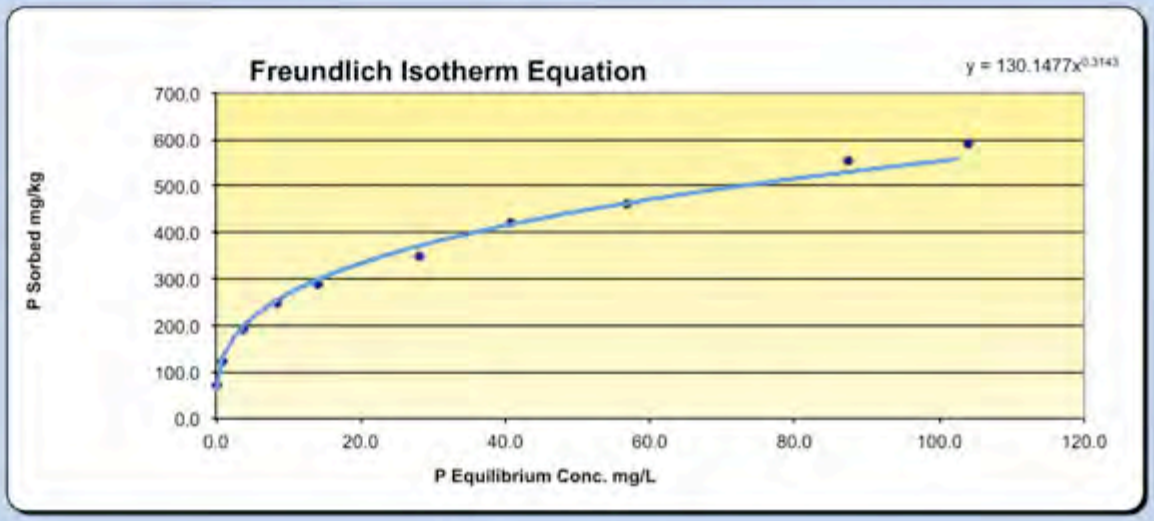
Colwell P mg/kg
30.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.1161	68.84
10.00	0.793	122.07
20.00	3.846	191.54
30.00	8.349	246.51
40.00	14.06	289.40
60.00	27.97	350.30
80.00	40.77	422.30
100.00	56.77	462.30
140.00	87.51	554.90
160.00	104	590.00

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.997



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	30.00
Adsorption Coefficient (A)	130.15
Adsorption Exponent (B)	0.3143
Desorption Exponent	0.2986

CONFIDENTIAL

Representative Soil 2: 50-60cm

1. Colwell P

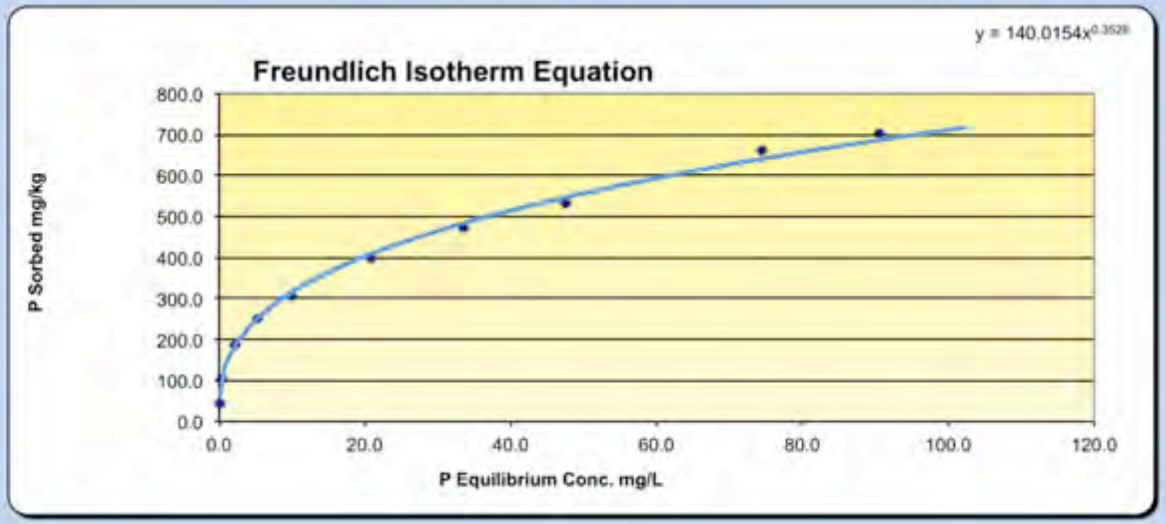
Colwell P mg/kg
6.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.05645	45.44
10.00	0.2673	103.33
20.00	2.121	184.79
30.00	5.431	251.69
40.00	9.985	306.15
60.00	20.74	398.60
80.00	33.45	471.50
100.00	47.5	531.00
140.00	74.38	662.20
160.00	90.49	701.10

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9937



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	6.00
Adsorption Coefficient (A)	140.02
Adsorption Exponent (B)	0.3528
Desorption Exponent	0.3352

CONFIDENTIAL

Representative Soil 3: 0-10cm

1. Colwell P

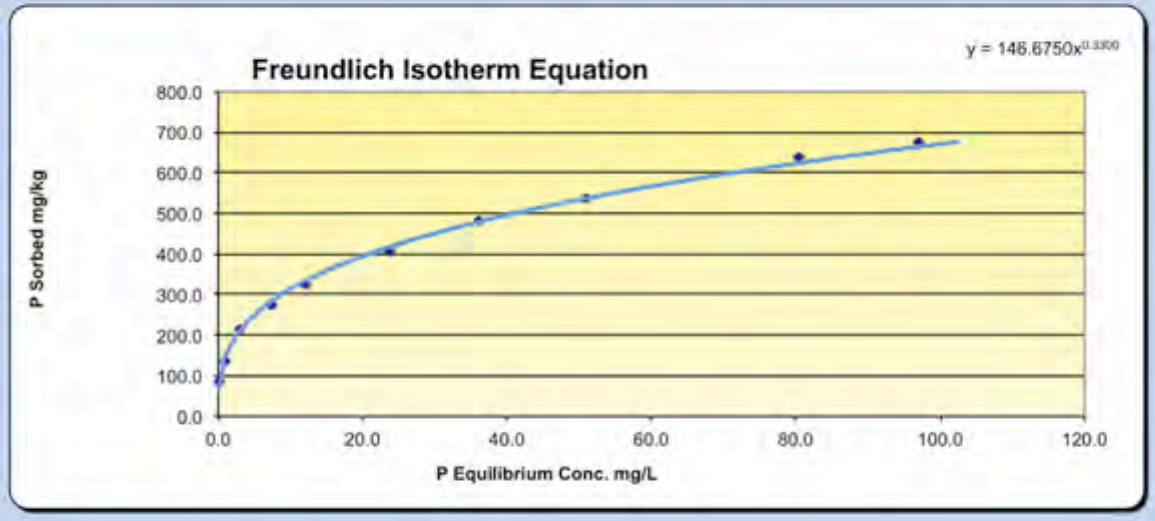
Colwell P mg/kg
45.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.174	83.26
10.00	0.7878	137.12
20.00	3.052	214.48
30.00	7.277	272.23
40.00	11.97	325.30
60.00	23.77	407.30
80.00	36.14	483.60
100.00	50.93	535.70
140.00	80.5	640.00
160.00	96.96	675.40

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9991



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	45.00
Adsorption Coefficient (A)	146.67
Adsorption Exponent (B)	0.3300
Desorption Exponent	0.3135

CON

Representative Soil 3: 30-40cm

1. Colwell P

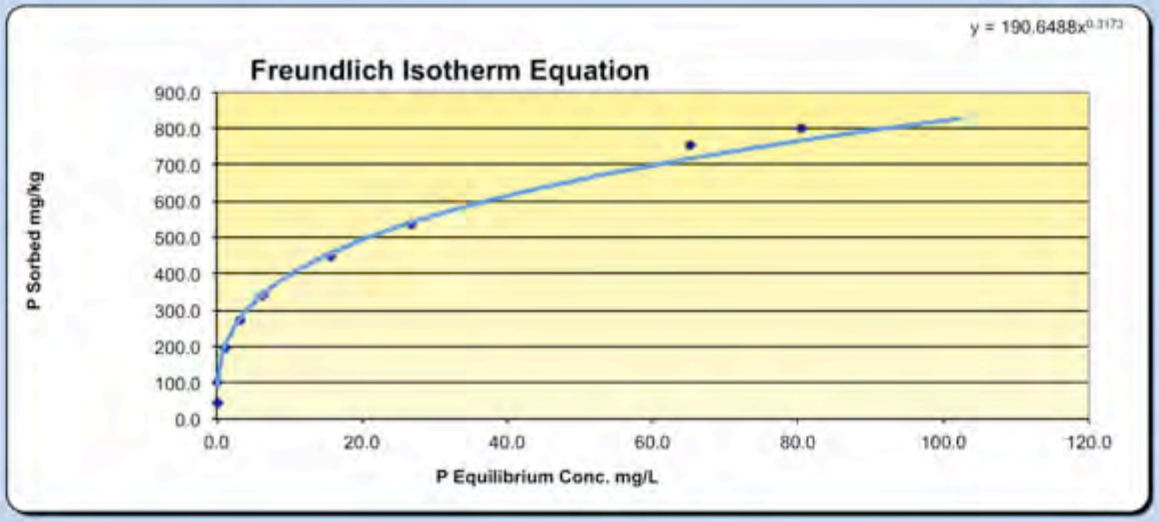
Colwell P mg/kg
4.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.007741	43.92
10.00	0.1752	102.25
20.00	1.13	192.70
30.00	3.257	271.43
40.00	6.438	339.62
60.00	15.67	447.30
80.00	26.79	536.10
140.00	65.18	752.20
160.00	80.47	799.30

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9978



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	4.00
Adsorption Coefficient (A)	190.65
Adsorption Exponent (B)	0.3173
Desorption Exponent	0.3014

CONFIDENTIAL

Representative Soil 3: 50-60cm

1. Colwell P

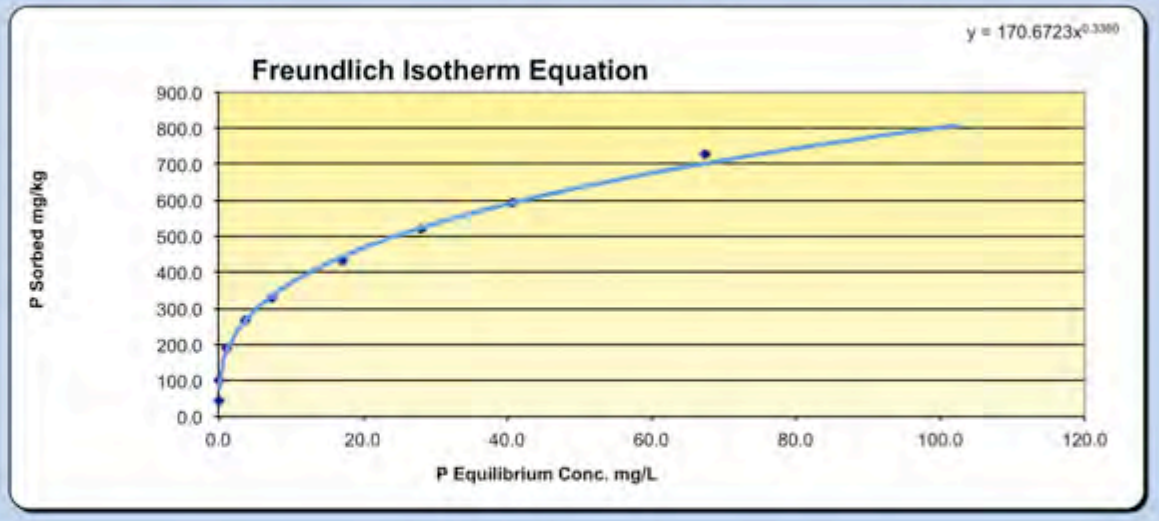
Colwell P mg/kg
3.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.01587	42.84
10.00	0.2181	100.82
20.00	1.258	190.42
30.00	3.82	264.80
40.00	7.497	328.03
60.00	17.22	430.80
80.00	28.08	522.20
100.00	40.82	594.80
140.00	67.41	728.90

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9994



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	3.00
Adsorption Coefficient (A)	170.67
Adsorption Exponent (B)	0.3360
Desorption Exponent	0.3192

CONFIDENCE

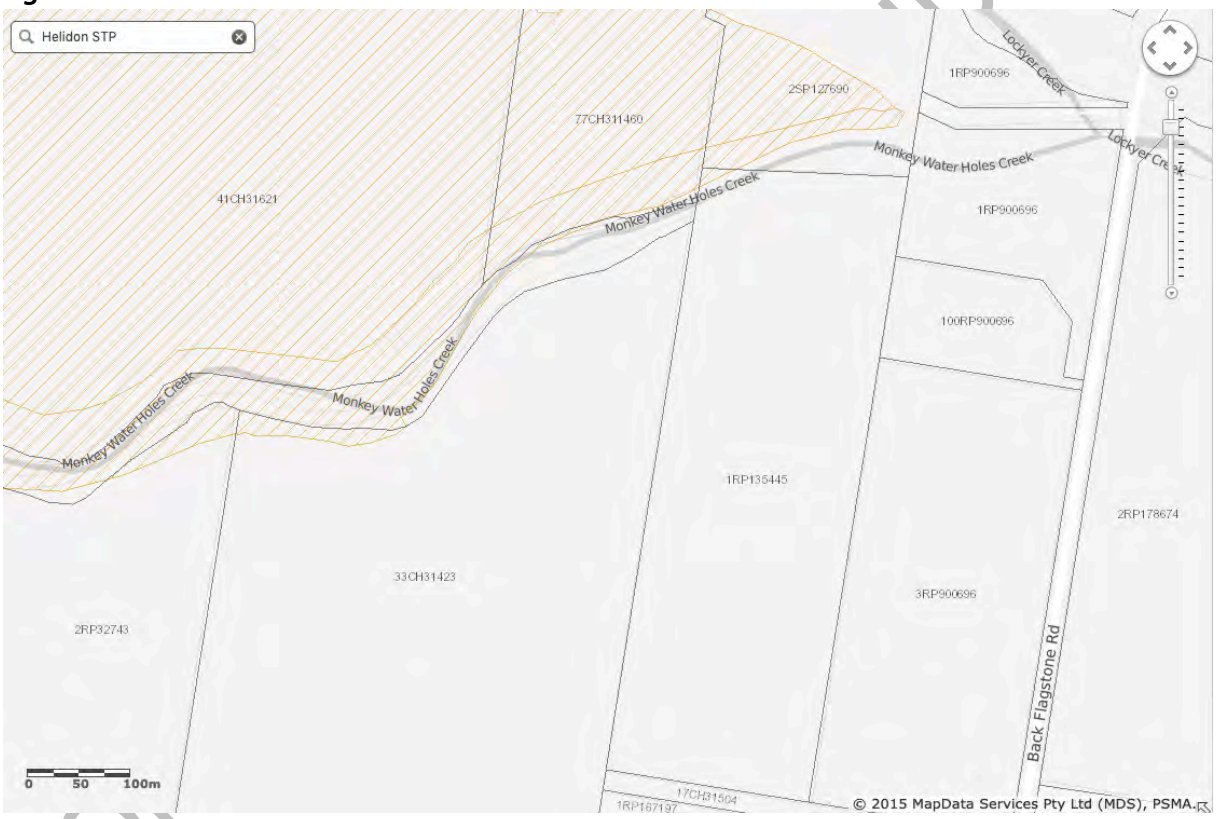
Attachment 4: Mapped State and Regional Environmental Values

The matters of State Environmental Significance (MSES) are shown in Figure 1[63]. The majority of the QUU land is also State designated -

- water supply buffer area and water resources catchment. No areas are declared as high ecological value water areas
- agricultural land classification Class A and Class B
- relevant to the stormwater management design objectives
- Regional Landscape and Rural Production Area

Figure 1 – Environmental Values

Figure 1a: MSES Wildlife habitat



[63] https://spp.dsdip.esriaustraliaonline.com.au/geoviewer/map/planmaking

Figure 1b: MSES Regulated Vegetation Category B



Figure 1c: Regional biodiversity values



Figure 1d: MSES Regulated Vegetation Category C



Figure 1e: MSES Regulated vegetation (essential habitat)

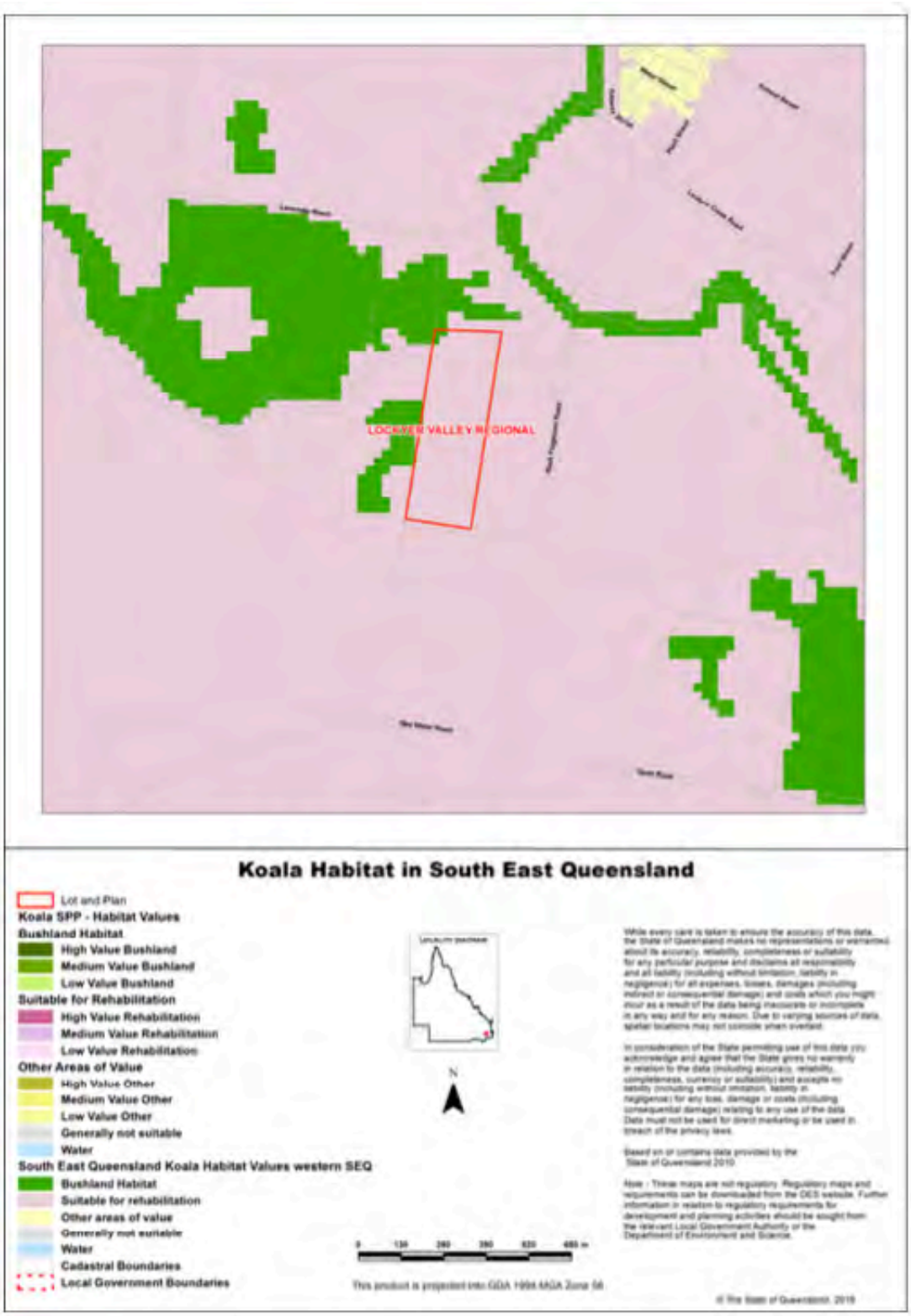


Figure 1f:MSES Regulated Vegetation (intersecting a watercourse)



COMMERCIAL IN

Figure 1g. Queensland Government Koala Habitat mapping for the Project Area environs, showing bushland habitat (green) and the QUU farm mapped as suitable for rehabilitation



6.5. Helidon Effluent Reuse Project – Part B Report: Planfuture

Please note: Printed copies of this document should be verified for currency against online version.

Helidon STP Effluent Reuse Project – Part A Report

QUU Reference	N53536
Project	Helidon STP Effluent Reuse Project – Draft for Discussion
Distribution	Andrew Lawrence, Project Manager Operations & Services QUU
	Cameron Jackson, Leader Water Quality & Environment, QUU
Date	13h MAY 2019
Contact	Tony Costantini, Principal Planfuture

Planfuture is pleased to provide Queensland Urban Utilities (QUU) with its report of findings under QUU Professional Services Agreement, Helidon STP Effluent Reuse Project.

The Report provides findings against the agreed deliverables and recommendations for moving to the next stages of design and implementation for the Helidon STP Effluent Reuse Project.

We understand that QUU encourages and promotes innovation; and are pleased to report that there are a number of innovative features of our work, which have already deepened the relationship between QUU and the Department of Environment & Science (DSE) and Lockyer Valley Regional Council (LVRC).

At QUU's request, the Report has been prepared in two parts: (a) Executive Summary and report against the Phases 1 & 2 Scope of Works; and (b) report against the Phase 3 Scope of Works, MEDLI modelling (this report). The latter will facilitate discussions with both DSE and LVRC, the former to achieve environmental licensing approvals the latter to achieve planning approvals.

Tony Costantini
Principal Planfuture
Mb: 0400 233 622



Limitations

This report is for use by the Central SEQ Distributor-Retailer Authority, trading as Queensland Urban Utilities (QUU), and should not be used or relied upon by any other person or entity or for any other project. This report has been prepared for the particular project described to Planfuture and its extent is limited to the scope of work agreed between QUU and Planfuture.

In completing this report, Planfuture has relied upon advice provided by QUU including in relation to the Helidon Sewage Treatment Plant (STP), effluent quality and quantity and preferred crop for the effluent reuse project. No responsibility is accepted by Planfuture or its Principal, servants, agents, staff or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.

To the extent that this report contain estimates for future works or services, physical or consulting, those estimates can only be considered current and will only reflect the extent to which the detail of the project is known to the consultant at the time given, details of which are provided in the report.

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Phase 3 – MEDLI Modelling

Summary

Queensland Urban Utilities (QUU) is seeking advice on the potential for effluent reuse at the Helidon STP, "*which supports re-establishment of native vegetation and provides an affordable and non-resource intensive irrigation solution*". To this end, in 2018 QUU prepared the Helidon STP Effluent Reuse Scope of Services[1] (Helidon Effluent Reuse Scope), which defined six Phases of work required to develop and define a reuse project.

This report addresses the third Phase of this schedule of works – MEDLI modelling of the Project Area. Specifically it reports upon the matters addressed in Section 3.3 of the Helidon Effluent Reuse Scope, which includes development of a bespoke MEDLI model for an eucalypt tree/grass preferred crop at the Project Area, with a view to scoping and assessing a preferred effluent irrigation project.

Based on the outcomes of the Phases 1 & 2 Scope of Works, the preferred crop for effluent irrigation at the Project Area comprises, in effect, two distinct crops:

a. A tree crop of regenerating Regional Ecosystem 12.3.3 (see Phase 1 report) established on a 5m x 5m grid basis using 90% blue gum (*Eucalyptus tereticornis*), 5% Moreton Bay Ash (*Corymbia tesselaris*) and 5% silver leaf ironbark (*E. melanaphloia*). The trees will not be harvested; rather will be used to generate environmental offsets.

b. A grass understory consisting of the extant non-improved pasture, which will be harvested on a cut-and-carry basis.

As MEDLI does not include a module for eucalypts or an understory pasture, we developed a bespoke blue gum forest module for Helidon. In doing this, we followed the approach that the Department of Science used to develop the MEDLI Melaleuca module in 1999. Our work had the added complexity of accommodating the interaction between the overstory tree crop and the grass understory crop as the tree crop matured. To inform this work we undertook a review of the literature and sort expert local knowledge to estimate the likely growth and performance potential for irrigated blue gum and the grass understory (Rhodes grass) at Helidon for the tree sapling stage (Year 1), when the trees are only modestly shading the grassy understory, and tree stage (Year 4+), when tree shading reduces growth potential of the grass understory.

Our bespoke blue gum forest module competently simulates irrigation, effluent storage, expected crop growth, water balance, percentage of effluent used, percentage of effluent discharged, crop nutrient sequestration and soil salinity over the intended 20 year irrigation project.

Based on the MEDLI modelling results, we have recommended:

[1] Queensland Urban Utilities Helidon STP Effluent Reuse Scope of Works November 2018.

- establishment of a 4ha irrigation area;
- installation of a minimum 250kL (preferable 500kL) storage tank with an overflow bypass to the existing turkey dam;
- applying 25mm at each irrigation event (evenly throughout the Planting area);
- use of a coarse droplet spray irrigation system, to achieve even irrigation throughout the Planting Area; and
- installation of an irrigation control system that can -
    - irrigate the desired volume to each 1ha of the Project Area on a sequential basis, and
    - incorporate rules for not irrigating given various antecedent daily rainfall (e.g. 10mm).

Using these recommendations, the blue gum forest model simulates irrigation supply of 18.6ML/year over 4 ha, equivalent to 4.6 ML/ha/yr. This quantum of irrigation approximates Average Dry Weather Flow for Helidon STP minus the net evaporation loss from the treatment lagoons. The modelling confirms that ≈3.3% of the total water input (rainfall plus irrigation) passes through the profile as deep drainage (41mm/yr).

Our modelling suggests that the blue gum forest crop (trees plus grass) will uptake around 88% of the nitrogen applied in effluent and around half of the applied phosphorus. The finding that the forest is not taking up 100% of the applied nutrients beyond around Years 5-6 is not surprising as eucalypts are effective in recycling nutrients and in relocating nutrients to the actively growing foliage and away from branch and stem biomass; and the crop will reach a reasonably stable leaf biomass around Year 5-6. While the tree component of the forest crop comprises >80% of the biomass produced at age 10, the grass understory will account for around 51% of the nitrogen uptake in that time.

We confirm that the Planting Area will be sufficient to accommodate the 25% increase in ADWF that was advised by QUU as being required to accommodate potential 2029 population growth.

We also conclude that the effluent reuse is sustainable. Both MEDLI and SALF modelling confirm that salinity is unlikely to be limiting and irrigation of low sodicity effluent is unlikely to have an adverse effect on soil structure. We believe that the actual amount of nitrogen leachate will be relatively small and manageable: We test this, both by MEDLI modelling and confirming model predictions with the results of a separate mass balance analyses. As any risk of excess nitrogen leaching would only be manifest after the trees reach canopy closure and tree leaf biomass plateaus (around Year 5), we recommend that QUU sample the soil leachate solution at age 6 years and, if no issues are confirmed, on a triennial basis thereafter.

Introduction

QUU is seeking advice on the potential for effluent reuse at the Helidon STP, "*which supports re-establishment of native vegetation and provides an affordable and non-resource intensive irrigation solution*". To this end, in 2018 QUU prepared the Helidon STP Effluent Reuse Scope of Services[2] (Helidon Effluent Reuse Scope), which defined six Phases of work required to develop and define a reuse project.

Planfuture has been engaged to undertake components of the first three Phases of this work programme. Phase 1 involved undertaking a suitability assessment of the Farm Investigation Area (QUU farm next to the Helidon STP). Key findings were that the site is suited for irrigated crop production as well as the regeneration of the pre-clearing Regional Ecosystem (RE) 12.3.3 (tall open blue gum forest with a grassy understory). Phase 2 demonstrated the potential to generate offset credits by re-establishing the RE 12.3.3 forest type.

This report addresses key components of the Phase3 schedule of work, MEDLI[3] modelling (Table 1).

Table 1: Tasks required for MEDLI modelling of the Project Area

Scope of Works Reference	**Phase 3 Tasks sought in this consultancy**
3.3.1	Develop a daily time-step water balance model as the basis for assessing future water use potential, given improved system management and modifications to the existing infrastructure (including STP minor works) and practices. The model will capture the changing irrigation demand and nutrient sequestration patterns from a planted tree crop with grass understory
3.3.2	The daily model would use historical climate data relevant to the area and provide the flexibility to assess different scenarios and analyse how they perform over time. Modelling scenarios to be undertaken for the project include 1in 20 dry year, 1in 10 dry year, median year, 1in 10 wet year, and 1in 20 wet year
3.3.3	Use the model to investigate how the Section Two Objectives can be met, and clearly detail a recommended native vegetation regeneration solution [Preferred Solution] to achieve the objectives reliably and effectively. The Consultant must demonstrate how the Preferred Solution optimises all environmental, economic and irrigation factors in addition to achieving QUU's objectives
3.3.4	Provide monthly volumes of effluent release pursuant to the Environmental Authority conditions for release to the environment (see Section 1) for the Preferred Solution
3.3.5	Undertake SALF modelling if indicated and, if not required, provide evidence of likely acceptable salinity management

Based on the outputs of Phases 1 & 2, Planfuture recommends that QUU establish an effluent reuse project on the Project Area, which is immediately adjacent to the eastern side of the STP and has a relatively large frontage to Monkey Water Holes Creek (Figure 1). This location has been confirmed by QUU (following high level engagement with the Lockyer Valley Regional Council) as being desirable for native vegetation regeneration.

[2] Queensland Urban Utilities Helidon STP Effluent Reuse Scope of Works November 2018.

[3] Model for Effluent Disposal using Land Irrigation. https://www.des.qld.gov.au/science/documents/medli-poster.pdf

Figure 1: The 4ha Project Area adjacent to the Helidon STP



The recommended crop for the Project Area comprises a tree crop of 95% *Eucalyptus tereticornis* (blue gum), 5% *E. melanaphloia* (silver-leaf ironbark) and 5% *Corymbia tesselaris* (Moreton Bay ash, planted on a 5m x 5m grid, with an understory of the existing unimproved grass crop.

Scope Reference 3.3.1 & 3.3.2: MEDLI Modelling & Scenario Testing

Description of MEDLI

MEDLI v2 is a recent upgrade of the MEDLI simulation model (Gardner *et al.* 1996[4]). Using a daily time-step, the model integrates waste production, pond water and nutrient balance, irrigation scheduling, soil water balance, plant growth, and soil nutrient cycling, steady-state soil salinity balance, groundwater nitrate transport and simple quantitative microbial risk analysis.

[4] Gardner, T., Atzeni, M., McGahan, E., Vieritz, A., and Casey, K. (1996). MEDLI-A computer model to help resolve environmental conflict in intensive rural industries. In: Proceedings of the Resolving Environmental Conflict Conference. 17pp. November. Brisbane, QLD. Institution of Engineers Australia.

MEDLI is a mass balance model that uses existing knowledge of bio-physical nutrient and water balance. It uses physically-based inputs, together with effluent production details linked to a library of default model parameters for specific types of pretreatment, crops and pastures, soil types, and irrigation method. Long term sustainability of a disposal system is evaluated using design and location specific effluent, pond, soil and plant parameters with long-term weather data.

The key aspect of MEDLI is long-term water balance integrated with the soil nutrient balance, plant growth and soil salinity. The water balance operates on a daily time step and requires long term daily climate files of rainfall, evaporation and temperature. Daily effluent production is defined and treated as being pumped to a large balancing storage (often equivalent to around 30 days' effluent production), from which it is then withdrawn for periodic irrigation based on defined watering rules. The balancing storage has its own water balance (inflows, extractions, overflows) and the objective of MEDLI irrigation designs is to minimise 'spillage' during periods of extended wet weather.

The water balance of the irrigation area is determined by using inputs of irrigation and rainfall, and outputs of evapotranspiration, runoff and deep drainage. The soil hydraulic properties determine the plant available water capacity, the drainable porosity and the saturated hydraulic conductivity.

Irrigation in MEDLI can be triggered by a number of criteria; the most common being a set soil water deficit (measured relative to the Field Capacity moisture profile). Irrigation depth can be defined to refill either all of the soil water deficit or some fraction of it. As MEDLI does not model multiple paddocks, irrigation application capacity is limited by the practicalities of system design, it is possible for an irrigation event to occur over longer periods (two or more days in some instances).

As the water balance is run over multi decade time intervals (usually 50+ years) the irrigation demand will vary from year to year with a maximum in low rainfall years and a minimum in high rainfall years. The very wet years are of particular interest to effluent reuse schemes, as excess effluent must be discharged. However, this is not the case for Helidon STP, where excess effluent can be safely discharged into the existing Turkey Nest Dam (south of the STP in Figure 1). [This dam has two parts; an initial ≈2,500m^2 compartment within a larger ≈32,500m^2 compartment. QUU discharges to the smaller compartment, which may overflow into the larger compartment.]

Plant growth modelling is a critical component of MEDLI as it impacts both water use and nutrient uptake and hence nutrient and water mass balances in irrigation. In MEDLI, plant growth is species specific and moderated by limitations of temperature, leaf nitrogen levels and stresses from water supply, water logging and soil salinity.

A critical performance criterion of a successful effluent irrigation scheme is that the land does not accumulate potentially harmful biological nutrients. MEDLI models soil nitrogen balance by considering denitrification, mineralization of native soil N, plant uptake and leaching below the root zone. Provided leaching losses are low (e.g. < 10mg/L NO3-N in soil

solution below root zone), then the reuse scheme is considered sustainable. A similar argument applies to phosphorus; but it is often immobilised via soil adsorption reactions.

A further constraining factor for plant growth in an irrigation area is the soil salinity: The higher the effluent salinity and the lower the deep drainage, the higher the risk of soil salinity limiting plant growth. In MEDLI, it is the water uptake weighted root zone salinity that is calculated and compared with published salinity thresholds for a range of crops. The common salinity metric is EC of the saturation extract, ECse, which requires conversion of traditional 1:5 EC values to equivalent saturation extract moisture contents.

MEDLI Inputs –

Soils

The Phase 1 report provides a detailed description of the Helidon Project Area soils and the soil chemical and physical characteristics that have been used to paramatise MEDLI. The Phase 1 report concluded that there were no obvious limitations to blue gum growth and that there were no significant risks to soil structure from the proposed irrigation rate (though this was to be confirmed through the SaLF[5] modelling as part of Phase 3).

We have constructed our MEDLI model using the most marginal of the Representative Soils identified in the Phase 1 Report – Representative Soil 3[6]. Salinity, waterlogging and drainage constraints are likely to be the most restrictive at this site; thereby providing a conservative basis for our MEDLI modelling and irrigation recommendations. However, our irrigation recommendations are applicable to the whole Project Area (viz. for all Representative Soils).

MEDLI requires input of Upper Storage Limit (USL), Lower Storage Limit (LSL) and (field) Saturation volumetric water contents. These values are expensive to collect in the field and hence are routinely estimated using more easily measured surrogate parameters using pedo-transfer functions[7]; or less satisfactorily, chosen from a library of soil properties in MEDLI, or from a bigger soil data base such as APSIM Soil[8].

This report utilises pedo-transfer functions have been used to determine various soil water properties (air-dry moisture content, soil evaporation parameters, Curve Number coefficient and saturated hydraulic conductivity of the limiting soil layer) from soil particle size, 15 bar moisture content and soil depth. Similarly, soil Bulk Density, which is needed to convert gravimetric moisture data into volumetric data and to calculate moisture content (in mm of depth), is estimated using regression equations driven by soil particle size.

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[5] Shaw, R.J. and Thorburn, P.J. (1985). Prediction of leaching fraction from soil properties, irrigation water and rainfall. *Irrigation Science*, **6**, 73-83.

[6] See the Phase 1 Report - Blenheim soil (imperfectly drained black and brown Vertosols with low subsoil salinity – Sampling Site 11

[7] Littleboy M. (1997). Spatial generalisation of biophysical simulation models for quantitative land evaluation: A case study for dryland wheat growing areas of Queensland. PhD Thesis. The University of Queensland.

[8] The Agricultural Production Systems sIMulator - https://www.apsim.info/

Effluent

QUU has provided Planfuture with data on effluent production and effluent quality, which have been used in both MEDLI and SALF modelling (Attachment A).

Using the *Public Health Regulation 2005* definition of effluent class for irrigation, the Helidon effluent (post the chlorine contact tank) is Class B. The proposed Project Area (Figure 1) is set back the prescribed distance (30m)[9] from the closest point to the STP security fence (circa 70m from the buildings and work area).

Average Dry Weather Flow (ADWF) is circa 21ML/year; with total effluent production increasing to circa 26ML/year when wet weather flow in an average rainfall year is considered. MEDLI adjusts inflow for each year using a leakage algorithm tuned to a low, medium or high inflow sewerage system.

Climate

Climate data was obtained from the SILO[10] website that supplies daily data for any location in Australia for periods dating back to 1889. Using the Boonah geo-location we obtained climate data from 1967 to 2016. This 50-year period contains representative periods of dry and wet years, which are adequate for effluent irrigation modelling[11]. Average annual rainfall for the period is 782 mm/yr whilst Class A pan evaporation is 1.780 mm/yr (Figure 2). There is an average nett evaporation loss every month; giving an accumulative loss of circa 1,000mm/year.

Irrigation Area

In early discussions with QUU regarding the potential for generating environmental offsets, a notional planting area of 5ha was used. Once the actual Average Dry Weather flow for the Helidon STP (circa 21ML/ha/yr before net evaporation loss), it became clear that irrigation volumes would be less than 4ML/ha/yr with a planting area of 5ha, potentially reducing crop performance. A 4ha planting area allows increased irrigation application rates and crop production; and likely represents a better balance between establishment/management costs for the effluent irrigation project and the potential value of environmental offsets. [Planting area is included in our sensitivity testing to assess the increasing plantings to 5ha.]

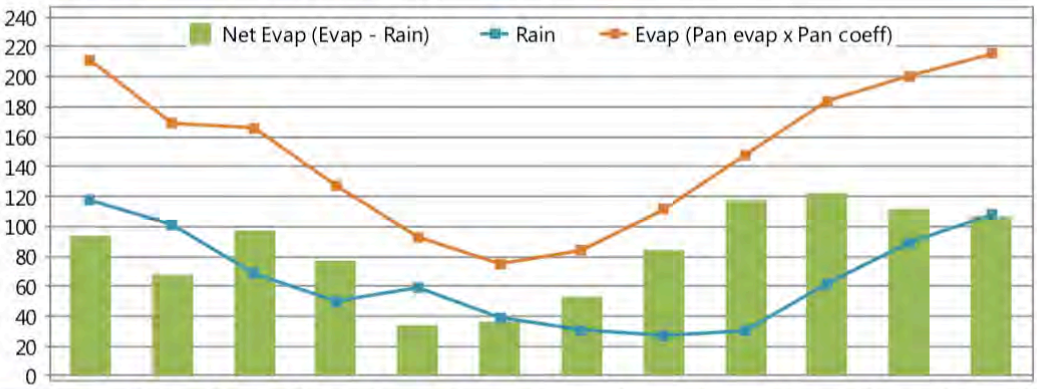
Accordingly, we have modelled the Project Area (Figure 1) as a single 4ha block for irrigation purposes. However, with the Helidon STP's average daily production rate (circa 57kL/day), it

[9] See for example Queensland Water Quality Guidelines 2005
[10] Scientific Information for Land Owners - https://www.longpaddock.qld.gov.au/silo/about.html
[11] Vieritz, A.M., Ramsay, I.R., Haworth, L.F.J., Tennakoon, S., and Gardner, E.A. (2011). Sustainable effluent irrigation over the past decade – The role of MEDLI modelling for wastewater discharge. 19th International Congress on Modelling and Simulation, Perth, Australia, 12–16 December 2011

would take about 4.5 days to generate the 250,000L required to apply 25mm of irrigation (a reasonable application for modelling purposes) to 1 ha; implying that it would require 18 days of production to generate the supply volume needed to irrigate the entire 4 ha (on a sequential 1ha basis).

Figure 2: Extract of a climate File Summary from a Helidon MEDLI run

Run Period: 01/01/1967 to 31/12/2016 50 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	117.5	101.2	68.4	50.1	59.1	39.1	30.9	27.1	30.3	62.0	89.2	107.8	782.6
Evap	211.0	168.9	166.0	127.3	92.9	75.0	84.0	111.2	147.9	184.0	200.7	215.1	1784.0
Net Evap	93.6	67.7	97.5	77.2	33.8	36.0	53.0	84.1	117.7	122.0	111.5	107.4	1001.4
Net Evap/day	3.0	2.4	3.1	2.6	1.1	1.2	1.7	2.7	3.9	3.9	3.7	3.5	2.7

MEDLI allows the user to trigger irrigation on both an 'as needs basis', for example using a Soil Water Deficit (SWD) of say 25mm; or on an interval basis, for example once every 18 days. We have tested both approaches, settling upon the SWD of 25mm (and irrigation of 25mm). Our modelling uses a 25mm Soil Water Deficit (SWD) trigger, applying 25mm per application.

The intent is to irrigate the Project Area for 20 years, at which time, irrigation will cease to the established trees in the irrigation area and for a new Planting area to be established on the Farm Investigation Area.

Storage

A balancing storage pond is always required to store surplus effluent production during wet / low evaporation times and supply effluent during dry times when irrigation demand is greater than effluent supply.

The Helidon STP has two treatment lagoons, a facultative lagoon of ≈ 4,210m^2 and a baffled lagoon of ≈2,158m^2. At the time Planfuture inspected the Helidon STP in November 2018 and March 2019, the STP also had two free water surface wetlands, one of which was decommissioned and the other managed with a preferential flow path. On these bases, effluent evaporation (effectively only from a preferential flow path) was assumed to be very low; and given the net evaporation potential of the site (Figure 2), the potential for net

rainfall additions were also considered to be very low. Accordingly, the free water wetlands were not considered further in modelling.

QUU has advised on their intent to install a balancing storage tank (sufficient to meet the objective of irrigating Average Dry Weather Flow) at the outlet of the chlorine contact tank. We have modelled various tank sizes.

While not a part of the scope for this project, the potential exists to use the small chamber in the larger Turkey Nest Dam for balancing storage (i.e. to avoid the need for a storage tank). While this is likely to be feasible, with no significant changes to the modelling outcomes (evapotranspiration would increase, available effluent for irrigation would decline and, depending on residency period, nutrient concentrations may decline. Despite this, use of an open storage dam has a number of operational consequences. Algal blooms will greatly increase filtration and filter maintenance effort and cost. In addition, assumptions regarding the effluent being Class B will no longer be relevant. Based on QUU's desire to deliver operational simplicity and efficiency and the benefits of being able to irrigate when sufficient effluent is available, Planfuture's recommendation is that QUU continue with its intention to install a storage tank and to continue disinfection ensuring appropriate chlorine residuals are maintained in the tank.

MEDLI Methodology

The crops used at the Project Area will, in effect, be a composite of two crops, both of which will be irrigated with effluent:

- Newly established tree crop of blue gum, silver-leaf ironbark and Moreton Bay ash, which will not be harvested. The trees will be established on a 5m x 5m grid, equivalent to 400 trees/ha, with a species split of 90%, 5% and 5% blue gum, silver-leaf ironbark and Moreton Bay ash respectively. Given the dominance of blue gum in this Regional Ecosystem (RE) type, tree crop modelling is based on blue gum.

- Existing unimproved grass crop[12], which will be harvested. No specific agronomy is recommended for the existing unimproved grass crop: Specifically, enrichment planting with improved pasture species and/or over-sowing with winter annuals are not recommended. The MEDLI Rhodes grass module is considered to best approximate the unimproved grass crop (which includes a component of Rhodes grass).

As noted above, MEDLI has in-built modules for modelling the elements of land-based effluent disposal systems such as the storages and overflows, chemical transformations, soil water balance, plant production, irrigation management, and nutrient uptake by various plant species and removal/harvesting.

[12] As noted in Phase 1 of this report, the RE is essentially tall open blue gum with a native grass understory. Shrubs are largely absent and, to the extent they occur, not a significant long-term component of the understory. *Acacia salicina* is present on the site and can be expected to be present in the understory: As it is not expected to be a significant component of the understory in the long-term, particularly if the grass sward is managed by periodic slashing, the understory is modelled as being a grass crop.

Although MEDLI can model a range of pastures and crops dynamically, it does not currently have a module for blue gum, or indeed other eucalypt species. The one module intended for use with tree crops, the Melaleuca module, assumes a biennial harvest through slashing to maintain the site as a firebreak. Consequently, there is a need to develop a bespoke approach for the Helidon Effluent Irrigation Project. To address this issue, experts at the Department of Science were consulted in the development of the modelling approach.

We identified four key stages of blue gum regeneration – effectively, an initial grass dominated establishment phase transitioning to a tree dominated phase where increasing shading of the understory reduces, but does not prevent, grass growth. Tree canopy closure[13] is considered complete after about 5 years:

a. Seedling stage – Years 0-1 commencing at the time trees are planted;
b. Early sapling stage – Years 1-3 as the trees grow rapidly to 'capture their immediate planting zone';
c. Late sapling stage – Years3-4 as the trees grow vertically and laterally (both above and below ground) until canopy closure is reached; and
d. Tree stage – Years 5-20 during which time the trees will grow vertically and in girth and, up to a point, the crowns will thicken.

The production of the understory will decrease through each of these stages; but, importantly, will not reach zero and, even after canopy closure, will continue to have an important role in water use and nutrient uptake. Assuming 100% of the area is irrigated, the pasture grasses will cover the entire area, except for the first three years, during which the immediate plant zone around the young eucalypts (circa 30% of total area), which will be kept free of grass competition[14]. The extent and vigour of grass cover will be greatest in Stage 'a' (blue gum seedling stage). The blue gum foliage will increase through Stages 'a' to 'd'; and, for modelling purposes, will plateau around Year 6. As the blue gum has a largely pendulous leaf form, blue gum forests transmit sufficient light to the forest floor to ensure the presence of an active grass sward, even after closure of the tree canopy.

We undertook an extensive literature review and consulted with forestry experts to estimate irrigated eucalypt crop production and nutrient uptake in order to generate estimates of crop production and nitrogen and phosphorus uptake for a regenerating irrigated blue gum at Helidon (Attachment B). We also reviewed the expected native pasture production during the four stages of regeneration noted above. These data were used to 'calibrate' a bespoke MEDLI model for Helidon.

The approach used to develop the bespoke MEDLI model broadly followed the approach used to develop the MEDLI Melaleuca module, which was developed to model effluent

[13] The definition of stages is arbitrary and is dependent upon site and silviculture. Those chosen for the irrigated tree crop at the Project Area are based on an initial stocking of 400 trees/ha with good supporting silviculture.

[14] The preferred silviculture will keep an area of 1.25m – 1.5m radius around the tree crop free of grass (the "plant zone": While the roots of grasses on the edge of plant zone will invade the plant zone, the immediate tree root zone (0.5m – 0.75m radius) will be weed root free, thereby promoting vigorous tree growth.

irrigated crops of *Melaleuca alternifolia* (Melaleuca) and *Imperata cylindrical* (blady grass), that were to be slashed bi-annually to provide a firebreak for the Couran Cove resort on Stradbroke Island[15]. The Melaleuca module development adapted the MEDLI pasture model, modifying growth parameters to reflect published growth data for irrigated Melaleuca.

In this study, we have adapted the Melaleuca methodology used to develop the Melaleuca module. Initially we considered tree-pasture growth after 4 year (year 4+) which corresponded to closure of the blue gum canopy:

a. Step 1: Develop a blue gum module without harvest[16]

b. Step 2: Model the grassy understory using the MEDLI Rhodes Grass module with harvest (cut-and-carry)[17]

c. Step 3: Adapt the blue gum module developed in Step 1 to generate a composite blue gum / Rhodes grass module (**the blue gum forest module**).

Step 1

In Step 1, we adapted the biomass development algorithms in the MEDLI pasture module (the module used in developing the Melaleuca model) to generate the blue gum growth parameters detailed in Attachment B. This involved:

- Defining Radiation Use Efficiency (RUE)[18] for unconstrained (unlimited water and nutrient) blue gum growth.
- Parameterising MEDLI's 'limiting factors for growth' response functions (namely temperature, nutrients, waterlogging and salinity).
- Iteratively running the MEDLI module with the RUE and the temperature, nutrient, waterlogging and salinity parameters to derive the Attachment B blue gum growth and performance outcomes provided at Attachment B.

For the purposes of determining RUE, we used Indian data from Minhas *et al*. (2015)[19], who reported 10 year biomass accumulation of 262 tonnes/ha for blue gum irrigated with circa 10ML/ha/yr (see Table 2 for interpolated results). At age 10, biomass comprised 91% stem 5% leaves & twigs and 4% branches.

[15] Gardner et al. (1977). A Report on Greywater Irrigation: Couran Cove Resort South Stradbroke Island.
[16] Achieved by setting a harvest trigger yield of 1,000, tonnes/ha and ensuring that none of the nutrient, temperature or waterlogging stress indices on Radiation Use Efficiency trigger a harvest in MEDLI modelling.
[17] Cut and carry harvest of the grassy understory was selected as this is the approach that QUU is presently using to managing the entire Farm Investigation Area and is likely to provide a low cost management solution
[18] Potential growth is considered to be a function of solar radiation, plant cover intercepting the solar radiation and the radiation use efficiency of the given pasture species. Radiation use efficiency (RUE) is defined as biomass produced (kg/ha) per unit solar radiation (MJ/m^2) intercepted
[19] Minhas *et al.* (2015). Effect of long-term irrigation with wastewater on growth, biomass production and water use by Eucalyptus (*Eucalyptus tereticornis* Sm.) planted at variable stocking density

Table 2: 'Unconstrained blue gum growth used to derive Radiation Use Efficiency

Age 7 years				Age 10 years			
Planting density similar to Helidon		Very high planting density (≈2,000 trees/ha)		Planting density similar to Helidon		Very high planting density (≈2,000 trees/ha)	
Roots	Shoots	Roots	Shoots	Roots	Shoots	Roots	Shoots
50	130	70	170	75	178	110	262

This analysis provided an initial estimate of RUE of 2.6 kg/ha/MJ/m^2 based on data included in Table 2 and published average daily solar irradiance for the Minhas *et al.* 2015 study area[20]. We also explored RUE within MEDLI by allowing unconstrained growth using the Helidon climate data to confirm the RUE to be used in the blue gum base model.

As the RUE parameter in MEDLI reflects unconstrained growth, we then sought to quantify reductions resulting from temperature, nutrient, waterlogging and salinity growth stresses. A summary of these stresses and their quantification for the Helidon site is provided in Attachment C. Importantly for modelling nutrient stresses, we use a composite of the leaf / branch / stem nutrient concentrations: We did not model the tree leaf / branch / stem components separately[21].

The final action in building the blue gum model involved iterative MEDLI modelling of the key stress indices for RUE until predicted above-ground biomass and nutrient uptake agreed with crop growth estimates for blue gum at Helidon (reported in Attachment B1 Table B1).

Step 2

In Step 2 we modify the MEDLI Rhodes Grass module to simulate the expected grass understory production and nutrient uptake (Attachment B, Table B3). We did this by reducing grass Radiation Use Efficiency to reflect the reduced solar radiation beneath a closed blue gum canopy (about 20% of clear sky solar radiation).

Step 3

Step 3 involves adapting the Step 1 blue gum model to develop a composite blue gum and grassy understory model for Year 4+ (denoted as the blue gum forest model Year 4+). There is no *a priori* correct approach for developing a composite model. This means that care in interpreting MEDLI runs is necessary.

The blue gum forest model was used to undertake sensitivity testing of:

- Irrigation area (5ha)
- Increases in Helidon STP Average Dry Weather Flow to 2029 (25% increase)
- Storage tank size
- Representative Soils 1 & 2 (the better quality soils in the Project Area)

[20] We note that Minhas *et al*. (2015) reported that for both planting densities (detailed above) leaf and twig biomass as a percentage of total biomass increased from ≈4% at Age 5 (interpolated) to ≈5% at Age 10, suggesting that Leaf Area Index is likely to plateau shortly after Year 5.

[21] To model the various tree components separately would be a significant research programme that is beyond the scope of this study.

After developing a Year 4+ blue gum forest model, we repeated each of the steps to produce a Year 1 blue gum forest model[22]. We did not repeat this exercise for Years 2-4 inclusive as we believe that linear interpretation between Year 1 and Year 4+ is sufficient.

Following are a number of high -evel observations from the blue gum forest model development experience:

- The Melaleuca module, on which our Eucalypt model is based, does not allow for specification of effluent quality; rather this has to be generated using the pond treatment algorithms in MEDLI. This meant that we had to adjust influent quality to ensure that the measured effluent output quality (Attachment A) was being predicted correctly.
- The base pasture module does not allow for input of crop factors, rather these are derived from canopy cover and crop coefficient inputs. We have simulated average monthly crop factors of circa 1.18 (Year 4+), which is in line with our expectations.
- The blue gum forest model accurately simulates published biomass production and nutrient uptake for both blue gum and Rhodes grass.
- The blue gum forest model suggests that 'mining of soil nitrogen store' is occurring despite the nitrogen added in the effluent slightly exceeding plant uptake. As a result, deep drainage of nitrogen is not well simulated. To ensure that the risk of nitrate leaching is acceptable, we have undertaken a separate spreadsheet-based mass balance modelling of nutrient uptake. We have also simulated the forest crop without mineralisation of the soil organic store.
- We have stress tested irrigation triggers, by separately trialling application of 25mm on a soil water deficit or fixed interval. There was little impact on irrigation demand (effluent reuse) and nutrient uptake.

Scope Reference 3.3.3: MEDLI Results and Irrigation Recommendation

Unless the context suggests otherwise, the results will focus on the blue gum forest model run (Attachment E) for the base scenarios of:

- 4ha Irrigation Area, irrigated for 20 years;
- Blue gum overstory, not to be harvested, and native unimproved grass understory managed on a cut-and-carry harvest basis;
- Irrigation of 25mm on a 25mm Soil Water Deficit;
- Representative Soil 3, being the more challenging soil types in the Project Area for effluent irrigation (see the Phase 1 report);
- High quality silvicultural and management inputs (to be developed further in Phases 5 & 6 of the Helidon Scope of Works); and
- Zero soil organic nitrogen store mineralisation.

[22] We have assumed a 1m rooting depth for the year 1 crop and the grassy understory (consistent with observed grass rooting (see Phase 1 Report) and 1.2m rooting depth for the Year 4+ blue gum. We have also tested 2.0m rooting depth.

Modelled Soil Hydraulic Parameters

The MEDLI derived soil hydraulic characteristics are provided in Table 3. These parameters are indicative of clay soils in the Lockyer Valley. No impediments to irrigation are suggested.

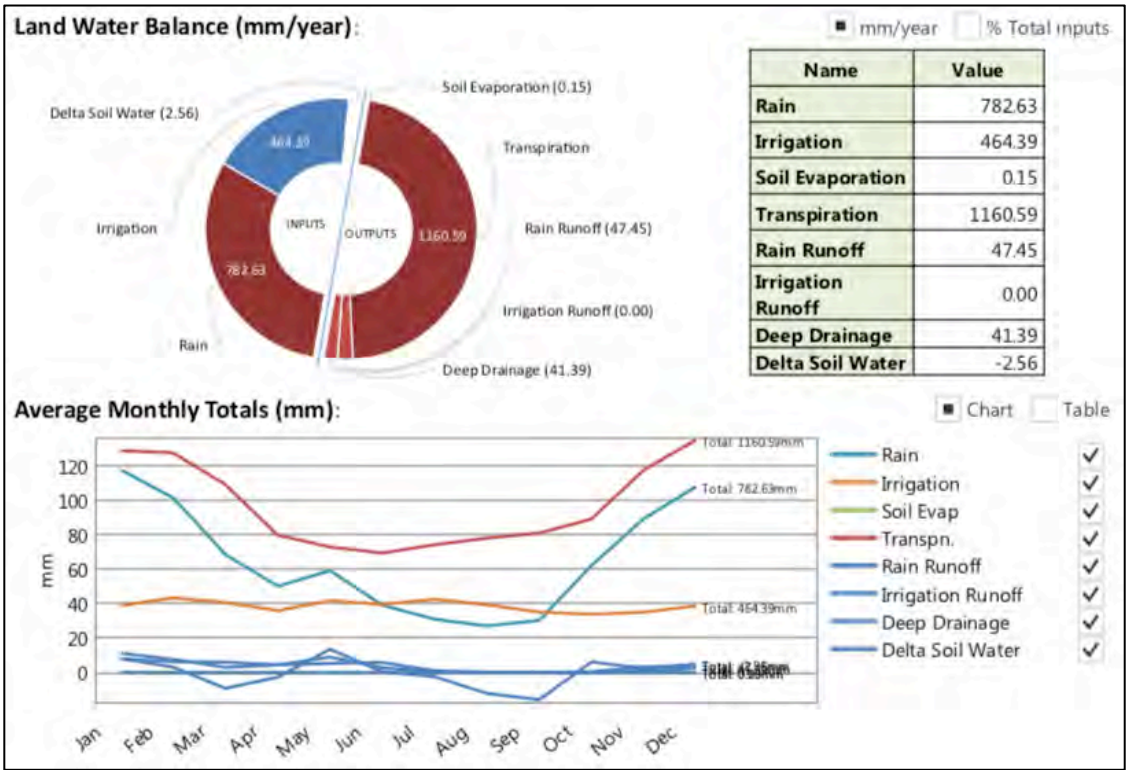
Table 3: Derived soil hydraulic parameters to 1,200mm

Parameter	Derived Value
Profile porosity	589mm
Profile saturation water content	553mm
Profile drained upper limit (field capacity)	479mm
Profile lower storage limit (permanent wilting point)	349mm
Profile available water capacity	129mm
Profile limiting saturated hydraulic conductivity	1.44 mm/hour
Surface saturated hydraulic conductivity	3.47mm/hour

Water Balance

The blue gum forest model predicts irrigation of 18.6ML/year, which over 4 ha is equivalent to 4.6 ML/ha/yr (or 465mm/yr – See Figure 3). This quantum of irrigation approximates Average Dry Weather Flow minus the net evaporation loss from the treatment lagoons (Figure 1). Around 3.3% of the total rainfall plus irrigation input (47mm/year) passes through the profile as deep drainage (Figure 1).

Figure 3: Land water balance

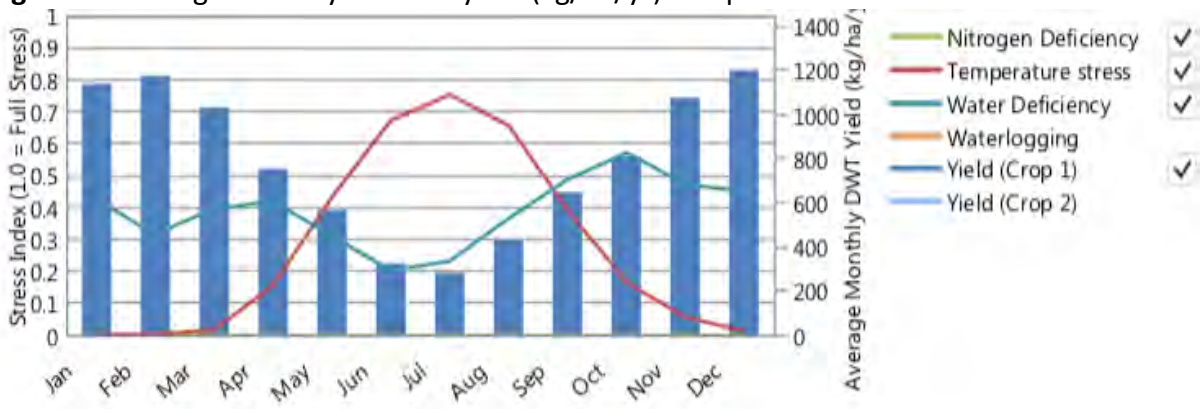


Crop Growth

The combined shoot dry matter yield is circa 9.4 tonnes/ha/year. Consistent with the Attachment B growth assumptions for Helidon (see Attachment B), total biomass production is expected to comprise circa 7.5 tonnes/ha/year of tree crop biomass and circa 1.8 tonnes/ha/year grass biomass. For the trees, these biomass values equate to circa 7m^3/ha/yr tree stem growth (a reasonable value for irrigated blue gum on this site).

As Figure 4 highlights, growth is constrained (by lower temperatures during winter and water deficiency in spring, summer and autumn. Water logging is not constraining growth.

Figure 4: Average monthly biomass yield (kg/ha/yr) and plant stresses



Nutrient Uptake

The average total nitrogen and phosphorus concentrations of irrigation water are 22mg/L and 10mg/L respectively (consistent with Attachment A). After ammonia loss during spray irrigation, the nitrogen concentrations reduce to 18.5mg/L. With an average irrigation rate of 4.6ML/ha/yr, nutrient inputs of nitrogen are 85kg/ha/year and 47kg/ha/yr for phosphorus (Figure 5).

Key implications of the land based nutrient balance (Figure 5) are:

- The blue gum forest will sequester around ≈90% of the irrigation applied nitrogen.
- The model indicates that some 25kg/ha/yr of nitrogen is being mineralised from the soil organic nitrogen store.
- The indicative amount on nitrogen leached (without mineralisation) is about 8g/ha/year, which is modest.
- Around half the applied phosphorus is taken up by the forest, with the remainder adsorbed on the soil.

There is no *a priori* reason why the soil organic nitrogen store would be being 'mined' as the amount of nitrogen applied in irrigation exceeds the amount of nitrogen sequestered in plant biomass. Accordingly, we tested the soil nitrogen dynamics without mineralisation of the soil organic nitrogen store: The simulation indicated average nitrate leaching reduced to ≈8kg/ha/yr, which is consistent with the disparity between nitrogen applied in irrigation effluent and nitrogen taken up by the crop. We believe the mineralisation is an artefact of the base MEDLI pasture/Melaleuca module, which we will pursue with the Department of Science prior to finalising our report[23].

The finding that the crop is not taking up 100% of the applied nutrients after Years 5-6 is not surprising as eucalypts are highly effective in recycling nutrients and in relocating nutrients to the actively growing foliage and away from branch and stem biomass; and because the nutrient rich leaf biomass plateaus. Indeed, the understory grass biomass in a mixed tree/grass forest planting will, subject to other constraints such as sufficient radiation transmission through the tree canopy, be an important nutrient sink.

Applying the expected crop growth and nutrient uptake data (detailed in Attachment B), we prepared a mass balance for biomass (Attachment D Table D1 and Figure D1), nitrogen (Attachment D Table D2 and Figure D2) and phosphorus (Attachment D Table D3 and Figure D3) for 20 years of irrigation. Over the 20-year irrigation period, key expected outcomes are summarised in Table 4 (and described in further detail in Attachment D):

Table 4: Comparative biomass production and nutrient uptake of the tree and grass components of the regenerating blue gum forest

Parameter	Tree component of forest	Grass component of forest
Percentage of Year 10 accumulated biomass	18%	82%
Percentage of Year 10 accumulated nitrogen uptake	51%	49%
Effluent reuse (proportion of inflow + net rain gain) that is irrigated (as a fraction)	53%	47%

While the trees will account for 82% of biomass accumulation (more if roots were counted), the grass will sequester circa 50% of the nitrogen and phosphorus taken up by the forest.

[23] Rather than be mineralise, a number of key studies of effluent reuse have either shown a build-up of soil organic nitrogen through effluent irrigation of eucalypts (e.g. for blue gum - Minhas, PS., Yadav, R>K, Lal, K., and Chaturvedi, R.K. (2015). Effect of long-term irrigation with wastewater on growth, biomass production and water use by Eucalyptus (*Eucalyptus tereticornis* Sm.) planted at variable stocking density) or no nett change in nitrogen store despite applied nitrogen exceeding the amount of nitrogen taken up by the crop (e.g as a result of denitrification in the WC Fields work; or ammonification in the Wagga Wagga work. Regardless that the research is not sufficiently certain to conclude that soil organic nitrogen at Helidon would increase (most likely with a gradual build up in soil carbon), there is no evidence or *a priori* reason to expect soil organic nitrogen stores to decrease due to mineralisation.

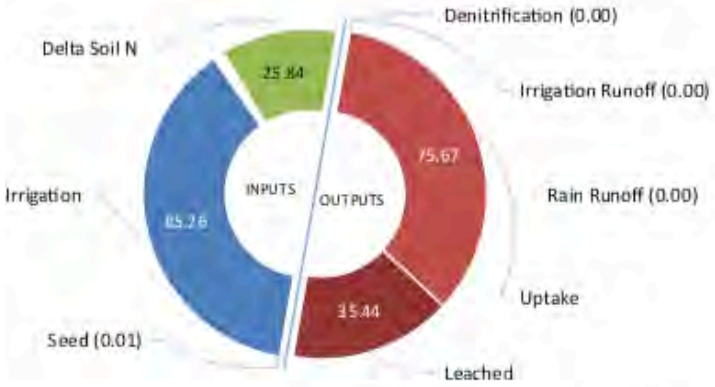
Salinity

Soil salinity can be an issue for irrigated crop production if the irrigation water is saline, the irrigation loading rate is high, the rainfall low, the cropped species is salt sensitive, and most importantly, the deep drainage below the plant root zone is insufficient to leach excess soil salt. None of these factors apply to the Project Area soils, in that the effluent water has only moderate salinity (≈1.2 dS/m), the blue gum (and Rhodes grass) are salt tolerant, and the predicted deep drainage is adequate, in the of the order of 36 mm/yr.

MEDLI also calculates the salt balance of the root zone and estimated an average water uptake weighted root zone saturate extract (ECse) of 1.8 dS/m, which is well below the threshold number that causes blue gum and Rhodes grass growth limitations. Consequently, the number of years that pasture yields would be expected to fall below 90% of potential is zero (from MEDLI predictions). We conclude that salinity is highly unlikely to be an issue for the Project Area irrigation: However, we also undertook a further check using SALF modelling in Scope Reference Section 3.3.5 of this Report.

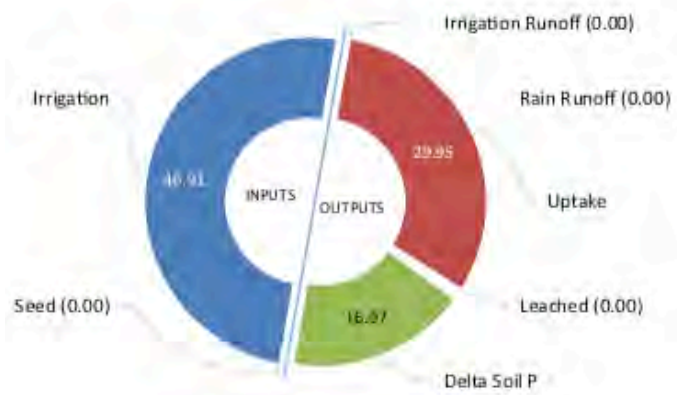
Figure 5: Land nitrogen and phosphorus balances

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	0.01
Irrigation	85.26
Denitrification	2.88E-04
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	75.67
Leached	35.44
Delta Soil N	-25.84

Land Phosphorus Balance (kg/ha/year)



Name	Value
Seed	3.60E-03
Irrigation	46.91
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	29.95
Leached	7.21E-04
Delta Soil P	16.97

Nutrients

The concern with assessing nutrient sustainability is to ensure that loading of excess nutrients is not occurring especially if the biomass is not removed from the irrigation area after harvest. For the Project Area, the grassy understory will be cut-and-carry harvested and, in addition, the tree plantation has a finite 20 year life.

For our irrigation recommendation (circa 4.6ML/ha/year), the average nitrogen and phosphorus loading rates are 85kg/ha/yr and 47kg/ha/year respectively, which are considered to be very low for nitrogen fertilized irrigated pasture, and about average for phosphorus fertilizer applications.

For phosphorus, the excess of amounts added in irrigation over the amounts sequestered in plants (about 20kg/ha/yr) is available for soil adsorption reactions. Accordingly leached phosphorus is effectively zero (Figure 5).

For the reasons noted above, we believe that the likely quantity of nitrogen leachate is 8kg/ha/year, with an average nitrate concentration of ≈ 19mg/L.

We also note that the potential nitrogen leachate in a forest (mixed tree and grass) biome may be reduced further as a result of:

- Nitrogen in fallen leaves (trees) is in the organic form, and must undergo a number of mineralization steps before it becomes available again for plant uptake or leaching (i.e. as ammonia or nitrate). During this mineralization process, nitrogen is more likely to accumulate in the increasing organic matter store, rather than be converted to labile nitrate in the soil solution[24].
- The plant nutrient uptake model excluding roots. While this is a convenient assumption for grass crops (roots are not harvested and can be expected to reach an equilibrium biomass around the time canopy closure occurs and have little impact on nutrient stores beyond that time), it is a conservative assumption for crops such as blue gum, where circa 15% of total biomass might be stored in roots[25]. If the assumption is made that the roots have the same nitrogen concentrations as the branches (≈0.04% - see Attachment B), then over the 20 year irrigation period, the roots will accumulate around 110kg/ha nitrogen. This compares with the predicted excess of nitrogen applied in irrigation over nitrogen taken up by plants over the 20 year irrigation period (500kg/ha).

For all these reasons, we conclude that there is a small risk of nitrogen leaching. That said, we believe that it would be prudent to sample the soil leachate solution[26] – say at 6 years

[24] Cameron K.C., Di H.J. and Moir J.L. (2013) Nitrogen losses from the soil/plant system: A review. *Annals of Applied Biology* 162(2): 145-173.
Probert M.E., Delve R.J., Kimani S.K. and Dimes J.P. (2005). Modelling nitrogen mineralization from manures: representing quality aspects by varying C:N ratio of sub-pools. *Soil Biology and Biochemistry* 37: 279–287.
[25] Singh and Sharma (1976). Biomass estimation in five different plantations of *Eucalyptus tereticornis* Smith in western Uttar Pradesh. In Cannell (1982). World Forest Biomass and Primary Production Data. Academic Press
[26] For affordable sampling guidance, see - https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/423156/Primefact-1143.pdf

when canopy closure has occurred and accumulation of nitrogen in tree leaf biomass plateaus, and on a triennial basis thereafter.

Sensitivity Testing

We used the blue gum forest model to test various scenarios for irrigation area, population increase, soil type, method of triggering irrigation and the impact of an irrigation rule that prohibits irrigation with 10mm antecedent rainfall.

Irrigation Area

In early discussions with QUU regarding the potential for generating environmental offsets, a notional planting area of 5ha was used. Once the actual Average Dry Weather flow for the Helidon STP (circa 21ML/ha/yr before net evaporation loss), it became clear that irrigation volumes would be less than 4ML/ha/yr with a planting area of 5ha, potentially reducing crop performance. A 4ha planting area allows increased irrigation application rates and crop production; and likely represents a better balance between establishment/management costs for the effluent irrigation project and the potential value of environmental offsets.

We investigated both 4ha (detailed above) and 5ha planting solutions. With a 5ha planting area, circa 3.7ML/ha/year of effluent is applied and soil moisture availability limits crop growth for six months of the year. Yield reduction is around 10%. While our model does not allow us to partition the decreased productivity between the grass understory and tree crop, our expectation is that the decreased effective water availability per hectare will decrease the relative component of grass productivity, with the effect of potentially reducing nitrogen uptake beyond that which is predicted – an undesirable outcome.

We conclude that a 4ha planting area provides a better irrigation solution than a 5ha planting area.

Population increase

QUU has requested that we test the impact of potential population growth through to 2029, based on 25% growth in 2019 effluent volumes.

Under the 25% increased Average Dry Weather Flow scenario, irrigation volume increases to 24ML/ha/yr, equivalent to a circa 6ML/ha/yr irrigation rate across the 4ha Project Area. Effluent reuse efficiency remains at 99% with a 96% probability of at least 90% of effluent being reused.

The effect of the additional effluent on a 4ha planting is to essentially remove water stress for all months (on average). While the average nitrate concentration of deep drainage increases slightly, the crop is continuing to use circa 70% of the applied nitrogen. Our

simulations indicate that the increased water availability will increase crop productivity: While our model does not allow us to partition the increased productivity between the grassy understory and tree crop, our expectation is that the increased water availability will increase the relative component of grass productivity, with the effect of increasing nitrogen uptake beyond what is predicted.

We conclude that the 4ha planting area will accommodate population growth through to 2029. If effluent production increases beyond 125% of 2019 levels (e.g. through unforeseen population growth at the latter stages of the 20 year irrigation project), then it may be appropriate to add another hectare of plantings at that time – but only after monitoring demonstrated that the additional effluent resulted in unacceptable levels of nitrogen leachate.

Soil type

As expected, irrigation sustainability parameters when MEDLI was calibrated for the other representative soils were either similar to, or superior to, those experienced in the base model.

Irrigation trigger

Our simulations used an irrigation trigger of a 25mm Soil Water Deficit (SWD). The use of a SWD is traditionally used for irrigation planning. The reality is that in many irrigation scenarios, other irrigation trigger rules can be more convenient. This will likely be the case for QUU at Helidon, where the simplest irrigation rule is likely to be – 'accumulate effluent in the storage tank until there is sufficient effluent to apply the desired irrigation amount (25mm). With a 250kL tank (see next section), the tank will fill in ≈4.5 days and provide sufficient effluent to irrigate 1ha. If 1ha is irrigated on a rolling basis every ≈4.5 days, then the 4ha will be irrigated every ≈18 days.

To assess the potential of an interval (time) based irrigation trigger, we simulated an 18 day irrigation interval. The interval trigger had negligible impact on irrigation rate or efficiency. We conclude that QUU could choose between a SWD-based irrigation trigger or 'tank full' guide to trigger irrigation.

We also tested adding an irrigation rule that prohibited/delayed irrigation if rainfall in the antecedent 24 hours exceeded 10mm. Such a rule would assist in ensuring that irrigation is not applied during wet periods when irrigation runoff risk is elevated. This too had only a minor impact of irrigation rate or efficiency. We conclude that QUU may incorporate an irrigation rule of this nature in its irrigation management.

Storage Tank Optimisation

We modelled various balancing storage tank sizes (Table 5) by specifying the balancing storage pond as a tank in MEDLI, turning off rainfall and turning off evaporation. Because

nett evaporation is zero, the results we report in Table 5 provide a slightly higher estimate of irrigation volume available than the results reported previously. For this reason, while the data in Table 5 is sufficient to provide a comparative analysis of potential tank sizes, actual reuse performance is best gauged from the results in earlier sections of this report.

While a 250kL tank is likely to adequate for the Project Area, a larger 500kL tank would maximise effluent irrigation at a relatively small increase in costs. [We have made brief enquiries of the cost of installing the different tank[27] sizes: These range from circa $60,000 for the 250kL tank to $80,000 for a 500kL tank.] Our preference is for the larger 500kL tank.

Table 5: Comparative performance of storage tank sizes on irrigation supply

Parameter	100kL	175kL	250kL	500kL
Volume irrigated	3.9ML/ha/yr	4.3ML/ha/yr	4.6ML/ha/yr	4.9ML/ha/yr
Volume of overflow	5.4ML/yr	3.5ML/yr	2.4ML/yr	1.2ML/yr
Effluent reuse (percentage of inflow that is irrigated)	74%	83%	88%	94%
Probability of at least 90% reuse (as a fraction)	0.0	0.17	0.50	0.75

Either the 250kL or 500kL sizing will also provide reasonable insurance for expected population growth over the next decade; though the larger tank will be superior.

Irrigation Recommendation

Based on our findings in this report, we recommend:

- establishment of a 4ha irrigation area to be irrigated for 20 years;
- installation of a minimum 250kL (500kL preferable) storage tank with an overflow bypass to the existing Turkey Nest dam;
- irrigating on a 25mm soil water deficit (evenly applied throughout the Planting area);
- use of a coarse droplet spray irrigation system, to achieve even irrigation throughout the Planting Area; and
- installation of an irrigation control system that can -
    - irrigate the desired volume to each 1ha of the Project Area on a sequential basis, and
    - incorporate rules for not irrigating given various antecedent daily rainfall (e.g. 10mm); and
- building in sufficient redundancy in the irrigation infrastructure to be able to accommodate potential 2029 population growth; and
- sampling the soil leachate solution at Year 6 and then triennially thereafter.

QUU will need to define a pumping rate. Our view is that it would be appropriate to empty the 500kL tank during a working day.

[27] Aquamate (https://www.aquamate.com.au/): Galvanised tanks on concrete pads, with bladder.

Scope Reference 3.3.4: Irrigation Overflows

Presently, effluent from the Helidon STP is discharged into the smaller compartment of the adjacent 120ML turkey nest dam (Figure 6) in accordance with the STP's Environmental Authority prohibits the release of contaminants into the environment other than via:

- "*the outfall pipe located in waters described as 'the adjacent 120ML farm dam'*"; and
- *an emergency overflow pipe from the secondary lagoon*.

The proposed reuse scheme will require an Environmental Authority amendment: It is proposed that effluent will be collected in the 500kL storage tank until irrigation is triggered. [With the 25mm irrigation, 250kL will need to be collected to irrigate 1ha.] Any overflow is diverted to the existing small compartment in the Turkey Nest Dam (Figure 6).

Our results reported in Scope Reference 3.3.3 are based on average climate conditions and as a result, there will be wet years when the irrigation demand will be less than average and dry years when irrigation demand will be above average. Overflow diagnostics for the Year 4+ forest crop are summarised in Table 6; and the climate effect is depicted visually in Figure 7, where the cumulative probability of fractional effluent reuse (i.e. as a fraction of effluent supplied) exceedance is shown.

Figure 6: Existing and proposed effluent release management

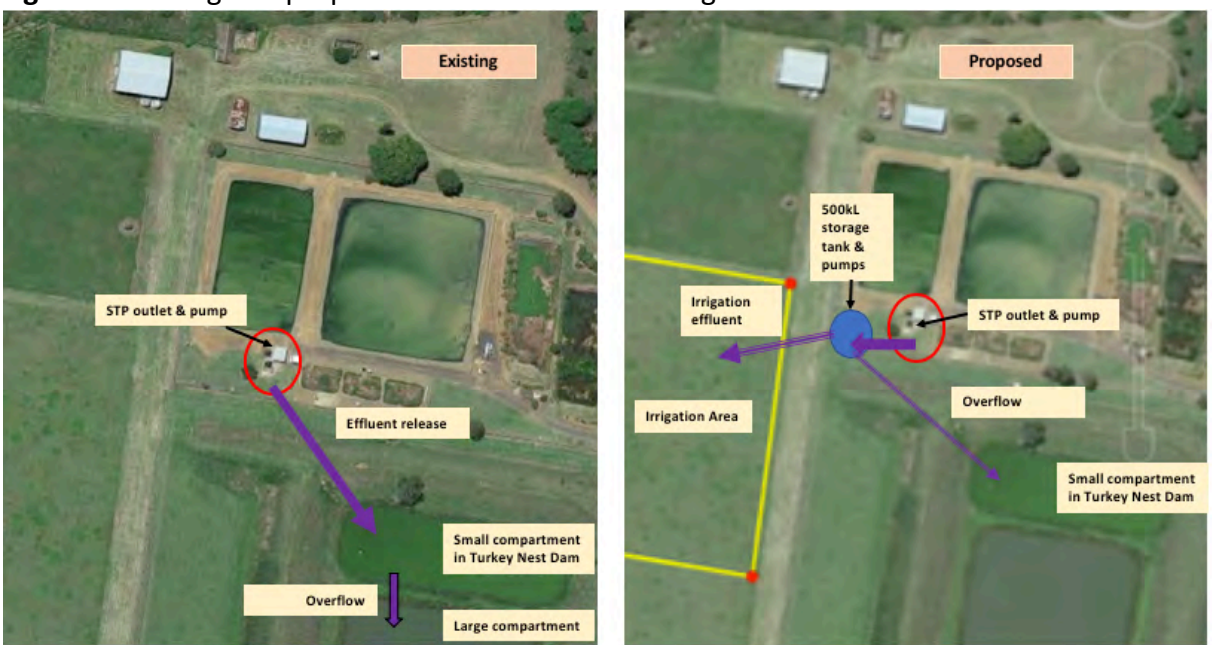


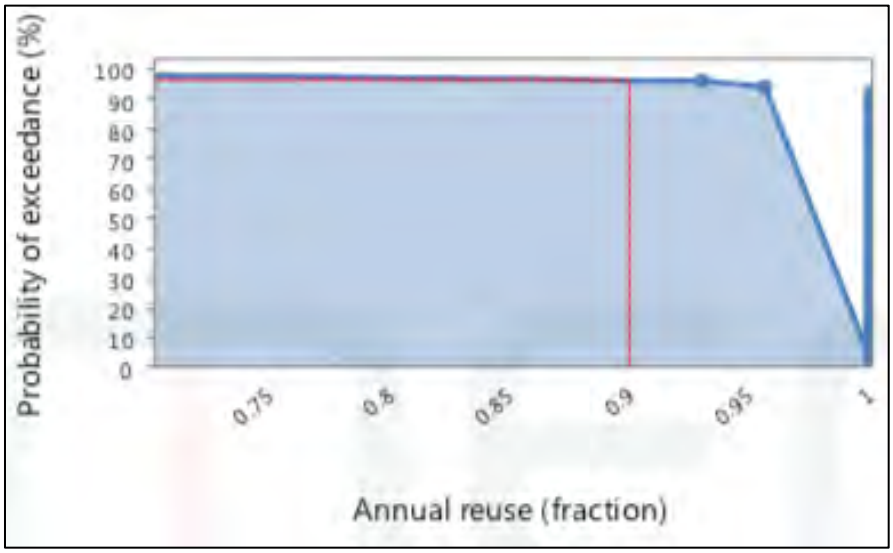
Table 6: Overflow diagnostics

Parameter	Derived Value
Volume of overflow	0.3ML
Number of days that the pond overflows	3.6 days
Average duration of overflow	20 days
Effluent reuse (proportion of inflow + net rain gain) that is irrigated (as a fraction)	0.98
Probability of at least 90% reuse (as a fraction)	0.96

The data suggests an excellent reuse outcome with an average 98% reuse. Indeed, there is a 75% chance that the reuse will almost equal 100% (Figure 7); that is, for 75 years out of 100 years (or 16 years of the 20 years of actual irrigation), all the effluent generated will be used in satisfying the irrigation demand of the regenerating blue gum forest. As the reuse fraction target becomes smaller, the chances of this figure being reached, increases. For a 1 in 10 wet year (90% probability of exceedance), the Reuse Fraction reduces to about 93%, implying that that about 0.5ML of effluent is not processed.

Overflow risk is not a significant issue for the Helidon effluent project. Any overflow will be directed to the Turkey Nest dam (Figure 6), which is presently being used to store 100% of effluent production. Potential evaporation from the dam will greatly exceed the volume of the small amounts of overflow dispatched to the dam.

Figure 7: The cumulative probability of exceedance of fractional effluent reuse for couch grass grown on 16.6ha of golf course and irrigated with 91ML/yr of Class A effluent



Scope Reference 3.3.5: SALF Modelling

SALF is a salinity, soil, water, irrigation and plant salt tolerance calculator, designed as a decision support tool to assist in evaluating the impacts of irrigation on plants and soils and to calculate soil and water parameters of importance to soil and irrigation management. These parameters include soil profile salinity and leachate concentration below the root zone.

SALF is an empirical model that predicts Deep Drainage (DD) based on soil and water chemistry, clay percentage and clay mineralogy. SALF uses these parameters to provide a conservative estimation of the suitability of available irrigation water for the soils intended for irrigation, and an estimation of the potential impact on the plants intended for use in the irrigation area.

The input data for SALF is available for each of the three Representative Soils at the Helidon Project Area (see Phase 1 Report), and QUU has provided relevant water chemistry for the Helidon effluent (Attachment A). We have used the Rhodes grass algorithms in SALF firstly because the species is present in the extant grassy understory at Helidon, and secondly because blue gum has a higher salinity tolerance, thereby ensuring our findings are conservative.

SALF provides a guide to the expected soil surface stability for combinations of EC and SAR of the irrigation waters. Figure 7 shows soil stability lines for the most sensitive soil (red line) and least sensitive soil (blue line). As the Helidon sample lies to the right of the red line in Figure 8, the soil structure can be expected to be stable under irrigation. The SAR of the Helidon effluent falls within the permissible irrigation water SAR (4.8) to maintain stable soils following heavy rainfall.

Table 6: Predicted sustainability indicators for the Helidon Project Area Representative Soils

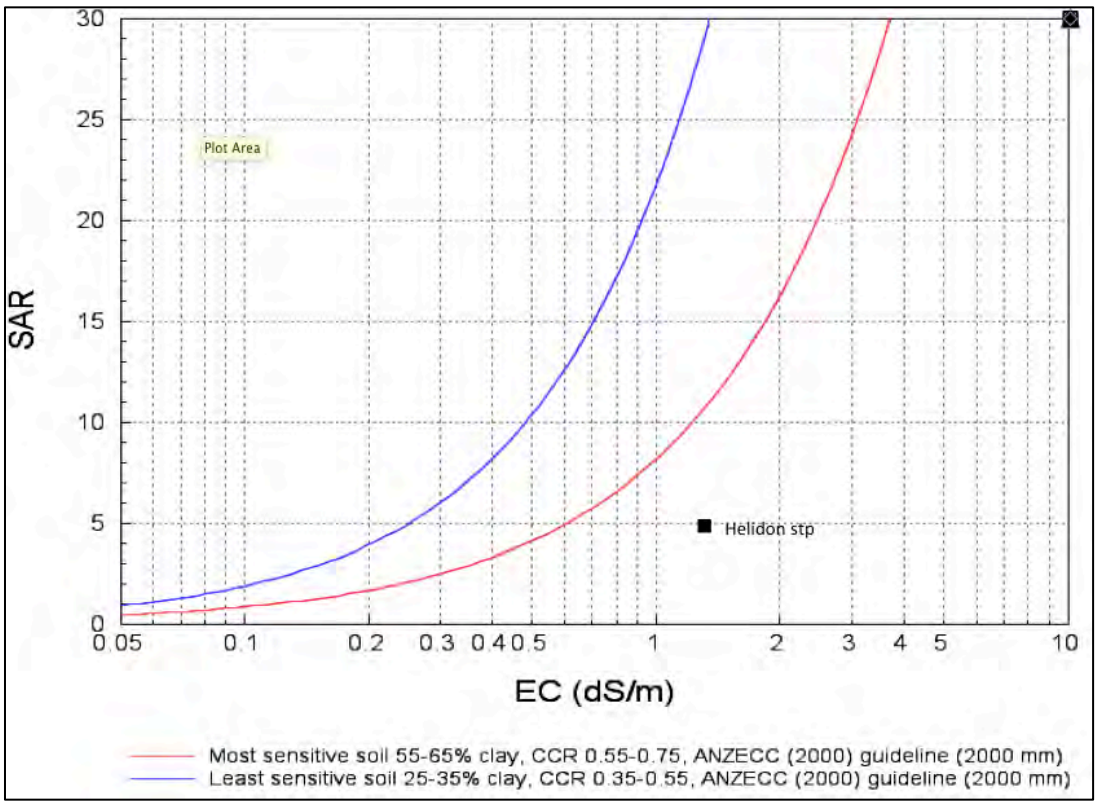
Parameter	Soil Leaching Fraction (irrigation + rainfall)	Water Uptake Weighted Root Zone Salinity (ECse)	Plant Yield (as percentage of potential)	Deep Drainage Irrigation + Rainfall (mm/yr)
Representative Soil 1	0.048	5.5	100%	52
Representative Soil 2	0.194	0.9	100%	236
Representative Soil 3	0.013	1.8	100%	141

The predicted soil leaching, root zone salinity, plant yield and DD for the three Helidon soils are provided in Table 6. For all Representative Soils (see Phase 1 report for details), the ECs are less than the threshold values that will cause yield decline in the Rhodes grass.

There is poor agreement between SALF and MEDLI deep drainage estimates (compare Figure 3 and Table 6, for Representative Soil 3 (Site 11) (41mm/yr MEDLI and 141mm/yr SALF). It is probable that neither estimate is correct as MEDLI depends on soil permeability (estimated, not measured) and drainable porosity (calculated from pedo- transfer functions) whilst SALF uses regression equations developed for dryland soils. In any event, the modelled deep drainage numbers are not large and correspond to a Leaching Fractions that are commonly encountered in irrigated soils provided the irrigation salinity is moderate.

Overall SALF modelling indicates that soil salinity will not limit plant growth, and that deep drainage is not excessive for any of the Representative Soils.

Figure 8: Soil structural stability line for irrigation water with different SAR-EC combinations. The most sensitive (red line) and least sensitive (blue line) soils are shown with the Helidon sample



Attachment A: Helidon STP Effluent Production and Quality

QUU Guidance

"ADWF for modelling purposes: 21ML/yr or 57.5kl/day

Total inflow: estimate 25% increase to ADWF = 26.3ML/yr or 72kl/day (for an average rainfall year). Suggest 66% of this non-ADWF volume will bypass the new recycled water storage tank and flow into the emergency storage lagoon on rainy days.

EP: not relevant

Usage/EP/day: not relevant

Expected growth rate (for ADWF estimate in 10 years): not relevant -weather induced flow the relevant variable. Use a maximum ADWF of 25ML/year over the next 10 years (to account for wetter years and perhaps low pop. Growth [<1%/year]) – flow variation not linear – higher flow year is weather dependent and could be next year or could be 2029."

Effluent Quantity

QUU has provided Planfuture with two periods of water quality data for the Helidon STP:

a. 5.11.2015 to 16.11 2017, effluent quality at the chlorine contact tank [tpf2000b.csv]; and
b. 17.01.2017 to 12.12.2018, effluent quality at the chlorine contact tank and influent quality at the second free water surface wetland [Helidon.xlsx].

Key water quality parameters are summarised in Table A1a for influent water quality and Tables A1b and A1c for effluent water quality.

Table A1a: Helidon STP influent water quality (2017 – 2018)

	Number of Samples	Average	Median	80% Percentile	95% Percentile
Ammonia (Mg/L Total N)	24	62	62	68	76
Total Phosphorus (mg/L)	24	11	10	12	17
Total Nitrogen (mg/L)	24	84	79	84	133
Orthophosphorus (mg/L)	24	7	7	8	9
Total Suspended Solids (mg/L)	24	401	340	442	921
Biological Oxygen Demand (mg/L)	24	268	275	310	361
Conductivity (mS/m)	24	1168	1200	1240	1385

Table A1b: Helidon STP effluent water quality (2017 – 2018)

	Number of Samples	Average	Median	80% Percentile	95% Percentile
Ammonia (Mg/L Total N)	22	16	14	24	28
Total Phosphorus (mg/L)	22	10	10	12	14
Total Nitrogen (mg/L)	22	22	19	30	31
Orthophosphorus (mg/L)	22	9	9	11	13
Total Suspended Solids (mg/L)	22	22	14	23	60
Biological Oxygen Demand (mg/L)	22	6	3	5	22
Conductivity (mS/m)	22	1070	1100	1180	1200
pH	22	7.9	7.9	8.1	8.3
Alkalinity as $CaCO_3$ (mg/L)	22	280	280	310	330
Total Chlorine (mg/L)	23	10	12	12	12

Table A1c: Helidon STP effluent water quality (2015 – 2017)

	Number of Samples	Average	Median	80% Percentile	95% Percentile
Conductivity (mS/m)	149	1045	1100	1200	1200
Sodium Adsorption Ratio	13	4	4	5	5
Escherichia coli (cfu/100mL)	149	72	5	5	78
Magnesium (mg/L)	13	16	16	17	19
Sodium (mg/L)	13	122	120	136	150
Potassium (mg/L)	1	25	25	25	25
Calcium (mg/L)	13	37	37	41	43

Effluent Nutrient and salinity concentrations are consistent with secondary treated effluent; *viz.* Class C Secondary treated effluent[28]. In relation to the Table A1c data, it is noted that:

[28] National Water Quality Management Strategy. (1997). Australian Guidelines for Sewerage Systems Effluent Management.

- Helidon STP effluent is suitable for moderately salt sensitive crops (limit 1300 mS/m)[29]. *E. tereticornis* is moderately salt tolerant[30]
- *Escherichia coli* levels are consistent with chlorine disinfection; though it is noted that there are a number of spikes, which Planfuture understands from discussions with QUU relate to efficiency of chlorination and have now been resolved.

Using QUU's historical effluent quality sampling data, we investigated nutrient concentrations (see Table A2 for Total N) to assess if there have been any systematic changes in the Helidon STP's performance. No systematic change in performance is evident: The winter 2017 spike in nitrogen concentration for example is not replicated in 2018. Most likely the effectiveness of N treatment is related to whether the two free water surface wetlands and the sub-surface flow reed beds are operational and, if so, whether they are functioning efficiently. In the absence of any obvious systematic variation that might be attributable to treatment efficiency, we have modelled arithmetic means of water quality data collected from 2017 and 2018.

Table A2: Helidon STP with respect to total Nitrogen

Date	Total N (mg/L)
17/1/17	19
15/2/17	18
15/3/17	18
12/4/17	13
9/5/17	18
12/6/17	30
12/7/17	32
18/9/17	31
23/10/17	30
20/11/17	18
19/12/17	17
19/1/18	18
14/3/18	18
9/4/18	21
17/5/18	18
14/6/18	20
10/7/18	25
9/8/18	25
6/9/18	31
30/10/18	29
27/11/18	19
12/12/18	17

[29] Queensland Government Science Notes - Land series –L137

[30] Salinity Management Handbook. https://publications.qld.gov.au/dataset/salinity-management-handbook/resource/529b12b0-8e23-4cd3-a1cd-7659d0b9b3b4

QUU provided Planfuture with an April 2019 laboratory analyses of post treatment effluent quality (Table A3): These data have been used for SaLF analysis.

Table A3: Helidon STP Post Treatment Effluent Quality April 2019

Parameter	Value	Unit
pH	8	pH Unit
Conductivity at 25°C	1,300	uS/cm
Total Dissolved Salts	840	mg/L
Total Alkalinity as $CaCO_3$	338	mg/L
Bicarbonate Alkalinity as $CaCO_3$	335	mg/L
Carbonate Alkalinity as $CaCO_3$	3	mg/L
Chloride	200	mg/L
Calcium as Ca	48	mg/L
Magnesium as Mg	24	mg/L
Sodium as Na	163	mg/L
Potassium as K	37	mg/L
Sodium Absorption Ratio	4.8	
Sulphur as SO4	44	mg/L
Arsenic as As	<0.050	mg/L
Cadmium as Cd	<0.005	mg/L
Chromium as Cr	<0.01	mg/L
Copper as Cu	<0.005	mg/L
Lead as Pb	<0.05	mg/L
Nickel as Ni	<0.01	mg/L
Selenium as Se	<0.050	mg/L
Zinc as Zn	<0.005	mg/L
Mercury as Hg	<0.1	µg/L

Attachment B: Expected irrigated crop production and performance at the Helidon Project Area

Tree crop growth:

There is significant merit in establishing tree crops in September in Helidon, particularly if some supplementary watering capacity is available. The risk of seedling damage due to harsh winter frost events is avoided; and the risk of heat stress on harsh summer days is avoided when the seedling is at its most vulnerable (when the root system is largely confined to the volume of nursery pots). For the purposes of our present modelling, best practice September planting is assumed, meaning that Year 1 growth is from September of the planting year to the following September; Year 2 growth is from the end of Year 1 to the following September; and so forth.

There are no direct growth and performance data for blue gum in the Lockyer Valley and, as a result, both published data and expert forestry opinion have been used to synthesise a conservative estimate of growth and performance data for blue gum (see Table B1). The various published data are provided in Table B2 and, in addition to informing the summary data in Table B1, were used to inform four other growth-related inputs into blue gum water and nutrient use modelling:

a. Blue gum is a non-deciduous species that will grow year-round providing there is adequate soil water and a suitable temperature. As a result, no strong seasonal variations in water use or growth are expected. Minhas *et al.* (2015) provided evidence for the species year-round growth capacity: For blue gum grown in India, water use varied from "1*.24*PAN-E during August–October --- and 1.12*PAN-E during winter months of December–February*". Blue gum leaf fall is expected to be reasonably regular throughout the year, with spikes on hotter, windier days. Blue gum's year round growth potential means that linear interpolation of growth data within each of the four blue gum regeneration stages (seedling, early sapling, late sapling and tree) is appropriate.

b. Blue gum water use will plateau at around year 5. *Minhas et al*. (2015) noted that blue gum "*water use does not continue to increase throughout the life of a stand but attains an equilibrium level"*, which for the authors' study was also around 5–6 years.

c. Blue gum is not sensitive to saline soils below ECse = 9 dS m-1 (approx. EC1:5 water1.3) and is likely to reduce growth down to ECse 16 dS m-1 (approx. EC1:5 water 1.8), at which point growth effectively ceases.

d. Blue gum has differential nutrient concentrations in the various tree parts – most prominently, leaf (and petiole) nutrient concentrations are often multiples higher than stem nutrient concentrations. The species is able to preferentially relocate essential nutrients to the most actively growing parts of the foliage. For the various crop species modelled in MEDLI, there is an assumption that shoot nitrogen concentrations will largely reflect nutrient concentrations in harvested biomass. However, in the case of trees, average nitrogen concentration for the whole tree decreases after Year 5 when

leaf biomass (high nutrient content) plateaus and the volume of stems (relatively low nutrient content) increases as a proportion of overall tree volume.

Table B1:Blue gum growth parameters for four regeneration growth stages

Parameter	**Blue gum regeneration stage**			
	Seedling (0-1 years)	Early Sapling (1-3 years)	Late Sapling (3-4 years)	Tree (5-20 years)
Crown diameter	0.15m (yr 0) 1m (yr 1)	1m (yr 1) 3.5m (yr 3)	3.5m (yr 3) 5.5m (yr 4)	5.5m (crown closure & deepening)
Lateral root extent diameter	0.1m (yr 0) 1.25m (yr 1)	1.25m (yr 1) 3.5m (yr 3)	3.5m (yr 3) 5.5m (yr 4)	5.5m (increasing density & overlap)
Root depth (unimpeded)	0.1m (yr 0) 0.75m (yr 1)	0.75m (yr 1) 1.25m (yr 3)	1.25m (yr 3) 1.5m (yr 4)	1.5m (yr 4) >2m beyond yr 5
Indicative tree height	0.3m (yr 0) 1.25m (yr 1)	1.25 (yr 1) 3.5m (yr 3)	3.5 (yr 3) 5m (yr 4)	5m (yr 4) 20m (yr 20)
Crop factor	0 (yr 0) 0.1 (yr 1)	0.1 (yr 1) 0.5 (yr 3)	0.5 (yr 3) 0.8 (yr 4)	1.0 (yr 5) 1.2 (yr5+)
Leaf Area Index (m^2leaves/m^2 land area	0.5 (yr 1)	2.5 (yr 3)	3.0 (yr 4)	4.0 (yr 5 plus) 4.5 (yr 6) plateau at 4.5
Total biomass (Accumulative to yr 4)	2,000 kg/ha (yr 1)	16,000 kg/ha (yr 2) 40,000kg/ha (yr 3)	70,000 kg/ha (yr 4)	[Determine new growth: – Leaves – increasing to 6,500 kg/ha in year 6 and then plateauing – Branches – increasing by 500 kg/ha/yr Stem – increasing by 7,000 kg/ha/yr]
Biomass distribution (%)	(yr 1) Leaves 40% Branches 30% Stem 30%	(yr 2) Leaves 30% Branches 30% Stem 40%	(yr 4) Leaves 8% Branches 15% Stem 78%	
Nitrogen Total % of total above ground biomass	 30 kg/ha (yr 1) 1.0% (yr 1)	 100 kg/ha (yr 2) 142kg/ha (yr3) 0.55% (yr 2) 0.35% (yr 3)	 220 kg/ha (yr 4) 0.3% (yr 4)	[Determine from biomass growth data assuming nitrogen concentrations in leaves, branches and stems of 2%, 0.4% and 0.25% respectively.]
Nitrogen distribution (%)	(yr 1) Leaves 75% Branches 15% Stem 10%	(yr 2) Leaves 59% Branches 20% Stem 21%	yr 4) Leaves 28% Branches 22% Stem 50%	
Phosphorus Total % of total above ground biomass		 20 kg/ha (yr 2) 0.13%	 40 kg/ha (yr 4) 0.10	 60 kg/ha (yr 5) 0.08 [growing at 0.08% of new biomass]

Table B2: Literature used to inform the growth parameters reported in Table B1.

Growth parameter	**References**
	[Expert opinion is used to inform assessment of blue gum (*E. tereticornis*) performance from experiences with non-blue gum irrigated plantations]
Tree growth	Minhas *et al.* (2015). Effect of long-term irrigation with wastewater on growth, biomass production and water use by Eucalyptus (*Eucalyptus tereticornis* Sm.) planted at variable stocking density Gardner, T. (2003). The WC Fields Project: An Examination of Sustainable Irrigation of Trees and Pature using Treated Sewage Effluent. Department of Natural Resources and Mines Edraki *et al.* (2004) - Water balance of Swamp Mahogany and Rhodes grass irrigated with treated sewage effluent

	Myers *et al*. (1995). Growth and water use of *Eucalyptus grandis* and *Pinus radiata* plantations irrigated with effluent Myers *et al.* (1997). Environmentally-sound management of water and nutrients in Australian effluent-irrigated plantations Falkiner et al. (2006). Root distribution of *Eucalyptus grandis* and *Corymbia maculata* in degraded saline soils of south-eastern Australia O'Brien, N.D. (1998). Nutritional physiology of Eucalyptus grandis and Pinus radiate irrigated with municipal effluent. PhD Thesis. University of Melbourne Singh and Sharma (1976). Biomass estimation in five different plantations of *Eucalyptus tereticornis* Smith in western Uttar Pradesh. In Cannell (1982). World Forest Biomass and Primary Production Data. Academic Press Anon. https://pfaf.org/user/Plant.aspx?LatinName=Eucalyptus+tereticornis Forest &Wood Products Association (2009). Review of fertiliser use in Australian Forestry
Tree Salinity	Department of Natural Resources (2011). Salinity management handbook. Bell and Williams (1977). Eucalypt ecophysiology. In Williams and Woinarski (1977). Eucalypt Ecology: Individuals to Ecosystems
Tree crop factor	Minhas *et a*l. (2015). Effect of long-term irrigation with wastewater on growth, biomass production and water use by Eucalyptus (Eucalyptus *tereticornis* Sm.) planted at variable stocking density Myers and Talsma (1992). Site water balance and tree water status in irrigated and fertilised stands of *Pinus radiata* Morris and Wehner (1987). Daily and annual water use by four eucalypt species irrigated with wastewater at Robinvale Edraki *et al*. (2004) - Water balance of Swamp Mahogany and Rhodes grass irrigated with treated sewage effluent Heuperman, A.F. 2000, Biodrainage: an Australian overview and two Victorian case studies Victorian Department of Conservation and Forests - http://www.epa.wa.gov.au/sites/default/files/PER_documentation/A0654_R0638_PER_Stage%202_Planning%20Study%20into%20Land%20Treatment%20of%20Albany%20Wastewater.pdf Myers et al. (1995). Growth and water use of *Eucalyptus grandis* and *Pinus radiata* plantations irrigated with effluent
Leaf Area Index	Edraki *et al*. (2004) - Water balance of Swamp Mahogany and Rhodes grass irrigated with treated sewage effluent
Tree Nutrient uptake	Edraki et al. (2004) - Water balance of Swamp Mahogany and Rhodes grass irrigated with treated sewage effluent Snow et al. (1999). Nitrogen dynamics in a eucalypt plantation irrigated with sewage effluent or bore water. Aust. J. Soil Res. Sheriff and Nambiar (1991a). Nitrogen Nutrition, Growth and Gas Exchange in Eucalyptus globulus Labill. Seedling. Aust. J of Plant Physiology. Sheriff and Nambiar (1991a). Nitrogen Nutrition, Growth and Gas Exchange in Eucalyptus globulus Labill. Seedling. Functional Plant Biology. Medhurst and Beadle (2004). Photosynthetic capacity and foliar nitrogen distribution in *Eucalyptus nitens* is altered by high-intensity thinning. Tree Physiology. Shelly et al. (1995). Diagnosis of nitrogen deficiency and toxicity of *Eucalyptus globulus* seedlings by foliar analysis. Plant and Soil Vol 1777. Ferreira et al. (2015). Leaf total nitrogen concentration as an indicator of nitrogen status for plantlets and young plants of eucalyptus clones. Rev. Bras. Ciênc. Solo vol.39 Bell and Williams (1977). Eucalypt ecophysiology. In Williams and Woinarski (1977). Eucalypt Ecology: Individuals to Ecosystems

Grass crop growth:

The intent at the Helidon Project Area is to irrigate the volunteer grass sward, rather than introduce new grass species or to deliberately thicken plantings. Grazing, other than by

native fauna, will be excluded and swards in the tree inter-rows will be harvested using a cut-and-carry regime.

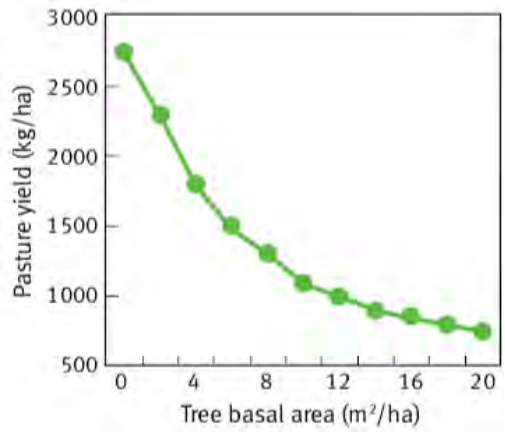
Expert opinion within Planfuture is that the MEDLI Rhodes Grass module is best suited for modelling the grassy understory expected at Helidon. We note that Rhodes grass is a component of the volunteer grass cover at the Project Area.

The published literature dealing with the effects of overstory (eucalypt) canopy shade on understory grass growth reports widely differing results[31]. The expected decline in light penetration as the blue gum canopy closes[32] and blue gum leaf area index expands during the early regeneration stages has informed our expert choice of effective grass cover and of grass crop factors.

Importantly, we have used knowledge of the inverse relationship between pasture yield and overstory canopy cover (approximated by basal area in Figure B1) for dryland pasture[33] together with the yield algorithms in the Rhodes grass MEDLI model to estimate crop yield as follows:

- Dryland grass yield (from Figure B1) –
  - No overstory competition = 3,000kg/ha/yr; and
  - High overstory competition = 650kg/ha/yr.
- MEDLI prediction of irrigated Rhodes grass production at Helidon (100% ground cover; zero overstory) = 8,000 kg/ha.
- Using the ratio between MEDLI production/Dryland yield (i.e. 8000/3000), to adjust Rhodes production under Year 4+ shading - viz. (650 x 8000)/3000 = 1,750kg/ha/yr.
- For year 1 modelling, Rhodes production is estimated as 2,500kg/ha/yr (from Figure B1 – very low overstory basal area), adjusted by the ratio between MEDLI production/Dryland yield – viz. (2500 x 8000)/3000; and then adjusted to remove the 30% clear area around the trees = 4,500kg/ha/yr.

Figure B1: Dryland relationship between pasture yield and tree overstory



[31] Ranging from increased grass production (beneficial shading, improved soil condition, etc.,) to greatly decreased grass production and/or grass loss (competition for light and other resources)
[32] Bell and Williams (1997) reported light penetration under tall open forests in North Queensland of 30%
[33] Department of Agriculture, Fisheries and Forests (2013). Pasture management for Southeast Queensland

Our growth assumptions for the grass understory at Helidon are provided in Table B3, reflecting information mentioned above and in the references summarised in Table B4.

Table B3: Grass understory growth and performance data for the Helidon Project Area

Parameter	**Grassy Understory Performance – for each blue gum regeneration Stage**			
	(0-1 years)	(1-2 years)	(2-3 years)	(4-20 years)
Comparative tree crop stage	Seedling	Early Sapling	Late Sapling	Tree
Grass Cover	70% (yr 0) 80% (yr 1)	80% (yr 1) 70%m (yr 2)	60% (yr 2) 30% (yr 3)	50%
Grass Crop factor	0.8	0.7	0.5	0.4
Critical thresholds for the growth response to temperature utilise data in MEDLI				
Crop yield	4,500kg/ha/ yr			1,750kg/ha/yr
Nitrogen leaf concentration	1.25%			1.5%
Phosphorus leaf concentration	0.1%			0.15%

Table B4: Reference used in compilation of Table B3 data

Grass cover (Rhodes)	Snow *et al.* (1999). Nitrogen dynamics in a eucalypt plantation irrigated with sewage effluent or bore water [Deals with E*. grandis*: Bell and Williams (1977). Eucalypt ecophysiology
Grass growth	Prakash et.al (1994). Effect of nitrogen, phosphorus and potassium fertilisation on herbage yield and quality and plant parasitic nematode populations in an irrigated Rhodes grass (*Chloris gayana*) pasture in Oman. Tropical Grasslands. Vol 28 Department of Agriculture, Fisheries and Forests (2013). Pasture management for Southeast Queensland

Attachment C: Quantification of stresses for blue gum growth at Helidon to be used in MEDLI modelling[34]

The Minhas *et al*. (2015) 10 year biomass data with nitrogen and phosphorus concentrations of 0.3% and 0.08% respectively together with the derived RUE were used to estimate unconstrained blue gum growth at Helidon. Quantification of key stress indices used to 'reduce the unconstrained blue gum growth' in MEDLI modelling are as follows:

- Nitrogen stress index for Radiation Use Efficiency. MEDLI requires an estimate of minimum nitrogen concentration for growth to commence and the concentration for maximum growth. The algorithm reflects the response of photosynthetic rate to foliar nitrogen concentrations.

  Snow *et al*. (1999) reported little growth response of *E. grandis* to application of effluent that had high nitrogen loads compared to that measured when irrigating with groundwater. This suggests that the minimum nitrogen availability required for growth is relatively low. Edraki *et al*. (2004), working with another eucalypt on soils with inherently lower soil nitrogen than those reported by Snow *et al.* (1999), found increases in biomass of 70% at six years as effluent nitrogen concentration increased from 10 mg/l to 40 mg/l.

  Sheriff and Nambiar (1991a) working with another *E. globulus*, determined through modelling that "*with no environmental constraints, exposed mature leaves with high N (1.5 mmol g-1) assimilate 5.4 times more carbon than similar leaves with low N (0.5 mmol g-1*)". These data equate to 2.1% and 0.7% leaf nitrogen respectively. Sheriff and Nambiar (1991b) noted from pot trials that "*Carbon assimilation, N uptake, growth, and leaf production and expansion were all greater at higher N*". Consistent with the Sheriff and Nambiar (1991a) findings –

  - Edraki *et al.* (2004) found leaf nitrogen concentrations of 1.1% in resulted in strong growth of *E. robusta*.
  - Shelly *et al.* (1995), working in *E. globulus* pot trials, found that total leaf nitrogen concentration "*for the severely deficient, deficient, adequate, and toxic ranges were <1.4%, 1.4–2.5%, 2.6–3.5%, > 4.3%*".
  - Ferreira *et al*. (2015) examined the relationship between leaf nitrogen concentration and *E. globulus* growth for both pot and field (2 year old) and noted that leaf nitrogen concentration was less in field trials, reflecting nitrogen translocation from ageing tissues to new leaf tissues. The authors noted adequate growth at 1.6% leaf nitrogen concentration

  While nutrient deficient soils are known to limit growth of eucalypts, many species, including blue gum, are known for the ability to retain nutrients and differentially translocate many nutrients, including nitrogen, to the leaves where it is needed most.

[34] Refer to Attachment B Table B2 for references

There is no *a priori* relationship between nitrogen concentration in total biomass (leaves + branches + stems) as eucalypts will preferentially translocate nitrogen to the growing leaves. Estimates of nitrogen concentrations of leaves, branches and stems are included in A Table A1. Based on these data, we have used a minimum leaf nitrogen concentration for growth to commence = 0.2%.

- Temperature Stress Index for Radiation Use Efficiency.

  The input parameters are lowest temperature for any growth to occur; lowest temperature for optimal growth; highest temperature for optimal growth and highest temperature for any growth to occur.

  It is important to note that blue gum is not deciduous and does not have a natural winter dormancy. For much of the species range, growth is limited by moisture (Minhas *et a*l. (2015). Otherwise, the species is known for its good growth over a wide range of environmental and soil conditions

  Blue gum tolerates frosts in the 0^o - -5^o range[35]; though the growth, if any, in these conditions is unknown. It is also known to be tolerant to temperatures exceeding 45^o; but again it is unlikely that growth is occurring at these extremes. Indeed, eucalypts are known to grow throughout the year, with growth slowing in both cold temperatures and in high temperatures due to stomatal response to high vapour pressure deficits.

  In the absence of published data, we investigated two approaches to defining temperature stress metrics:
  - Use the metrics in the Melaleuca module: These will likely be conservative for blue gum, which is likely to have a wider tolerance range to temperature than Melaleuca.
  - Use the mean winter monthly temperatures for Helidon as guides to likely growth impacts –
    - Lowest temperature for growth = mean minimum temperature for July (the coldest month) = 10^oC
    - Lowest temperature for optimal growth = mean minimum temperature for September = 22^oC

- Waterlogging stress index for Radiation Use Efficiency.
  Blue gum is tolerant of waterlogging[36]; though will be more sensitive than Melaleuca. We approximated parameters for the waterlogging index by adjusting the Melaleuca parameters based on the relative tolerance to flooding of both species.

[35] file:///Users/Tony/Documents/Tony/Planfuture/2018%20Projects/QUU/Research/Factsheet%20-%20Eucalyptus%20tereticornis.html

[36] Blue gum has a reasonable tolerance to waterlogging. While the relationship between waterlogging and growth for the species is unknown, the authors are aware of the plants ability to survive on South-east Queensland floodplains while they are submerged for extended periods (providing the crowns are not submerged). While Melaleuca is likely to have a higher waterlogging tolerance than blue gum, the site at Helidon is unlikely to provide significant waterlogging stress.

Attachment D: Mass Balance Biomass, Nitrogen and Phosphorus Spreadsheet Modelling

Applying the expected crop growth and nutrient uptake data recorded in Attachment B, we have calculated a mass balance for biomass (Table D1 and Figure D1), nitrogen (Table D2 and Figure D2) and phosphorus (Table D3 and Figure D3) for the 20 years of irrigation.

Over the 20 year irrigation period, key expected outcomes are:

- The tree stem and branches (wood) will comprise 95%+ of tree biomass, with the trees accounting for >80% of total biomass produced.
- The forest (tree plus grass) crop takes up around 75% of the applied nitrogen, with the grass understory accounting for circa 55%, highlighting the importance of the grass understory for nitrogen sequestration.
- The forest crop takes up around 40% of the phosphorus applied in effluent, of which the tree crop accounts for circa 55%

Table D1: Cumulative Crop Biomass Production

Year	Total Tree + Grass Biomass (kg/ha)	Total grass biomass (kg/ha)	Total Tree Biomass (kg/ha)	Tree Leaf Biomass (kg/ha)	Tree Branch Biomass (kg/ha)	Tree Stem Biomass (kg/ha)
1	6500	4500	2000	800	600	600
2	24500	8500	16000	4800	4800	6400
3	52000	12000	40000	5200	7650	27150
4	85000	15000	70000	5600	10500	54600
5	95400	16750	78650	6050	11000	61600
6	105100	18500	86600	6500	11500	68600
7	114350	20250	94100	6500	12000	75600
8	123600	22000	101600	6500	12500	82600
9	132850	23750	109100	6500	13000	89600
10	142100	25500	116600	6500	13500	96600
11	151350	27250	124100	6500	14000	103600
12	160600	29000	131600	6500	14500	110600
13	169850	30750	139100	6500	15000	117600
14	179100	32500	146600	6500	15500	124600
15	188350	34250	154100	6500	16000	131600
16	197600	36000	161600	6500	16500	138600
17	206850	37750	169100	6500	17000	145600
18	216100	39500	176600	6500	17500	152600
19	225350	41250	184100	6500	18000	159600
20	234600	43000	191600	6500	18500	166600

Figure D1 Cumulative tree and grass biomass as a function of time over 20 years

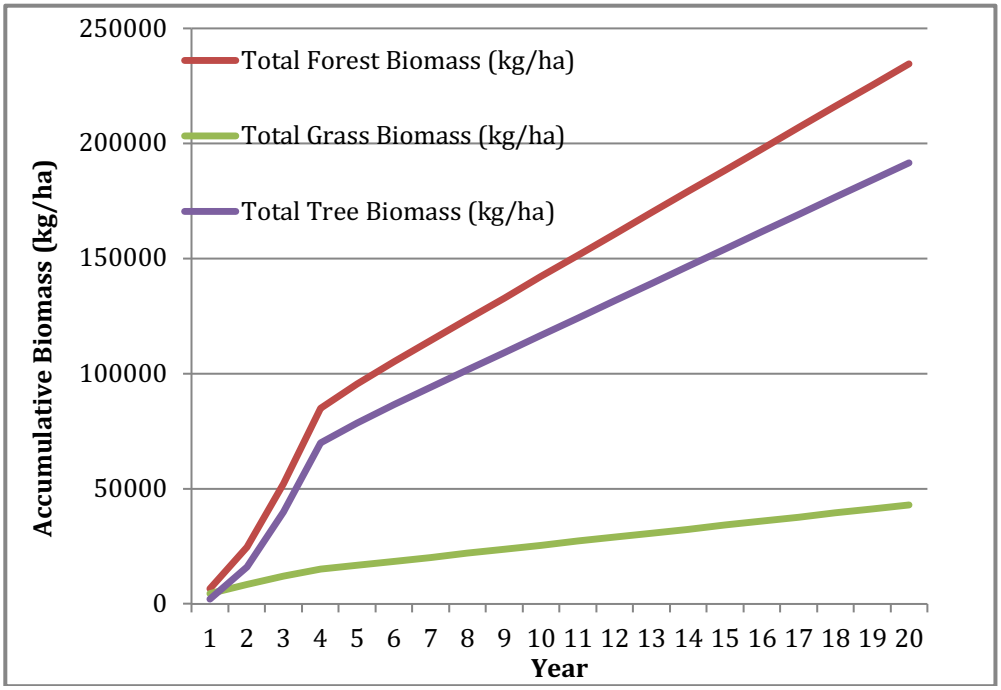


Table D2: Cumulative Nitrogen Mass Balance over the 20 year growth period

Year	Effluent Nitrogen (kg/ha)	Forest Total Nitrogen (kg/ha)	Grass Total Nitrogen (kg/ha)	Tree Total Nitrogen (kg/ha)
1	85	85	65	20
2	169	256	125	131
3	254	382	180	202
4	339	516	225	291
5	423	579	260	319
6	508	643	295	348
7	592	697	330	367
8	677	752	365	387
9	762	806	400	406
10	846	861	435	426
11	931	915	470	445
12	1016	970	505	465
13	1100	1024	540	484
14	1185	1079	575	504
15	1270	1133	610	523
16	1354	1188	645	543
17	1439	1242	680	562
18	1524	1297	715	582
19	1608	1351	750	601
20	1693	1406	785	621

The average nitrogen applied is 99kg/ha/year

Figure D2 Cumulative tree and grass sequestration of nitrogen over the 20 year growth period together with cumulative nitrogen applied in effluent at 4.6ML/ha/yr

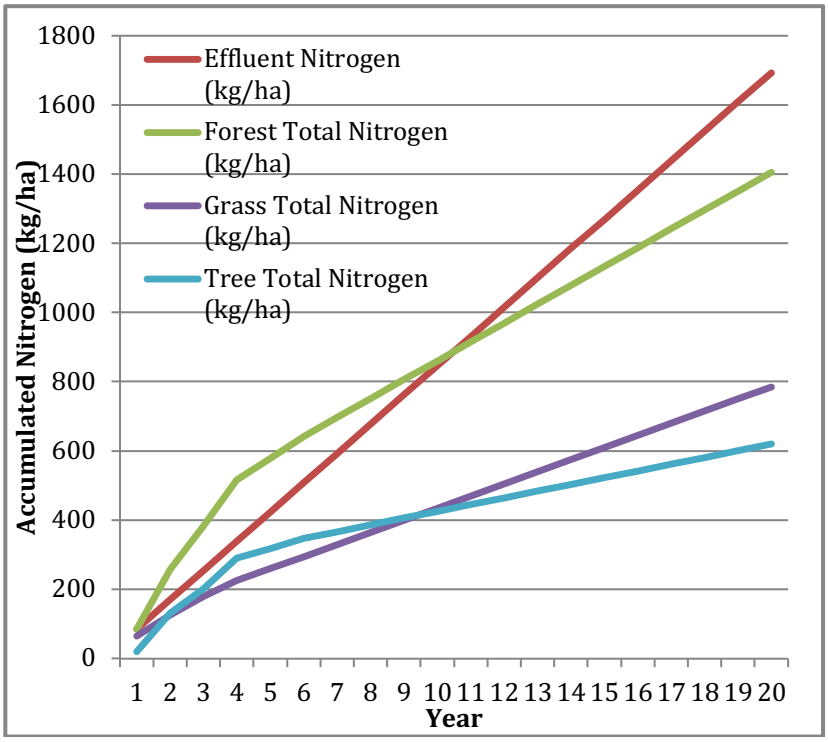
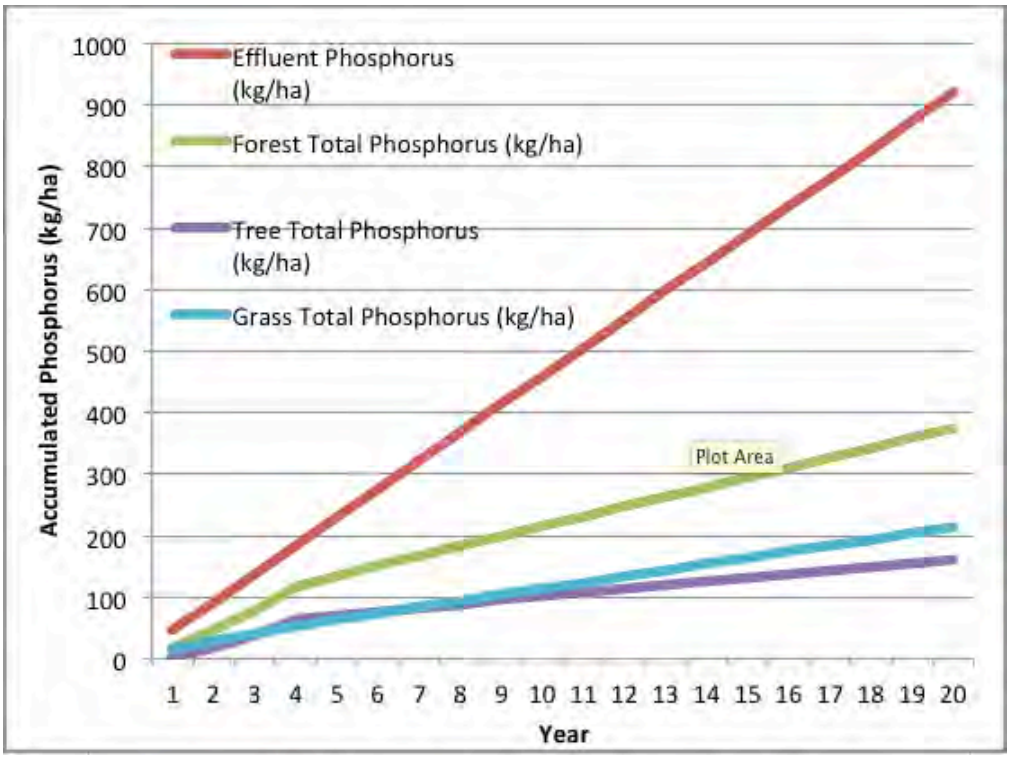


Table D3: Cumulative phosphorus mass balance over the 20 year growth period

Year	Effluent Phosphorus (kg/ha)	Forest Total Phosphorus (kg/ha)	Tree Total Phosphorus (kg/ha)	Grass Total Phosphorus (kg/ha)
1	46	18	3	15
2	92	48	19	29
3	138	80	38	42
4	184	117	63	54
5	230	134	70	64
6	276	151	77	74
7	322	167	83	84
	368	183	89	94
9	414	199	95	104
10	460	215	101	114
11	506	231	107	124
12	552	247	113	134
13	598	263	119	144
14	644	279	125	154
15	690	295	131	164
16	736	311	137	174
17	782	327	143	184
18	828	343	149	194
19	874	359	155	204

20	920	375	161	214

Figure D2 Cumulative tree and grass sequestration of phosphorus over the 20 year growth period together with cumulative phosphorus applied in effluent at 4.6ML/ha/yr



Attachment E: Base MEDLI output –

MEDLI REPORT - FULL RUN

Enterprise: **Helidon Blue gum base model with grass new 5**

Description:
Base model

Client: **QUU PlanFuture**

MEDLI User: INTSS-PC\INTSS

Scenario Details:

DESCRIPTION

Climate Data: HelidonDD, -27.55°, 152.1°

Run Period: 01/01/1967 to 31/12/2016 50 years, 0 days

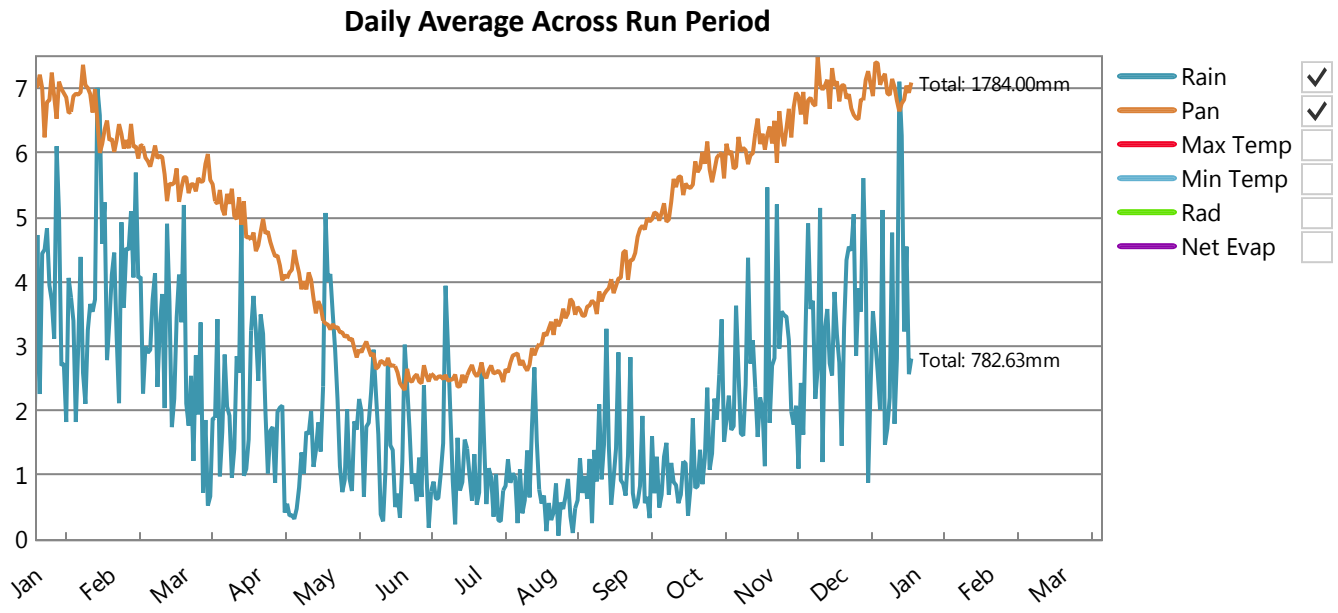
Climate Statistics:

	5th Percentile	50th Percentile	95th Percentile
Rainfall (mm/year)	422	739	1212
Pan Evaporation (mm/year)	1561	1794	1998

Climate Data:

Chart Table

Monthly Daily

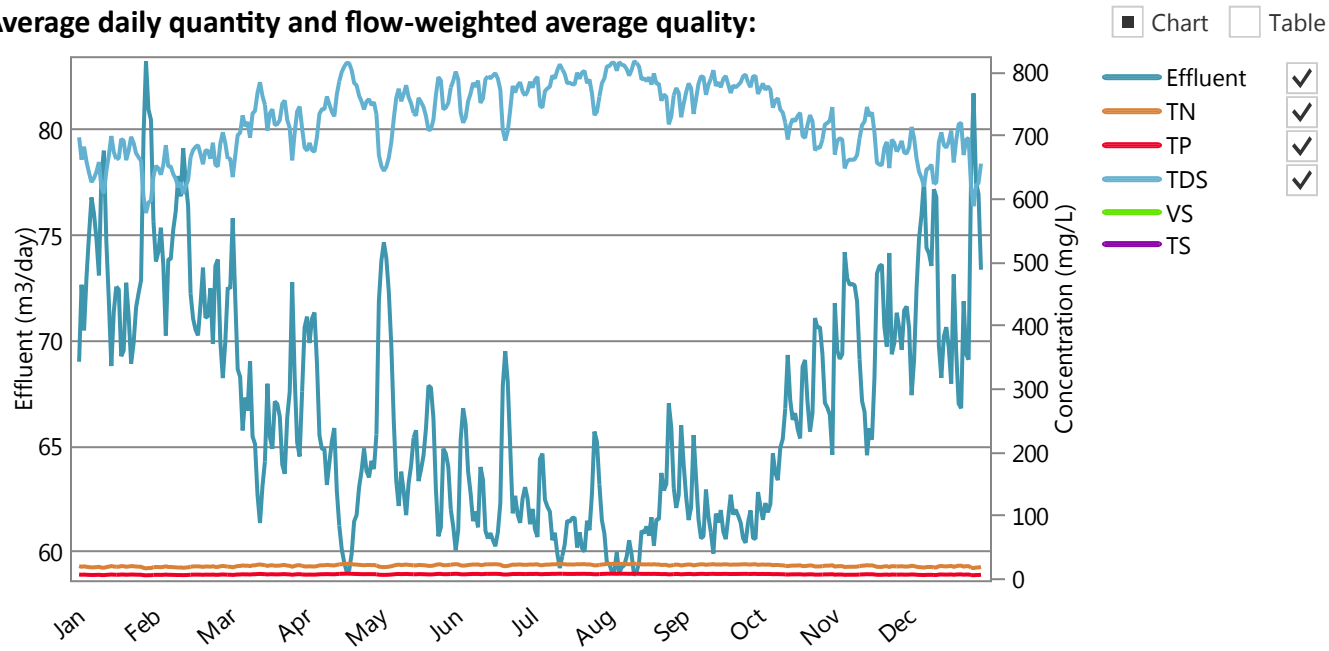


DESCRIPTION

Effluent type: Helidon STP 3

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **24366.62 m3/year** or 66.71 m3/day (Min-Max: 57.31 - 544.06)

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

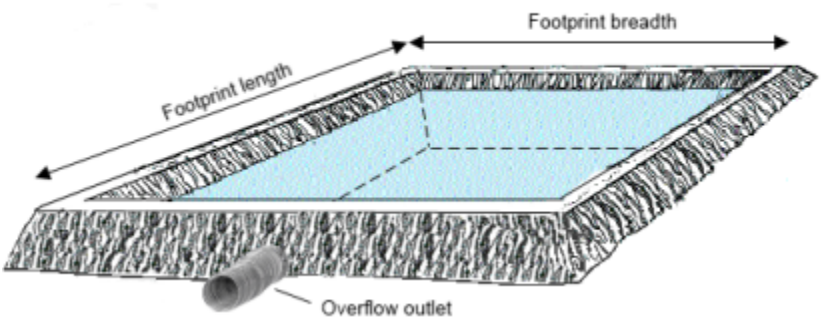
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	21.48 (2.63 - 25.00)	523.28 (522.91 - 524.34)
Total Phosphorus	7.73 (0.95 - 9.00)	188.38 (188.25 - 188.76)
Total Dissolved Salts	721.57 (88.48 - 840.00)	17582.23 (17569.71 - 17617.85)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

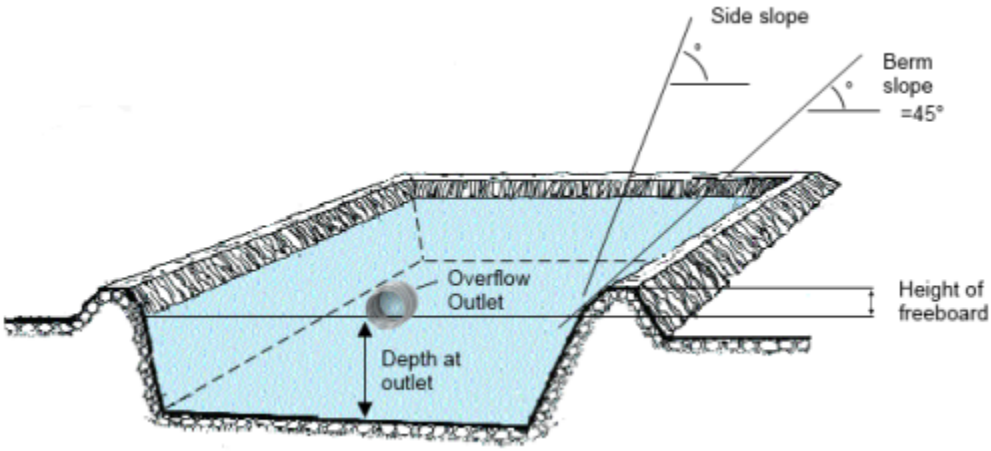
DESCRIPTION

Pond system: 1 facultative, aerobic or storage pond

Pond system details:

	Pond 1
Maximum pond volume (m3)	6000.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	1.00
Maximum water surface area (m2)	6105.88
Pond footprint length (m)	56.25
Pond footprint width (m)	111.51
Pond catchment area (m2)	6272.64
Average active volume (m3)	323.34





Irrigation pump limits:

Minimum pump rate limit (ML/day)	0.00
Maximum pump rate limit (ML/day)	25.00

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

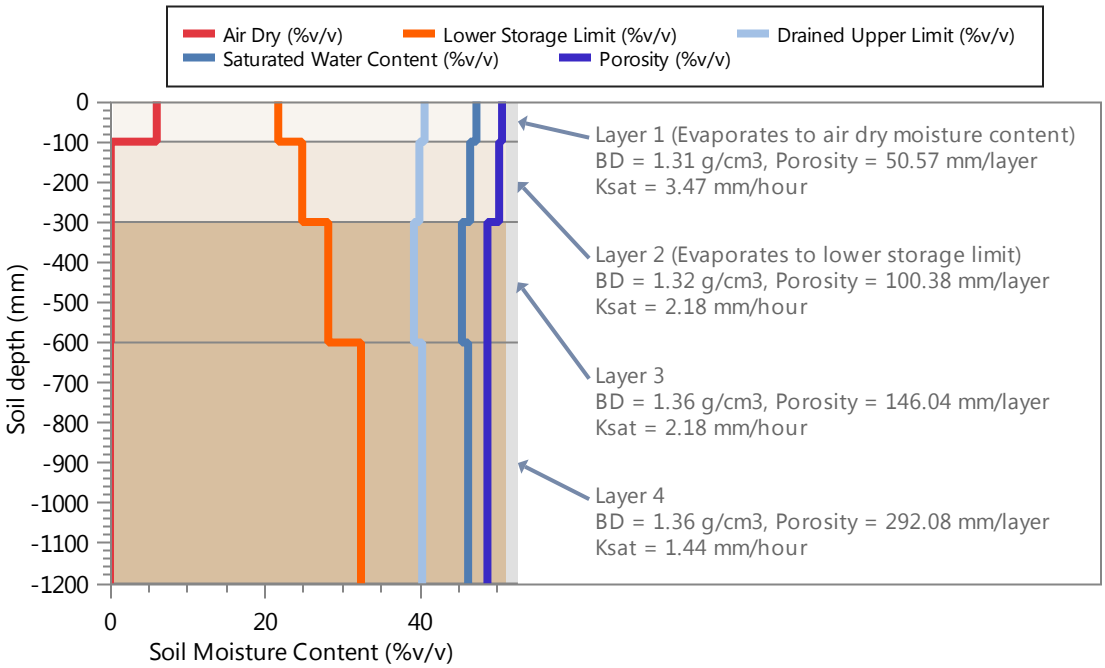
DESCRIPTION

Land: helidon bluegumbase

Area (ha): 4.00

Soil Type: Helidon site 11 3, 1200.00 mm defined profile depth

Profile Porosity (mm)	589.06
Profile saturation water content (mm)	553.47
Profile drained upper limit (or field capacity) (mm)	479.53
Profile lower storage limit (or permanent wilting point) (mm)	349.95
Profile available water capacity (mm)	129.58
Profile limiting saturated hydraulic conductivity (mm/hour)	1.44
Surface saturated hydraulic conductivity (mm/hour)	3.47
Runoff curve number II (coefficient)	85.00
Soil evaporation U (mm)	9.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Blue Gum offset 3 with grass, kick started

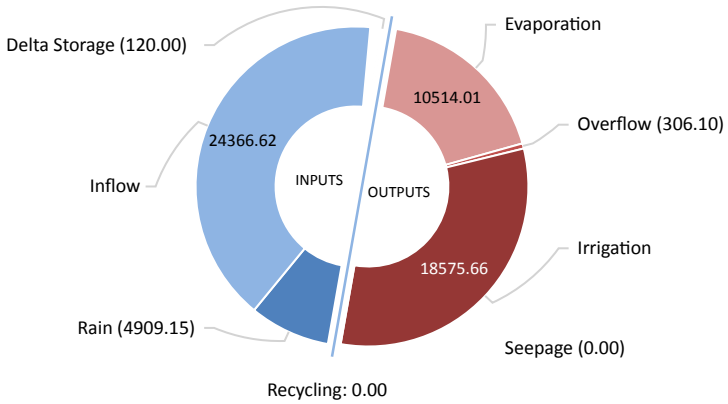
Average monthly cover (fraction) (minimum - maximum)	0.98 (0.96 - 0.99)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 1.2 x Pan coefficient 1)	1.20
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Maximum potential root depth in defined soil profile (mm)	1200.00
Salt tolerance	Tolerant
Salinity threshold EC sat. ext. (dS/m)	8.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.05

PERFORMANCE

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

Capacity of wet weather storage pond: **6000 m3**

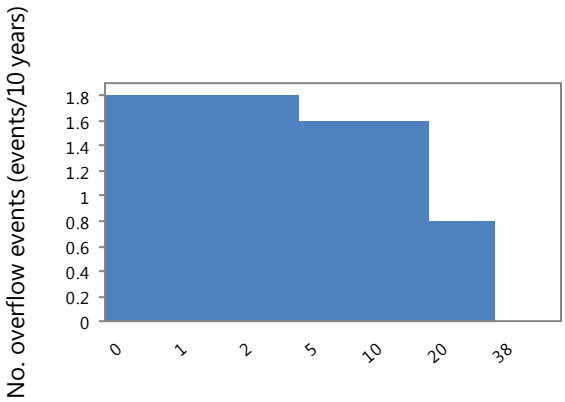
Pond System Water Balance (m3/year)



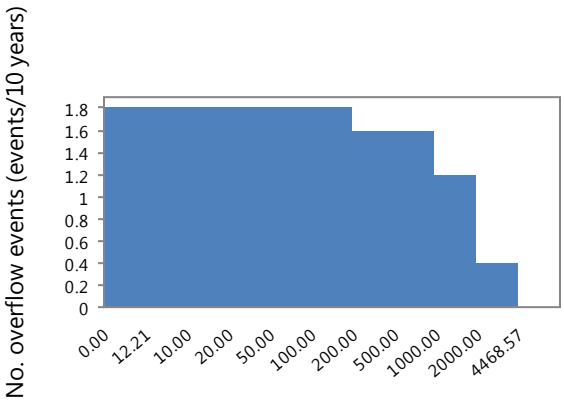
Name	Value
Rain	4909.15
Inflow	24366.62
Recycling	0.00
Evaporation	10514.01
Overflow	306.10
Irrigation	18575.66
Seepage	0.00
Delta Storage	-120.00

Overflow Diagnostics

Volume of overflow (m3/year)	306.10
No. days pond overflows (days/year)	3.64
Average duration of overflow (days)	20.22
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.98
Probability of at least 90% reuse (fraction)	0.96



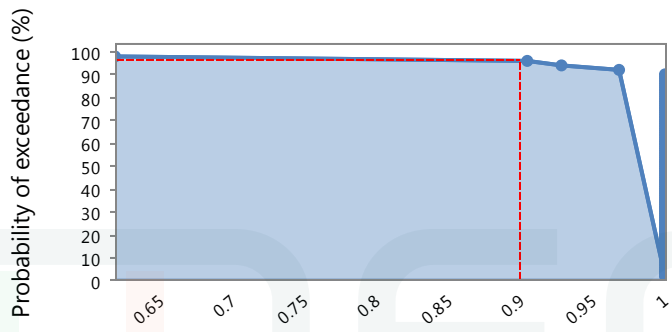
Overflow event duration exceeded (days)



Overflow volume exceeded (m3)

Export plot

Export plot



Annual reuse (fraction)

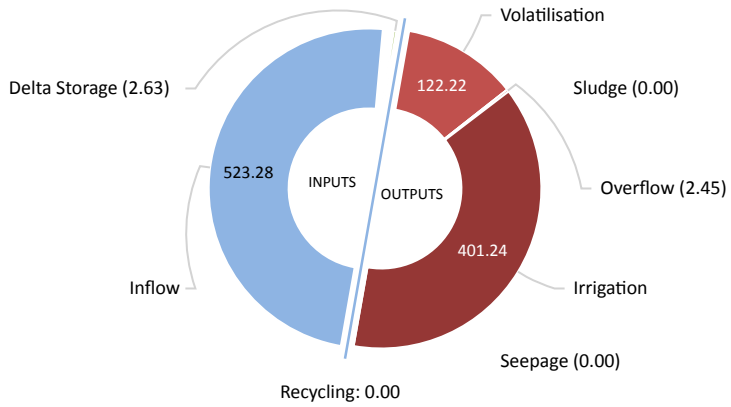
Export plot

PERFORMANCE

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

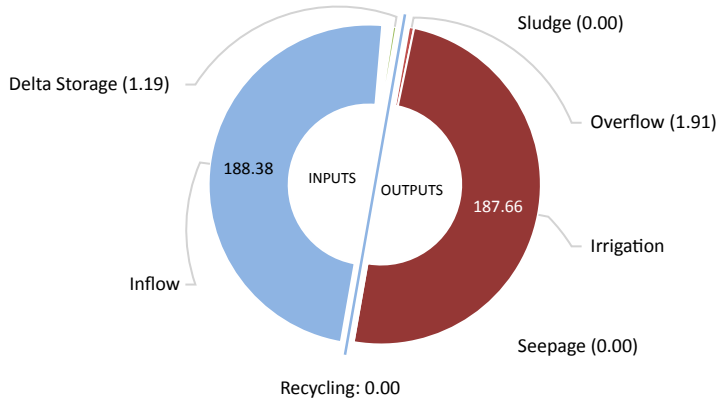
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



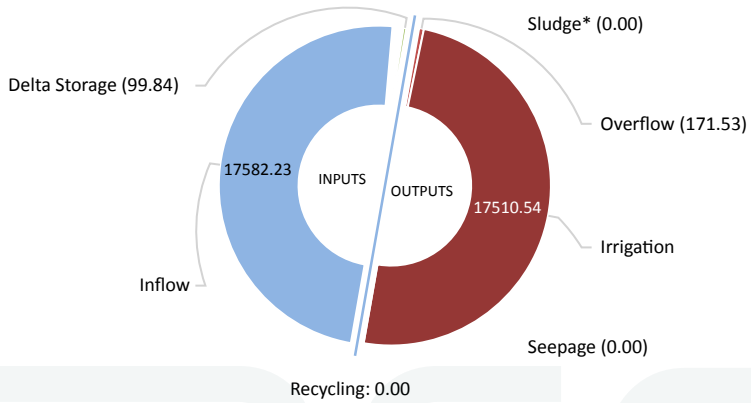
Name	Value
Inflow	523.28
Recycling	0.00
Volatilisation	122.22
Sludge	0.00
Overflow	2.45
Irrigation	401.24
Seepage	0.00
Delta Storage	-2.63

Phosphorus Balance (kg/year)



Name	Value
Inflow	188.38
Recycling	0.00
Sludge	0.00
Overflow	1.91
Irrigation	187.66
Seepage	0.00
Delta Storage	-1.19

Salt Balance (kg/year)



Name	Value
Inflow	17582.23
Recycling	0.00
Sludge*	0.00
Overflow	171.53
Irrigation	17510.54
Seepage	0.00
Delta Storage	-99.84

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

Pond System Sludge Accumulation: 0.00 kg dwt/year

PERFORMANCE

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

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	6.96
Average phosphorus concentration of pond liquid (mg/L)	5.74
Average salinity of pond liquid (dS/m)	0.82

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

* Not determined. Pond is empty.

PERFORMANCE

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (m3/year)	18575.66
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	18575.66
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 m3/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation Quality:

Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	21.60
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	18.36
Average phosphorus concentration of irrigation water (mg/L)	10.10
Average salinity of irrigation water (dS/m)	1.47

Irrigation Diagnostics:

Proportion of Days rain prevents irrigation (fraction)	0.26
Proportion of Days water demand too small to trigger irrigation (fraction)	0.07
Proportion of Days pond volume below min. vol. for irrigation (fraction)	0.01
Proportion of Days irrigation occurs (fraction)	0.66

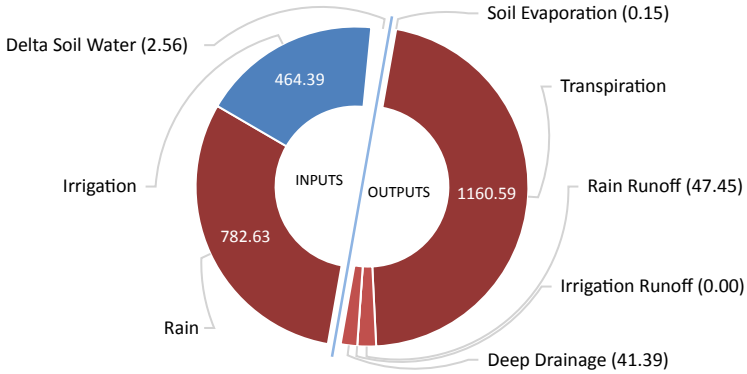
PERFORMANCE

Land Performance - Soil Water

Paddock: helidon bluegumbase, 4 ha
Soil Type: Helidon site 11 3, 129.58 mm PAWC at maximum root depth

Land Water Balance (mm/year):

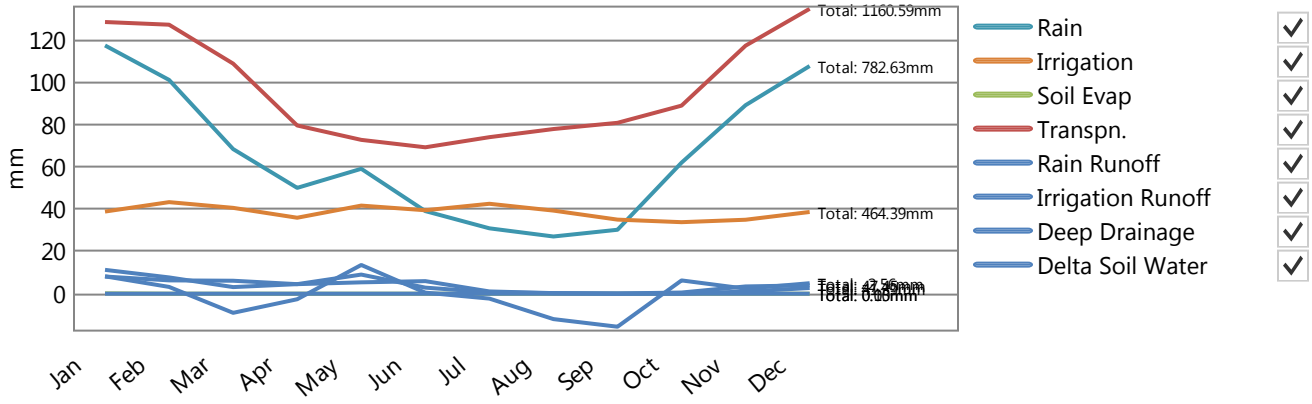
mm/year % Total inputs



Name	Value
Rain	782.63
Irrigation	464.39
Soil Evaporation	0.15
Transpiration	1160.59
Rain Runoff	47.45
Irrigation Runoff	0.00
Deep Drainage	41.39
Delta Soil Water	-2.56

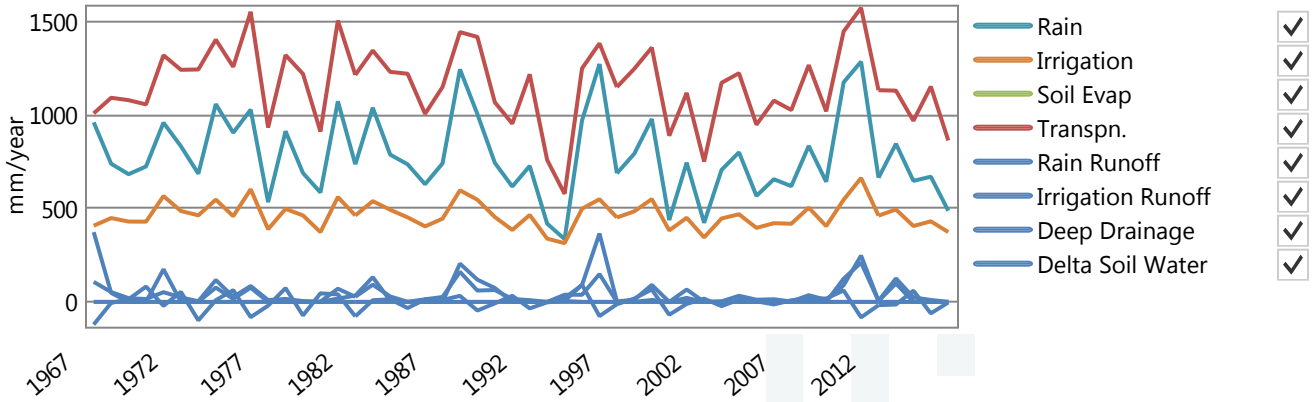
Average Monthly Totals (mm):

Chart Table



Average Annual Totals (mm/year):

Chart Table



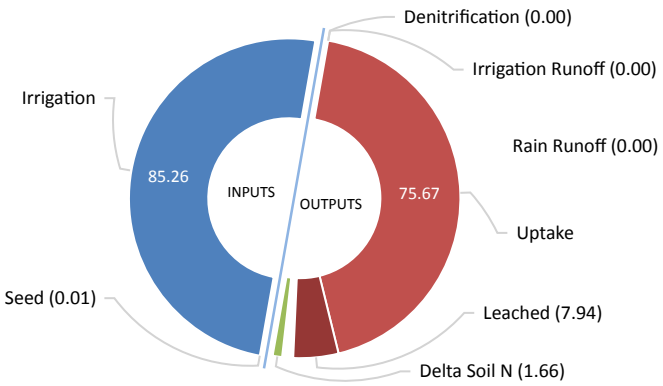
PERFORMANCE

Land Performance - Soil Nutrient

Paddock: helidon bluegumbase, 4 ha **Soil Type**: Helidon site 11 3

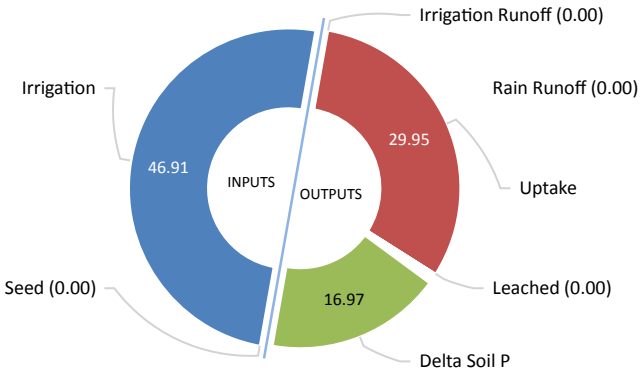
Irrigation ammonium volatilisation losses (kg/ha/year): 15.05
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.75

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	0.01
Irrigation	85.26
Denitrification	1.80E-04
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	75.67
Leached	7.94
Delta Soil N	1.66

Land Phosphorus Balance (kg/ha/year)



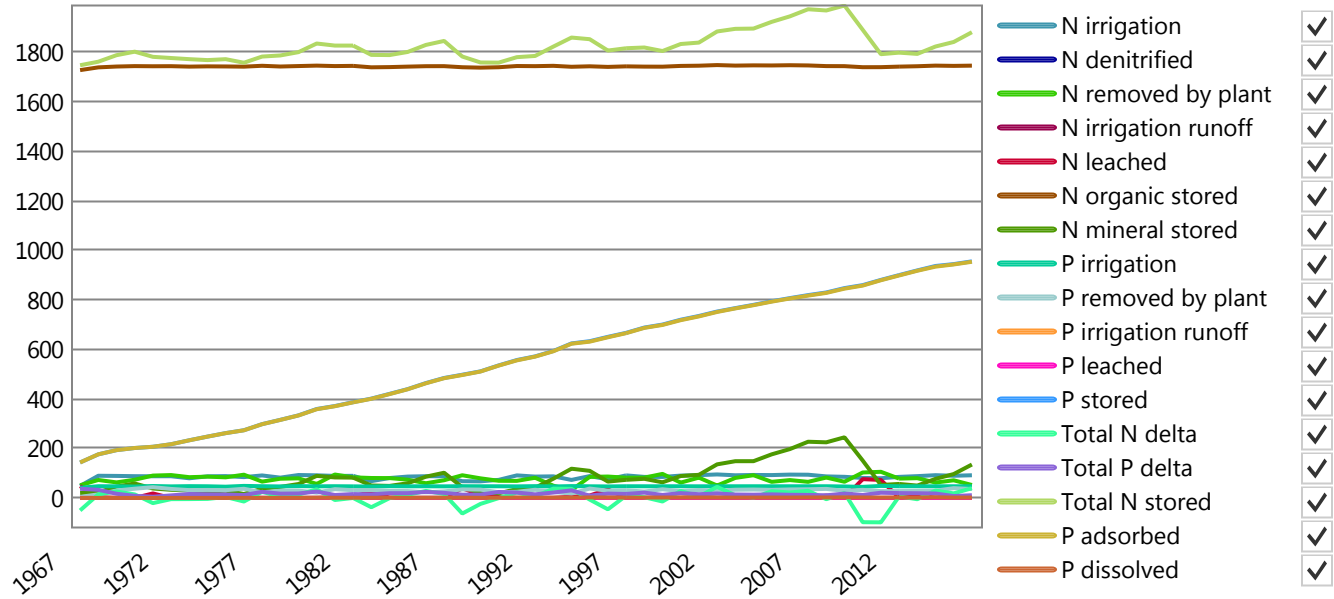
Name	Value
Seed	3.60E-03
Irrigation	46.91
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	29.95
Leached	7.21E-04
Delta Soil P	16.97

PERFORMANCE

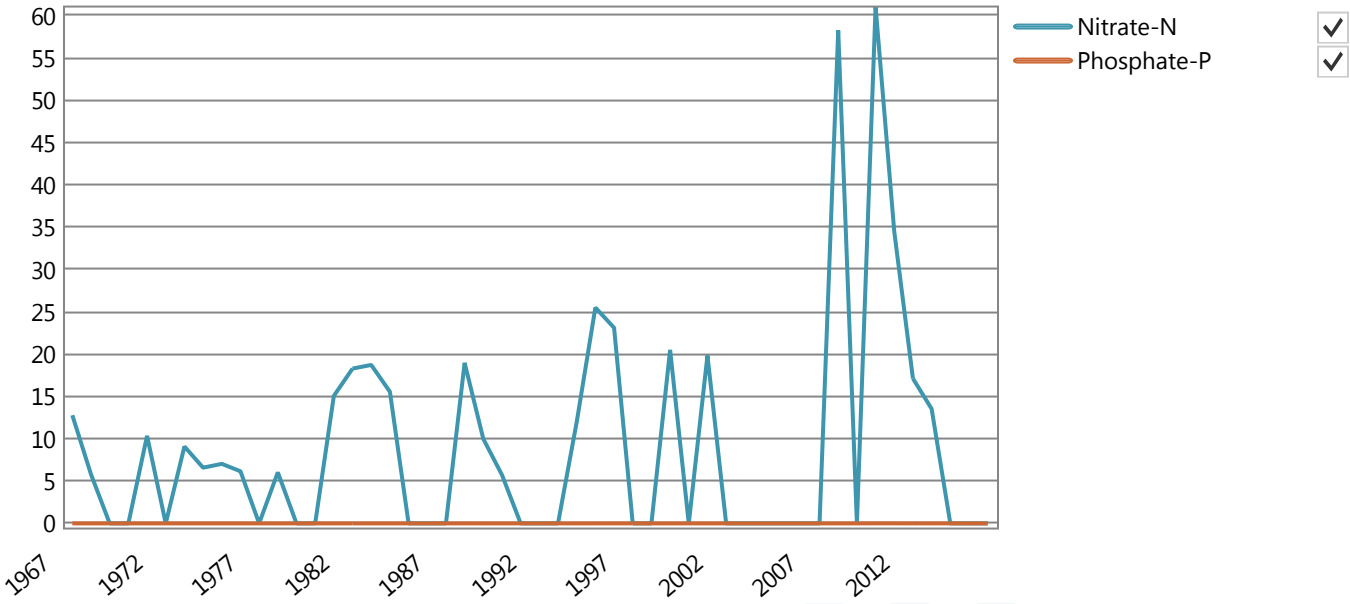
Land Performance - Soil Nutrient

Paddock: helidon bluegumbase, 4 ha **Soil Type**: Helidon site 11 3

Annual Nutrient Totals (kg/ha):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

Plant Performance and Nutrients

Paddock: helidon bluegumbase, 4 ha **Soil Type**: Helidon site 11 3

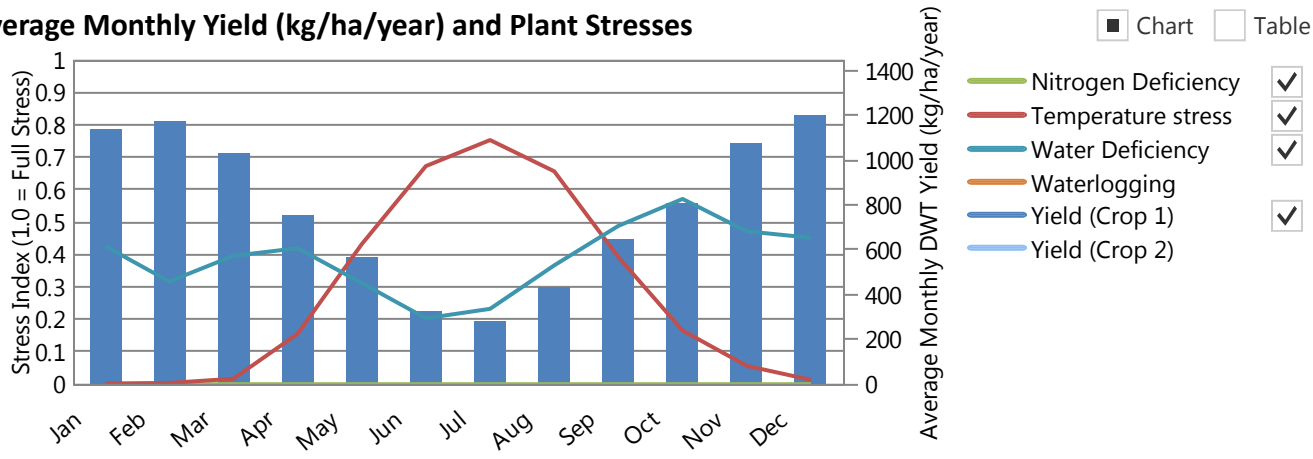
Plant: Continuous Blue Gum offset 3 with grass, kick started

Average annual shoot dry matter yield (kg/ha/year)	9459.33 (3967.61 - 13283.54)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.98 (0.96 - 0.99)
Average monthly root depth (mm) (minimum - maximum)	1177.49 (1157.20 - 1193.52)

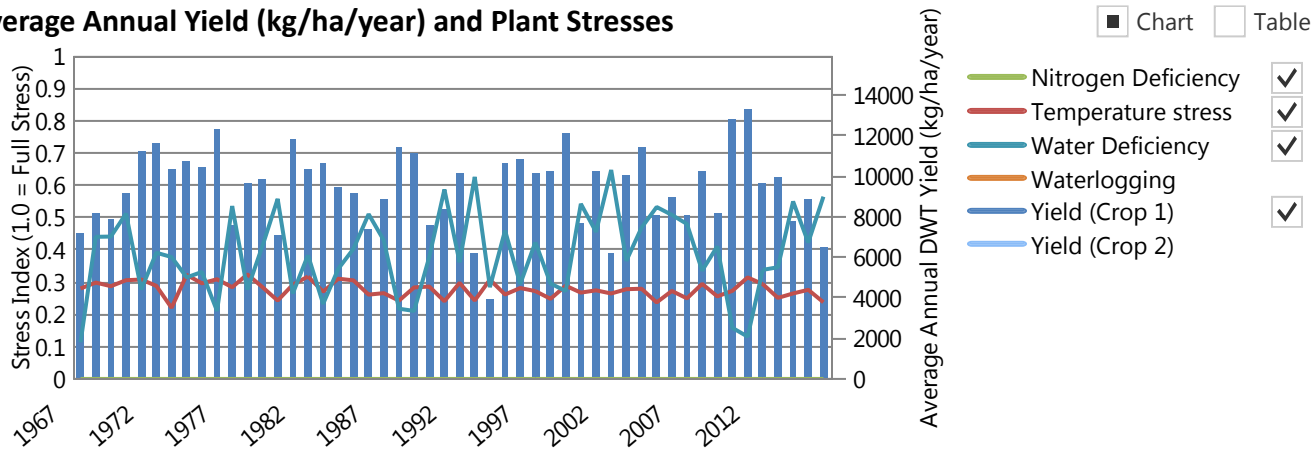
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/ha/year)	75.67 (31.68 - 105.52)
Average annual net phosphorus removed by plant uptake (kg/ha/year)	29.95 (4.31 - 43.36)
Average annual shoot nitrogen concentration (fraction dwt)	0.01 (0.01 - 0.01)
Average annual shoot phosphorus concentration (fraction dwt)	0.003 (0.001 - 0.004)

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



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



No. of harvests/year: 0.02 (forced by crop death due to water stress (0.02))
No. days without crop/year (days/year): 0.34 due to water stress (0.34)

PERFORMANCE

Land Performance

Paddock: helidon bluegumbase, 4 ha **Soil Type**: Helidon site 11 3

Plant: Continuous Blue Gum offset 3 with grass, kick started

Salt tolerance	Tolerant
Salinity threshold EC sat. ext. (dS/m)	8.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.05
No. years assumed for leaching to reach steady-state (years)	10.00

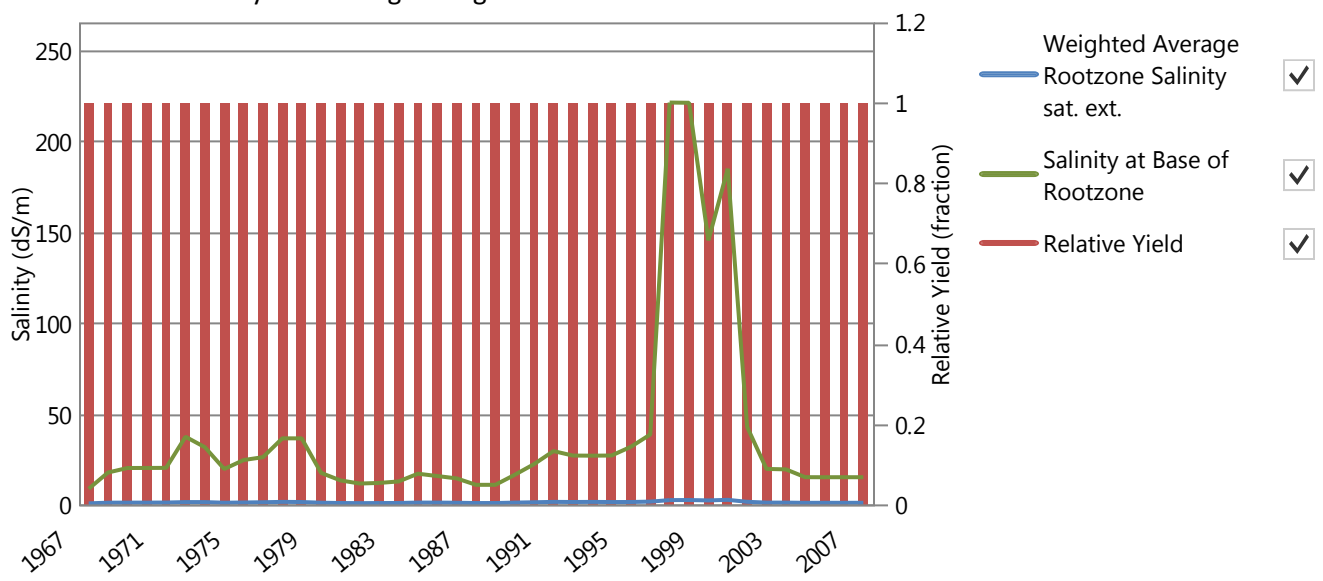
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.59
Salt added by rainfall (kg/ha/year)	141.15
Average annual effluent salt added & leached at steady state (kg/ha/year)	4518.79
Average leaching fraction based on 10 year running averages (fraction)	0.16
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	1.73
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	38.73
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

Average Annual Rootzone Salinity and Relative Yield:

Chart Table

All values based on 10 year running averages



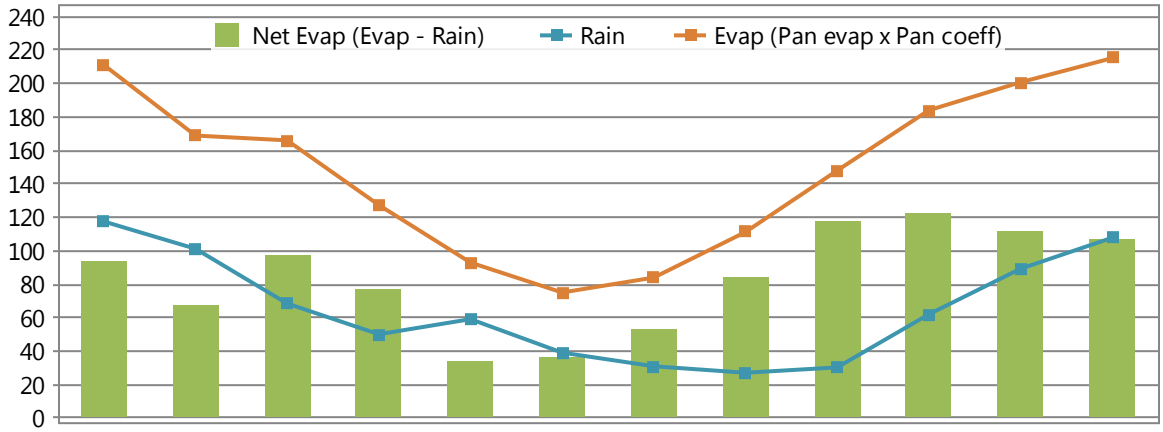
DIAGNOSTICS

Sustainability Diagnostics: Helidon Blue gum base model with grass new 5

Averaged Historical Climate Data Used in Simulation (mm)

Location: HelidonDD, -27.55°, 152.1°

Run Period: 01/01/1967 to 31/12/2016 50 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	117.5	101.2	68.4	50.1	59.1	39.1	30.9	27.1	30.3	62.0	89.2	107.8	782.6
Evap	211.0	168.9	166.0	127.3	92.9	75.0	84.0	111.2	147.9	184.0	200.7	215.1	1784.0
Net Evap	93.6	67.7	97.5	77.2	33.8	36.0	53.0	84.1	117.7	122.0	111.5	107.4	1001.4
Net Evap/day	3.0	2.4	3.1	2.6	1.1	1.2	1.7	2.7	3.9	3.9	3.7	3.5	2.7

DIAGNOSTICS

Sustainability Diagnostics: Helidon Blue gum base model with grass new 5

Pond System: 1 facultative, aerobic or storage pond

Helidon STP 3 - 24366.62 m3/year or 66.71 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

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

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	21.48 (2.63 - 25.00)	523.28 (522.91 - 524.34)
Total Phosphorus	7.73 (0.95 - 9.00)	188.38 (188.25 - 188.76)
Total Dissolved Salts	721.57 (88.48 - 840.00)	17582.23 (17569.71 - 17617.85)
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)

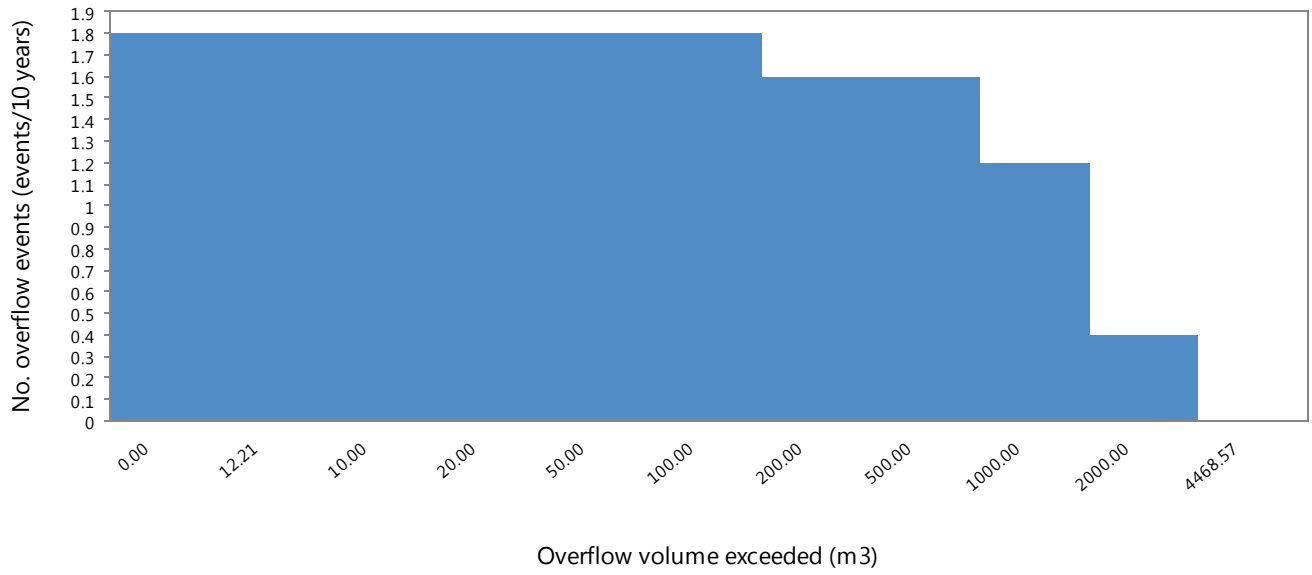
Last pond (Wet weather store): 6000.00 m3

Theoretical hydraulic retention time (days)	89.94
Average volume of overflow (m3/year)	306.10
No. overflow events per year exceeding threshold* of 12.21 m3 (no./year)	0.18
Average duration of overflow (days)	20.22
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.98
Probability of at least 90% effluent reuse (fraction)	0.96
Average salinity of last pond (dS/m)	0.82
Salinity of last pond on final day of simulation (dS/m)	75231.72
Ammonia loss from pond system water area (kg/m2/year)	1.03

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

Overflow exceedance:

Chart Table



Export plot

DIAGNOSTICS

Sustainability Diagnostics: Helidon Blue gum base model with grass new 5

Irrigation Information

Irrigation: 4 ha total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (m3)	18575.66	4643.91
Total nitrogen applied (kg)	341.05	85.26
Total phosphorus applied (kg)	187.66	46.91
Total salts applied (kg)	17510.54	4377.63

Shandying

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

Irrigation Issues

Proportion of Days irrigation is prevented when triggered (fraction)	0.27
Proportion of Days water demand is too small to trigger irrigation (fraction)	0.07
Proportion of Days irrigation occurs (fraction)	0.66

DIAGNOSTICS

Sustainability Diagnostics: Helidon Blue gum base model with grass new 5

Paddock Land: helidon bluegumbase: 4 ha

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Irrigation triggered when soil water deficit reaches 25.00 mm and rainfall is less than or equal to 0.10 mm
Irrigate a fixed amount of 25.00 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): Helidon site 11 3, 129.58 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	117.5	101.2	68.4	50.1	59.1	39.1	30.9	27.1	30.3	62.0	89.2	107.8	782.6
Irrigation	38.9	43.3	40.6	35.9	41.7	39.5	42.6	39.3	35.1	33.8	35.0	38.7	464.4
Soil Evap	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Transpn.	128.6	127.3	108.9	79.6	72.8	69.3	74.1	77.9	80.9	89.0	117.4	134.8	1160.6
Rain Runoff	11.3	7.7	3.1	4.5	9.0	2.9	0.7	0.2	0.1	0.6	3.4	4.0	47.4
Irr. Runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drainage	8.1	6.3	6.1	4.5	5.4	5.9	1.1	0.3	0.0	0.0	1.0	2.7	41.4
Delta	8.2	3.2	-9.1	-2.6	13.6	0.5	-2.3	-12.0	-15.6	6.3	2.4	5.0	-2.6

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	85.26
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	75.67
Average annual soil nitrogen removed by denitrification (kg/ha/year)	1.80E-04
Average annual soil nitrogen leached (kg/ha/year)	7.94
Average annual nitrate-N loading to groundwater (kg/ha/year)	7.94
Soil organic-N kg/ha (Initial - Final)	1716.10 - 1745.02
	80.95 - 134.85
Average nitrate-N concentration of deep drainage (mg/L)	19.19
Max. annual nitrate-N concentration of deep drainage (mg/L)	61.06

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/ha/year)	46.91
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	29.95
Average annual soil phosphorus leached (kg/ha/year)	7.21E-04
Dissolved phosphorus (kg/ha) (Initial - Final)	0.01 - 1.68
Adsorbed phosphorus (kg/ha) (Initial - Final)	106.23 - 953.27
Average phosphate-P concentration in rootzone (mg/L)	0.28
Average phosphate-P concentration of deep drainage (mg/L)	1.74E-03
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.01
Design soil profile storage life based on average infiltrated water phosphorus concn. of 3.91 mg/L (years)	131.44

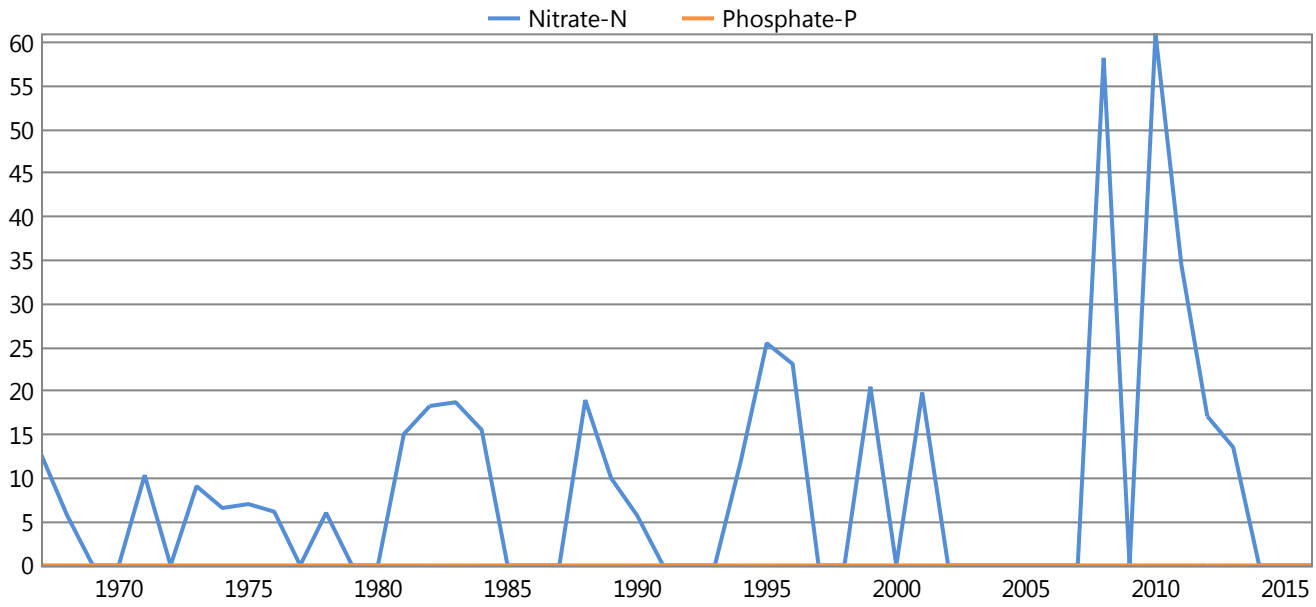
DIAGNOSTICS

Sustainability Diagnostics: Helidon Blue gum base model with grass new 5

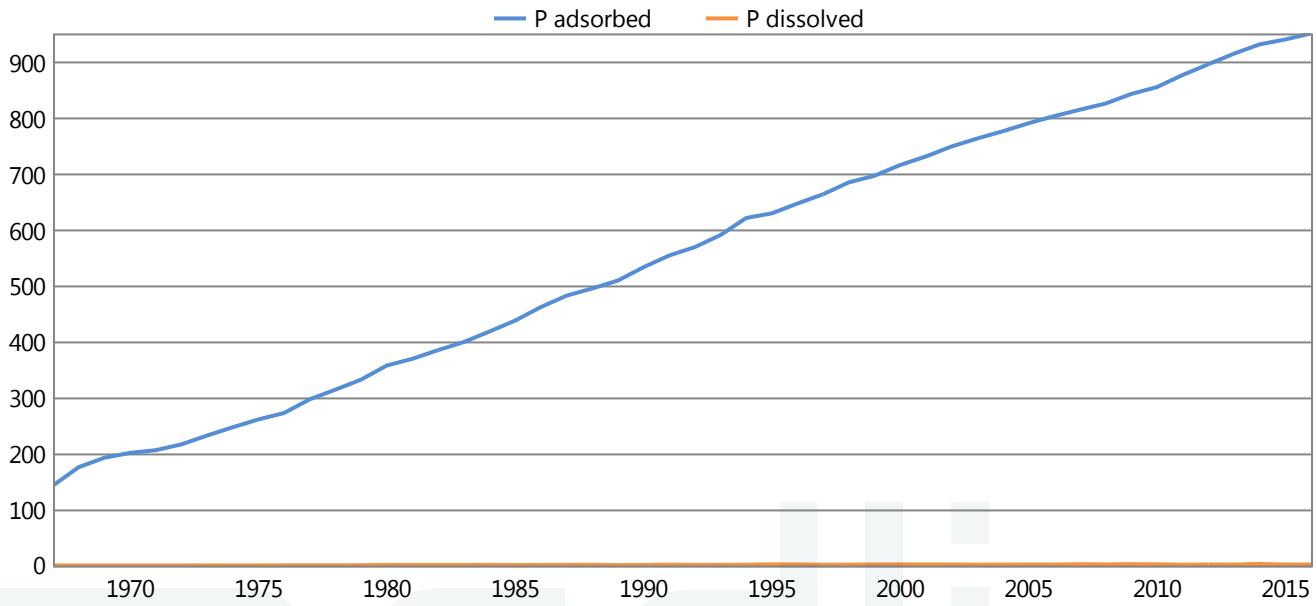
Paddock Land: helidon bluegumbase: 4 ha

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/ha)



DIAGNOSTICS

Sustainability Diagnostics: Helidon Blue gum base model with grass new 5

Paddock Plant Performance: helidon bluegumbase: 4 ha

Average Plant Performance (Minimum - Maximum): Continuous Blue Gum offset 3 with grass, kick started

Average annual shoot dry matter yield (kg/ha/year)	9459.33 (3967.61 - 13283.54)
Average monthly plant (green) cover (fraction)	0.98 (0.96 - 0.99)
Average monthly crop factor (fraction)	1.18 (1.16 - 1.19)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	1177.49 (1157.20 - 1193.52)
Average number of normal harvests per year (no./year)	0.00 (0.00 - 0.00)
Average number of normal harvests for last five years only (no./year)	0.00
Average number of crop deaths per year (no./year)	0.02 (0.00 - 1.00)
Average number of crop deaths for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.02)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.75 (0.49 - 0.88)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.39 (0.20 - 0.57)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	0.34

Soil Salinity - Plant salinity tolerance: Tolerant

Assumes 1.0 dS/m Electrical Conductivity = 640 mg/L Total Dissolved Salts
All values based on 10 year running averages

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.59
Salt added by rainfall (kg/ha/year)	141.15
Average annual effluent salt added & leached at steady state (kg/ha/year)	4518.79
Average leaching fraction based on 10 year running averages (fraction)	0.16
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	1.73
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	38.73
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

DIAGNOSTICS

Run Messages

Messages generated when the scenario was run:

WARNING: Irrigation water salinity exceeds 10 dS/m. Leaf scorching and yield reduction likely. Careful irrigation management needed.
Full run chosen

6.6. Groundwater Bore Reports

Please note: Printed copies of this document should be verified for currency against online version.

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
14320196	Sub-Artesian Facility	Existing	27/07/1973	Gatton	4580 - LOCKYER VALLEY REGIONAL

Details

Description			
Parish	6000 - NO LONGER USED		
Original Name	B5		
Driller Name			
Const Method	CABLE TOOL		
Bore Line	HTS - HELIDON TOWN SUPPLY LINE		
D/O File No	OB1	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	DNR
Roles	WR Investigation Sub-Artesian Monitoring		

Location

Datum	GDA94	**Basin**	1432
Latitude	27-33-44.6	**Sub-area**	L01
Longitude	152-07-21.2	**Lot**	
GIS Latitude	-27.562389341	**Plan**	
GIS Longitude	152.1225561972		
Easting	413379.6	**Map Scale**	
Northing	6950965.5	**Map Series**	C - Commission (DNR/QWRC/IWSC)
Zone	56	**Map No**	K2-64091
Accuracy	GPS	**Map Name**	
GPS Accuracy	4	**Prog Section**	
Checked	Yes		

Casing

1 ***records for RN*** **14320196**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	27/07/1973	1	0.00	11.60	Plastic Casing		WT - Wall Thickness	51

Strata Logs

8 ***records for RN*** **14320196**

Rec	Top (m)	Bottom (m)	Strata Description

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	0.90	SANDY TOPSOIL
2	0.90	1.50	SAND AND GRAVEL
3	1.50	2.70	SAND AND GRAVEL
4	2.70	8.50	COARSE SAND AND GRAVEL
5	8.50	8.80	SANDY CLAY
6	8.80	11.00	SAND AND GRAVEL
7	11.00	11.90	SANDSTONE DECOMPOSED
902			27/7/1973 SWL -3.20 M TMP NUL C

Stratigraphies

2 *records for RN* **14320196**

Source	Rec	Top (m)	Bottom (m)	Strata Description
DNR	1	0.00	11.00	LOCKYER CREEK ALLUVIUM
DNR	2	11.00	11.90	GATTON SANDSTONE

Aquifers

1 *records for RN* **14320196**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	0.00	11.00	GRAV - Gravel SAND - Sand						Y	UC	LOCKYER CREEK ALLUVIUM

Pump Tests Part 1

0 *records for RN* **14320196**

Pump Tests Part 2

0 *records for RN* **14320196**

Bore Conditions

0 *records for RN* **14320196**

Elevations

4 *records for RN* **14320196**

Bore Report

From Year:

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	05/03/1974	127.75	SVY	Surveyed	STD - State Datum	R	Reference Point	
A	01/01/2011	127.77	SVY	Surveyed	STD - State Datum	R	Reference Point	LEVELLED FROM 14320195 - NEW PROTECTOR
X	05/03/1974	127.47	SVY	Surveyed	STD - State Datum	N	Natural Surface	
X	01/01/2011	127.27	SVY	Surveyed	STD - State Datum	N	Natural Surface	LEVELLED FROM 14320195

Water Analysis Part 1

6 *records for RN* **14320196**

Pipe	Date	Rec	Analyst	Analysis No	Depth (m)	Meth	Src	Cond (uS/cm)	pH	Si (mg/L)	Total Ions (mg/L)	Total Solids (mg/L)	Hard	Alk	Fig. of Merit	SAR	RAH
A	11/08/1960	1	GCL	020555	12.00	PU	GB	1190	7.4		763.80	763.80	451	547	1.4	2.9	1.90
A	10/03/1980	1	GCL	085967		PU	GB	1320	8.0	30	928.60	735.46	301	365	0.8	4.1	1.27
A	10/06/1981	1	GCL	089236	12.00	PU	GB	1340	8.3	31	932.00	739.86	299	370	0.8	4.2	1.41
A	05/10/1982	1	GCL	095849		AI	GB	1350	8.0	34	984.00	776.56	314	396	0.8	4.3	1.63
A	18/10/1983	1	GCL	100386	12.00	AI	GB	1350	8.1	23	949.32	741.04	304	379	0.8	4.1	1.49
A	18/03/1985	1	GCL	108099	12.00	AI	GB	1350	7.8	29	955.92	748.56	299	385	0.8	4.3	1.71

Water Analysis Part 2

6 *records for RN* **14320196**

Pipe	Date	Rec	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	11/08/1960	1	143.0		74.4	64.4		0.0		327.5	150.2			4.3				
A	10/03/1980	1	165.0	4.0	48.0	44.0		439.0		2.8	225.0	0.20	0.6	0.0				
A	10/06/1981	1	166.0	4.0	44.0	46.0		439.0		5.8	221.0	0.20	1.0	5.0				
A	05/10/1982	1	175.0	4.0	50.0	46.0		475.0		3.7	230.0	0.30	0.0	0.0				
A	18/10/1983	1	165.0	4.1	51.0	43.0	0.00	455.0	0.12	3.6	220.0	0.20	2.3	5.0				
A	18/03/1985	1	170.0	4.0	49.0	43.0	0.01	465.0	0.01	2.1	220.0	0.30	0.5	2.0				

Water Levels

120 *records for RN* **14320196**

Bore Report

From Year:

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	21/06/1974		-3.50	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	19/02/1975		-3.80	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	12/05/1975		-3.80	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	02/09/1975		-3.55	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	10/11/1975		-3.50	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	21/01/1976		-2.55	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	01/07/1976		-2.65	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	13/08/1976		-4.10	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	23/11/1976		-4.80	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	16/09/1977		-4.20	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	11/04/1980		-4.29	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	10/02/1981		-3.29	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	23/03/1981		-3.89	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	10/08/1981		-3.92	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	05/01/1982		-3.82	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	15/07/1983		-3.75	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	18/10/1983		-3.94	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	06/07/1984		-6.00	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	09/11/1984		-3.96	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	25/01/1985		-4.22	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	12/04/1985		-4.26	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	28/06/1985		-4.24	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	30/09/1985		-4.26	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	13/12/1985		-4.11	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	21/03/1986		-4.35	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Bore Report

From Year:

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	19/06/1986		-4.28	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	05/11/1986		-4.39	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	16/01/1987		-4.35	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	03/07/1987		-4.58	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	23/10/1987		-4.55	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	08/01/1988		-4.50	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	21/09/1989		-4.15	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	21/11/1989		-4.10	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	30/01/1990		-4.24	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	24/05/1990		-3.80	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	23/07/1990		-4.13	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	19/09/1990		-4.21	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	09/11/1990		-4.30	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	29/01/1991		-4.22	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	01/05/1991		-4.33	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	11/06/1991		-4.29	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	09/08/1991		-4.31	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	01/10/1991		-4.40	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	20/01/1992		-4.38	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	02/06/1992		-4.29	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	11/06/2003		-3.92	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	10/09/2003		-4.13	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	03/12/2003		-4.19	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	04/03/2004		-4.02	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	12/08/2004		-4.17	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Bore Report

From Year:

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	13/09/2004		-4.21	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	06/12/2004		-4.24	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	07/03/2005		-4.25	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	06/06/2005		-4.26	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	28/09/2005		-4.28	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	12/12/2005		-4.16	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	06/03/2006		-4.20	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	31/05/2006		-4.23	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	07/09/2006		-4.21	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	15/12/2006		-4.26	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	21/03/2007		-4.37	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	07/06/2007		-4.38	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	15/06/2007		-4.38	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	10/09/2007		-4.26	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	06/12/2007		-4.25	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	28/02/2008		-4.05	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	02/06/2008		-4.25	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	01/09/2008		-4.20	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	12/11/2008		-4.28	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	25/11/2008		-3.68	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	08/01/2009		-3.42	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	02/03/2009		-4.03	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	01/06/2009		-3.96	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	24/08/2009		-4.16	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	23/11/2009		-4.26	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Bore Report

From Year:

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	31/03/2010		-3.97	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	09/06/2010		-4.12	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	01/09/2010		-4.14	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	07/12/2010		-3.34	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	24/03/2011		-3.21	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	31/05/2011		-3.59	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	07/06/2011		-3.61	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	29/08/2011		-3.69	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	12/12/2011		-3.29	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	08/03/2012		-3.40	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	28/06/2012		-3.49	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	11/09/2012		-3.78	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	27/11/2012		-3.80	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	04/03/2013		-2.21	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	21/05/2013		-3.87	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	05/09/2013		-4.00	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	03/12/2013		-3.93	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	03/03/2014		-4.08	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	03/06/2014		-4.00	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	02/09/2014		-4.00	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	03/12/2014		-4.06	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	16/03/2015		-4.05	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	02/06/2015		-3.95	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	07/09/2015		-3.98	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	01/03/2016		-4.10	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements

Bore Report

From Year:

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	02/06/2016		-4.10	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	06/09/2016		-4.06	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	01/12/2016		-4.12	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	07/02/2017		-4.14	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	30/05/2017		-4.01	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	29/08/2017		-4.04	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	04/12/2017		-4.00	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	28/02/2018		-4.09	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	22/05/2018		-4.09	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	20/08/2018		-4.12	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	13/11/2018		-4.18	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	18/02/2019		-4.56	R	Reference Point		ACT	Actual	DH	MA	Manual/Hand		1	Good - Actual Manual Measurements
A	06/06/2019		-4.75	R	Reference Point		ACT	Actual	DH	MA	Manual/Hand		1	Good - Actual Manual Measurements
A	16/08/2019		-4.89	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	20/11/2019		-5.08	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	05/07/2021		-4.08	R	Reference Point		ACT	Actual	DH	MA	Manual/Hand		1	Good - Actual Manual Measurements
A	21/09/2021		-4.12	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	11/01/2022		-3.84	R	Reference Point		ACT	Actual	DH	MA	Manual/Hand		1	Good - Actual Manual Measurements
A	16/12/2024		-3.92	R	Reference Point		ACT	Actual	DH	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
X	27/07/1973		-3.20	N	Natural Surface		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **14320196**

Field Measurements

0 ***records for RN*** **14320196**

Special Water Analysis

0 ***records for RN*** **14320196**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
143723	Sub-Artesian Facility	Existing	12/04/2010	Gatton	4580 - LOCKYER VALLEY REGIONAL

Details

Description			
Parish	4505 - TERRY		
Original Name	HAGAN		
Driller Name	CZISLOWSKI, ALAN		
Const Method	CABLE TOOL		
Bore Line			
D/O File No	515 004 1242	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	143722
Log Received Date	17/05/2010	**Data Owner**	
Roles	Water Supply		

Location

Datum	GDA94	**Basin**	1432
Latitude	27-33-49	**Sub-area**	
Longitude	152-07-19	**Lot**	1
GIS Latitude	-27.5636165	**Plan**	RP900696
GIS Longitude	152.1220756		
Easting	413333	**Map Scale**	253 - 1: 25 000
Northing	6950829	**Map Series**	M - Metric Series
Zone	56	**Map No**	9342-44
Accuracy		**Map Name**	
GPS Accuracy		**Prog Section**	
Checked	Yes		

Casing

6 ***records for RN*** **143723**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	12/04/2010	1	0.00	19.10	Polyvinyl Chloride	7.000	WT - Wall Thickness	160
A	12/04/2010	2	13.50	19.00	Perforated or Slotted Casing	1.000	AP - Aperture Size	160
X	12/04/2010	3	0.00	6.00	Grout			250
X	12/04/2010	4	6.00	7.00	Bentonite Seal			250
X	12/04/2010	5	7.00	8.50	Gravel Pack	6.000	GR - Gravel Size	250

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	12/04/2010	6	8.50	19.10	Gravel Pack	6.000	GR - Gravel Size	225

Strata Logs

6 *records for RN* **143723**

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	TOPSOIL
2	1.00	9.00	CLAYEY LOAM
3	9.00	13.00	BROWN SAND
4	13.00	16.10	SAND & GRAVEL
5	16.10	17.60	SAND & BLUE GRAVEL
6	17.60	19.10	WHITE SANDSTONE

Stratigraphies

2 *records for RN* **143723**

Source	Rec	Top (m)	Bottom (m)	Strata Description
DNR	1	0.00	17.60	LOCKYER CREEK ALLUVIUM
DNR	2	17.60	19.10	GATTON SANDSTONE

Aquifers

1 *records for RN* **143723**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	9.00	17.60	SAGR - Sand and Gravel	12/04/2010	-10.30	N	BRACKISH	4.00	Y	UC	LOCKYER CREEK ALLUVIUM

Pump Tests Part 1

0 *records for RN* **143723**

Pump Tests Part 2

0 *records for RN* **143723**

Bore Conditions

0 *records for RN* **143723**

Bore Report

From Year:

Elevations

0 *records for RN* **143723**

Water Analysis Part 1

0 *records for RN* **143723**

Water Analysis Part 2

0 *records for RN* **143723**

Water Levels

1 *records for RN* **143723**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	12/04/2010		-10.30	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality

Wire Line Logs

0 *records for RN* **143723**

Field Measurements

0 *records for RN* **143723**

Special Water Analysis

0 *records for RN* **143723**

Bore Report

From Year:

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6.7. Phase 1 Farm Investigation Area Assessment Report Planfuture

Please note: Printed copies of this document should be verified for currency against online version.

Phase 1 – Farm Investigation Area Assessment

Terminology

Helidon Effluent Reuse Scope	*Queensland Urban Utilities Helidon STP Effluent Reuse Scope of Works November 2018*
Farm Investigation Area	*The QUU owned Helidon land identified in the Helidon Effluent Reuse Scope as requiring investigation*
Project Area	*The 4ha block with the Farm Investigation Area identified for effluent irrigation and regeneration of native vegetation*

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Summary

Queensland Urban Utilities (QUU) is seeking advice on the potential for effluent reuse at the Helidon STP, "*which supports re-establishment of native vegetation and provides an affordable and non-resource intensive irrigation solution*". To this end, in 2018 QUU prepared the Helidon STP Effluent Reuse Scope of Services[1] (Helidon Effluent Reuse Scope), which defined six Phases of work required to develop and define a reuse project.

This report addresses key components of the first of these Phases of work – the suitability of the Helidon Sewage Treatment Plant (STP) Farm Investigation Area for irrigated crop production. Specifically it reports upon the matters addressed in Section 3.1.2 of the Helidon Effluent Reuse Scope, which includes topography, soils, flood risk and vegetation; and provides a high level summary of a number of the matters relevant to Section 3.1.1.

The Farm Investigation Area is a laser-levelled block that has most recently been used for irrigated (unimproved) pasture production and appears to be well suited to effluent irrigation that includes regeneration of natural vegetation.

There are five distinct soil types on the Farm Investigation Area and four distinct soil types in the Project Area (compared with one generic soil type identified in the Queensland Government Globe Map at 1:50,000 scale). All are suited to irrigated crop production with low to moderate management inputs. Soil chemical analyses of the major Representative Soils at the Project Area confirm that there are no obvious limitations for utilising the site for irrigated crop/tree production.

While it is expected that the Farm Investigation Area will experience periodic inundation (circa 40 year Annual Recurrence Interval), the site does not appear to have experienced significant flooding during the 2011 South-east Queensland floods. The flooding characteristics of the site will not limit regeneration of native vegetation.

The pre-clearing native vegetation is the endangered Regional Ecosystem, tall open blue gum (*Eucalyptus tereticornis*) forest with a grassy understory. The Farm Investigation is well suited for effluent irrigation of a blue gum regeneration crop.

[1] Queensland Urban Utilities Helidon STP Effluent Reuse Scope of Works November 2018.

Introduction

QUU is seeking advice on the potential for effluent reuse at the Helidon STP, "*which supports re-establishment of native vegetation and provides an affordable and non-resource intensive irrigation solution*". To this end, in 2018 QUU prepared the Helidon STP Effluent Reuse Scope of Services[2] (Helidon Effluent Reuse Scope), which defined six Phases of work required to develop and define a reuse project.

This report addresses key components of the first of these Phases – the suitability of the Helidon Sewage Treatment Plant (STP) Farm Investigation Area (Figure 1), the site that QUU has available for effluent irrigated crop production. Specifically, it provides a detailed land suitability assessment of the Helidon STP Farm Investigation Area by addressing the matters detailed in Table 1 to underpin:

- land assessment of the Farm Investigation Area;
- selection of suitable species/community for the effluent reuse crop;
- site specific calibration of necessary MEDLI models; and
- development of recommendations for defining a native vegetation crop, effluent storage requirements and irrigation effluent volumes.

DISCUSSION

Figure 1: Location of the Helidon STP Farm Investigation Area (highlighted in yellow)



[2] Queensland Urban Utilities Helidon STP Effluent Reuse Scope of Works November 2018.

Table 1: Tasks required to undertake land assessment of the Farm Investigation Area

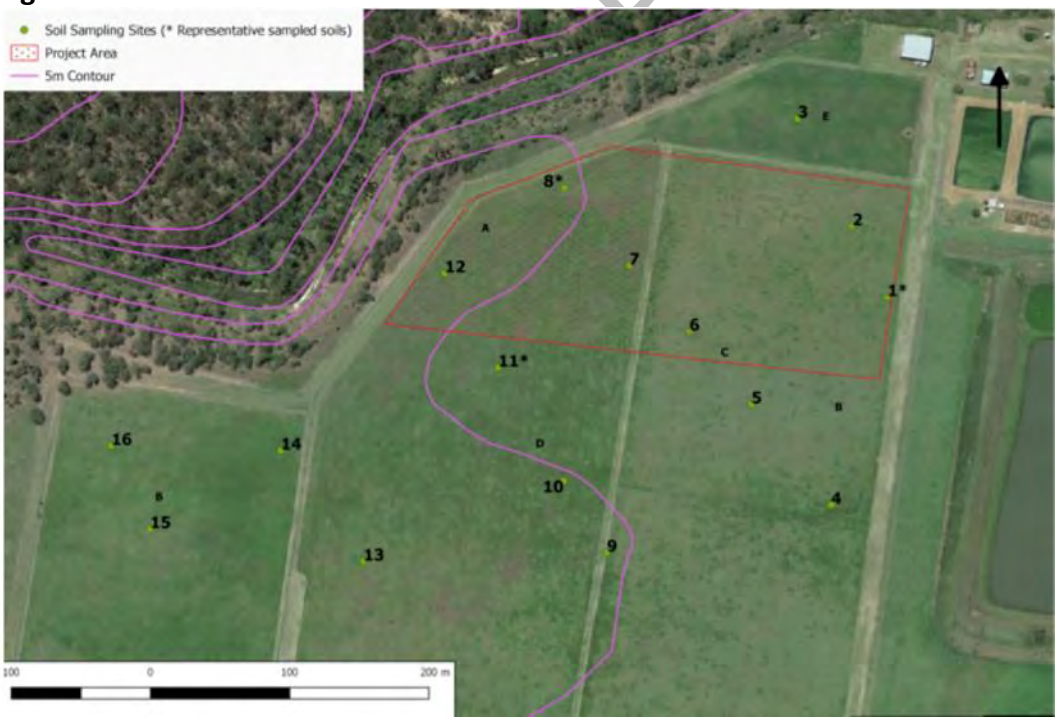
Scope of Works Reference	Phase 1 Tasks sought in this consultancy
3.1.2	Undertake land assessment of the Farm investigation Area as follows: a. Topography: Utilise Queensland Government open-access Lidar data to develop a 50cm topography map, and highlight natural drainage on site; b. Soils: Define major soil types and soil type boundaries at 1:10,000 using recognised Australian soil survey methodology and intensity[3]; c. Flood risk: Assess flood risk and any flood implications for management of effluent during extremely wet periods; and d. Pre-existing vegetation: Assess the likely structure and species composition of the pre-clearing regional ecosystem.

DISCUSSION

Scope Reference 3.1.2a: Topography

The Farm Investigation Area lies to the south of Monkey Water Holes Creek, which on the southern side is marked by a naturally occurring levy (140m ASL) around 10m above the Creek bed. The entire Farm Investigation Area lies between the 140m – 145m contour and has been laser levelled to fall at a grade <1% to a constructed retention basin to the south of the holding dam. The original intent of the Farm Investigation Area design was to direct runoff water to the retention basis for pumping into the holding dam (Figure 2). The State's LiDAR database for this area is not in an accessible form: Given the laser levelling, the 5m contours are adequate for site suitability evaluation and planning.

Figure 2: 5m Contours



[3] Sampling methodology and intensity must follow:

- McKenzie NJ, Grundy MJ, Webster R and Ringrose-Voase AJ. (2008). (Eds) Guidelines for Surveying Soil and Land Resources (2nd edn) CSIRO Publishing: Melbourne.
- National Committee on Soil and Terrain (2009). 'Australian soil and land survey field handbook (3rd Edition)'. CSIRO Publishing, Melbourne.

Scope Reference 3.1.2b: Soils

The Queensland Government's on line mapping and data resource, the Queensland Globe, provides 1: 50,000 soil mapping for the Farm Investigation Area (Figure 3). The dominant soil typed identified over the Farm Investigation Area is Blenheim (heavy) Black Earth[4] (occupying the back plains), with a small amount of Robinson Alluvial Soils along the narrow Monkey Water Holes Creek levee and immediately adjacent back-slopes to the north.

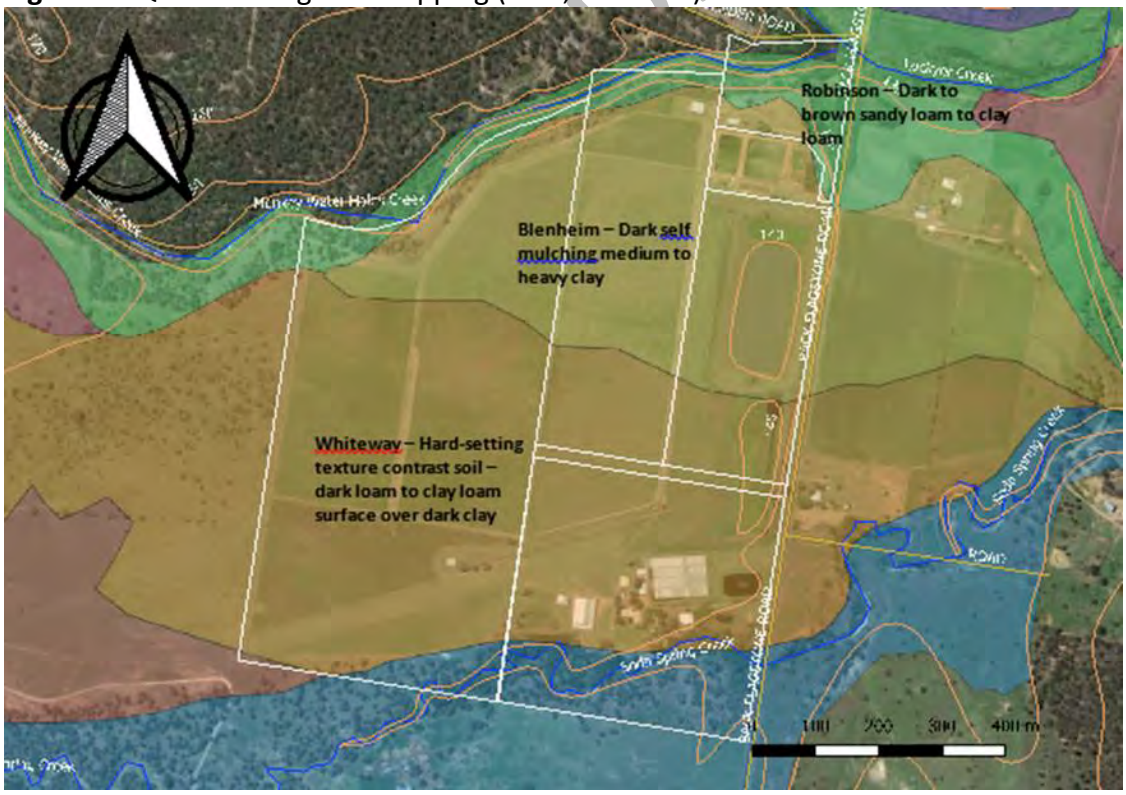
The Soils and Land Suitability of the Lockyer Valley Alluvial Plains[5] descriptions of both soil types are detailed in Table 2.

DISCUSSION

Table 2: Queensland Globe site suitability parameters at the Farm Investigation Area

Suitability parameter	Blenheim (heavy) – Bl(h)	Robinson - Rs
Erosion	<5%	<5%
Soil depth	1.0m – 1.5m	0.6m – 1m
Available water	>100mm	>100mm
Flooding	>40 year frequency	6-9 year frequency
General Irrigation Suitability	Suitable with moderate limitations	Suitable with moderate limitations
Agricultural land class	A	A

Figure 3: Queensland globe mapping (1:50,000 scale) soil resources at the Helidon STP

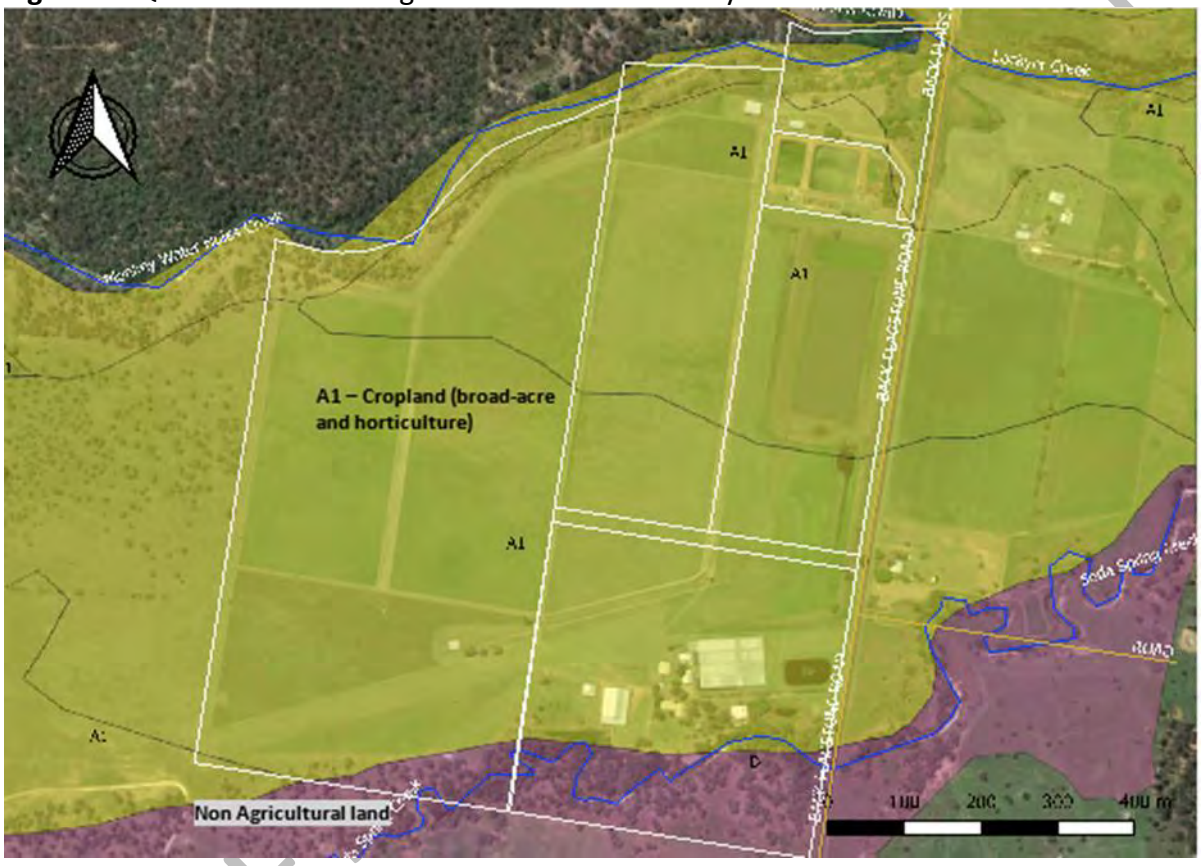


[4] Great Soil Group - Stace, H C T , Hubble, G D , Brewer, R , Northcote, K H , Sleeman, J R , Mulcahy, M J , and Hallsworth, E G (1968) 'A Handbook of Australian Soils' (Rellim Tech Publs Glenside, SA)

[5] Powell, Loi and Christianos (2002). The Soils and Land Suitability of the Lockyer Valley Alluvial Plains South-East Queensland

The Queensland Globe shows the entirety of the QUU land, including the Farm Investigation, Area Class A agricultural land (Figure 4) – *viz*. "*land suitable for current and potential crops with limitations to production which range from none to moderate levels*". While the Queensland Globe data for the Farm Investigation Area is broad-scale, it indicate a general suitability to irrigated crop production and provides the basis for the more detailed soil sampling and analyses needed to frame an effluent reuse recommendation.

Figure 4: Queensland Globe Agricultural Land Suitability Class



Consistent with the *Helidon STP Effluent Reuse Scope of Services*, we designed a soil sampling programme that aligns with best practice soil survey and suitability assessment guidelines[6] and locally defined soil types[7] (Figure 5).

Soil were sampled at each of the sampling locations shown in Figure 5 using a 42mm diameter push tube which delivered an intact core to 1.2m depth. Cores were laid out and described as per the standards of the Handbook of Australian Soils[8], and classified according to the Australian Soil Classification[9], the Factual Key[10] and Great Soil Group[11]. Soil profiles

[6] McKenzie NJ, Grundy MJ, Webster R and Ringrose-Voase AJ. (2008). (Eds) Guidelines for Surveying Soil and Land Resources (2nd edn) CSIRO Publishing: Melbourne & National Committee on Soil and Terrain (2009). 'Australian soil and land survey field handbook (3rd edn)'. CSIRO Publishing, Melbourne

[7] see Powell, B., Loi, J., and Christianos, N.G. (2002). Soils and Land Suitability of the Lockyer Valley Alluvial Plains of South-East Queensland. Queensland Department of Natural Resources and Mines.

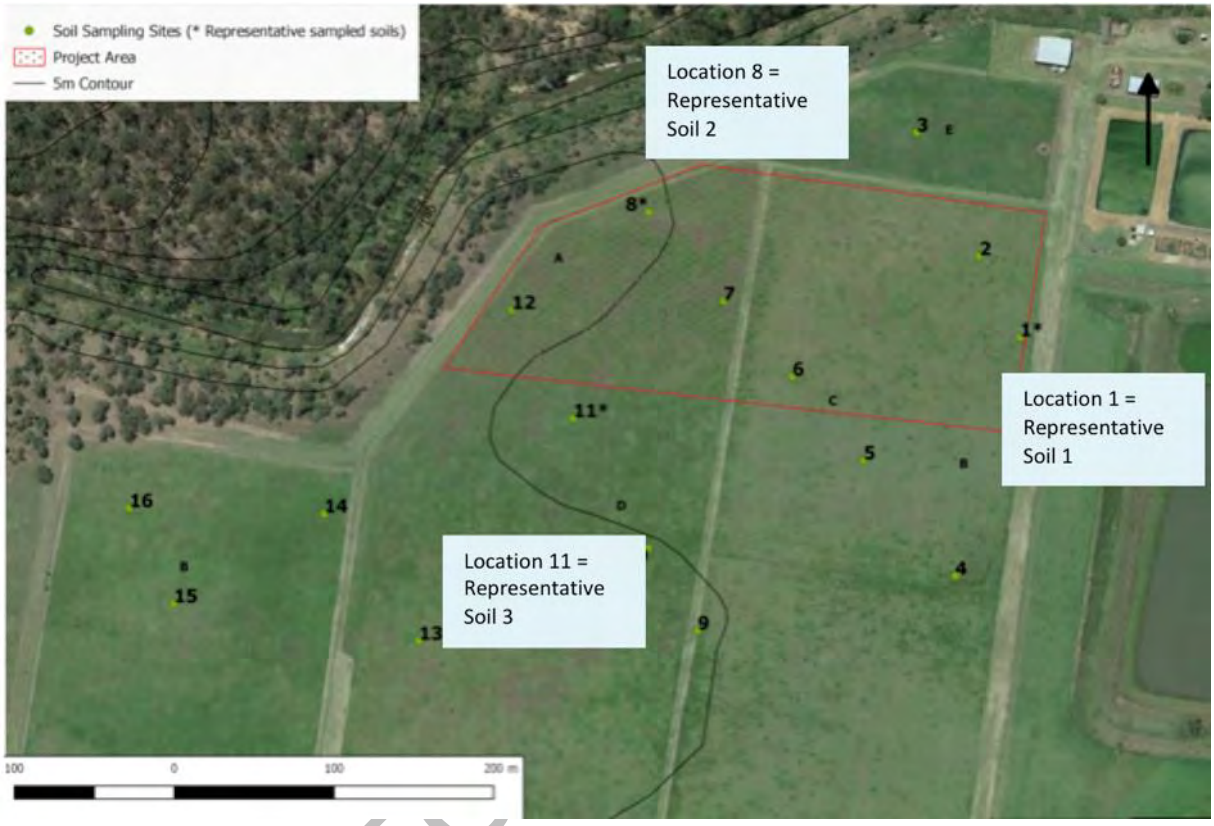
8 National Committee on Soils and Terrain, 2009. http://www.clw.csiro.au/aclep/asc_re_on_line/soilhome.htm

[9] Isbell, R.F. (1996). The Australian Soil Classification. CSIRO Publishing: Melbourne

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were also field tested for pH, dispersion using a modified Emerson's dispersion test and Electrical Conductivity (1:5 aqueous) using a TPS multi-range conductivity electrode; and then photographed. The descriptions are provided at Attachment 1.

Figure 5: Farm Investigation Area showing soil sampling sites and the proposed 4 ha planting area



Soils at all 16 sampling sites had a number of features in common, including being largely black (or brown or grey equivalents close to black) in colour with calcareous lenticular structure in the deep subsoil B horizons. A number of sites had light gravel at the surface, which is thought to be introduced road material that has been inadvertently distributed during laser levelling.

Despite the features in common, the detailed soil descriptions highlight differences between the cores in surface texture, degree of surface cracking and self-mulching, the thickness of the A horizon, the hue colour and depth to subsoil clay containing calcareous accumulations. In addition, the subsoil B horizons varied in their level of salinity. While all soils had low salinity ($EC_{1:5}$ < 0.8dS/m), our soil type classification distinguishes between three relative levels of subsoil salinity derived in field $EC_{1:5}$ assessments, which typically are higher than actual ECs determined in the laboratory:

[10] Northcote, K.H. (1979). A Factual Key for the Recognition of Australian Soils. 4th Edition, Rellim Technical Publications: Coffs Harbour NSW

[11] Stace, H.C.T., Hubble, G.D., Brewer, R., Northcote, K.H., Sleeman, J.R., Mulcahy, M.J. and Hallsworth,E.G. (1968). A Handbook of Australian Soils. Rellim Technical Publications

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- Low subsoil salinity (field $EC_{1:5}$ < 0.4 dS/m
- Medium subsoil salinity (field $EC_{1:5}$ 0.4 dS/m – 0.8 dS/m
- High subsoil salinity (field $EC_{1:5}$ > 0.8 dS/m

Based on these distinguishing attributes, five key soil types were identified on the Farm Investigation Area (Table 3). A 1:10,000 scale soil map of the Farm Investigation Area is presented in Figure 6.

Table 2. Key distinguishing features of five soil types at the Farm Investigation Area

Soil map unit	Landscape position and site no.	Distinguishing features	Australian Soil Classification	Properties affecting tree selection
Cavendish-high subsoil salinity	Levee (3)	Hardsetting light clay surface, weakly cracking, alkaline black and brown clay subsoils	Brown Dermosol	Moderately well drained, elevated subsoil salinity
Cavendish - Hooper low subsoil salinity	Levee (8, 12)	Hardsetting clayloam to light medium clay surface, weakly cracking, black and brown alkaline clay subsoils	Black and Brown Dermosols and Chromosol	Moderately well drained
Blenheim-low subsoil salinity	Back plain (7, 9 10, 11, 13, 14)	Self-mulching, moderately cracking clay surface, black and brown alkaline clay subsoils	Black Vertosol	Shrink swell can rupture roots, Imperfect drainage
Blenheim-moderate subsoil salinity	Back plain (1, 2, 4, 15, 16)	Self-mulching, moderately to strongly cracking clay surface, black and brown alkaline clay subsoils	Black Vertosol	Shrink swell can rupture roots, Imperfect drainage
Blenheim-high subsoil salinity	Back plain (5, 6)	Self-mulching, moderately cracking clay surface, black and grey brown alkaline clay subsoils	Black Vertosol	Shrink swell can rupture roots, Imperfect drainage, elevated subsoil salinity

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While the 1: 50 000 scale soil map (Figure 6) shows most of the Farm Investigation Area to be a Blenheim soil deep Black Vertosol[12], Map 3 provides the finer resolution required in site specific soil survey when undertaking land assessment for irrigated crop production.

Figure 6 also shows the preferred area for the effluent irrigation area (Project Area)[13]. The Project Area comprises around:

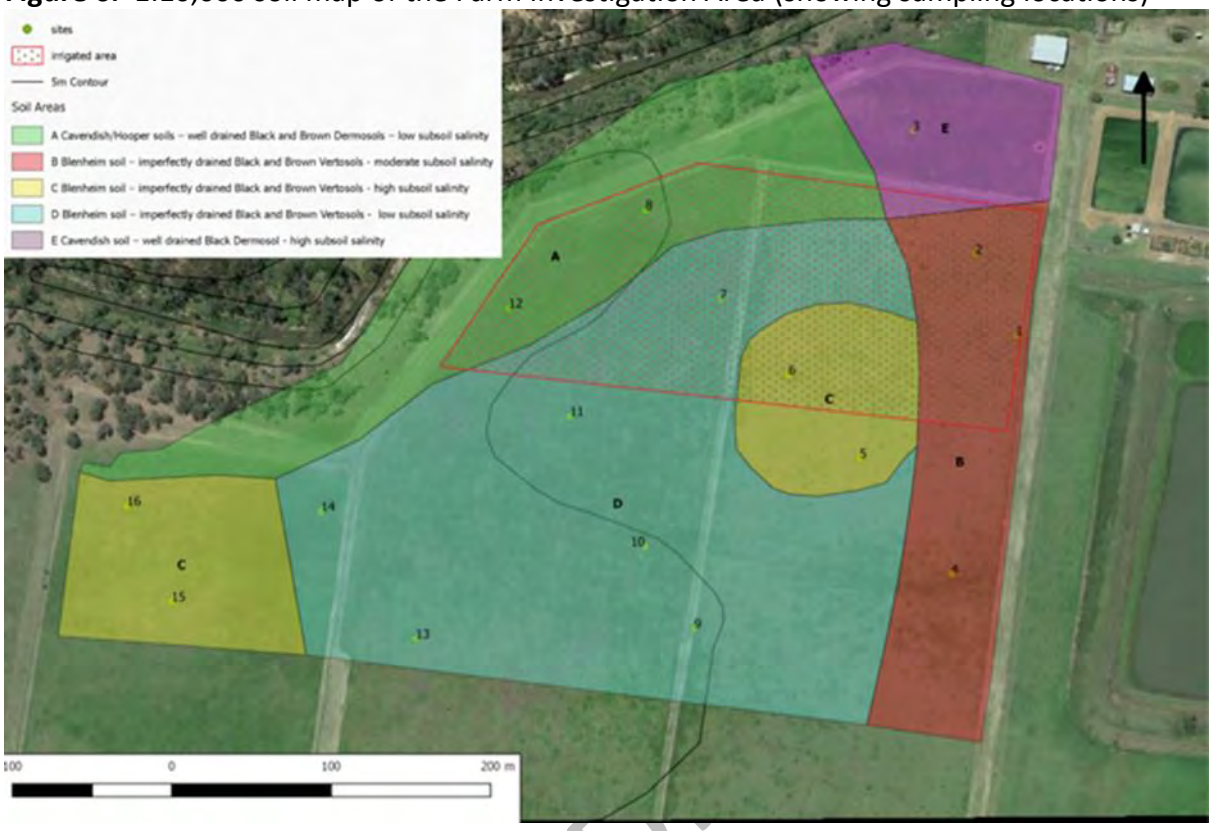
- 40% Blenheim soil, brown and black vertosol with low subsoil salinity;
- 20% Cavendish soil, brown and black dermosol with low subsoil salinity;
- 20% Blenheim soil, brown and black vertosol with moderate subsoil salinity; and
- 10% Blenheim soil, brown and black vertosol with high subsoil salinity[14].

[12] Laser levelling may have destroyed evidence of the Whiteway (Ww) soil mapped nearby, which is a deep Black Chromosol with a heavy clay loam surface. Once disturbed by cultivation, and levelling, mixing the topsoil and heavy clay subsoil results, causing this soil to become a Vertosol with Blenheim features.

[13] Definition of the Project Area is discussed further below.

[14] Noting that the terms 'moderate' and 'high' are gradations of a low subsoil salinity used to distinguish soil types and define 'a most sensitive' soil for sensitivity testing in modelling.

Figure 6. 1:10,000 soil map of the Farm Investigation Area (showing sampling locations)



The first three of these soil types, which collectively comprise ≈90% of the Project Area, are referred to as Representative Soils (Table 4) in the remainder of this report.

Table 4: Representative Soil Types at the Project Area

Representative Soils at Project Area	**Figure 4 Soil Type**
Representative Soil 1 [Sampling Site 1]	Blenheim soil - imperfectly drained black and brown Vertosols with moderate subsoil salinity [Red shading in Figure 4]
Representative Soil 2 [Sampling site 8]	Cavendish/Hooper soils - well drained black and brown Dermosols with low subsoil salinity [Blue shading in Figure 4]
Representative Soil 3 [Sampling Site 11]	Blenheim soil - imperfectly drained black and brown Vertosols with low subsoil salinity [Green shading in Figure 4]

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Each of the Representative Soils were further sampled, using a composite of three cores, for analyses of the following by the Queensland Department of Sciences laboratory:

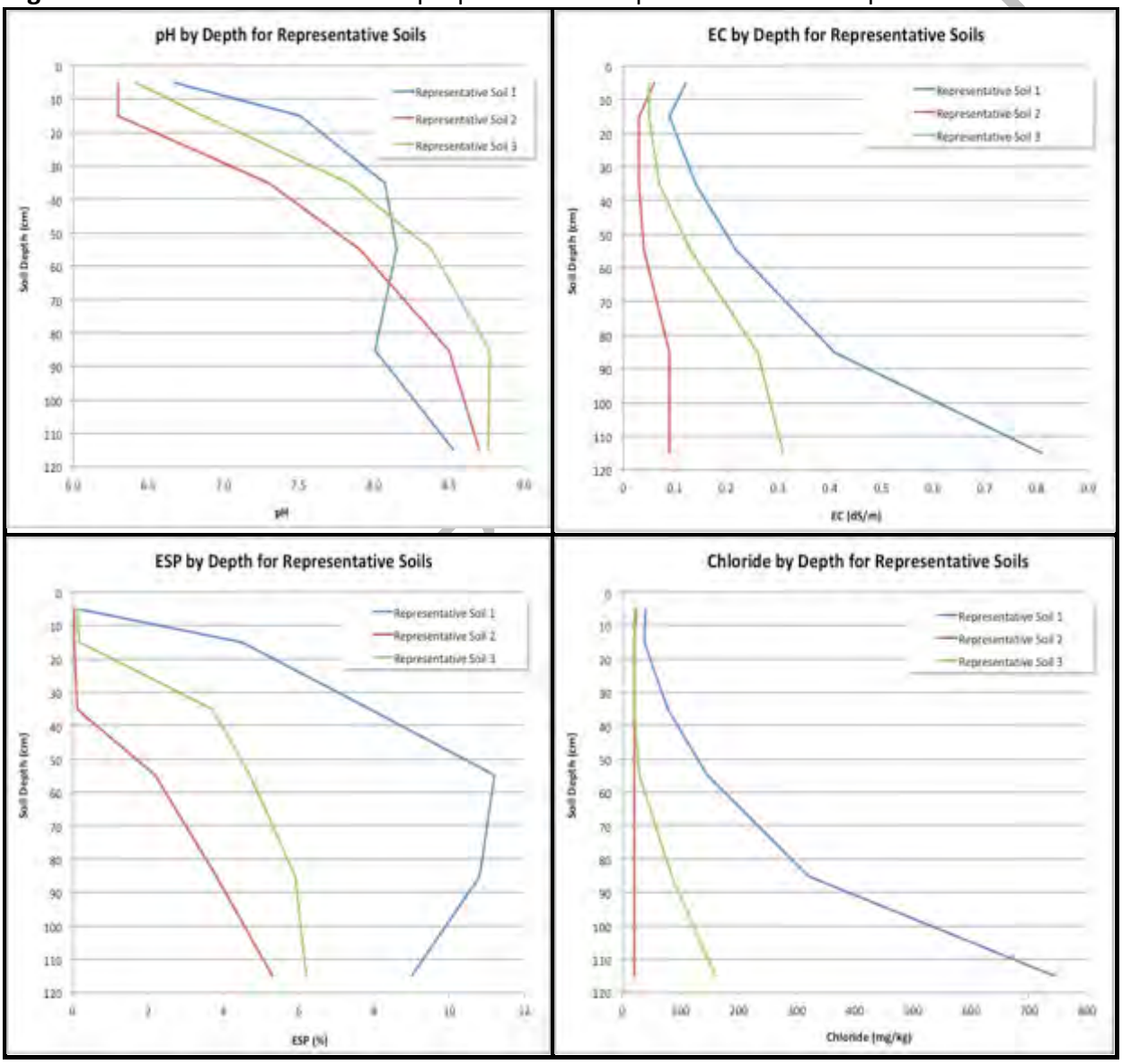
- ADMC, TN%, pH, EC, 15Bar, ECEC (effective CEC), Exchangeable Cations, ESP, PSA, R1, R2 at six depths (0-10cm; 10-20cm; 30-40cm; 50-60cm; 80-90cm; 110-120cm)[15];
- PBI Colwell (indication of max P storage capacity) and Colwell P at four depths (0-10cm; 30-40cm; 80-90cm)[16];

[15] Respectively, Average Dry Moisture Content, Total Nitrogen, Electrical Conductivity (1:5), Exchangeable Sodium percentage, Particle Size Analyses, R1 Dispersion Ratio, R2 Dispersion Ratio

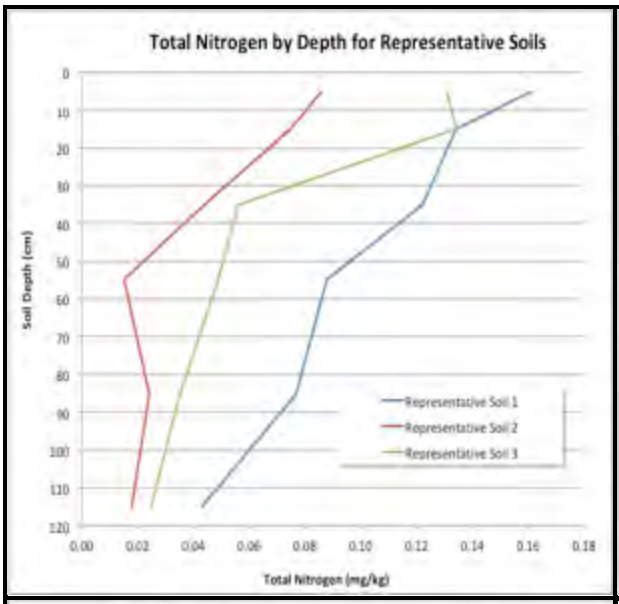
- Fertility - B, Cu, Fe, Mn, Zn, BSES-P, organic C, and Kjeldahl N on the surface samples on the surface samples[17];
- P Adsorption Isotherms at three depths (0-10cm; 30-40cm; 50-60cm); and
- Bulk density[18].

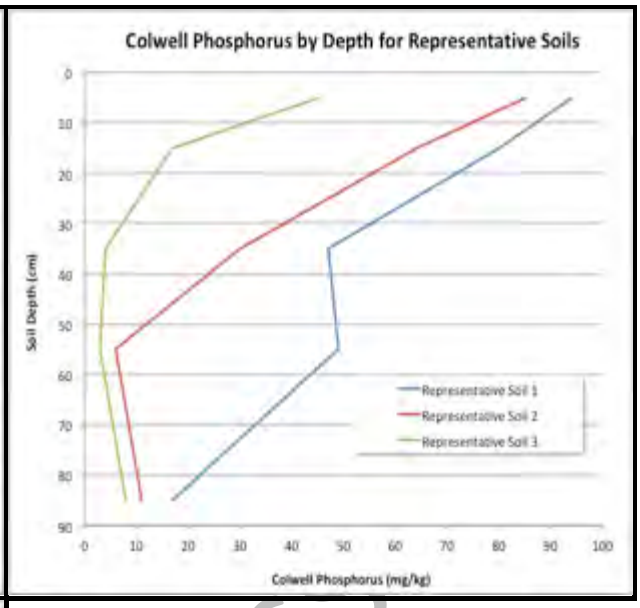
Detailed laboratory data for three sites representative of the area are presented in Attachment 2 and Figure 7.

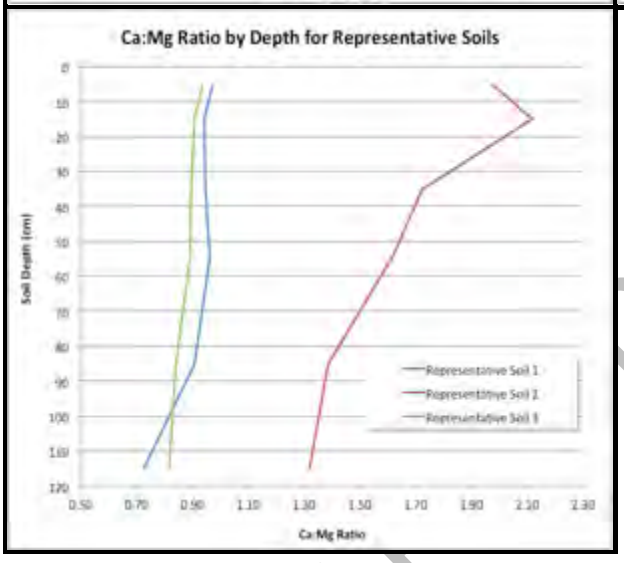
Figure 7: Variation of selected soil properties with Depth for the three Representative Soils



[16] Respectively Phosphorus Buffering Index and Colwell Phosphorus
[17] 0-10cm; 30-40cm and 50-60cm depths
[18] 0-10cm; 20-30cm; 40-50cm; 60-80cm; 90-a00cm







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Laboratory analysis shows that the Blenheim soils were high in clay (>45%) throughout the profile, had neutral to alkaline pHs, variable levels of subsoil salinity, slightly elevated magnesium levels compared to calcium an small increases in Exchangeable sodium in the subsoil. The soils higher in subsoil salinity have higher levels of Exchangeable percentage (ESP>6) and were shown to have higher dispersion. The Blenheim soils exhibited a relatively high magnesium, which may have implications for boron availability[19].

The lighter textured Cavendish-Hooper soil differed in that it had lower clay contents in the surface soil, a lower level of Mg relative to Ca and low levels of salinity.

Soil fertility testing in all the soils sampled showed high levels of P in the surface 0-20cm layers, and adequate levels of K, Ca, Mg and trace elements. Nitrogen levels were low and organic carbon levels modest. Measures of water retention showed high Plant Available Water Capacity (PAWC) for these soils.

[19] A boron response in crops is often observed on more alkaline soils, such as the Blenheim soils at depth – see for example, https://www.jstor.org/stable/42607341?seq=1#page_scan_tab_contents

Using field characterization and laboratory analysis the soils are assessed for their suitability to grow irrigated trees native to the locality. All soils on the Project Area are considered to be suitable for irrigating blue gum (*Eucalyptus tereticornis*), the dominant pre-clearing species on both the Blenheim and Cavendish soil types (see next section). A small area of the Blenheim soils (around 10% of the Project Area) was observed in field testing to have higher subsoil salinity: From a precautionary perspective, this area is best suited to the establishment of trees tolerant of soil salinity, sodicity and waterlogging. Blue gum has these qualities[20].

Specifically, there are no obvious limitations to blue gum growth; though supplementary fertilising of nitrogen and boron at establishment may be desirable. Likewise, there are no significant risks with the proposed irrigation for soil structure; and this has been confirmed through SaLF modelling, particularly for the lower profiles of Representative Soil 1, which have marginal ESP at depth.

Scope Reference 3.1.2c: Flood risk

There is no detailed flood mapping of the Farm Investigation Area. Based on the 2011 flood records at Helidon (Insurance Council of Australia Hydrology Panel, 2011) and the mapped relative elevations, it was concluded that the Queensland Globe flood frequency expectations of circa every 40 years was reasonable. The finding is consistent with expert eco-physiological interpretation of the site.

Despite this, Lockyer Valley flood mapping of the 2011 South-east Queensland floods does not suggest any serious inundation of the Farm Investigation Area (Figure 8)[21]. Floodwaters in Lockyer Creek during the 2011 event came from Murphys Creek, Fifteen Mile Creek, a number of westerly flowing creeks to the north of Helidon and from Rocky Creek, and that, as a result, the limited flooding observed at the Farm Investigation Area would have been affected by backwater from Lockyer Creek and/or from the various flood lines that traverse the Farm Investigation Area (red lines Figure 8). The Figure 8 flood mapping is also consistent with QUU records, which do not show any significant damage / inundation at the STP during the 2011 Event; though it is recommended that his be tested with local famers.

On balance, we are of the view that the Queensland globe estimate of flood frequency (circa every 40 years) is reasonable. It is also consistent with flood mapping on the Globe (Figure 9). The frequency and level of flooding expected at the Farm Investigation Stage would present no limitations to a regenerating blue gum crop (Salinity Management Handbook). The species is tolerant of waterlogging[22], salinity, sodicity and frost and is suitable for saline discharges.

Figure 8: Lockyer Valley Regional Council flood mapping for the 2011 flood event

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[20] Salinity management handbook 2nd Edition. Queensland Government 2011

[21] GSC Flood Map F1 - https://www.lockyervalley.qld.gov.au/our-services/strategic-planning/Pages/Flood-Regulation-.aspx

[22] Blue gum is tolerant of periodic inundation providing the crown remains above the water line

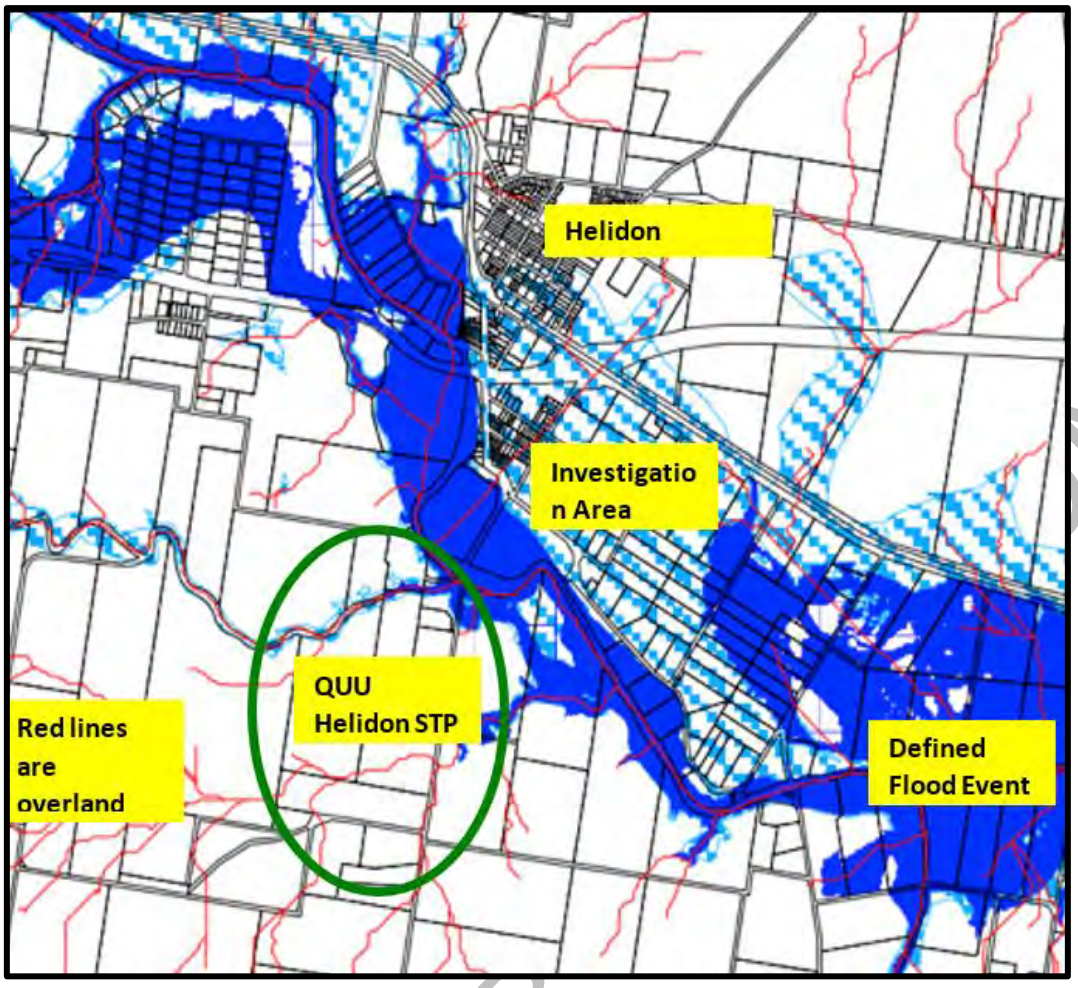
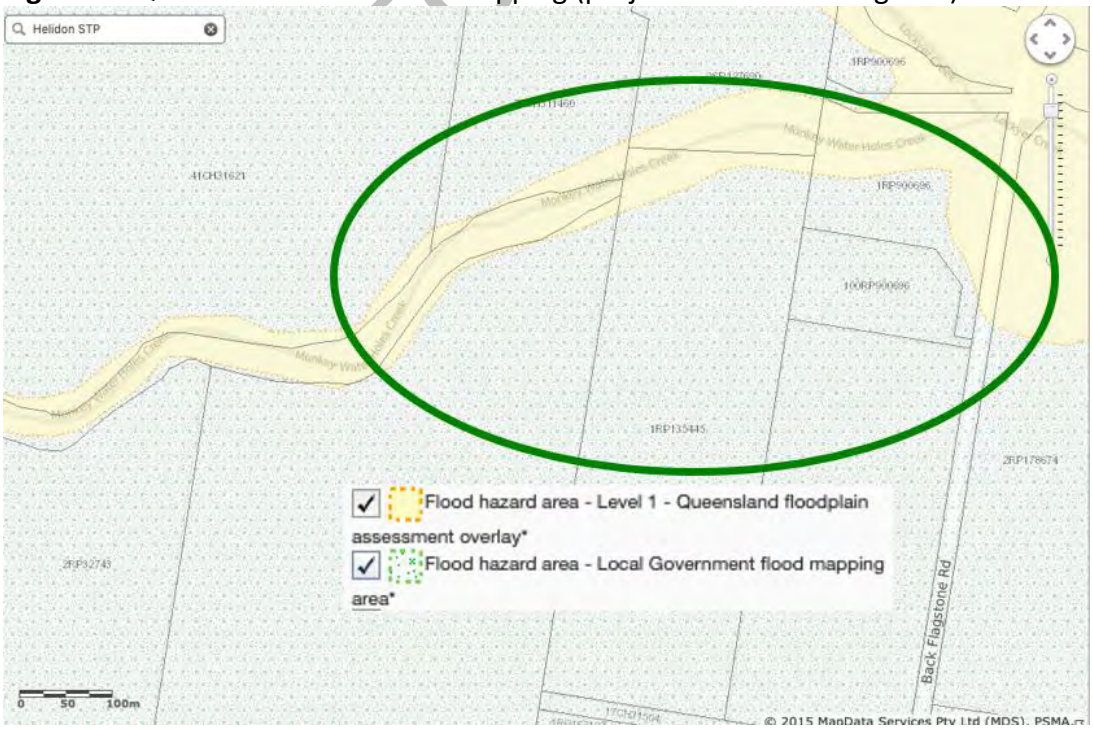


Figure 9. Queensland Globe flood mapping (project area shown in green)



Scope Reference 3.1.2d: Pre clearing vegetation

The Queensland Government defines Regional Ecosystems (RE) as "*communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil*"[23]. The naming convention for RE has numeric codes for bioregion, land zone and vegetation. For the Helidon area, the bioregion is '12', 'South east Queensland' and the land zone is '3', 'recent Quaternary alluvial systems', which includes vertosols and dermosols. The vegetation is defined by the predominant strata.

For the Farm Investigation Area, four separate pieces of evidence indicate that blue gum (*E. teriticornis*) is the dominant strata:

a. Blue gum is recorded as the dominant species on Blenheim soils in the Soil and Land Suitability of the Lockyer Valley Alluvial Plains guide[24];
b. The Salinity Management Handbook details the tolerance of blue gum to the waterlogging and edaphic features of the Lockyer floodplains;
c. Periodic remnant blue gum trees can be still found in the landscape; and
d. Expert opinion of ecologists in the Planfuture team.

The RE type for the site is 12.3.3. The RE is variable, ranging from woodland in drier parts to tall open forest in higher rainfall areas and mono-specific to mixed with other canopy species. Based on the evidence sources detailed above, the pre-clearing RE at the Farm Investigation Area (12.3.3) would be blue gum dominated forests, tending towards mono-specific, but with representation of other tree species, including *Corymbia tessellaris* (Moreton Bay Ash) and *E. melanophloia* (silver-leaf ironbark) and, more so on the levees than the floodplain, *E. crebra* (narrow leaf ironbark).

12.3.3 blue gum forests at the Farm Investigation Area would likely have ben 20m – 30m, tall open forests, sometimes described as dry sclerophyll forest.

Two broad understory types may develop in open forest south of the Tropic of Capricorn. One is characteristic of the widespread infertile soils in the area and contains a dense assemblage of xeromorphic shrubs to 2 m tall and a ground layer that is poorly developed. The other, found on more fertile soils, is mostly herbaceous grasses, sedges and herbs with a poorly-developed shrub layer that may be absent altogether. Between areas of these extremes there are many places of intermediate soil type where the vegetation can be a mixture of both understory types. The likely understory type at Helidon is mostly herbaceous grasses, with understory shrubs limited to individual *Acacia salicina*.

Historically, traditional owners would, most likely, have managed the grassy understory of the tall open blue gum forests using periodic traditional burning practices to encourage grass eating fauna.

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[23] https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/framework
[24] Powell, B., Loi, J. and Christianos (2002). Qld Dept. Natural Resources and Mines. QNRM01215

While blue gum remains common in the landscape, very few intact stands remain. The RE is an endangered vegetation management class with less than 10% of the pre-clearing RE extent remaining in 2017 (present area circa 40,000ha). It is important koala habitat. Blue gum itself will also develop into very large hollow-forming tree and has a special significance for fauna species, especially in drier area.

Blue gum will regenerate readily but there is a lack of recruitment to replace old trees in stands that are logged, thinned or grazed and regularly burnt. The grasses and herbs associated with intact blue gum communities also persist in the landscape, so there is a potential for re-establishing the RE and increasing its remnant area.

The site is well suited to regeneration of a blue gum dominant forest (see also Table 5 from the Salinity Management Manual.

Table 5. Tolerance of key species to potential growth constraints at the Helidon Farm Investigation Area

Potential Growth Constraint	**Blue Gum (*E. tereticornis*)**	**Moreton Bay Ash (*C. tessellaris*)**	**Sally Acacia (*A. salicina*)**
Soil Salinity	High	High	High
Water logging	High	Low	Low
Soil Sodicity	High	High	High
Frost	High	high	High
Suitability for saline discharge	high	-	Moderate

It is also noted that the levee along monkey Waterhole Creek to the North of the Project Area has a small area of remnant vegetation and is listed as having a very small area of endangered Regional Ecosystem 12.3.10 (*E. populnea* woodland on alluvial plain). No *E. populnea* has been observed on the levee. The levee is also essential habitat for *Phascolarctos cinereus* (Koala), as too is the remnant vegetation to the north of the Creek.

Other general land suitability matters

While Section 3.1.1 Scope of Works does not form part of this study, we have included a number of observations that can help inform a general land suitability assessment for the Farm Investigation Area:

- Lockyer Valley Regional Council advises that there are a number of animal (wild dogs) and plant (groundsel) pests that have established in the riparian area of Monkey Water Holes Creek. Council is working with landowners and QUU to control these pests. Neither pest places any constraint on the use of the Project Area for blue gum regeneration.
- The nearest neighbours appear to be circa 300m to the north and 400m to the east and south, with a shed around 150m to the north of the Project Area. This consideration will be relevant to the health assessment to be undertaken as part of the next stage of this project.

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- The site is not earmarked for transport infrastructure development, infrastructure development or economic development.
- The area to the north of Monkey Water Holes Creek is classified as medium potential bushfire risk and the area immediately at the northern boundary of the Project Area is a buffer area. Properly maintained and irrigated, the fire risk at the Project Area should be able to be minimised.
- The Farm Investigation Area is a Water Supply Buffer Area and Water Resources Catchment and, accordingly, the State Planning Policy—state interest guideline Water quality April 2016 applies[25] as follows:
    - Policy 6 (Planning for safe, secure and efficient water supply) and Policy 7 (Including requirements that development in water resource catchments is undertaken in a manner which contributes to the maintenance and enhancement (where possible) of water quality to protect the drinking water and aquatic ecosystem environmental values in those catchments), Item 6/7.4 states –*"Include planning and engineering measures to ensure development in identified water supply buffer areas and water resource buffer areas is planned and designed to manage stormwater and waste water in ways that minimise impacts on water quality. For example an SEQ local government may reference the Seqwater Development Guidelines: Development guidelines for water quality management in drinking water catchments or include similar provision within relevant assessment codes or planning scheme policies."*
    - Policy 8 (For development in a water supply buffer area), Item 8.1 and Item 8.2 respectively state i*nter alia* –*"specific outcomes and measures contained in the Seqwater Development Guidelines: Development Guidelines for Water Quality Management in Drinking Water Catchments 2012" and "advice from the Queensland Bulk Water Supply Authority is sought where a reduced separation distance is proposed".*

  The matters addressed in Seqwater guidelines need to be considered by QUU in the next stage of this project; but with best practice effluent irrigation management should not pose any *a priori* risk.
- Presently all effluent is transferred to the large turkey dam[26] to the south of the STP, providing essentially the only source of water to the dam other than direct rainfall. The dam is frequented by a number of birds. The proposed effluent reuse project will reduce flow to the dam (wet weather flows to the dam will continue).

While QUU will need to investigate these further, none of the matters noted in this supplementary section should limit the suitability of the site to blue gum regeneration.

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[25] https://www.dlgrma.qld.gov.au/resources/guideline/spp/spp-guideline-water-quality.pdf

[26] The large two turkey dams has a small nested dam, into which QUU effluent is transferred, with overflow moving to the larger component of the turkey dam.

Attachment 1: Field Soil Descriptions and Classifications at the Helidon Farm Investigation Area

PROJECT Helidon STP Site 01

Location (GDA94): Long. 152.119135 E, Lat. -27.564336 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Self mulching Black Vertosol, clayey, deep **GSG**: Black Earth **PPF**: Ug5.17
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.15	Black 10YR32		Medium heavy clay	Moderate Granular 5-10mm		No segregations	Strong Dry	Clear
2	B21	0.15	0.70	Black 10YR2/1		Heavy clay	Strong angular blocky 20-50mm		No ségrégations	Strong dry	Clear
3	B22k	0.70	1.1+	Black 10YR3/2		Heavy clay	Strong lenticular 20-50mm		Few hard carbonate nodules	Firm Moist	Clear

Notes: Roots to 0.8 m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.110
0.3	7.0	0.137
0.6	7.5	0.154
0.9	8.0	0.626

FOR DISCUSSION

PROJECT Helidon STP Site 02

Location (GDA94): Long. 152.119527 E, Lat. -27.565038 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. Plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Self mulching Brown Vertosol, clayey, deep **GSG**: Brown Clay **PPF**: Ug5.3
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.20	Black 7.5YR32		Medium heavy clay	Moderate Granular 5-10mm		No segregations	Strong Dry	Clear
2	B1	0.20	0.35	Brown 7.5YR4/3		Medium heavy clay	Strong lenticular 20-50mm		No ségrégations	Strong dry	Clear
3	B21	0.35	0.85	Brown 7.5YR4/4		Medium clay	Strong lenticular 20-50mm	Thin gravel line at 0.5m	No segregations	Strong dry	Clear
4	2B22k	0.85	1.1+	Black 10YR2/1		Medium heavy clay	Strong lenticular 20-50mm		Few hard carbonate nodules	Strong dry	

Notes: Roots to1.15 m

Field Laboratory Data



Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.053
0.3	7.5	0.29
0.6	8.5	0.72
0.9	8.5	0.24

FOR DISCUSSION

PROJECT Helidon STP Site 03

Location (GDA94): Long. 152.11978 E, Lat. -27.5655 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Moderately permeable **Drainage**: Moderately well drained **Surface Condition**: Firm, weakly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name:** Hooper
Soil Classification ASC: Brown Dermosol, clayey, deep **GSG**: Chernozem **PPF**: Uf6.31

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.10	Black 7.5YR3/2	Nil	Fine sandy light clay	Moderate cloddy 50-100mm	Nil	No segregations	Strong Dry	Abrupt
2	B1	0.10	0.30	Brown 7.5YR4/3	Nil	Light medium clay	Strong subangular blocky 50-100mm	Nil	No ségrégations	Strong dry	Diffuse
3	B21k	0.30	0.60	Brown 7.5YR4/4	Nil	Light medium clay	Strong prismatic 20-50mm	Nil	Few soft carbonate nodules	Strong dry	Diffuse
4	2B22	0.60	1.2+	Black 10YR2/1	Nil	Light medium clay	Strong prismatic 20-50mm	Nil	No ségrégations	Strong dry	

Notes: Roots to1.2 m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.09
0.3	6.7	0.07
0.6	8.0	0.28
0.9	8.0	
1.2	8.0	1.12

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PROJECT Helidon STP Site 04

Location (GDA94): Long. 152.11936 E, -27.566847 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, strongly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Vertosol, clayey, deep **GSG**: Black Earth **PPF**: Ug5.17
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A11	0.00	0.10	Black 10YR3/2	Nil	Light medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	A12	0.10	0.30	Black 10YR3/2	Nil	Heavy clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.30	0.95	Black 10YR2/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	No ségrégations	Strong dry	Diffuse
4	2B22k	0.95	1.2+	Brown 3/3	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to 1.0m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.16
0.3	7.0	0.071
0.6	9.0	0.106
0.9	9.0	0.186
1.2	9.0	0.416

FOR DISCUSSION

PROJECT Helidon STP Site 05

Location (GDA94): 152.118784 -27.566189 **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Black Vertosol, clayey, deep **GSG**: Black Earth **PPF**: Ug5.16
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A11	0.00	0.15	Black 7.5YR3/2	Nil	Light medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	A12	0.10	0.40	Black 7.5YR3/2	Nil	Medium clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.30	0.80	Grey brown 10YR4/2	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	2B22k	0.60	1.1+	Grey brown 10YR4/2	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	Moderate carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.086
0.3	7.5	0.246
0.6	8.5	0.750
0.9	8.5	0.966
1.1		0.904

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PROJECT Helidon STP Site 06

Location (GDA94): 152.118336 -27.565713 **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Black Vertosol, clayey, deep **GSG**: Black Earth **PPF**: Ug5.16
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.15	Black 10YR3/2	Nil	Medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B1	0.10	0.45	Black 10YR3/2	Nil	Medium clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.450	0.90	Black 10YR3/2	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	2B22k	0.60	1.2+	Grey brown 10YR4/2	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	Moderate carbonate nodules	Strong dry	

Notes: Roots to1.2m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	7.0	0.07
0.3	8.5	0.172
0.6	8.5	1.4
0.9	8.5	1.56
1.1	9.0	

T FOR DISCUSSION

PROJECT Helidon STP Site 07

Location (GDA94): 152.117902 -27.565283 **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Moderately permeable **Drainage**: Moderately well drained **Surface Condition**: Self mulching, weak cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Hooper
Soil Classification ASC: Black Dermosol, clayey, deep **GSG**: Chernozem **PPF**: Uf6.32
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.10	Black 10YR3/2	Nil	Light medium clay	Moderate granular 50-100mm	Nil	No segregations	Strong Dry	Abrupt
2	B21	0.10	0.40	Black 10YR3/2	Nil	Medium clay	Strong subangular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B22k	0.30	0.90	Brown 7.5YR4/3	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	Many carbonate nodules	Strong dry	Diffuse
4	B23	0.60	1.1+	Brown 7.5YR4/3	Few brown	Medium heavy clay	Strong angular blocky 20-50mm	Nil	Many carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.077
0.3	7.0	0.176
0.6	8.5	0.229
0.9	8.5	0.214

FOR DISCUSSION

PROJECT Helidon STP Site 08

Location (GDA94) 152.117434 -27.564774 **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Moderately permeable **Drainage**: Moderately well drained **Surface Condition**: Firm, weakly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Cavendish
Soil Classification ASC: Brown Chromosol, clayey, deep **GSG**: Chernozem **PPF**: Db3.13
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.30	Black 7.5YR32	Nil	Clay loam, fine sandy	Moderate cloddy 20-50mm	Nil	No segregations	Strong Dry	Abrupt
2	B21	0.30	0.80	Brown 7.5YR4/4	Nil	Fine sandy medium clay	Strong prismatic 20-50mm	Nil	No segregations	Strong dry	Diffuse
3	2B22k	0.60	1.2+	Black 10YR2/1	Nil	Fine sandy medium clay	Strong prismatic 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.056
0.3	7.5	0.040
0.6	8.5	0.063
0.9	8.5	0.058
1.2		

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PROJECT Helidon STP Site 09

Location (GDA94): 152.117725 E -27.567146 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim/Flagstone intergrade
Soil Classification ASC: Black Vertosol, clayey, deep **GSG**: Black Earth **PPF**: Ug5.16

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.35	Black 10YR3/2	Nil	Fine sandy medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B21k	0.35	0.95	Grey brown 7.5YR4/2	Nil	Heavy clay	Strong lenticular 50-100mm	Nil	Abundant carbonate nodules	Strong dry	Diffuse
4	2B22k	0.95	1.2+	Grey brown 7.5YR4/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Moderate carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.5	0.054
0.3	7.5	0.154
0.6	9.0	0.247
0.9	8.5	0.200
1.1		0.264

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PROJECT Helidon STP Site 10

Location (GDA94): 152.117414 E, -27.56668 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Brown Vertosol, clayey, deep **GSG**: Brown clay **PPF**: Ug5.3
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.10	Black 7.5YR3/2	Nil	Fine sandy light medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B21	0.10	0.50	Brown 7.5YR4/3	Nil	Medium clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B22k	0.50	1.1	Black 10YR3/2	Nil	Medium clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	Diffuse
4	B23	1.1	1.2+	Brown 10YR4/3	Nil	Medium clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.2m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.054
0.3	6.5	0.044
0.6	7.5	0.088
0.9	8.0	0.119

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PROJECT Helidon STP Site 11

Location (GDA94): 152.116944 E, -27.565939 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Black Vertosol, clayey, deep **GSG:** Black earth **PPF**: Ug5.15

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.20	Black 7.5YR3/2	Nil	Light medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B21	0.20	0.60	Black 7.5YR3/2	Nil	Medium heavy clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B22k	0.60	0.75	Brown 7.5YR4/3	Nil	Medium clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	B23	0.75	1.2+	Brown 10YR4/3	Nil	Medium heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.073
0.3	7.0	0.055
0.6	8.0	0.053
0.9	8.5	0.124

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PROJECT Helidon STP Site 12

Location (GDA94): 152.11656 E, -27.565325 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Moderately permeable **Drainage**: Moderately well drained **Surface Condition**: Firm, weakly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Hooper
Soil Classification ASC: Black Dermosol, clayey, deep **GSG**: Chernozem **PPF**: Uf6.33
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.40	Black 7.5YR32	Nil	Medium heavy clay	Moderate cloddy 50-100mm	Nil	No segregations	Strong Dry	Abrupt
2	*B1*	*0.40*	*0.60*	*Grey brown 7.5YR4/2*	Nil	*Medium heavy clay*	*Strong subangular blocky 50-100mm*	Nil	*No segregations*	*Strong dry*	*Diffuse*
3	*D1*	*0.30*	*0.75*	*Brown 7.5YR4/3*	Nil	*Coarse sandy clay*	*Massive*	Nil	*No segregations*	*Strong dry*	*Diffuse*
4	*2B21*	*0.75*	*1.05*	*Brown 7.5YR4/3*	Nil	*Fine sandy light medium clay*	*Strong prismatic 20-50mm*	Nil	*No segregations*	*Strong dry*	
5	*2B22k*	*1,05*	*1.20*	*Grey brown 7.5YR4/2*	Nil	*Medium heavy clay*	*Strong lenticular 20-50mm*	Nil	*Few carbonate nodules*		

Notes: Roots to1.2m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.081
0.3	7.0	0.091
0.6	8.0	0.108
0.9	8.5	0.135

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PROJECT Helidon STP Site 13

Location (GDA94): 152.115954 E -27.567193 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Hard setting, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim 152.115359 -27.566468
Soil Classification ASC: Black Vertosol, clayey, deep **GSG:** Black earth **PPF**: Ug5.4
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.10	Black 10YR3/2	Nil	Medium heavy clay	Moderate cloddy 50-100mm	Nil	No segregations	Strong Dry	Abrupt
2	B1	0.10	0.50	Black 10YR3/2	Nil	Heavy clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.50	0.90	Black 10YR3/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	B22k	0.90	1.1+	Black 10YR3/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.077
0.3	6.5	0.036
0.6	7.0	0.111
0.9	8.0	0.244

DRAFT FOR DISCUSSION

PROJECT Helidon STP Site 14

Location (GDA94): 152.115359 E, -27.566468 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Self mulching, moderately cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Hooper
Soil Classification ASC: Black Vertosol, clayey, deep **GSG:** Black earth **PPF**: Ug5.15
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.20	Black 7.5YR3/2	Nil	Fine sandy light clay	Massive	Nil	No segregations	Strong Dry	Abrupt
2	B11	0.20	0.40	Black 7.5YR3/2	Nil	Fine sandy light medium clay	Strong granular 20-50mm	Nil	No segregations	Strong dry	Diffuse
3	B21	040	0.80	Brown 7.5YR4/3	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	B22k	0.80	1.1+	Brown 10YR4/3	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.060
0.3	6.5	0.028
0.6	7.0	0.027
0.9	8.0	0.089

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PROJECT Helidon STP Site 15

Location (GDA94): 152.114404 -27.566972 **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Strongly self mulching, Strongly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Black Vertosol, clayey, deep **GSG:** Black earth **PPF**: Ug5.15
Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.10	Black 10YR3/2	Nil	Medium heavy clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B1	0.10	0.55	Black 10YR3/1	Nil	Heavy clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.550	0.85	Brown 7.5YR4/3	Few black (down cracks)	Heavy clay	Strong angular blocky 20-50mm	Nil	Very few soft carbonate	Strong dry	Diffuse
4	B22k	0.85	1.1+	Grey brown 10YR4/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	

Notes: Roots to1.1m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.080
0.3	7.0	0.042
0.6	8.0	0.220
0.9	8.5	0.688

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PROJECT Helidon STP Site 16

Location (GDA94): 152.114126 E, -27.56643 S **Date**: 16/02/2019 **Geology**: Quaternary alluvium **Landform**: <1% alluv. plain
Runoff: Slow **Permeability**: Slowly permeable **Drainage**: Imperfectly drained **Surface Condition**: Strongly self mulching, Strongly cracking
Disturbance: Cultivated and laser levelled **Local Soil Name**: Blenheim
Soil Classification ASC: Black Vertosol, clayey, deep **GSG:** Black earth **PPF**: Ug5.15

Profile Description

No	Horizon	Upper (m)	Lower (m)	Colour (moist)	Mottles	Texture	Structure	Coarse Fragments	Segregations	Strength	Boundaries
1	A1	0.00	0.15	Black 10YR3/2	Nil	Light medium clay	Moderate Granular 10-20mm	Nil	No segregations	Strong Dry	Abrupt
2	B1	0.15	0.40	Black 10YR3/2	Nil	Medium clay	Strong angular blocky 50-100mm	Nil	No segregations	Strong dry	Diffuse
3	B21	0.40	0.60	Black 10YR3/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	No segregations	Strong dry	Diffuse
4	B22k	0.60	1.0	Brown 10YR4/3	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Few carbonate nodules	Strong dry	
5	B23	1.0	1.2+	Grey brown 10YR4/2	Nil	Heavy clay	Strong lenticular 20-50mm	Nil	Very few carbonate modules	Strong dry	

Notes: Roots to1.2m



Field Laboratory Data

Depth (m)	pH	EC (1:5)w dS/m
0.1	6.0	0.050
0.3	7.0	0.060
0.6	8.5	0.146
0.9	8.5	0.336

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Attachment 2: Soil analytical results – Helidon Farm Investigation Area

The details below relate to the three Representative Soil types:

Representative Soils at Project Area	Soil Type
Representative Soil 1	Blenheim soil (imperfectly drained black and brown Vertosols with moderate subsoil salinity
Representative Soil 2	Cavendish/Hooper soils (well drained black and brown Dermosols with low subsoil salinity
Representative Soil 3	Blenheim soil (imperfectly drained black and brown Vertosols with low subsoil salinity

Soil Chemistry

Soils were collected at the Helidon Farm Investigation Area on 16 February 2019. At each of the representative soil sites, composite samples of three cores were combined and bagged; and dispatched to the Department of Science laboratory on 18 February 2019.

Results are summarised in the Tables below. *A priori*, the soils appear to be suitable for blue gum forests irrigated with Helidon STP effluent at the volumes proposed. Specifically, there are no obvious limitations to blue gum growth; though supplementary fertilising of nitrogen and boron at establishment may be desirable. Likewise, there are no significant risks with the proposed irrigation for soil structure; though this will be confirmed through SaLF modelling, particularly for the lower profiles of Representative Soil 1, which have marginal ESP at depth.

Representative Soil	Soil Depth (m)	pH (1:5 water)	$EC_{1:5}$ (dS/m)	Cl (mg/kg)	Clay (%)	CEC cmol_c/kg	ESP (%)
1	0.00-0.10	6.68	0.12	39	44.7	30	0.2
1	0.10-0.20	7.51	0.09	37	48.2	34	4.5
1	0.30-0.40	8.07	0.14	78	59.2	43	7.9
1	0.50-0.60	8.15	0.22	146	59.0	42	11.2
1	0.80-0.90	8.01	0.41	321	59.3	47	10.8
1	1.10-1.20	8.53	0.81	743	58.9	47	9.0
2	0.00-0.10	6.32	0.06	24	22.3	14	0.0
2	0.10-0.20	6.30	0.03	<20	22.3	13	0.1
2	0.30-0.40	7.28	0.03	<20	38.2	27	0.1
2	0.50-0.60	7.90	0.04	<20	34.9	28	2.2
2	0.80-0.90	8.50	0.09	<20	33.1	33	3.8
2	1.10-1.20	8.73	0.09	<20	29.7	34	5.3
3	0.00-0.10	6.42	0.05	<20	39.8	26	0.1
3	0.10-0.20	6.87	0.05	<20	43.8	30	0.2
3	0.30-0.40	7.83	0.07	<20	47.4	36	3.7
3	0.50-0.60	8.38	0.13	29	45.7	42	4.7
3	0.80-0.90	8.77	0.26	85	51.5	51	5.9
3	1.10-1.20	8.76	0.31	160	47.9	49	6.2

- All soils are predominately neutral to moderately alkaline, tending to strongly alkaline below ≈ 90cm
- EC (1:5) is low for all soils (less than 0.8 dS/m)
- Cl levels are high below 1m in Representative Soil 1

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Representative Soil	Soil Depth (cm)	Colwell P (mg/kg)	PBI Colwell	PBI Unadjusted	P (Ext) (mg/kg)	TKP (%)
1	0.00-0.10	94	93	75	131	94
1	0.10-0.20	80	93	78	126	80
1	0.30-0.40	47	130	120	78	47
1	0.50-0.60	49	-----	-----	-----	49
1	0.80-0.90	17	99	96	-----	17
1	1.10-1.20	-----	-----	-----	-----	-----
2	0.00-0.10	85	56	42	116	85
2	0.10-0.20	64	53	42	99	64
2	0.30-0.40	30	86	80	49	30
2	0.50-0.60	6	-----	-----	-----	6
2	0.80-0.90	11	82	80	-----	11
2	1.10-1.20	-----	-----	-----	-----	-----
3	0.00-0.10	45	89	80	80	45
3	0.10-0.20	17	94	91	50	17
3	0.30-0.40	4	103	102	78	4
3	0.50-0.60	3	-----	-----	-----	3
3	0.80-0.90	8	101	99	240	8
3	1.10-1.20	-----	-----	-----	-----	-----

- Surface phosphorus levels are medium, trending low at depth in Representative Soils 2 & 3
- Soils have low phosphorus buffering capacity, implying that a higher component of applied phosphorus will be plant available
- Potassium levels in surface soils are moderate

Representative Soil	Soil Depth (cm)	Total Carbon (%)	Organic Carbon (%)	Total N (%)	TKN (%)	NO3-N (mg/kg)	TKP (%)
1	0.00-0.10	1.90	1.45	0.161	0.148	11	94
1	0.10-0.20	1.57	1.29	0.134	0.122	3	80
1	0.30-0.40	1.63	1.18	0.122	0.108	2	47
1	0.50-0.60	1.21	-----	0.088	-----	<1	49
1	0.80-0.90	1.58	-----	0.077	-----	2	17
1	1.10-1.20	0.82	-----	0.043	-----	2	-----
2	0.00-0.10	1.25	1.03	0.086	0.095	6	85
2	0.10-0.20	0.92	0.86	0.075	0.071	2	64
2	0.30-0.40	0.49	0.44	0.044	0.039	<1	30
2	0.50-0.60	0.39	-----	0.015	-----	<1	6
2	0.80-0.90	0.30	-----	0.024	-----	<1	11
2	1.10-1.20	0.23	-----	0.018	-----	<1	-----
3	0.00-0.10	1.59	1.44	0.131	0.125	5	45
3	0.10-0.20	1.14	0.94	0.134	0.086	1	17
3	0.30-0.40	0.67	0.60	0.056	0.053	<1	4
3	0.50-0.60	0.71	-----	0.049	-----	<1	3
3	0.80-0.90	0.76	0.60	0.035	0.032	<1	8
3	1.10-1.20	0.73	-----	0.025	-----	<1	-----

- Organic carbon levels are low, indicative of laser levelling and cut-and-carry pasture management on a heavier clay
- Surface nitrogen levels are low – medium, with Representative Soils 2 & 3 being low-very low at depth

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Representative Soil	Soil Depth (cm)	Ca cmol_c/kg	Mg cmol_c/kg	K cmol_c/kg	Na cmol_c/kg	Base set (%)
1	0.00-0.10	75	131	1.36	0.703	-----
1	0.10-0.20	14.5	15.4	0.688	1.52	95
1	0.30-0.40	18.7	19.8	0.485	3.44	98
1	0.50-0.60	18.5	19.2	0.406	4.73	102
1	0.80-0.90	20.5	22.6	0.332	5.04	104
1	1.10-1.20	18.8	25.9	0.381	4.21	105
2	0.00-0.10	42	116	0.871	0.082	42
2	0.10-0.20	42	99	0.500	0.113	42
2	0.30-0.40	80	49	0.408	0.436	80
2	0.50-0.60	17.6	10.9	0.228	0.613	106
2	0.80-0.90	19.7	14.2	0.241	1.26	106
2	1.10-1.20	19.5	14.8	0.240	1.79	108
3	0.00-0.10	80	80	0.767	0.370	80
3	0.10-0.20	91	50	0.463	0.699	91
3	0.30-0.40	16.7	18.7	0.305	1.33	102
3	0.50-0.60	20.1	22.6	0.320	1.97	108
3	0.80-0.90	23.2	27.6	0.401	3.01	106
3	1.10-1.20	21.2	26.0	0.327	3.02	104

- Representative Soil 1 is slightly sodic at depth. Representative Soils 2 & 3 are non sodic
- Potassium fertility is good

Representative Soil	Soil Depth (cm)	Ca:CEC	Ca:Mg	K:CEC	Mg:CEC	Mg:Ca	Mg:K	Na:K
1	0.00-0.10	-----	-----	-----	-----	-----	-----	-----
1	0.10-0.20	0.427	0.942	0.0203	0.453	1.06	22.3	2.20
1	0.30-0.40	0.431	0.941	0.0112	0.458	1.06	40.8	7.08
1	0.50-0.60	0.438	0.963	0.0096	0.455	1.04	47.3	11.6
1	0.80-0.90	0.438	0.905	0.0070	0.483	1.10	68.2	15.2
1	1.10-1.20	0.400	0.725	0.0081	0.551	1.38	67.8	11.0
2	0.00-0.10	-----	-----	-----	-----	-----	-----	-----
2	0.10-0.20	-----	-----	-----	-----	-----	-----	-----
2	0.30-0.40	-----	-----	-----	-----	-----	-----	-----
2	0.50-0.60	0.633	1.62	0.0082	0.392	0.619	47.6	2.69
2	0.80-0.90	0.591	1.39	0.0072	0.426	0.722	58.9	5.22
2	1.10-1.20	0.580	1.32	0.0071	0.440	0.758	61.7	7.46
3	0.00-0.10	-----	-----	-----	-----	-----	-----	-----
3	0.10-0.20	-----	-----	-----	-----	-----	-----	-----
3	0.30-0.40	0.461	0.892	0.0084	0.517	1.12	61.3	4.36
3	0.50-0.60	0.484	0.891	0.0076	0.543	1.12	70.6	6.16
3	0.80-0.90	0.454	0.839	0.0078	0.541	1.19	68.7	7.51
3	1.10-1.20	0.434	0.815	0.0066	0.533	1.23	79.6	9.24

- CEC for all soils is indicative of high fertility
- Exchangeable calcium is low and exchangeable magnesium high; though not unexpected in the Lockyer alluvial plains

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Representative Soil	Soil Depth (cm)	Cu (mg/kg)	Zn (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	K cmol_c/kg	B (mg/kg)
1	0.00-0.10	2.9	2.2	59.1	29.0	1.30	0.9
1	0.10-0.20	2.6	3.0	39.3	14.1	0.70	1.3
1	0.30-0.40	2.6	2.1	28.8	7.7	0.50	1.5
1	0.50-0.60	-----	-----	-----	-----	-----	-----
1	0.80-0.90	-----	-----	-----	-----	-----	-----
1	1.10-1.20	-----	-----	-----	-----	-----	-----
2	0.00-0.10	1.5	2.4	63.0	23.3	0.88	0.4
2	0.10-0.20	1.5	2.6	69.7	24.0	0.57	0.3
2	0.30-0.40	1.7	1.1	32.3	5.4	0.39	0.5
2	0.50-0.60	-----	-----	-----	-----	-----	-----
2	0.80-0.90	-----	-----	-----	-----	-----	-----
2	1.10-1.20	-----	-----	-----	-----	-----	-----
3	0.00-0.10	3.0	1.6	66.1	24.2	0.76	0.6
3	0.10-0.20	2.6	1.3	46.6	16.7	0.44	0.9
3	0.30-0.40	1.7	0.6	17.3	5.5	0.40	1.2
3	0.50-0.60	-----	-----	-----	-----	-----	-----
3	0.80-0.90	1.7	0.4	13.3	<2.0	0.49	1.3
3	1.10-1.20	-----	-----	-----	-----	-----	-----

- Zinc, copper and manganese levels are medium. Boron levels are medium in Representative Soils 1 & 3, and low in Representative Soil 2. Boron availability may be reduced in the alkaline soils.

Representative Soil	Soil Depth (cm)	ADMC (%)	Coarse sand (%)	Fine Sand (%)	Silt (%)	Clay (%)
1	0.00-0.10	3.9	12.9	27.7	17.3	44.7
1	0.10-0.20	4.7	11.4	28.0	17.7	48.2
1	0.30-0.40	6.9	7.0	19.2	18.8	59.2
1	0.50-0.60	6.7	8.6	18.5	16.7	59.0
1	0.80-0.90	7.6	6.2	17.3	20.7	59.3
1	1.10-1.20	6.7	6.2	16.3	18.8	58.9
2	0.00-0.10	2.1	23.1	45.2	18.0	22.3
2	0.10-0.20	2.0	25.1	39.3	17.9	22.3
2	0.30-0.40	3.7	23.3	29.3	9.6	38.2
2	0.50-0.60	4.1	23.9	30.2	9.6	34.9
2	0.80-0.90	4.7	8.0	45.2	15.1	33.1
2	1.10-1.20	4.9	10.3	48.0	15.2	29.7
3	0.00-0.10	4.2	14.6	28.8	18.5	39.8
3	0.10-0.20	5.2	14.7	29.9	17.0	43.8
3	0.30-0.40	5.4	16.1	26.2	11.8	47.4
3	0.50-0.60	5.6	9.0	28.3	20.5	45.7
3	0.80-0.90	6.6	2.7	18.1	29.6	51.5
3	1.10-1.20	6.7	2.1	19.5	31.4	47.9

- Representative Soils 1 & 3 are clays throughout their profiles typical of Blenheim soil profiles; whereas Representative Soil 2 has a sandy clay loam surface and more variable higher clay layers at depth, reflecting historic episodes of alluvial deposition.

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Soil physical parameters

Representative Soil	Soil Depth (cm)	Disp. Ratio R1	Disp. Ratio R2	1/3 Bar (%)	15 Bar (%)
1	0.00-0.10	0.69	0.38	34.3	18.2
1	0.10-0.20	0.73	0.46	41.7	20.4
1	0.30-0.40	0.71	0.46	49.9	26.3
1	0.50-0.60	0.74	0.49	50.0	26.7
1	0.80-0.90	0.79	0.55	55.1	27.4
1	1.10-1.20	0.67	<0.10	53.8	26.6
2	0.00-0.10	0.60	0.26	32.9	9.7
2	0.10-0.20	0.60	0.30	27.8	9.3
2	0.30-0.40	0.75	0.42	35.1	16.1
2	0.50-0.60	0.65	0.35	37.7	16.4
2	0.80-0.90	0.66	0.31	39.9	17.3
2	1.10-1.20	0.76	0.41	35.2	16.5
3	0.00-0.10	0.51	0.30	30.8	16.3
3	0.10-0.20	0.56	0.33	36.9	18.5
3	0.30-0.40	0.65	0.40	40.5	20.1
3	0.50-0.60	0.62	0.34	45.2	21.8
3	0.80-0.90	0.63	0.34	47.6	25.1
3	1.10-1.20	0.60	0.30	44.3	24.1

Bulk Density

Bulk density samples were collected using a Honda jack hammer soil core sampler with a 42mm diameter bore. Cores were extracted from the steel sampling tube and carefully laid out on a PVC half pipe before being and cut into lengths and paper bagged for oven dry weight assessment. The method is suitable for providing an estimate of bulk density used for planning operational works and for comparative analyses. As a technique it will typically result in an over-estimate of bulk density and, as a result, both derived values and these values are used in MEDLI modelling.

Soil Depth (cm)	Representative Soil 1	Representative Soil 2	Representative Soil 3
0-10	1.2	1.4	1.3
10-30	1.6	1.4	1.7
40-50	1.4	1.7	1.6
60-80	1.7	1.8	1.6
90-100	1.7	1.7	1.7

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Attachment 3: P Sorption Curves

Representative Soil 1: 0-10cm

1. Colwell P

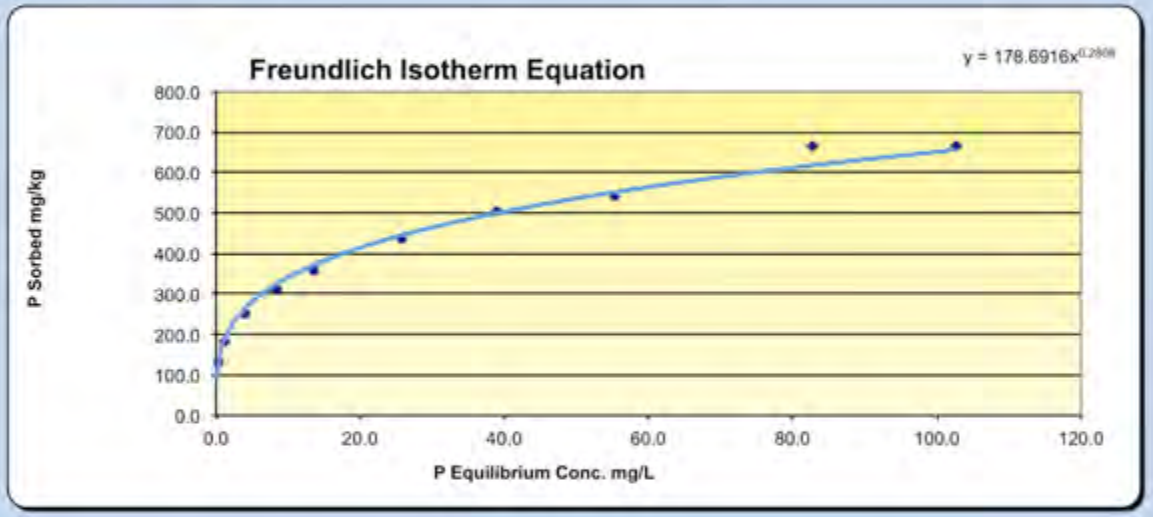
Colwell P mg/kg
94.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.2719	131.28
10.00	1.088	183.12
20.00	4.068	253.32
30.00	8.388	310.12
40.00	13.6	358.00
60.00	25.65	437.50
80.00	38.98	504.20
100.00	55.17	542.30
140.00	82.67	667.30
160.00	102.7	667.00

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9942



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	94.00
Adsorption Coefficient (A)	178.69
Adsorption Exponent (B)	0.2808
Desorption Exponent	0.2668

Representative Soil 1: 30-40cm

1. Colwell P

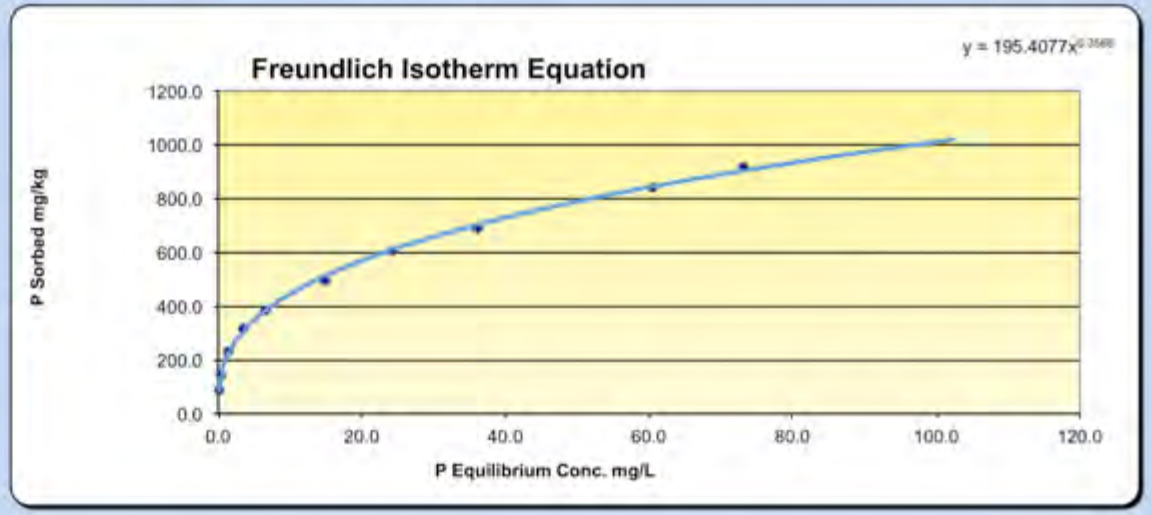
Colwell P mg/kg
47.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.1227	85.77
10.00	0.3622	143.38
20.00	1.398	233.02
30.00	3.532	311.68
40.00	6.516	381.84
60.00	14.99	497.10
80.00	24.31	603.90
100.00	36.06	686.40
140.00	60.52	841.80
160.00	73.16	915.40

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9975



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	47.00
Adsorption Coefficient (A)	195.41
Adsorption Exponent (B)	0.3566
Desorption Exponent	0.3388

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Representative Soil 1: 50-60cm

1. Colwell P

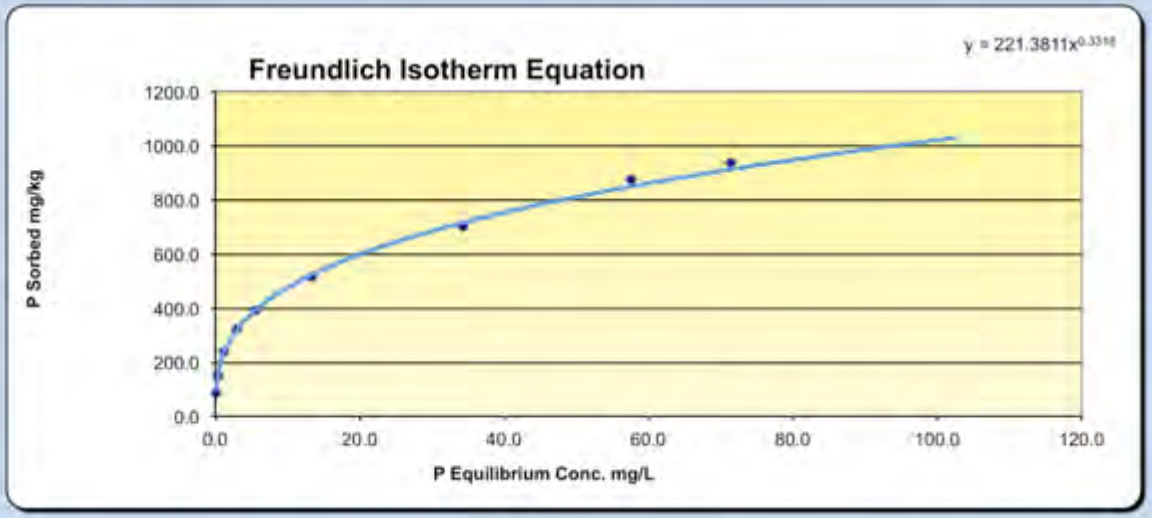
Colwell P mg/kg
49.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.06343	88.37
10.00	0.2901	146.10
20.00	1.191	237.09
30.00	2.989	319.11
40.00	5.51	393.90
60.00	13.35	515.50
100.00	34.44	704.60
140.00	57.7	872.00
160.00	71.3	936.00

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9998



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	49.00
Adsorption Coefficient (A)	221.38
Adsorption Exponent (B)	0.3318
Desorption Exponent	0.3152

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Representative Soil 2: 0-10cm

1. Colwell P

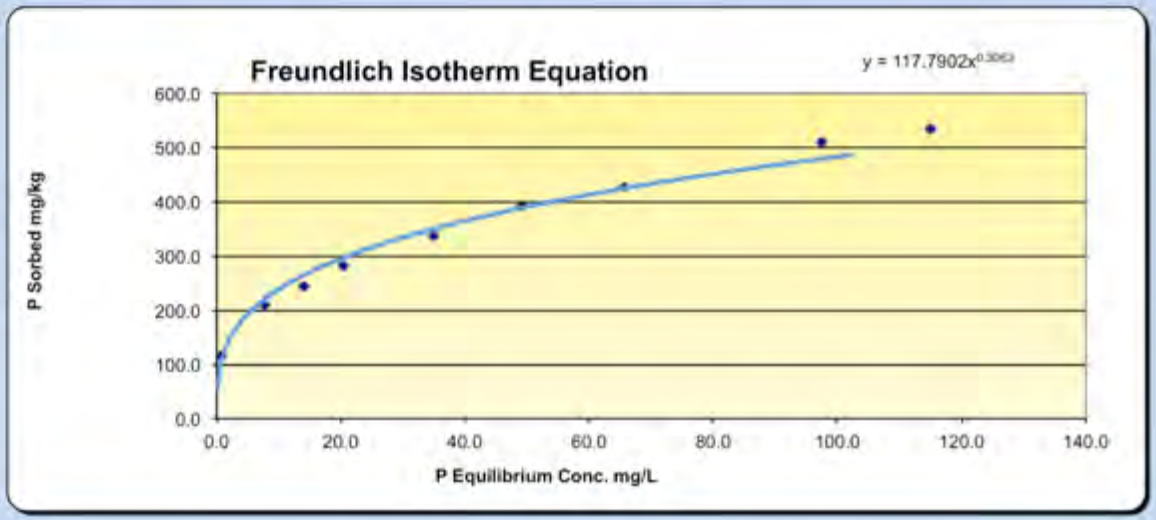
Colwell P mg/kg
65.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.7486	117.51
20.00	7.732	207.68
30.00	14.09	244.10
40.00	20.29	282.10
60.00	34.81	336.90
80.00	49.21	392.90
100.00	65.7	428.00
140.00	97.55	509.50
160.00	115.1	534.00

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9847



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	85.00
Adsorption Coefficient (A)	117.79
Adsorption Exponent (B)	0.3063
Desorption Exponent	0.2910

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Representative Soil 2: 30-40cm

1. Colwell P

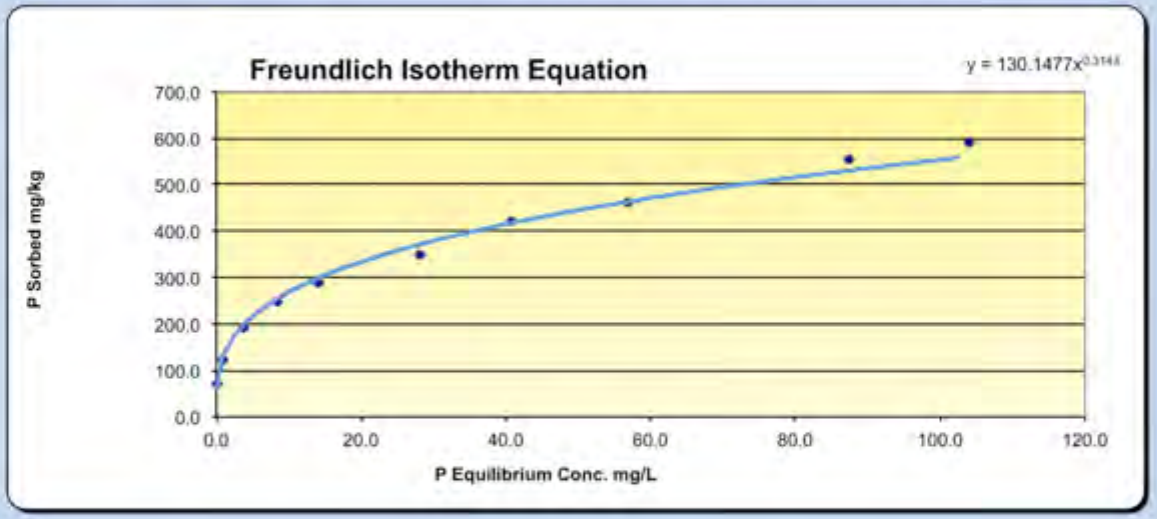
Colwell P mg/kg
30.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.1161	68.84
10.00	0.793	122.07
20.00	3.846	191.54
30.00	8.349	246.51
40.00	14.06	289.40
60.00	27.97	350.30
80.00	40.77	422.30
100.00	56.77	462.30
140.00	87.51	554.90
160.00	104	590.00

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.997



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	30.00
Adsorption Coefficient (A)	130.15
Adsorption Exponent (B)	0.3143
Desorption Exponent	0.2986

DRAFT

Representative Soil 2: 50-60cm

1. Colwell P

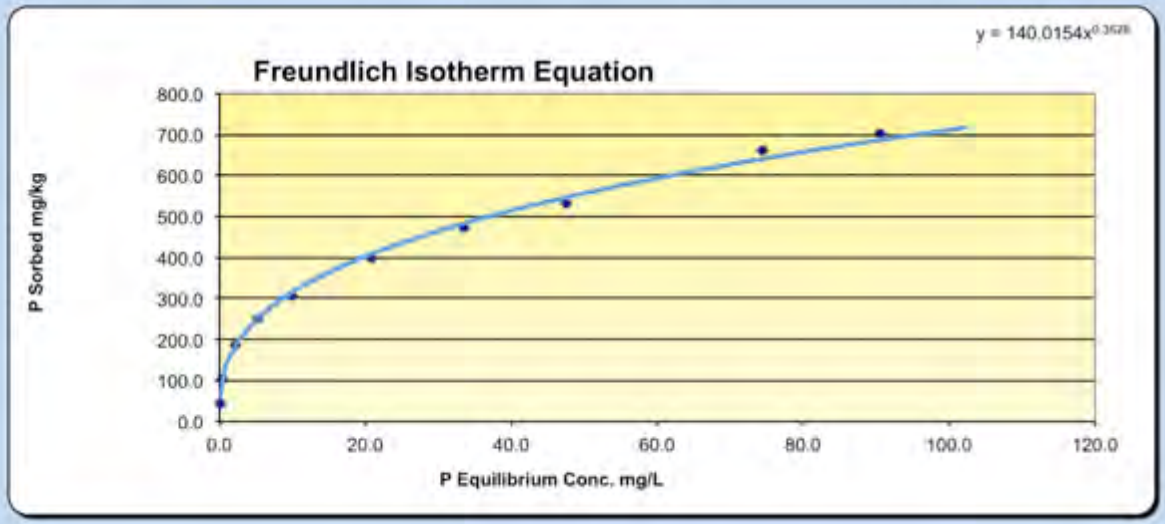
Colwell P mg/kg
6.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.05645	45.44
10.00	0.2673	103.33
20.00	2.121	184.79
30.00	5.431	251.69
40.00	9.985	306.15
60.00	20.74	398.60
80.00	33.45	471.50
100.00	47.5	531.00
140.00	74.38	662.20
160.00	90.49	701.10

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9937



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	6.00
Adsorption Coefficient (A)	140.02
Adsorption Exponent (B)	0.3528
Desorption Exponent	0.3352

DRAFT

Representative Soil 3: 0-10cm

1. Colwell P

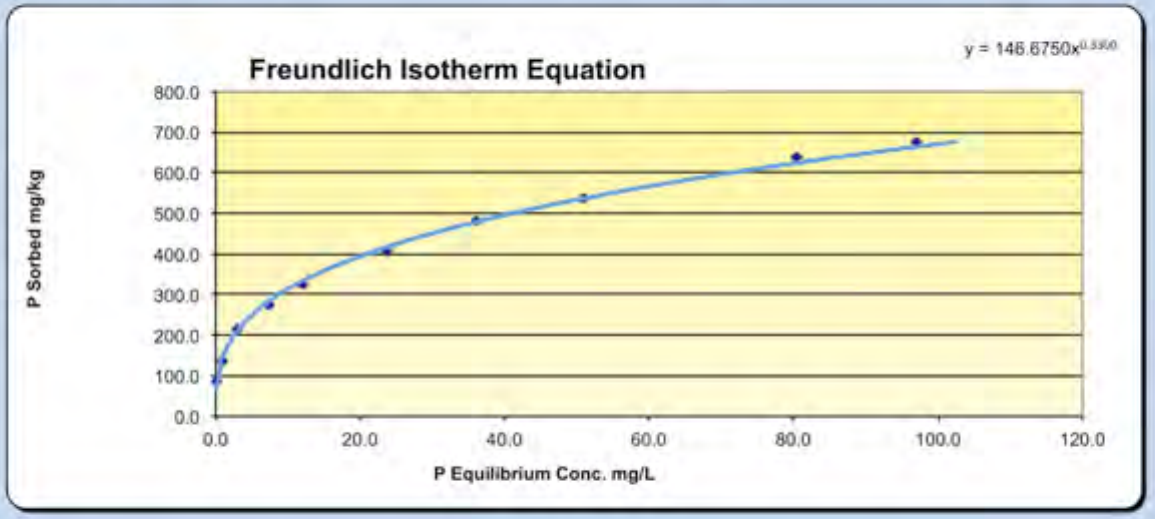
Colwell P mg/kg
45.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.174	83.26
10.00	0.7878	137.12
20.00	3.052	214.48
30.00	7.277	272.23
40.00	11.97	325.30
60.00	23.77	407.30
80.00	36.14	483.60
100.00	50.93	535.70
140.00	80.5	640.00
160.00	96.96	675.40

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9991



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	45.00
Adsorption Coefficient (A)	146.67
Adsorption Exponent (B)	0.3300
Desorption Exponent	0.3135

DR

Representative Soil 3: 30-40cm

1. Colwell P

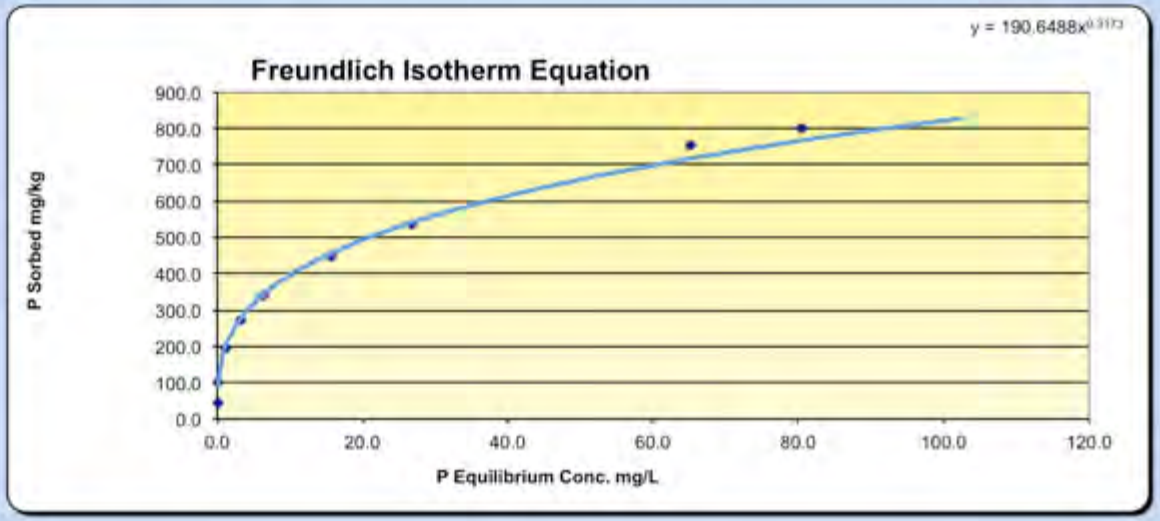
Colwell P mg/kg
4.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.007741	43.92
10.00	0.1752	102.25
20.00	1.13	192.70
30.00	3.257	271.43
40.00	6.438	339.62
60.00	15.67	447.30
80.00	26.79	536.10
140.00	65.18	752.20
160.00	80.47	799.30

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9978



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	4.00
Adsorption Coefficient (A)	190.65
Adsorption Exponent (B)	0.3173
Desorption Exponent	0.3014

DR

Representative Soil 3: 50-60cm

1. Colwell P

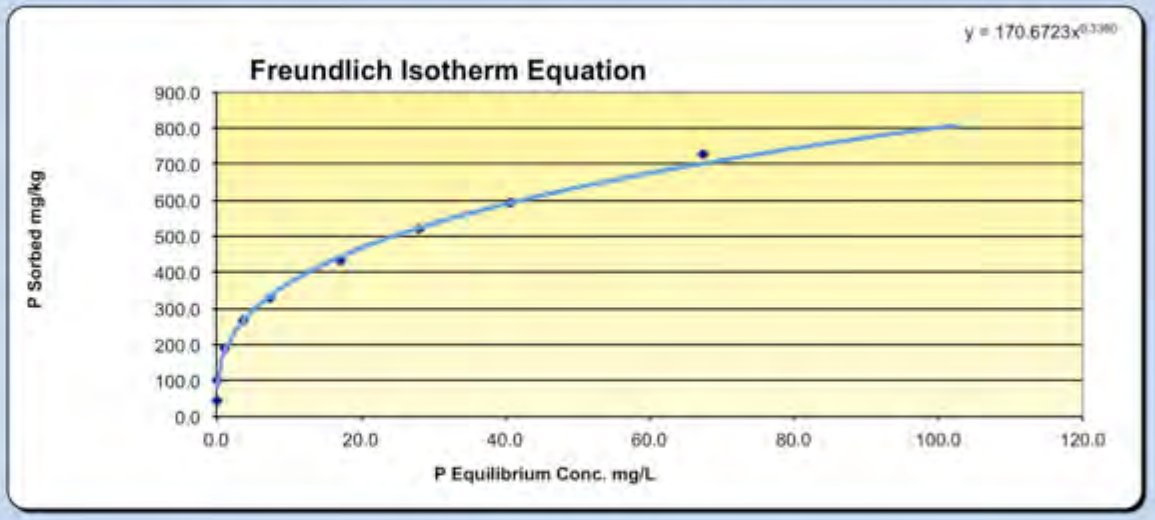
Colwell P mg/kg
3.00

2. Isotherm Data - Blank rows allowed at bottom of table only. You must have at least three rows of data in the table for the calculations be valid.

Solution:Soil ratio (mL/g): 10.00

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
4.00	0.01587	42.84
10.00	0.2181	100.82
20.00	1.258	190.42
30.00	3.82	264.80
40.00	7.497	328.03
60.00	17.22	430.80
80.00	28.08	522.20
100.00	40.82	594.80
140.00	67.41	728.90

MEDLI's isotherm equation $Y=AX^B$ is shown as the orange line on the graph
with an R-Square value of 0.9994



3. MEDLI Parameters for $Y = AX^B$

Initial Soil Phosphorus (mg/kg)	3.00
Adsorption Coefficient (A)	170.67
Adsorption Exponent (B)	0.3360
Desorption Exponent	0.3192

DR

6.8. Protected Matters – MNES Report

Please note: Printed copies of this document should be verified for currency against online version.

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 17-Jul-2025

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	49
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	22
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	6
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity	Buffer Status
Moreton bay	50 - 100km upstream from Ramsar site	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	Community may occur within area	In feature area
Grey box-grey gum wet forest of subtropical eastern Australia	Endangered	Community may occur within area	In feature area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area	In feature area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community may occur within area	In feature area
Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions	Endangered	Community likely to occur within area	In feature area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia			
Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat known to occur within area	In feature area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat known to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In feature area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Lathamus discolor](#) Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
[Rostratula australis](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In feature area
[Stagonopleura guttata](#) Diamond Firetail [59398]	Vulnerable	Species or species habitat may occur within area	In feature area
[Tringa nebularia](#) Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area
[Turnix melanogaster](#) Black-breasted Button-quail [923]	Vulnerable	Species or species habitat likely to occur within area	In feature area
MAMMAL			
[Chalinolobus dwyeri](#) Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat may occur within area	In feature area
[Dasyurus hallucatus](#) Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat may occur within area	In feature area
[Dasyurus maculatus maculatus (SE mainland population)](#) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area	In feature area
[Macroderma gigas](#) Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area	In feature area
[Nyctophilus corbeni](#) Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Petauroides volans](#) Greater Glider (southern and central) [254]	Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Petaurus australis australis](#)			
Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Petrogale penicillata](#)			
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)](#)			
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area	In feature area
[Potorous tridactylus tridactylus](#)			
Long-nosed Potoroo (northern) [66645]	Vulnerable	Species or species habitat may occur within area	In feature area
[Pteropus poliocephalus](#)			
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
PLANT			
[Arthraxon hispidus](#)			
Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area	In feature area
[Bulbophyllum globuliforme](#)			
Miniature Moss-orchid, Hoop Pine Orchid [6649]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
[Cadellia pentastylis](#)			
Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Coleus omissus listed as Plectranthus omissus](#)			
[91381]	Endangered	Species or species habitat may occur within area	In feature area
[Dichanthium setosum](#)			
bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Eucalyptus taurina](#)			
Helidon Ironbark [64255]	Endangered	Species or species habitat likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Grevillea quadricauda [64651]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat likely to occur within area	In feature area
Leuzea australis listed as Rhaponticum australe Austral Cornflower, Native Thistle [9363]	Vulnerable	Species or species habitat known to occur within area	In feature area
Macadamia integrifolia Macadamia Nut, Queensland Nut Tree, Smooth-shelled Macadamia, Bush Nut, Nut Oak [7326]	Vulnerable	Species or species habitat may occur within area	In feature area
Notelaea lloydii Lloyd's Olive [15002]	Vulnerable	Species or species habitat may occur within area	In feature area
Paspalidium grandispiculatum a grass [10838]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Phebalium distans Mt Berryman Phebalium [81869]	Endangered	Species or species habitat likely to occur within area	In feature area
Picris evae Hawkweed [10839]	Vulnerable	Species or species habitat may occur within area	In feature area
Samadera bidwillii Quassia [29708]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Sarcochilus weinthalii Blotched Sarcochilus, Weinthals Sarcanth [12673]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area	In feature area
REPTILE			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Anomalopus mackayi			
Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat may occur within area	In feature area
Delma torquata			
Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Furina dunmalli			
Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area	In feature area
Hemiaspis damelii			
Grey Snake [1179]	Endangered	Species or species habitat likely to occur within area	In feature area

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Cuculus optatus			
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Hirundapus caudacutus			
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat known to occur within area	In feature area
[Tringa nebularia](#) Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
[Anseranas semipalmata](#) Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In feature area
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Bubulcus ibis as Ardea ibis](#) Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
[Chalcites osculans as Chrysococcyx osculans](#) Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In feature area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
[Hirundapus caudacutus](#) White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
[Lathamus discolor](#) Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
[Merops ornatus](#) Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
[Monarcha melanopsis](#) Black-faced Monarch [609]		Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In feature area
Pterodroma cervicalis White-necked Petrel [59642]		Species or species habitat may occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat may occur within area overfly marine area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area

Extra Information

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Inland Rail Gowrie to Helidon Project, Qld	2017/7882	Controlled Action	Assessment Approach	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Inland Rail Helidon to Calvert, Qld	2017/7883	Controlled Action	Assessment Approach	In buffer area only
Toowoomba Bypass Highway Corridor	2003/1143	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Inland Rail Gowrie to Kagaru Geotechnical Project, QLD	2018/8263	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
Construction & Operation 275/330kV Transmission Line	2006/2820	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Bioregional Assessments			[Resource Information]
SubRegion	BioRegion	Website	Buffer Status
Clarence-Moreton	Clarence-Moreton	BA website	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
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-Tasmanian Herbarium
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-Australian Government, Department of Defence
Forestry Corporation, NSW
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-CSIRO
-Australian Tropical Herbarium, Cairns
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-Museum and Art Gallery of the Northern Territory
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-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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6.9. Wildlife Online Search

Please note: Printed copies of this document should be verified for currency against online version.

WN Taxon ID	Kingdom	Class	Family	Scientific name	Common name	NCA status	EPBC status	Superseded	Conservation significant	Establishment	Sensitive species	Area survey lists	Sighting records	Specimen records	Sighting summary
35081	Animalia	Insecta	Aeshnidae	Anax papuensis	Australian Emperor			No	No	QAI	No		4	0	4
35111	Animalia	Insecta	Coenagrionidae	Ischnura aurora	aurora bluetail			No	No	QAI	No		2	0	2
35112	Animalia	Insecta	Coenagrionidae	Ischnura heterosticta heterosticta	common bluetail			No	No	QAI	No		4	0	4
35114	Animalia	Insecta	Coenagrionidae	Pseudagrion aureofrons	gold-fronted riverdamsel			No	No	QA	No		10	0	10
35116	Animalia	Insecta	Coenagrionidae	Pseudagrion ignifer	flame-headed riverdamsel			No	No	QA	No		2	0	2
35119	Animalia	Insecta	Coenagrionidae	Pseudagrion microcephalum	blue riverdamsel			No	No	QAI	No		1	0	1
35121	Animalia	Insecta	Coenagrionidae	Xanthagrion erythroneurum	red & blue damsel			No	No	QAI	No		1	0	1
35124	Animalia	Insecta	Corduliidae	Hemicordulia australiae	Australian emerald			No	No	QAI	No		3	0	3
35128	Animalia	Insecta	Corduliidae	Hemicordulia superba	superb emerald			No	No	QA	No		4	0	4
35144	Animalia	Insecta	Gomphidae	Austrogomphus amphiclitus	pale hunter			No	No	QA	No		4	0	4
35148	Animalia	Insecta	Gomphidae	Austrogomphus cornutus	unicorn hunter			No	No	QA	No		3	0	3
35153	Animalia	Insecta	Gomphidae	Austrogomphus ochraceus	jade hunter			No	No	QA	No		2	0	2
35159	Animalia	Insecta	Gomphidae	Hemigomphus heteroclytus	stout vicetail			No	No	QA	No		1	0	1
20022	Animalia	Insecta	Hesperiidae	Suniana sunias				No	No	QAI	No		1	0	1
35198	Animalia	Insecta	Libellulidae	Crocothemis nigrifrons	black-headed skimmer			No	No	QAI	No		9	0	9
35199	Animalia	Insecta	Libellulidae	Diplacodes bipunctata	wandering percher			No	No	QAI	No		1	0	1
35200	Animalia	Insecta	Libellulidae	Diplacodes haematodes	scarlet percher			No	No	QAI	No		11	0	11
35204	Animalia	Insecta	Libellulidae	Hydrobasileus brevistylus	water prince			No	No	QAI	No		1	0	1
35219	Animalia	Insecta	Libellulidae	Orthetrum caledonicum	blue skimmer			No	No	QAI	No		12	0	12
35223	Animalia	Insecta	Libellulidae	Orthetrum villosovittatum	fiery skimmer			No	No	QAI	No		4	0	4
35229	Animalia	Insecta	Libellulidae	Rhyothemis graphiptera	graphic flutterer			No	No	QAI	No		6	0	6
35237	Animalia	Insecta	Libellulidae	Tramea loewii	common glider			No	No	QAI	No		3	0	3
35244	Animalia	Insecta	Lindeniidae	Ictinogomphus australis	Australian tiger			No	No	QA	No		2	0	2
35252	Animalia	Insecta	Megapodagrionidae	Austroargiolestes icteromelas icteromelas	pale-mouth common flatwing			No	No	QA	No		1	0	1
19147	Animalia	Insecta	Nymphalidae	Charaxes sempronius sempronius	tailed emperor			No	No	QA	No		1	0	1
19177	Animalia	Insecta	Nymphalidae	Danaus plexippus	monarch			No	No	II	No		2	0	2
19172	Animalia	Insecta	Nymphalidae	Junonia villida villida	meadow argus			No	No	QAI	No		1	0	1
19176	Animalia	Insecta	Nymphalidae	Tirumala hamata hamata	blue tiger			No	No	QAI	No		1	0	1
19068	Animalia	Insecta	Papilionidae	Papilio aegeus aegeus	orchard swallowtail (Australian subspecies)			No	No	QA	No		1	0	1
19110	Animalia	Insecta	Pieridae	Belenois java teutonia	caper white			No	No	QAI	No		1	0	1
19098	Animalia	Insecta	Pieridae	Delias argenthona argenthona	scarlet jezebel			No	No	QA	No		1	0	1
19118	Animalia	Insecta	Pieridae	Pieris rapae	cabbage white			No	No	II	No		1	0	1
35264	Animalia	Insecta	Platycnemididae	Nososcticta solida	orange threadtail			No	No	QA	No		8	0	8
35287	Animalia	Insecta	Synthemistidae	Parasynthemis regina	royal tigertail			No	No	QA	No		1	0	1
26896	Animalia	Actinopterygii	Ambassidae	Ambassis agassizii	Agassiz's glassfish			No	No	QA	No		9	0	9
26910	Animalia	Actinopterygii	Anguillidae	Anguilla reinhardtii	longfin eel			No	No	QAI	No		14	0	14
26920	Animalia	Actinopterygii	Atherinidae	Craterocephalus stercusmuscarum	flyspecked hardyhead			No	No	QA	No		13	0	13
19545	Animalia	Actinopterygii	Cyprinidae	Carassius auratus	goldfish			No	No	II	No		5	0	5
26955	Animalia	Actinopterygii	Eleotridae	Hypseleotris galii	firetail gudgeon			No	No	QA	No		14	0	14
26956	Animalia	Actinopterygii	Eleotridae	Hypseleotris klunzingeri	western carp gudgeon			No	No	QA	No		16	0	16
18168	Animalia	Actinopterygii	Eleotridae	Mogurnda adspersa	southern purplespotted gudgeon			No	No	QA	No		6	0	6
26968	Animalia	Actinopterygii	Eleotridae	Philypnodon grandiceps	flathead gudgeon			No	No	QA	No		6	0	6
26969	Animalia	Actinopterygii	Eleotridae	Philypnodon macrostomus	dwarf flathead gudgeon			No	No	QA	No		3	0	3
27024	Animalia	Actinopterygii	Melanotaeniidae	Melanotaenia duboulayi	crimsonspotted rainbowfish			No	No	QA	No		23	0	23
27054	Animalia	Actinopterygii	Plotosidae	Tandanus tandanus	freshwater catfish			No	No	QA	No		21	0	21
27055	Animalia	Actinopterygii	Poeciliidae	Gambusia holbrooki	mosquitofish			No	No	II	No		26	0	26
27061	Animalia	Actinopterygii	Retropinnidae	Retropinna semoni	Australian smelt			No	No	QA	No		13	0	13
27083	Animalia	Actinopterygii	Terapontidae	Amniataba percoides	barred grunter			No	No	QA	No		2	0	2
27089	Animalia	Actinopterygii	Terapontidae	Leiopotherapon unicolor	spangled perch			No	No	QA	No		19	0	19
716	Animalia	Amphibia	Bufonidae	Rhinella marina	cane toad			No	No	II	No		1	0	1
608	Animalia	Amphibia	Hylidae	Litoria fallax	eastern sedgefrog	C		No	No	QA	No		1	0	1
611	Animalia	Amphibia	Hylidae	Litoria gracilenta	graceful treefrog	C		No	No	QA	No		1	0	1
1419	Animalia	Aves	Acanthizidae	Acanthiza chrysorrhoa	yellow-rumped thornbill	C		No	No	QA	No		17	0	17
1422	Animalia	Aves	Acanthizidae	Acanthiza nana	yellow thornbill	C		No	No	QA	No		1	0	1
1423	Animalia	Aves	Acanthizidae	Acanthiza pusilla	brown thornbill	C		No	No	QA	No		1	0	1
1425	Animalia	Aves	Acanthizidae	Acanthiza reguloides	buff-rumped thornbill	C		No	No	QA	No		2	0	2
1407	Animalia	Aves	Acanthizidae	Gerygone fusca	western gerygone	C		No	No	QA	No		2	0	2
1396	Animalia	Aves	Acanthizidae	Gerygone olivacea	white-throated gerygone	C		No	No	QAI	No		6	0	6
1403	Animalia	Aves	Acanthizidae	Pyrrholaemus sagittatus	speckled warbler	C		No	No	QA	No		5	0	5
1382	Animalia	Aves	Acanthizidae	Sericornis frontalis	white-browed scrubwren	C		No	No	QA	No		7	0	7
1371	Animalia	Aves	Acanthizidae	Smicrornis brevirostris	weebill	C		No	No	QA	No		2	0	2
1742	Animalia	Aves	Accipitridae	Accipiter cirrocephalus	collared sparrowhawk	C		No	No	QAI	No		2	0	2
1729	Animalia	Aves	Accipitridae	Accipiter fasciatus	brown goshawk	C		No	No	QAI	No		3	0	3
1730	Animalia	Aves	Accipitridae	Accipiter novaehollandiae	grey goshawk	C		No	No	QAI	No		1	1	1
1732	Animalia	Aves	Accipitridae	Aquila audax	wedge-tailed eagle	C		No	No	QAI	No		6	0	6
1721	Animalia	Aves	Accipitridae	Aviceda subcristata	Pacific baza	C		No	No	QAI	No		4	0	4
1722	Animalia	Aves	Accipitridae	Circus approximans	swamp harrier	C		No	No	QAI	No		2	0	2
1723	Animalia	Aves	Accipitridae	Circus assimilis	spotted harrier	C		No	No	QA	No		1	0	1
1725	Animalia	Aves	Accipitridae	Elanus axillaris	black-shouldered kite	C		No	No	QAI	No		9	0	9
1728	Animalia	Aves	Accipitridae	Erythrotriorchis radiatus	red goshawk	E	E	No	Yes	QA	No		1	0	1
1718	Animalia	Aves	Accipitridae	Haliaeetus leucogaster	white-bellied sea-eagle	C		No	No	QAI	No		1	0	1
1707	Animalia	Aves	Accipitridae	Haliastur sphenurus	whistling kite	C		No	No	QAI	No		4	0	4
1710	Animalia	Aves	Accipitridae	Hieraaetus morphnoides	little eagle	C		No	No	QAI	No		2	0	2
1712	Animalia	Aves	Accipitridae	Lophoictinia isura	square-tailed kite	C		No	No	QA	No		2	0	2
1714	Animalia	Aves	Accipitridae	Milvus migrans	black kite	C		No	No	QAI	No		3	0	3
1305	Animalia	Aves	Acrocephalidae	Acrocephalus australis	Australian reed-warbler	C		No	No	QAI	No		17	0	17
1973	Animalia	Aves	Aegothelidae	Aegotheles cristatus	Australian owlet-nightjar	C		No	No	QAI	No		1	0	1
1652	Animalia	Aves	Alaudidae	Mirafra javanica	Horsfield's bushlark	C		No	No	QAI	No		2	0	2
1776	Animalia	Aves	Alcedinidae	Ceyx azureus	azure kingfisher	C		No	No	QAI	No		26	0	26
1767	Animalia	Aves	Alcedinidae	Dacelo novaeguineae	laughing kookaburra	C		No	No	QA	No		13	0	13
1760	Animalia	Aves	Alcedinidae	Todiramphus macleayii	forest kingfisher	C		No	No	QAI	No		1	0	1
1762	Animalia	Aves	Alcedinidae	Todiramphus sanctus	sacred kingfisher	C		No	No	QAI	No		12	0	12
1992	Animalia	Aves	Anatidae	Anas castanea	chestnut teal	C		No	No	QA	No		1	0	1
1993	Animalia	Aves	Anatidae	Anas gracilis	grey teal	C		No	No	QAI	No		8	0	8
1998	Animalia	Aves	Anatidae	Anas superciliosa	Pacific black duck	C		No	No	QAI	No		26	0	26
1999	Animalia	Aves	Anatidae	Aythya australis	hardhead	C		No	No	QAI	No		5	0	5
2003	Animalia	Aves	Anatidae	Chenonetta jubata	Australian wood duck	C		No	No	QA	No		12	0	12
1977	Animalia	Aves	Anatidae	Dendrocygna arcuata	wandering whistling-duck	C		No	No	QAI	No		1	0	1
1978	Animalia	Aves	Anatidae	Dendrocygna eytoni	plumed whistling-duck	C		No	No	QA	No		7	0	7
1980	Animalia	Aves	Anatidae	Malacorhynchus membranaceus	pink-eared duck	C		No	No	QA	No		1	0	1
1985	Animalia	Aves	Anatidae	Oxyura australis	blue-billed duck	C		No	No	QA	No		2	0	2
1996	Animalia	Aves	Anatidae	Spatula rhynchotis	Australasian shoveler	C		No	No	QAI	No		1	0	1
1279	Animalia	Aves	Anhingidae	Anhinga novaehollandiae	Australasian darter	C		No	No	QAI	No		2	0	2
1971	Animalia	Aves	Apodidae	Hirundapus caudacutus	white-throated needletail	V	V	No	Yes	QAI	No		2	0	2
1829	Animalia	Aves	Ardeidae	Ardea alba modesta	eastern great egret	C		No	No	QAI	No		3	0	3
1832	Animalia	Aves	Ardeidae	Ardea pacifica	white-necked heron	C		No	No	QA	No		1	0	1
1830	Animalia	Aves	Ardeidae	Bubulcus ibis	cattle egret	C		No	No	QAI	No		16	0	16
1840	Animalia	Aves	Ardeidae	Egretta garzetta	little egret	C		No	No	QAI	No		1	0	1
1826	Animalia	Aves	Ardeidae	Egretta novaehollandiae	white-faced heron	C		No	No	QAI	No		14	0	14
1818	Animalia	Aves	Ardeidae	Nycticorax caledonicus	nankeen night-heron	C		No	No	QAI	No		4	0	4
1660	Animalia	Aves	Artamidae	Artamus leucorynchus	white-breasted woodswallow	C		No	No	QA	No		4	0	4
1647	Animalia	Aves	Artamidae	Artamus personatus	masked woodswallow	C		No	No	QA	No		7	0	7
1649	Animalia	Aves	Artamidae	Artamus superciliosus	white-browed woodswallow	C		No	No	QA	No		4	0	4
1654	Animalia	Aves	Artamidae	Cracticus nigrogularis	pied butcherbird	C		No	No	QA	No		26	0	26
1656	Animalia	Aves	Artamidae	Cracticus torquatus	grey butcherbird	C		No	No	QA	No		6	0	6
1644	Animalia	Aves	Artamidae	Gymnorhina tibicen	Australian magpie	C		No	No	QAI	No		34	0	34
1645	Animalia	Aves	Artamidae	Strepera graculina	pied currawong	C		No	No	QA	No		6	0	6
1191	Animalia	Aves	Cacatuidae	Cacatua galerita	sulphur-crested cockatoo	C		No	No	QAI	No		4	0	4
1194	Animalia	Aves	Cacatuidae	Cacatua sanguinea	little corella	C		No	No	QAI	No		2	0	2
1196	Animalia	Aves	Cacatuidae	Calyptorhynchus banksii	red-tailed black-cockatoo	C		No	No	QA	No		2	0	2
1171	Animalia	Aves	Cacatuidae	Calyptorhynchus lathami	glossy black-cockatoo	V		No	Yes	QA	No		1	0	1
22494	Animalia	Aves	Cacatuidae	Calyptorhynchus lathami lathami	glossy black-cockatoo (eastern)	V	V	No	Yes	QA	No		5	0	5
1193	Animalia	Aves	Cacatuidae	Eolophus roseicapilla	galah	C		No	No	QA	No		15	0	15
1173	Animalia	Aves	Cacatuidae	Nymphicus hollandicus	cockatiel	C		No	No	QA	No		12	0	12
1185	Animalia	Aves	Cacatuidae	Zanda funerea	yellow-tailed black-cockatoo	C		No	No	QA	No		1	0	1
1634	Animalia	Aves	Campephagidae	Coracina lineata	barred cuckoo-shrike	C		No	No	QA	No		1	0	1
1635	Animalia	Aves	Campephagidae	Coracina maxima	ground cuckoo-shrike	C		No	No	QA	No		1	0	1
1636	Animalia	Aves	Campephagidae	Coracina novaehollandiae	black-faced cuckoo-shrike	C		No	No	QAI	No		30	0	30
1640	Animalia	Aves	Campephagidae	Lalage leucomela	varied triller	C		No	No	QAI	No		1	0	1
1642	Animalia	Aves	Campephagidae	Lalage tricolor	white-winged triller	C		No	No	QAI	No		11	0	11
1940	Animalia	Aves	Charadriidae	Elseyornis melanops	black-fronted dotterel	C		No	No	QAI	No		12	0	12
1933	Animalia	Aves	Charadriidae	Vanellus miles novaehollandiae	masked lapwing (southern subspecies)	C		No	No	QAI	No		23	0	23
18143	Animalia	Aves	Charadriidae	Vanellus tricolor	banded lapwing	C		No	No	QA	No		3	0	3
1294	Animalia	Aves	Cisticolidae	Cisticola exilis	golden-headed cisticola	C		No	No	QAI	No		33	0	33
1617	Animalia	Aves	Climacteridae	Cormobates leucophaea	white-throated treecreeper	C		No	No	QA	No		1	0	1
18293	Animalia	Aves	Climacteridae	Cormobates leucophaea metastasis	white-throated treecreeper (southern)	C		No	No	QA	No		1	0	1
1804	Animalia	Aves	Columbidae	Columba livia	rock dove			No	No	II	No		9	0	9
1809	Animalia	Aves	Columbidae	Geopelia cuneata	diamond dove	C		No	No	QA	No		1	0	1
1810	Animalia	Aves	Columbidae	Geopelia humeralis	bar-shouldered dove	C		No	No	QAI	No		21	0	21
18323	Animalia	Aves	Columbidae	Geopelia placida	peaceful dove	C		No	No	QAI	No		11	0	11
1793	Animalia	Aves	Columbidae	Ocyphaps lophotes	crested pigeon	C		No	No	QA	No		38	0	38
1795	Animalia	Aves	Columbidae	Phaps chalcoptera	common bronzewing	C		No	No	QA	No		2	0	2
1774	Animalia	Aves	Columbidae	Spilopelia chinensis	spotted dove			No	No	II	No		7	0	7
1779	Animalia	Aves	Coraciidae	Eurystomus orientalis	dollarbird	C		No	No	QAI	No		4	0	4
1609	Animalia	Aves	Corvidae	Corvus orru	Torresian crow	C		No	No	QAI	No		52	0	52
1610	Animalia	Aves	Corvidae	Corvus sp.		C		No	No	U	No		1	0	1
1754	Animalia	Aves	Cuculidae	Cacomantis flabelliformis	fan-tailed cuckoo	C		No	No	QAI	No		1	0	1
1750	Animalia	Aves	Cuculidae	Cacomantis pallidus	pallid cuckoo	C		No	No	QAI	No		4	0	4
1743	Animalia	Aves	Cuculidae	Cacomantis variolosus	brush cuckoo	C		No	No	QAI	No		2	0	2
1751	Animalia	Aves	Cuculidae	Centropus phasianinus	pheasant coucal	C		No	No	QA	No		8	0	8
1744	Animalia	Aves	Cuculidae	Chalcites basalis	Horsfield's bronze-cuckoo	C		No	No	QAI	No		1	0	1
1745	Animalia	Aves	Cuculidae	Chalcites lucidus	shining bronze-cuckoo	C		No	No	QAI	No		2	0	2
1756	Animalia	Aves	Cuculidae	Chalcites minutillus barnardi	Eastern little bronze-cuckoo	C		No	No	QAI	No		1	0	1
1747	Animalia	Aves	Cuculidae	Chalcites osculans	black-eared cuckoo	C		No	No	QAI	No		3	0	3
1736	Animalia	Aves	Cuculidae	Cuculus optatus	oriental cuckoo	SL		No	Yes	QAI	No		1	0	1
1738	Animalia	Aves	Cuculidae	Eudynamys orientalis	eastern koel	C		No	No	QAI	No		4	0	4
1740	Animalia	Aves	Cuculidae	Scythrops novaehollandiae	channel-billed cuckoo	C		No	No	QAI	No		6	0	6
1611	Animalia	Aves	Dicaeidae	Dicaeum hirundinaceum	mistletoebird	C		No	No	QAI	No		19	0	19
1601	Animalia	Aves	Dicruridae	Dicrurus bracteatus	spangled drongo	C		No	No	QAI	No		4	0	4
22469	Animalia	Aves	Dicruridae	Dicrurus bracteatus bracteatus	spangled drongo (eastern Australia)	C		No	No	QAI	No		1	0	1
1366	Animalia	Aves	Estrildidae	Lonchura castaneothorax	chestnut-breasted mannikin	C		No	No	QAI	No		31	0	31
1369	Animalia	Aves	Estrildidae	Neochmia modesta	plum-headed finch	C		No	No	QA	No		25	0	25
1359	Animalia	Aves	Estrildidae	Neochmia temporalis	red-browed finch	C		No	No	QA	No		6	0	6
1342	Animalia	Aves	Estrildidae	Taeniopygia bichenovii	double-barred finch	C		No	No	QA	No		44	0	44
1343	Animalia	Aves	Estrildidae	Taeniopygia guttata	zebra finch	C		No	No	QA	No		20	0	20
1962	Animalia	Aves	Eurostopodidae	Eurostopodus argus	spotted nightjar	C		No	No	QA	No		1	0	1
1949	Animalia	Aves	Eurostopodidae	Eurostopodus mystacalis	white-throated nightjar	C		No	No	QAI	No		1	0	1
1716	Animalia	Aves	Falconidae	Falco berigora	brown falcon	C		No	No	QAI	No		10	0	10
1704	Animalia	Aves	Falconidae	Falco cenchroides	nankeen kestrel	C		No	No	QAI	No		13	0	13

1691	Animalia	Aves	Falconidae	Falco longipennis	Australian hobby	C		No	No	QAI	No	4	0	4
1692	Animalia	Aves	Falconidae	Falco peregrinus macropus	Australian peregrine falcon	C		No	No	QA	No	4	0	4
1693	Animalia	Aves	Falconidae	Falco subniger	black falcon	C		No	No	QA	No	2	0	2
1583	Animalia	Aves	Hirundinidae	Cheramoeca leucosterna	white-backed swallow	C		No	No	QA	No	20	0	20
1572	Animalia	Aves	Hirundinidae	Hirundo neoxena	welcome swallow	C		No	No	QAI	No	22	0	22
1585	Animalia	Aves	Hirundinidae	Petrochelidon ariel	fairy martin	C		No	No	QA	No	16	0	16
1573	Animalia	Aves	Hirundinidae	Petrochelidon nigricans	tree martin	C		No	No	QAI	No	4	0	4
1291	Animalia	Aves	Locustellidae	Cincloramphus cruralis	brown songlark	C		No	No	QA	No	2	0	2
1292	Animalia	Aves	Locustellidae	Cincloramphus mathewsi	rufous songlark	C		No	No	QA	No	11	0	11
1289	Animalia	Aves	Locustellidae	Cincloramphus timoriensis	tawny grassbird	C		No	No	QAI	No	12	0	12
1287	Animalia	Aves	Locustellidae	Poodytes gramineus	little grassbird	C		No	No	QAI	No	1	0	1
1570	Animalia	Aves	Maluridae	Malurus cyaneus	superb fairy-wren	C		No	No	QA	No	27	0	27
18458	Animalia	Aves	Maluridae	Malurus lamberti	variegated fairy-wren	C		No	No	QA	No	5	0	5
1558	Animalia	Aves	Maluridae	Malurus melanocephalus	red-backed fairy-wren	C		No	No	QA	No	15	0	15
1694	Animalia	Aves	Megapodiidae	Alectura lathami	Australian brush-turkey	C		No	No	QA	No	1	0	1
1523	Animalia	Aves	Meliphagidae	Caligavis chrysops	yellow-faced honeyeater	C		No	No	QA	No	1	0	1
1539	Animalia	Aves	Meliphagidae	Entomyzon cyanotis	blue-faced honeyeater	C		No	No	QAI	No	4	0	4
1497	Animalia	Aves	Meliphagidae	Lichmera indistincta	brown honeyeater	C		No	No	QA	No	28	0	28
1500	Animalia	Aves	Meliphagidae	Manorina melanocephala	noisy miner	C		No	No	QA	No	6	0	6
1504	Animalia	Aves	Meliphagidae	Meliphaga lewinii	Lewin's honeyeater	C		No	No	QA	No	5	0	5
1507	Animalia	Aves	Meliphagidae	Melithreptus albogularis	white-throated honeyeater	C		No	No	QAI	No	4	0	4
1483	Animalia	Aves	Meliphagidae	Melithreptus gularis	black-chinned honeyeater	C		No	No	QA	No	1	0	1
1489	Animalia	Aves	Meliphagidae	Myzomela sanguinolenta	scarlet honeyeater	C		No	No	QA	No	12	0	12
1493	Animalia	Aves	Meliphagidae	Philemon citreogularis	little friarbird	C		No	No	QAI	No	11	0	11
1494	Animalia	Aves	Meliphagidae	Philemon corniculatus	noisy friarbird	C		No	No	QAI	No	8	0	8
1471	Animalia	Aves	Meliphagidae	Plectorhyncha lanceolata	striped honeyeater	C		No	No	QA	No	24	0	24
1513	Animalia	Aves	Meliphagidae	Ptilotula fusca	fuscous honeyeater	C		No	No	QA	No	1	0	1
1546	Animalia	Aves	Meliphagidae	Sugomel nigrum	black honeyeater	C		No	No	QA	No	6	0	6
1764	Animalia	Aves	Meropidae	Merops ornatus	rainbow bee-eater	C		No	No	QAI	No	31	0	31
1589	Animalia	Aves	Monarchidae	Grallina cyanoleuca	magpie-lark	C		No	No	QAI	No	35	0	35
1600	Animalia	Aves	Monarchidae	Myiagra inquieta	restless flycatcher	C		No	No	QA	No	1	0	1
1586	Animalia	Aves	Monarchidae	Myiagra rubecula	leaden flycatcher	C		No	No	QAI	No	1	0	1
1455	Animalia	Aves	Motacillidae	Anthus novaeseelandiae	Australasian pipit	C		No	No	QAI	No	6	0	6
1442	Animalia	Aves	Oriolidae	Oriolus sagittatus	olive-backed oriole	C		No	No	QAI	No	8	0	8
1444	Animalia	Aves	Oriolidae	Sphecotheres vieilloti	Australasian figbird	C		No	No	QAI	No	8	0	8
1449	Animalia	Aves	Pachycephalidae	Colluricincla harmonica	grey shrike-thrush	C		No	No	QAI	No	2	0	2
1436	Animalia	Aves	Pachycephalidae	Pachycephala pectoralis	golden whistler	C		No	No	QAI	No	1	0	1
1437	Animalia	Aves	Pachycephalidae	Pachycephala rufiventris	rufous whistler	C		No	No	QAI	No	7	0	7
1389	Animalia	Aves	Pardalotidae	Pardalotus punctatus	spotted pardalote	C		No	No	QA	No	2	0	2
1392	Animalia	Aves	Pardalotidae	Pardalotus striatus	striated pardalote	C		No	No	QA	No	26	0	26
1360	Animalia	Aves	Passeridae	Passer domesticus	house sparrow			No	No	II	No	14	0	14
1284	Animalia	Aves	Pelecanidae	Pelecanus conspicillatus	Australian pelican	C		No	No	QAI	No	3	0	3
1347	Animalia	Aves	Petroicidae	Eopsaltria australis	eastern yellow robin	C		No	No	QA	No	3	0	3
1329	Animalia	Aves	Petroicidae	Petroica goodenovii	red-capped robin	C		No	No	QA	No	1	0	1
1332	Animalia	Aves	Petroicidae	Petroica rosea	rose robin	C		No	No	QA	No	1	0	1
1261	Animalia	Aves	Phalacrocoracidae	Microcarbo melanoleucos	little pied cormorant	C		No	No	QAI	No	7	0	7
1263	Animalia	Aves	Phalacrocoracidae	Phalacrocorax sulcirostris	little black cormorant	C		No	No	QA	No	5	0	5
1264	Animalia	Aves	Phalacrocoracidae	Phalacrocorax varius	pied cormorant	C		No	No	QAI	No	3	0	3
1699	Animalia	Aves	Phasianidae	Coturnix pectoralis	stubble quail	C		No	No	QA	No	2	0	2
1687	Animalia	Aves	Phasianidae	Synoicus ypsilophorus	brown quail	C		No	No	QAI	No	7	0	7
1955	Animalia	Aves	Podargidae	Podargus strigoides	tawny frogmouth	C		No	No	QA	No	4	0	4
1249	Animalia	Aves	Podicipedidae	Tachybaptus novaehollandiae	Australasian grebe	C		No	No	QAI	No	14	0	14
1318	Animalia	Aves	Pomatostomidae	Pomatostomus temporalis	grey-crowned babbler	C		No	No	QAI	No	3	0	3
1180	Animalia	Aves	Psittaculidae	Alisterus scapularis	Australian king-parrot	C		No	No	QA	No	1	0	1
1182	Animalia	Aves	Psittaculidae	Aprosmictus erythropterus	red-winged parrot	C		No	No	QAI	No	1	0	1
1145	Animalia	Aves	Psittaculidae	Glossopsitta concinna	musk lorikeet	C		No	No	QA	No	1	0	1
1151	Animalia	Aves	Psittaculidae	Melopsittacus undulatus	budgerigar	C		No	No	QA	No	1	0	1
1147	Animalia	Aves	Psittaculidae	Parvipsitta pusilla	little lorikeet	C		No	No	QA	No	3	0	3
1136	Animalia	Aves	Psittaculidae	Platycercus adscitus	pale-headed rosella	C		No	No	QA	No	24	0	24
1124	Animalia	Aves	Psittaculidae	Trichoglossus chlorolepidotus	scaly-breasted lorikeet	C		No	No	QA	No	6	0	6
1125	Animalia	Aves	Psittaculidae	Trichoglossus moluccanus	rainbow lorikeet	C		No	No	QA	No	5	0	5
1623	Animalia	Aves	Psophodidae	Psophodes olivaceus	eastern whipbird	C		No	No	QA	No	5	0	5
1686	Animalia	Aves	Rallidae	Fulica atra	Eurasian coot	C		No	No	QAI	No	1	0	1
1673	Animalia	Aves	Rallidae	Gallinula tenebrosa	dusky moorhen	C		No	No	QAI	No	24	0	24
1675	Animalia	Aves	Rallidae	Gallirallus philippensis	buff-banded rail	C		No	No	QAI	No	7	0	7
1662	Animalia	Aves	Rallidae	Porphyrio melanotus	purple swamphen	C		No	No	QAI	No	6	0	6
1665	Animalia	Aves	Rallidae	Zapornia pusilla	Baillon's crake	C		No	No	QAI	No	1	0	1
1667	Animalia	Aves	Rallidae	Zapornia tabuensis	spotless crake	C		No	No	QAI	No	7	0	7
1893	Animalia	Aves	Recurvirostridae	Himantopus leucocephalus	pied stilt	C		No	No	QAI	No	11	0	11
1575	Animalia	Aves	Rhipiduridae	Rhipidura albiscapa	grey fantail	C		No	No	QAI	No	4	0	4
1576	Animalia	Aves	Rhipiduridae	Rhipidura leucophrys	willie wagtail	C		No	No	QAI	No	35	0	35
1883	Animalia	Aves	Rostratulidae	Rostratula australis	Australian painted-snipe	E	E	No	Yes	QA	No	1	0	1
1885	Animalia	Aves	Scolopacidae	Actitis hypoleucos	common sandpiper	SL		No	Yes	QAI	No	8	0	8
1855	Animalia	Aves	Scolopacidae	Limosa limosa	black-tailed godwit	E	E	No	Yes	QAI	No	1	0	1
1847	Animalia	Aves	Scolopacidae	Phalaropus lobatus	red-necked phalarope	SL		No	Yes	VU	No	2	0	2
1102	Animalia	Aves	Strigidae	Ninox boobook	southern boobook	C		No	No	QAI	No	4	0	4
1107	Animalia	Aves	Strigidae	Ninox strenua	powerful owl	V		No	Yes	QA	No	1	0	1
1314	Animalia	Aves	Sturnidae	Acridotheres tristis	common myna			No	No	II	No	19	0	19
1303	Animalia	Aves	Sturnidae	Sturnus vulgaris	common starling			No	No	II	No	18	0	18
1822	Animalia	Aves	Threskiornithidae	Platalea flavipes	yellow-billed spoonbill	C		No	No	QA	No	4	0	4
1812	Animalia	Aves	Threskiornithidae	Threskiornis molucca	Australian white ibis	C		No	No	QAI	No	4	0	4
1800	Animalia	Aves	Threskiornithidae	Threskiornis spinicollis	straw-necked ibis	C		No	No	QAI	No	13	0	13
1108	Animalia	Aves	Tytonidae	Tyto javanica	eastern barn owl	C		No	No	QAI	No	3	0	3
1096	Animalia	Aves	Tytonidae	Tyto novaehollandiae	masked owl	C		No	No	QAI	No	1	0	1
1276	Animalia	Aves	Zosteropidae	Zosterops lateralis	silvereye	C		No	No	QAI	No	22	0	22
1071	Animalia	Mammalia	Canidae	Vulpes vulpes	red fox			No	No	II	No	1	0	1
814	Animalia	Mammalia	Equidae	Equus caballus	horse			No	No	II	No	1	0	1
832	Animalia	Mammalia	Leporidae	Lepus europaeus	European brown hare			No	No	II	No	2	0	2
906	Animalia	Mammalia	Macropodidae	Macropus sp.		C		No	No	QA	No	1	0	1
904	Animalia	Mammalia	Macropodidae	Notamacropus rufogriseus	red-necked wallaby	C		No	No	QA	No	2	0	2
767	Animalia	Mammalia	Muridae	Hydromys chrysogaster	water rat	C		No	No	QAI	No	1	0	1
836	Animalia	Mammalia	Ornithorhynchidae	Ornithorhynchus anatinus	platypus	SL		No	Yes	QA	No	5	0	5
784	Animalia	Mammalia	Peramelidae	Isoodon macrourus	northern brown bandicoot	C		No	No	QAI	No	2	0	2
787	Animalia	Mammalia	Peramelidae	Perameles nasuta	long-nosed bandicoot	C		No	No	QA	No	1	0	1
879	Animalia	Mammalia	Petauridae	Petaurus norfolcensis	squirrel glider	C		No	No	QA	No	1	0	1
860	Animalia	Mammalia	Phascolarctidae	Phascolarctos cinereus	koala	E	E	No	Yes	QA	No	23	0	23
984	Animalia	Mammalia	Pteropodidae	Pteropus alecto	black flying-fox	C		No	No	QAI	No	1	0	1
962	Animalia	Mammalia	Pteropodidae	Pteropus poliocephalus	grey-headed flying-fox	C	V	No	Yes	QA	No	1	0	1
963	Animalia	Mammalia	Pteropodidae	Pteropus scapulatus	little red flying-fox	C		No	No	QAI	No	3	0	3
838	Animalia	Mammalia	Tachyglossidae	Tachyglossus aculeatus	short-beaked echidna	SL		No	Yes	QAI	No	2	0	2
554	Animalia	Reptilia	Agamidae	Intellagama lesueurii	eastern water dragon	C		No	No	QA	No	8	0	8
556	Animalia	Reptilia	Agamidae	Pogona barbata	bearded dragon	C		No	No	QA	No	1	0	1
519	Animalia	Reptilia	Boidae	Morelia spilota	carpet python	C		No	No	QA	No	2	0	2
63	Animalia	Reptilia	Chelidae	Chelodina longicollis	eastern snake-necked turtle	C		No	No	QA	No	3	0	3
43	Animalia	Reptilia	Chelidae	Emydura macquarii macquarii	Murray turtle	C		No	No	QA	No	6	0	6
54	Animalia	Reptilia	Chelidae	Wollumbinia latisternum	saw-shelled turtle	C		No	No	QA	No	4	0	4
512	Animalia	Reptilia	Colubridae	Dendrelaphis punctulatus	green tree snake	C		No	No	QAI	No	9	0	9
508	Animalia	Reptilia	Colubridae	Tropidonophis mairii	freshwater snake	C		No	No	QAI	No	3	0	3
454	Animalia	Reptilia	Elapidae	Pseudonaja textilis	eastern brown snake	C		No	No	QAI	No	7	0	7
61	Animalia	Reptilia	Varanidae	Varanus varius	lace monitor	C		No	No	QA	No	1	0	1
26888	Animalia	Incertae sedis	Indeterminate	Indeterminate	Unknown or Code Pending			No	No	U	No	4	0	4
23512	Fungi	Eurotiomycetes	Pyrenulaceae	Pyrenula quassiaecola		C		No	No	NTQ	No	1	1	1
35512	Fungi	Lecanoromycetes	Cladoniaceae	Cladia glaucolivida		C		No	No	NTQ	No	1	1	1
26558	Fungi	Lecanoromycetes	Coenogoniaceae	Coenogonium luteum		C		No	No	NTQ	No	1	1	1
23093	Fungi	Lecanoromycetes	Graphidaceae	Diploschistes actinostomus		C		No	No	NTQ	No	1	1	1
23316	Fungi	Lecanoromycetes	Megalosporaceae	Megalospora sulphurata		C		No	No	NTQ	No	1	1	1
27426	Fungi	Lecanoromycetes	Physciaceae	Physcia jackii		C		No	No	NTQ	No	1	1	1
23844	Fungi	Lecanoromycetes	Physciaceae	Rinodina xanthomelana		C		No	No	NTQ	No	1	1	1
23546	Fungi	Lecanoromycetes	Ramalinaceae	Ramalina celastri		C		No	No	NTQ	No	1	1	1
22988	Fungi	Lecanoromycetes	Teloschistaceae	Caloplaca cinnabarina		C		No	No	NTQ	No	1	1	1
23765	Fungi	Lecanoromycetes	Teloschistaceae	Teloschistes sieberianus		C		No	No	NTQ	No	1	1	1
28806	Fungi	Agaricomycetes	Agaricaceae	Agaricus arvensis		C		No	No	XU	No	1	0	1
17767	Plantae	Equisetopsida	Acanthaceae	Brunoniella australis	blue trumpet	C		No	No	NTQ	No	1	1	1
16262	Plantae	Equisetopsida	Acanthaceae	Rostellularia adscendens		C		No	No	NTQ	No	1	1	1
16015	Plantae	Equisetopsida	Aizoaceae	Trianthema triquetrum	red spinach	C		No	No	NTQ	No	1	1	1
32727	Plantae	Equisetopsida	Amaranthaceae	Alternanthera denticulata var. micrantha		C		No	No	NTQ	No	1	1	1
18029	Plantae	Equisetopsida	Amaranthaceae	Alternanthera nana	hairy joyweed	C		No	No	NTQ	No	1	1	1
11849	Plantae	Equisetopsida	Amaranthaceae	Alternanthera pungens	khaki weed			No	No	NAQ	No	1	0	1
10086	Plantae	Equisetopsida	Asteraceae	Artemisia verlotiorum				No	No	NAQ	No	1	0	1
35555	Plantae	Equisetopsida	Asteraceae	Brachyscome dalbyensis		C		No	No	NTQ	No	1	1	1
18905	Plantae	Equisetopsida	Asteraceae	Calotis cuneata		C		No	No	NTQ	No	1	1	1
15572	Plantae	Equisetopsida	Asteraceae	Camptacra barbata		C		No	No	NTQ	No	1	1	1
8398	Plantae	Equisetopsida	Asteraceae	Chrysocephalum apiculatum	yellow buttons	C		No	No	NTQ	No	1	1	1
11069	Plantae	Equisetopsida	Asteraceae	Eclipta platyglossa		C		No	No	NTQ	No	1	1	1
34823	Plantae	Equisetopsida	Asteraceae	Eclipta platyglossa subsp. platyglossa		C		No	No	NTQ	No	1	1	1
9092	Plantae	Equisetopsida	Asteraceae	Glossocardia bidens	native cobbler's pegs	C		No	No	NTQ	No	1	1	1
27379	Plantae	Equisetopsida	Asteraceae	Leiocarpa websteri		C		No	No	NTQ	No	1	1	1
3907	Plantae	Equisetopsida	Asteraceae	Leuzea australis		V	V	No	Yes	NTQ	No	3	2	3
10486	Plantae	Equisetopsida	Asteraceae	Senecio madagascariensis	fireweed			No	No	NAQ	No	1	0	1
30179	Plantae	Equisetopsida	Asteraceae	Senecio pinnatifolius var. pinnatifolius		C		No	No	NTQ	No	1	1	1
10488	Plantae	Equisetopsida	Asteraceae	Senecio tenuiflorus		C		No	No	NTQ	No	1	1	1
10440	Plantae	Equisetopsida	Asteraceae	Silybum marianum	variegated thistle			No	No	NAQ	No	2	0	2
10442	Plantae	Equisetopsida	Asteraceae	Solenogyne bellioides		C		No	No	NTQ	No	1	1	1
10443	Plantae	Equisetopsida	Asteraceae	Soliva anthemifolia	dwarf jo jo weed			No	No	NAQ	No	1	1	1
34624	Plantae	Equisetopsida	Asteraceae	Sphaeromorphaea australis		C		No	No	NTQ	No	1	1	1
14959	Plantae	Equisetopsida	Asteraceae	Vittadinia sulcata	native daisy	C		No	No	NTQ	No	1	1	1
25558	Plantae	Equisetopsida	Aytoniaceae	Asterella drummondii		C		No	No	NTQ	No	1	1	1
11193	Plantae	Equisetopsida	Boraginaceae	Heliotropium amplexicaule	blue heliotrope			No	No	NAQ	No	1	1	1
12221	Plantae	Equisetopsida	Brassicaceae	Lepidium bonariense	Argentine peppercress			No	No	NAQ	No	1	1	1
22343	Plantae	Equisetopsida	Brassicaceae	Lepidium peregrinum		C	E	No	Yes	NTQ	No	1	1	1
26206	Plantae	Equisetopsida	Bryaceae	Rosulabryum albolimbatum		C		No	No	NTQ	No	1	1	1
9535	Plantae	Equisetopsida	Cactaceae	Opuntia tomentosa	velvety tree pear			No	No	NAQ	No	1	0	1
36488	Plantae	Equisetopsida	Campanulaceae	Wahlenbergia capillaris		SL		No	Yes	NTQ	No	2	2	2
12654	Plantae	Equisetopsida	Cannabaceae	Celtis sinensis	Chinese elm			No	No	NAQ	No	1	1	1
21924	Plantae	Equisetopsida	Caryophyllaceae	Spergularia marina		C		No	No	NTQ	No	2	2	2
17707	Plantae	Equisetopsida	Casuarinaceae	Casuarina cristata	belah	C		No	No	NTQ	No	1	1	1
17684	Plantae	Equisetopsida	Chenopodiaceae	Chenopodium album	fat-hen			No	No	NAQ	No	1	1	1
10017	Plantae	Equisetopsida	Chenopodiaceae	Maireana decalvans	black cottonbush	C		No	No	NTQ	No	1	1	1
14720	Plantae	Equisetopsida	Commelinaceae	Commelina lanceolata		C		No	No	NTQ	No	1	1	1
17175	Plantae	Equisetopsida	Convolvulaceae	Evolvulus alsinoides var. decumbens		C		No	No	NTQ	No	1	1	1

14786	Plantae	Equisetopsida	Cyperaceae	Bolboschoenus caldwellii		C	No	No	NTQ	No	2	2	2
17526	Plantae	Equisetopsida	Cyperaceae	Cyperus laevigatus		C	No	No	NTQ	No	1	1	1
24659	Plantae	Equisetopsida	Daltoniaceae	Distichophyllum crispulum		C	No	No	NTQ	No	1	1	1
17443	Plantae	Equisetopsida	Ebenaceae	Diospyros geminata	scaly ebony	C	No	No	NTQ	No	1	1	1
14577	Plantae	Equisetopsida	Elatinaceae	Elatine gratioloides	waterwort	C	No	No	NTQ	No	1	1	1
24665	Plantae	Equisetopsida	Entodontaceae	Entodon mackaviensis		C	No	No	NTQ	No	1	1	1
36665	Plantae	Equisetopsida	Erpodiaceae	Venturiella hodgkinsoniae		C	No	No	NTQ	No	1	1	1
5309	Plantae	Equisetopsida	Euphorbiaceae	Euphorbia dallachyana		C	No	No	NTQ	No	1	1	1
11288	Plantae	Equisetopsida	Euphorbiaceae	Ricinus communis	castor oil bush		No	No	NAQ	No	1	1	1
24678	Plantae	Equisetopsida	Fabroniaceae	Fabronia sp. (Brisbane F.M.Bailey 296)		C	No	No	NTQ	No	1	1	1
24670	Plantae	Equisetopsida	Fissidentaceae	Fissidens			No	No		No	1	1	1
24705	Plantae	Equisetopsida	Fissidentaceae	Fissidens pallidus		C	No	No	NTQ	No	1	1	1
17059	Plantae	Equisetopsida	Goodeniaceae	Goodenia fascicularis		C	No	No	NTQ	No	1	1	1
11010	Plantae	Equisetopsida	Goodeniaceae	Goodenia gracilis		C	No	No	NTQ	No	2	1	2
15667	Plantae	Equisetopsida	Lamiaceae	Ajuga australis	Australian bugle	C	No	No	NTQ	No	1	1	1
41035	Plantae	Equisetopsida	Lamiaceae	Coleus australis		C	No	No	NTQ	No	1	1	1
15243	Plantae	Equisetopsida	Lamiaceae	Mentha satureioides	native pennyroyal	C	No	No	NTQ	No	1	1	1
15339	Plantae	Equisetopsida	Laxmanniaceae	Eustrephus latifolius	wombat berry	C	No	No	NTQ	No	1	1	1
15734	Plantae	Equisetopsida	Leguminosae	Acacia penninervis var. longiracemosa		C	No	No	NTQ	No	2	2	2
7678	Plantae	Equisetopsida	Leguminosae	Chamaecrista nomame var. nomame		C	No	No	NTQ	No	1	1	1
27173	Plantae	Equisetopsida	Leguminosae	Crotalaria montana var. angustifolia		C	No	No	NTQ	No	1	1	1
13897	Plantae	Equisetopsida	Leguminosae	Kennedia procurrens	purple running pea	C	No	No	NTQ	No	1	1	1
6280	Plantae	Equisetopsida	Leguminosae	Leucaena leucocephala subsp. leucocephala			No	No	NAQ	No	1	0	1
15241	Plantae	Equisetopsida	Leguminosae	Melilotus indicus	hexham scent		No	No	NAQ	No	1	1	1
15204	Plantae	Equisetopsida	Leguminosae	Neptunia gracilis		C	No	No	NTQ	No	1	1	1
15100	Plantae	Equisetopsida	Leguminosae	Rhynchosia minima var. minima		C	No	No	NTQ	No	1	1	1
14235	Plantae	Equisetopsida	Leguminosae	Senna artemisioides subsp. coriacea		C	No	No	NTQ	No	1	1	1
5852	Plantae	Equisetopsida	Leguminosae	Senna sophera var. (40Mile Scrub J.R.Clarkson+ 6908)		C	No	No	NTQ	No	1	1	1
8254	Plantae	Equisetopsida	Leguminosae	Swainsona queenslandica		C	No	No	NTQ	No	1	1	1
28383	Plantae	Equisetopsida	Leguminosae	Tephrosia sp. (Wyreema R.J.Fensham 2082)		C	No	No	NTQ	No	1	1	1
14952	Plantae	Equisetopsida	Leguminosae	Vigna lanceolata		C	No	No	NTQ	No	1	1	1
11979	Plantae	Equisetopsida	Lythraceae	Ammannia multiflora	jerry-jerry	C	No	No	NTQ	No	1	1	1
8340	Plantae	Equisetopsida	Malvaceae	Abutilon oxycarpum var. oxycarpum		C	No	No	NTQ	No	1	1	1
14327	Plantae	Equisetopsida	Menyanthaceae	Nymphoides indica	water snowflake	SL	No	Yes	NTQ	No	2	0	2
24877	Plantae	Equisetopsida	Meteoriaceae	Papillaria flexicaulis		C	No	No	NTQ	No	1	1	1
33123	Plantae	Equisetopsida	Myrsinaceae	Lysimachia arvensis			No	No	NAQ	No	1	1	1
6534	Plantae	Equisetopsida	Myrtaceae	Corymbia clarksoniana		C	No	No	NTQ	No	1	1	1
19941	Plantae	Equisetopsida	Nymphaeaceae	Nymphaea caerulea			No	No	NAQ	No	2	0	2
33129	Plantae	Equisetopsida	Oleaceae	Jasminum dianthifolium		C	No	No	NTQ	No	1	1	1
16840	Plantae	Equisetopsida	Oleaceae	Jasminum simplicifolium subsp. australiense		C	No	No	NTQ	No	1	1	1
11800	Plantae	Equisetopsida	Ophioglossaceae	Ophioglossum lusitanicum	adder's tongue	C	No	No	NTQ	No	1	1	1
14086	Plantae	Equisetopsida	Orchidaceae	Acianthus exsertus		SL	No	Yes	NTQ	Yes	1	1	1
9317	Plantae	Equisetopsida	Oxalidaceae	Oxalis chnoodes		C	No	No	NTQ	No	1	1	1
12804	Plantae	Equisetopsida	Papaveraceae	Fumaria muralis subsp. muralis	wall fumitory		No	No	NAQ	No	1	1	1
14521	Plantae	Equisetopsida	Phrymaceae	Glossostigma diandrum		C	No	No	NTQ	No	1	1	1
11327	Plantae	Equisetopsida	Phyllanthaceae	Bridelia exaltata		C	No	No	NTQ	No	1	1	1
16422	Plantae	Equisetopsida	Plantaginaceae	Plantago lanceolata			No	No	NAQ	No	1	1	1
12730	Plantae	Equisetopsida	Plantaginaceae	Plantago major	greater plantain		No	No	NAQ	No	1	0	1
41805	Plantae	Equisetopsida	Plantaginaceae	Plantago myosuros			No	No	NAQ	No	1	1	1
11119	Plantae	Equisetopsida	Poaceae	Aristida calycina var. praealta		C	No	No	NTQ	No	1	1	1
19746	Plantae	Equisetopsida	Poaceae	Arundo donax			No	No	NAQ	No	1	0	1
10316	Plantae	Equisetopsida	Poaceae	Bothriochloa decipiens var. decipiens		C	No	No	NTQ	No	1	1	1
14794	Plantae	Equisetopsida	Poaceae	Bromus catharticus	prairie grass		No	No	NAQ	No	1	1	1
15550	Plantae	Equisetopsida	Poaceae	Chloris divaricata var. divaricata	slender chloris	C	No	No	NTQ	No	1	1	1
15526	Plantae	Equisetopsida	Poaceae	Chloris ventricosa	tall chloris	C	No	No	NTQ	No	1	1	1
15485	Plantae	Equisetopsida	Poaceae	Cymbopogon refractus	barbed-wire grass	C	No	No	NTQ	No	1	1	1
15486	Plantae	Equisetopsida	Poaceae	Cynodon dactylon			No	No	NAQ	No	1	1	1
15490	Plantae	Equisetopsida	Poaceae	Dactyloctenium radulans	button grass	C	No	No	NTQ	No	1	1	1
34499	Plantae	Equisetopsida	Poaceae	Diplachne fusca var. fusca		C	No	No	NTQ	No	1	1	1
15408	Plantae	Equisetopsida	Poaceae	Enteropogon ramosus		C	No	No	NTQ	No	1	1	1
15367	Plantae	Equisetopsida	Poaceae	Eragrostis leptostachya		C	No	No	NTQ	No	1	1	1
10882	Plantae	Equisetopsida	Poaceae	Eragrostis pilosa	soft lovegrass		No	No	NAQ	No	1	1	1
15373	Plantae	Equisetopsida	Poaceae	Eragrostis sororia		C	No	No	NTQ	No	1	1	1
15380	Plantae	Equisetopsida	Poaceae	Eremochloa bimaculata	poverty grass	C	No	No	NTQ	No	1	1	1
15330	Plantae	Equisetopsida	Poaceae	Eriochloa crebra	spring grass	C	No	No	NTQ	No	1	1	1
10648	Plantae	Equisetopsida	Poaceae	Panicum buncei		C	No	No	NTQ	No	1	1	1
10870	Plantae	Equisetopsida	Poaceae	Panicum queenslandicum var. queenslandicum		C	No	No	NTQ	No	1	1	1
15184	Plantae	Equisetopsida	Poaceae	Paspalidium caespitosum	brigalow grass	C	No	No	NTQ	No	1	1	1
15147	Plantae	Equisetopsida	Poaceae	Phragmites australis	common reed	C	No	No	NTQ	No	1	1	1
10246	Plantae	Equisetopsida	Poaceae	Sorghum arundinaceum	Rhodesian Sudan grass		No	No	NAQ	No	1	1	1
15055	Plantae	Equisetopsida	Poaceae	Sporobolus caroli	fairy grass	C	No	No	NTQ	No	1	1	1
15000	Plantae	Equisetopsida	Poaceae	Sporobolus coromandelianus			No	No	NAQ	No	1	1	1
14169	Plantae	Equisetopsida	Poaceae	Sporobolus elongatus		C	No	No	NTQ	No	1	1	1
14974	Plantae	Equisetopsida	Poaceae	Themeda triandra	kangaroo grass	C	No	No	NTQ	No	1	1	1
29242	Plantae	Equisetopsida	Poaceae	Urochloa foliosa		C	No	No	NTQ	No	1	1	1
16496	Plantae	Equisetopsida	Polygonaceae	Persicaria lapathifolia	pale knotweed	C	No	No	NTQ	No	1	1	1
14351	Plantae	Equisetopsida	Polygonaceae	Persicaria orientalis	princes feathers	C	No	No	NTQ	No	1	1	1
42262	Plantae	Equisetopsida	Pontederiaceae	Pontederia cyanea		C	No	No	NTQ	No	1	1	1
25588	Plantae	Equisetopsida	Porellaceae	Porella crawfordii		C	No	No	NTQ	No	1	1	1
16410	Plantae	Equisetopsida	Portulacaceae	Portulaca australis		C	No	No	NTQ	No	1	1	1
14284	Plantae	Equisetopsida	Potamogetonaceae	Potamogeton ochreatus	blunt pondweed	SL	No	Yes	NTQ	No	1	0	1
40624	Plantae	Equisetopsida	Potamogetonaceae	Potamogeton perfoliatus var. minor		C	No	No	NTQ	No	1	0	1
24536	Plantae	Equisetopsida	Pottiaceae	Barbula			No	No		No	2	2	2
24533	Plantae	Equisetopsida	Pottiaceae	Barbula subcalycina		C	No	No	NTQ	No	1	1	1
24905	Plantae	Equisetopsida	Ptychomitriaceae	Ptychomitrium australe		C	No	No	NTQ	No	1	1	1
24718	Plantae	Equisetopsida	Ptychomniaceae	Euptychium cuspidatum		C	No	No	NTQ	No	1	1	1
16237	Plantae	Equisetopsida	Santalaceae	Santalum lanceolatum		SL	No	Yes	NTQ	No	1	1	1
17738	Plantae	Equisetopsida	Sapindaceae	Cardiospermum grandiflorum	heart seed vine		No	No	NAQ	No	1	1	1
8631	Plantae	Equisetopsida	Scrophulariaceae	Eremophila debilis	winter apple	C	No	No	NTQ	No	1	1	1
25188	Plantae	Equisetopsida	Sematophyllaceae	Sematophyllum homomallum		C	No	No	NTQ	No	1	1	1
26202	Plantae	Equisetopsida	Sematophyllaceae	Sematophyllum subhumile		C	No	No	NTQ	No	2	2	2
17493	Plantae	Equisetopsida	Solanaceae	Datura ferox	fierce thornapple		No	No	NAQ	No	1	0	1
16157	Plantae	Equisetopsida	Solanaceae	Solanum americanum			No	No	NAQ	No	1	1	1
14210	Plantae	Equisetopsida	Solanaceae	Solanum nemophilum		C	No	No	NTQ	No	1	1	1
17603	Plantae	Equisetopsida	Sparrmanniaceae	Corchorus trilocularis		C	No	No	NTQ	No	2	2	2
17049	Plantae	Equisetopsida	Sparrmanniaceae	Grewia latifolia	dysentery plant	C	No	No	NTQ	No	1	1	1
36374	Plantae	Equisetopsida	Thymelaeaceae	Pimelea altior		C	No	No	NTQ	No	1	1	1
8080	Plantae	Equisetopsida	Typhaceae	Sparganium erectum subsp. stoloniferum	erect bur-reed		No	No	NAQ	No	2	2	2
7796	Plantae	Equisetopsida	Verbenaceae	Phyla canescens			No	No	NAQ	No	1	1	1
25819	Plantae	Equisetopsida	Verbenaceae	Verbena africana		C	No	No	NTQ	No	1	1	1

6.10. Helidon STP Effluent Reuse Project 2024 - Report of performance

Please note: Printed copies of this document should be verified for currency against online version.

Helidon STP Effluent Reuse Project
2024 – Report of performance

QUU Reference	Purchase Order A71315
Project	Helidon STP Effluent Reuse Project – Provision of Specialist Forestry & Irrigation Services
Distribution	Cameron Jackson, Leader Water Quality & Environment Urban Utilities Cameron.Jackson@urbanutilities.com.au
Date	16th September 2024
Contact	Tony Costantini, Principal Planfuture

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Dear Cameron

Planfuture is pleased to provide the 2024 performance report for the Helidon STP Effluent Reuse Project (the Project).

The report outlines our agreed deliverables and details performance against these; as well as identifying emergent issues that arose throughout the year in review. It combines the performance reports for the 4ha of irrigated forests established in early October 2019 (4ha Block) and for the additional 3ha of irrigated forests established in late October 2022 (3ha Block). While growth for the two forest areas is addressed separately in this report, effluent reuse is summarised for the total 7ha forest area.

For the year in review, this report complements two other Planfuture reports that have been provided for the Project; the first necessitated by the (five year) capital works for the 4ha Block being completed; and the second resulting from the irrigation maintenance being undertaken under the operational programme:

a. Helidon STP Effluent Reuse Project - Commissioning Report - Irrigation Area One; and
b. Helidon STP Effluent Reuse Project - 2024 Performance Report - Irrigation maintenance.

The design and layout of the 4ha and 3ha Blocks was presented in the Project irrigation commissioning reports.

As reported in the Year 3 performance report for the 4ha block, while the forest was established in October 2019, delays in procuring the irrigation infrastructure resulted in effluent irrigation being delayed to December 2020. This left the newly planted trees exposed to the driest year in 150 years of rainfall records at Helidon, with 11 of the 12 months experiencing above average temperatures and the hottest December day ever recorded.

Despite these early setbacks for the 4ha Block, the plantations are now performing well, in large part due to the highly specialised and dedicated work of the Forest Land Management team, and continue to meet the recycling targets for the Project.

Planfuture would like to thank Urban Utilities for providing the opportunity to deliver this important project. Please do not hesitate in contacting me if you would like to discuss any aspect of this report, or if we can assist further in the operational maintenance and management of the Project.

Tony Costantini
Principal Planfuture

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June 24 aerial image of 4ha Block on left; northern compartment of 3ha Block in foreground and protected mapped vegetation in background

1. Project Introduction

The intent of the Project was to reuse Helidon STP Average Dry Weather Flow (ADWF) to regenerate the pre-clearing Regional Ecosystem (RE) type – RE12.3.3 – tall open blue gum forest over a grassy understory. The RE is recognised as being endangered, and has an overstory comprised of –

- 90% *Eucalyptus tereticornis* – blue gum;
- 5% *E. melanophloia* – broad-leafed ironbark; and
- 5% *Corymbia tessellaris* – Moreton Bay ash.

As the dominant species, the growth targets (KPIs) relate to the blue gum.

The Project comprises both works:

a. 'inside the STP' (pump, filters and control); and
b. 'outside the STP' (storage tank, pump shed, pump, filters, irrigation controller, forest, irrigation infrastructure).

Both works were to be completed simultaneously, with a view to establishing the irrigated forest (4ha Block) in October 2019. While the 'outside the STP' works were completed on time, Urban Utilities was unable to deliver the 'inside the STP' works until December 2020. Unfortunately, this left the newly established trees in the 4ha Block without irrigation during the worst drought on record (25% less rainfall than the next lowest year of rainfall recorded in 150 years of records), providing a serious setback in growth and reducing tree resilience to pests and diseases. Due in part to high quality silvicultural management into the 4ha Block during the five-year capital delivery period, the 4ha forest is now considered to be healthy, with good resilience to natural levels of pest, diseases and (native fauna) grazing.

At the time of planning for the Project, Urban Utilities estimated ADWF at *circa* 20ML/year. After early operation of the 4ha Block, Urban Utilities provided a revised estimate of ADWF as 30ML/year, necessitating that the Project be increased by 3ha (the 3ha Block). Tree planting for the 3ha Block was undertaken in October 2022.

The design of the irrigation infrastructure for the 4ha Block and 3ha Block are detailed in their respective irrigation infrastructure commissioning reports.

Effluent irrigation is undertaken in accordance with the MEDLI[1] modelling assumptions that informed Project design. A key objective of irrigation scheduling is to match irrigation to the deficit between evapotranspiration and rainfall. In practice, irrigation will broadly equal STP flows, until the sum of rainfall and irrigation exceeds evapotranspiration, at which time effluent is redirected to the turkey dam. Typically, irrigation scheduling seeks to ensure that evapotranspiration nett of rainfall plus irrigation is positive on a monthly basis; though if rainfall is confined to a short period, irrigation may be permitted outside that period. Irrigation is never applied if rainfall results in overland (surface) flow.

[1] MEDLI is the Queensland Government model for effluent reuse planning;

2. Year 5 tree performance in the 4ha Block

The Project Year Five growth Key Performance Indices (KPIs) are as follows:

- 95% survival;
- 7.5m P90 height;
- >10cm P90 Diameter at Breast Height (DBH);
- >4.0m diameter crown; and
- P90 plants are healthy.

Assessment of Year Five performance was undertaken in September 2024 at *c*. 59 months (Figure 1). The two Assessment Plots used for the original condition assessment were re-established (see Project condition assessment reports for more detail):

- Plot 1, 100m x 50m in an east-west direction, comprising 200 planting areas; and
- Plot 2, 100m x 50m in a north-south direction, comprising 200 planting areas.

Sample size (Plot 1 and Plot 2) is 25% of the tree population. Year Five performance outcomes versus the Year Five KPIs are shown in Figure 2 (survival), Figure 3 (height growth) and Figure 4 (DBH growth). Survival (all species) exceeds the KPI, resulting in the development of a well-stocked forest. Height growth achieves the KPI: Average blue gum height is now approaching 10m, which is a remarkable outcome given the forest's harsh early years. DBH development exceeds the KPI. In Planfuture's opinion, the forest is well managed; and is now resilient to natural levels of insect and fungal activity and predation. All works specified under Urban Utilities' contact C2500 with Forest Land Management have been delivered.

Figure 1: Block 1 in the Five Year old 4ha irrigated forest



Figure 2: Survival in the Five Year old 4ha irrigated forest

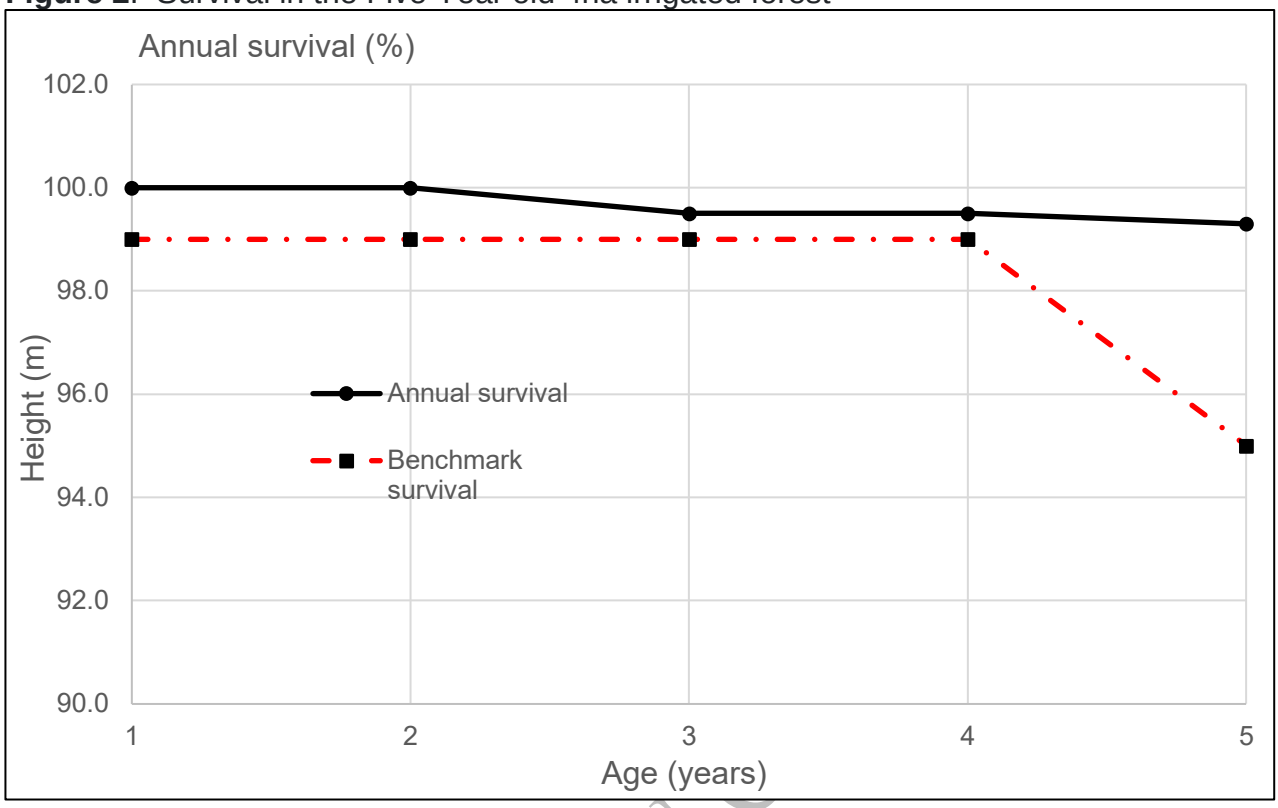


Figure 3: Height growth in the Five Year old 4ha irrigated forest

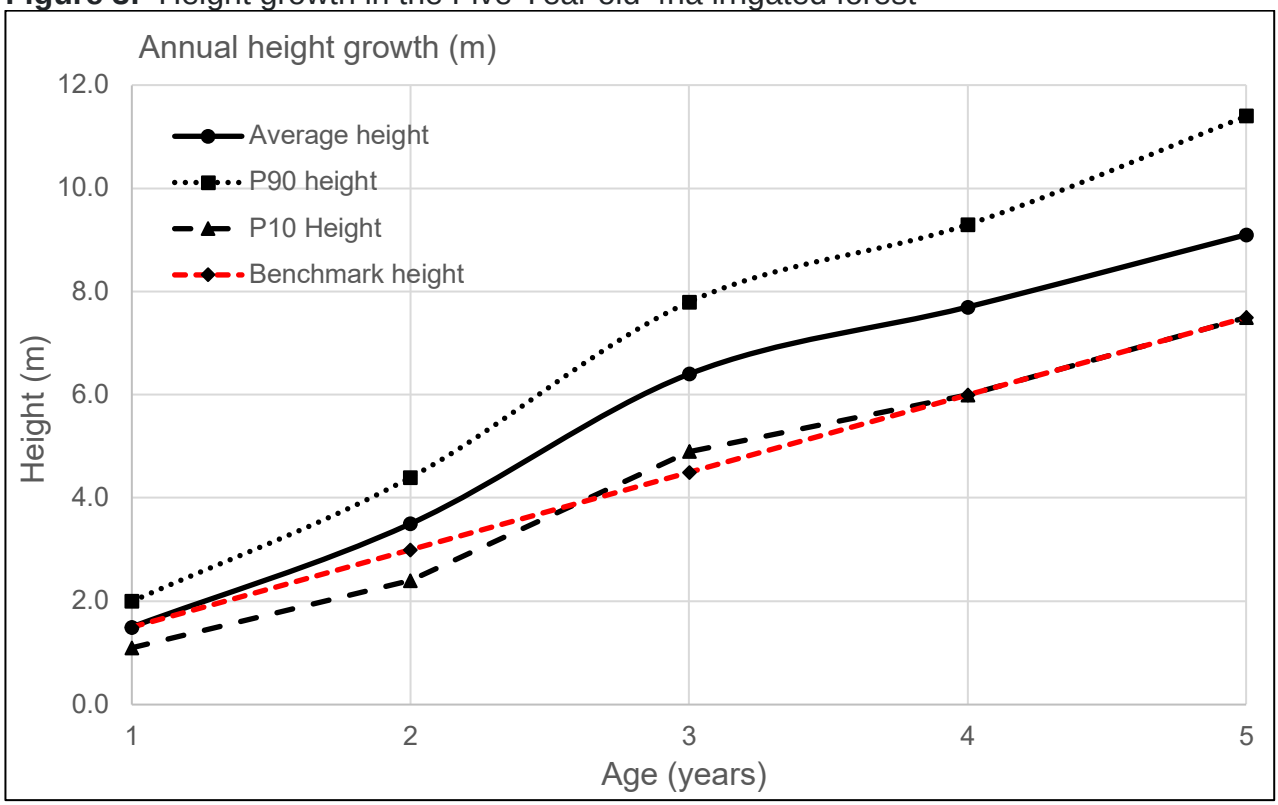
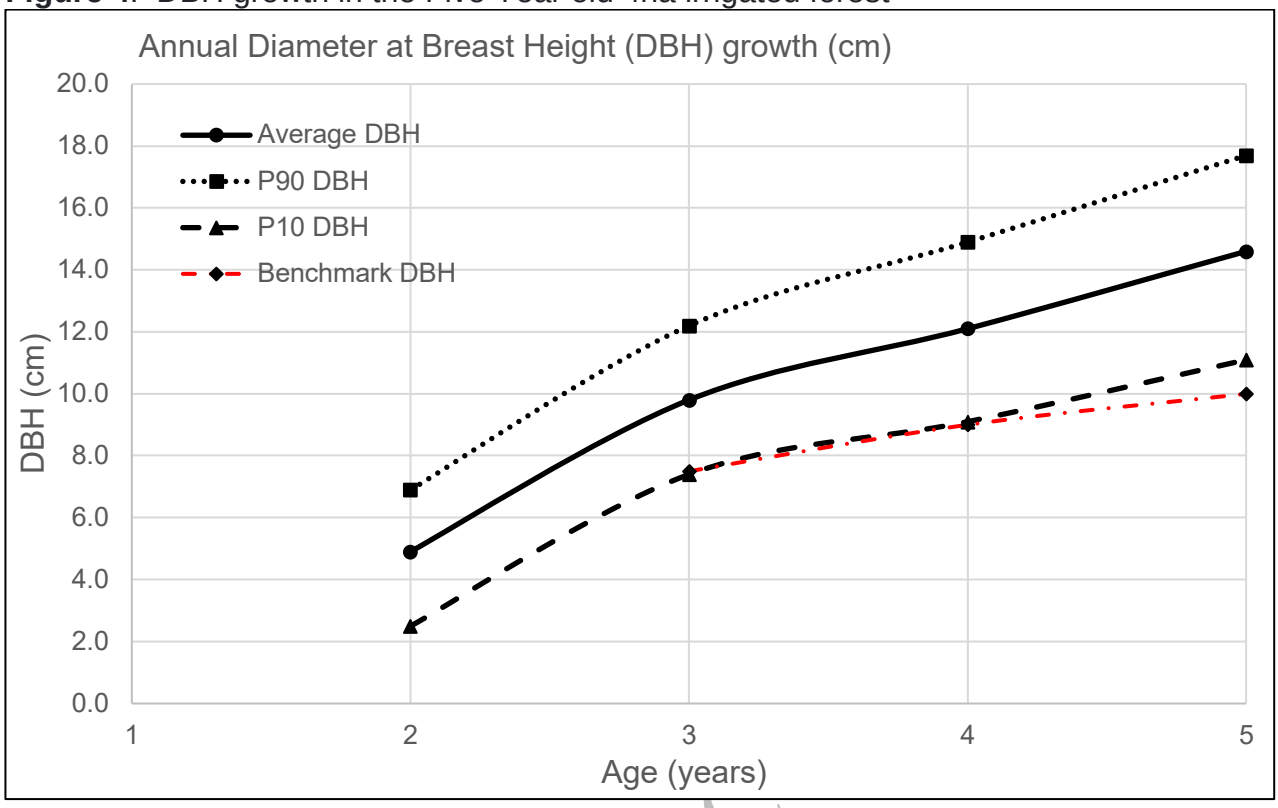
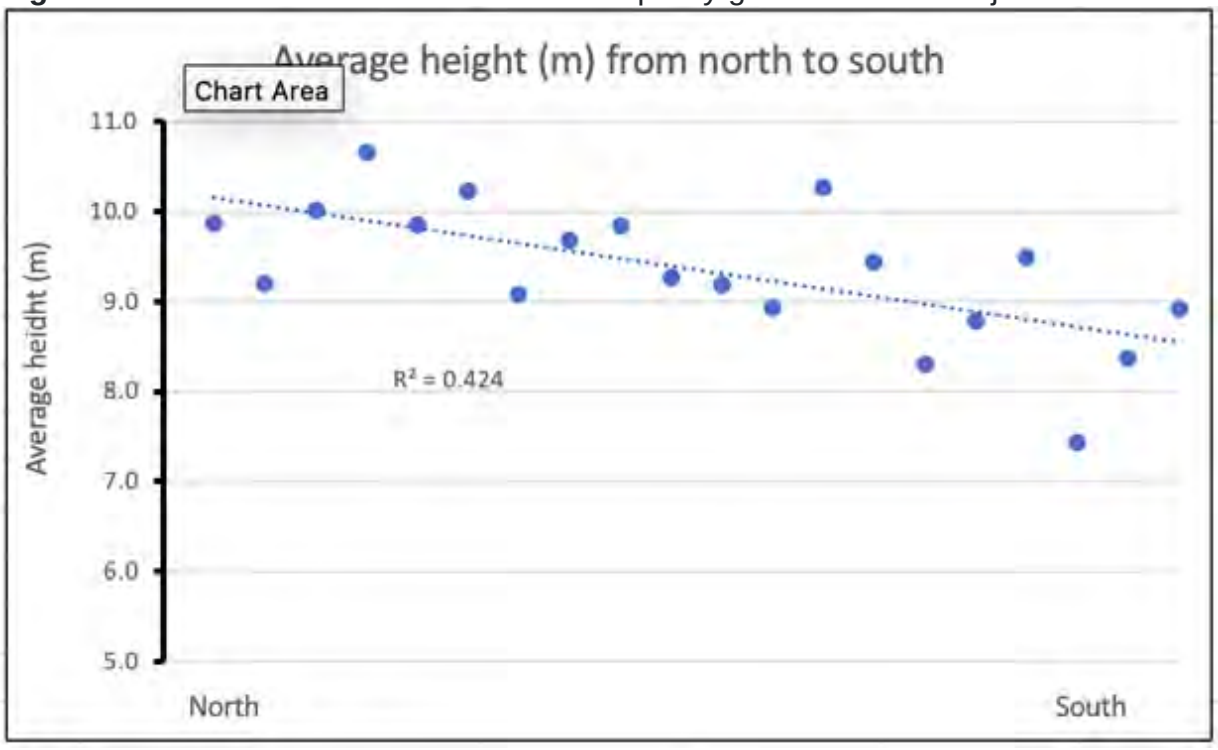


Figure 4: DBH growth in the Five Year old 4ha irrigated forest



Of note, site quality decreases from the north of the Project area to the south, due primarily to increased alkalinity and salinity: This is evident from relative height growth data from Assessment Plot 2, which is oriented north / south (Figure 5).

Figure 5: Evidence of the north / south site quality gradient at the Project Area



Achievement of the Crown Diameter KPI has been compromised by the need to prune lower branches (those that tend to have the largest spread in young trees) to enable tractor access for slashing. Despite this, the Five Year crown diameter KPI has been achieved – with average crown diameter of 4.5m (n=40; standard deviation = 0.84m).

4. 3ha Block – Year Two Performance

The Project Year Two growth KPIs for the 3ha Block are as follows:

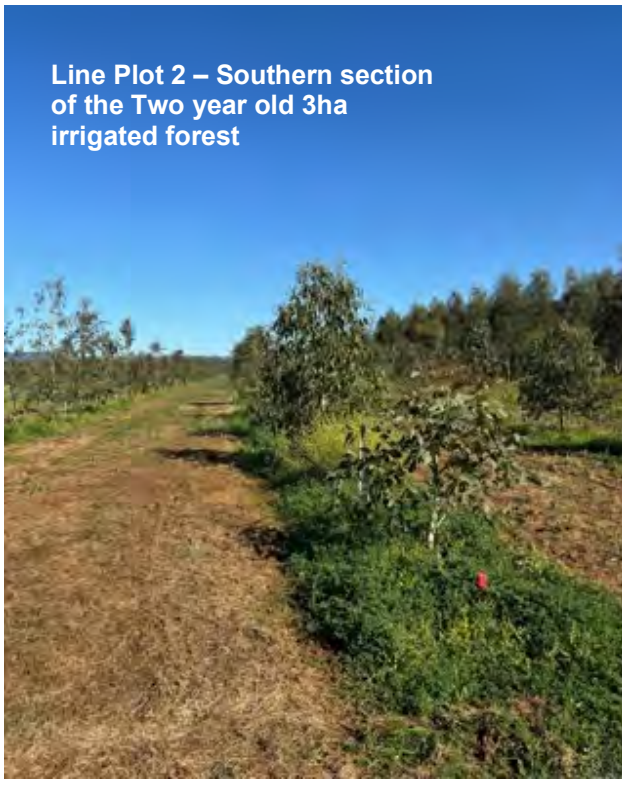
- 99% survival;
- 3.0m P90 height;
- 6.0cm P90 Diameter at Ground Level (DGL);
- 1.75m diameter crown; and
- P90 plants are healthy.

Assessment of Year Two performance was undertaken in September 2024 at *c*. 23 months. The single line plots established at the time of planting, were re-assessed (Figure 6), one in the northern section (Plot 1) of the 3ha Block and one in the southern section (Plot 2):

- Plot 1, 39 trees in an east-west direction; and
- Plot 2, 50 trees in an east-west direction.

Figure 6: The Two Year old 3ha irrigated forest showing planting lines that comprise Plot 1 and Plot 2





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Sample size (Plot 1 and Plot 2) is *circa* 7.5% of the tree population. Year Two performance outcomes versus the Year Two KPIs are summarised in Table 1. The north / south site quality gradient in the Project Area, observed in the Five Year old 4ha forest (Figure 5) is more pronounced in the Two Year old 3ha plantings (Table 1), with the norther plantings recording significantly superior growth (see also Figure 6). In Planfuture's view, all trees (northern and southern sections) are healthy and resilient to natural levels of fungal and insect activity and predation; and all works specified under Urban Utilities' contact C2500 with Forest Land Management have been delivered.

Survival and diameter growth have met or exceeded the KPIs. While average height growth is good, the P10 height growth has fallen marginally below the KPI. In Planfuture's view, this provides no cause for concern. Firstly, the trees are considered to be resilient and healthy. Secondly, it is likely that had the trees been measured at the end of October 2024 (full two-year's old), the early spring flush in height growth would have resulted in the KPI being exceeded. And, thirdly, the observed height growth is exceeding that observed in the 4ha forest at the same age (Table 2); and that forest has met its KPIs at Year Five (Figure 3). In Planfuture's view, the slower growth observed in the Two Year old southern plantings is due solely to site quality; and is not impacting the forest's potential to reuse effluent; or to develop into a healthy mature forest that will continue to meet the Project's reuse objectives.

Table 1: Year Two survival and growth performance for the 3ha Block.

Growth and performance criterion	Plot 1	Plot 2	All Plots
Total all species	39	40	79
Total *E. tereticornis*	37	33	70
Total *C. tessellaris*	1	2	3
Total E. *melanophloia*	1	5	6
Survival – all species	100%	98%	99%
Average height E. *tereticornis* (m)	3.7	4.3	4.0
P90 height E. *tereticornis* (m)	2.5	3.4	2.9
Average DGL *E. tereticornis* (cm)	9.4	11.3	10.4
P90 DGL *E. tereticornis* (cm)	7.3	8.8	8.1

Table 2: A comparison of blue gum growth performance in the 4ha Block at age Two Years with the Year Two performance observed in the 3ha Block.

Growth and performance criterion	4ha Block at Age Two (2021)	3ha Block at Age 2(2024)
Average height (m)	3.5	4.0
P90 height (m)	2.4	2.9
Average DGL (cm)	8.3	10.4
P90 DGL (cm)	5.9	8.1

Crown diameter development has met the KPI overall and in the northern Plot (2.5m; n=48); and, consistent with the site quality gradient, fallen slightly short of the KPI in Plot 2 (1.7m).

5. Effluent Reuse for the Year in Review

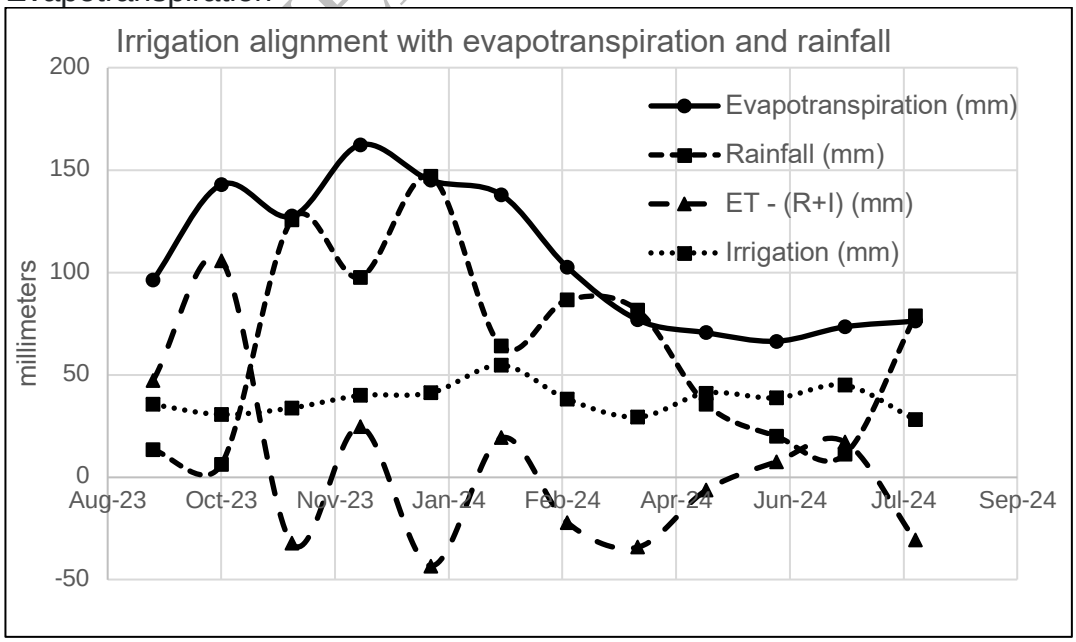
Irrigated effluent flows to the 7ha of irrigated forest are provided in Table 3. *Circa* 32ML were successfully reused in the year in review, in accordance with the MEDLI planning assumptions, including:

- no surface runoff of irrigation;
- broadly uniform spray irrigation across the entire irrigated forest; and
- irrigation scheduling such that monthly irrigation is not applied when monthly irrigation + rainfall significantly exceeds evapotranspiration (Figure 7).

Table 3: Monthly effluent irrigation flows (kl) during the year in review

Month	Irrigation (kl)
Sep-23	2,488
Oct-23	2,149
Nov-23	2,373
Dec-23	2,796
Jan-24	2,888
Feb-24	3,830
Mar-24	2,674
Apr-24	2,059
May-24	2,879
Jun-24	2,715
Jul-24	3,145
Aug-24	1,970
Total	**31,966**

Figure 7: Monthly irrigation scheduling outcomes (I = Irrigation; R = Rainfall; and ET = Evapotranspiration



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As Figure 7 shows, when effluent is available, it is applied to close the gap between evapotranspiration and rainfall. Where the Figure 7 nett water balance for a month is negative, irrigation scheduling within the month has ensured that irrigation is not applied within the month when surface moisture levels following heavy rainfall are high.

Note that the primary MEDLI sustainability criteria relating to deep drainage was unable to be tested in the year in review, as the Project piezometer observation wells were dry throughout the year.

6. Other Matters

This section summarises key issues impacting the Project and/or arising from the Project throughout the year in review.

6a. Wind damage

The Project site is an exposed site, with the result that some crown breakage is inevitable during strong winds. Ten trees experienced crown damage during the year in review. All were trimmed by Forest Land Management; and all will recover.

6b. Cooperation with STP operations

Cooperation with STP operators during the year in review has been very good; with operators working hard to deliver effluent to the reuse Project.

6c. Extension and public relations

The Project hosted multiple extension and public relations events, with Planfuture, including Urban Utilities, science and Lockyer Valley Regional Council visits.

6d. Project positive externalities

The Project has, and has continued to, generate positive externalities – largely associated with the regeneration of a small, but important, area of endangered RE adjacent to Waterholes Creek and mapped vegetation[2]. Earlier reports detailed the growing populations of native birds, reptiles and mammals.

The biodiversity value of the Project continues to grow (Figure 8), particularly as the older 4ha forests continue to mature and the forest increasingly offers habitat, as well as feeding, opportunities.

[2] See Queensland Government environmental mapping - https://environment.des.qld.gov.au/resources/maps-imagery-data/online

COMMERCIAL IN CONFIDENCE

Figure 8: The irrigated forests are increasingly home to many



7. Concluding comment

The following summarises the year in review:

- all works associated with Forest Land Management pursuant to C2500 have been successfully delivered;
- integration of forest and irrigation works has been successfully achieved;
- the Project has met all critical KPIs;
- the Project continues to provide multiple (and growing) positive externalities;
- Planfuture has assisted Urban Utilities in delivering extension events that highlight the success of the reuse Project;
- the Project has sustainably reused 32ML of effluent and achieves its primary reuse function; and
- the Project forest is well placed to continue to achieve its reuse objectives in accordance with the Project Plans and approvals going forward.

IN CONFIDENCE

Overview of Planfuture deliverables

Urban Utilities has engaged Planfuture to provide specialist forestry and irrigation expert support to the Project (Contract C2513).

Both the 4ha Block and 3ha Block were established in accordance with Urban Utilities' specifications for the irrigated plantations and irrigation infrastructure. This report details forest performance, effluent reuse and achievement of Planfuture deliverables for Year Five (4ha Block) and Year Two (3ha Block).

The table below provides an overview of Planfuture's performance against the C2513 deliverables -

Deliverables	Outcome
Coordinate and integrate services provided by the Irrigation Supplier and the Forestry Supplier	Achieved
Optimise timing of Forestry Services, ensuring that important silvicultural inputs are timed when they are required, not necessarily when they are scheduled	Achieved
Undertake high-level site assessment (monthly checks) to ensure that the effluent reuse project is conforming to the approved plans	Achieved
Coordinate and conduct training	Completed
Provide a point of contact for QUU operational staff if there are any issues	Achieved
Provide a point of contact for the Forestry Supplier if there are any issues	Achieved
Assess tree growth performance (annually) and ensure compliance with growth benchmarks	This report
Install photo point monitoring sites and collect photo evidence of performance	Achieved

Prepare an annual report of performance and compliance with the Environmental Authority	This report
Provide assurance that the beneficial reuse aligns with regulatory requirements	This report
Assist with realising the value of the Planting Area as an environmental offset	Achieved
Provide commissioning signoff for delivery of the capital programme	Year five deliverable
Assist Urban Utilities in any related documentation / communication	Achieved
Respond to any emergent issues	This report
Pre-October 2022 works	Achieved
Post-October 2022 works	This report

Limitations on use of the Report

This report is for use by the Central SEQ Distributor-Retailer Authority, trading as Urban Utilities, and should not be used or relied upon by any other person or entity. It has been prepared to meet the performance assessment deliverables of the specific project described to Planfuture; and its extent is limited to the scope of work agreed between Urban Utilities and Planfuture.

COMMERCIAL IN CONFIDENCE

6.11. MEDLI Model for Helidon Plantation August 2025

Please note: Printed copies of this document should be verified for currency against online version.

General Information

SCENARIO REPORT: Full run

General information

Enterprise: Helidon RRC
Client: Urban Utilities
MEDLI user: URBANUTILITIES\091411

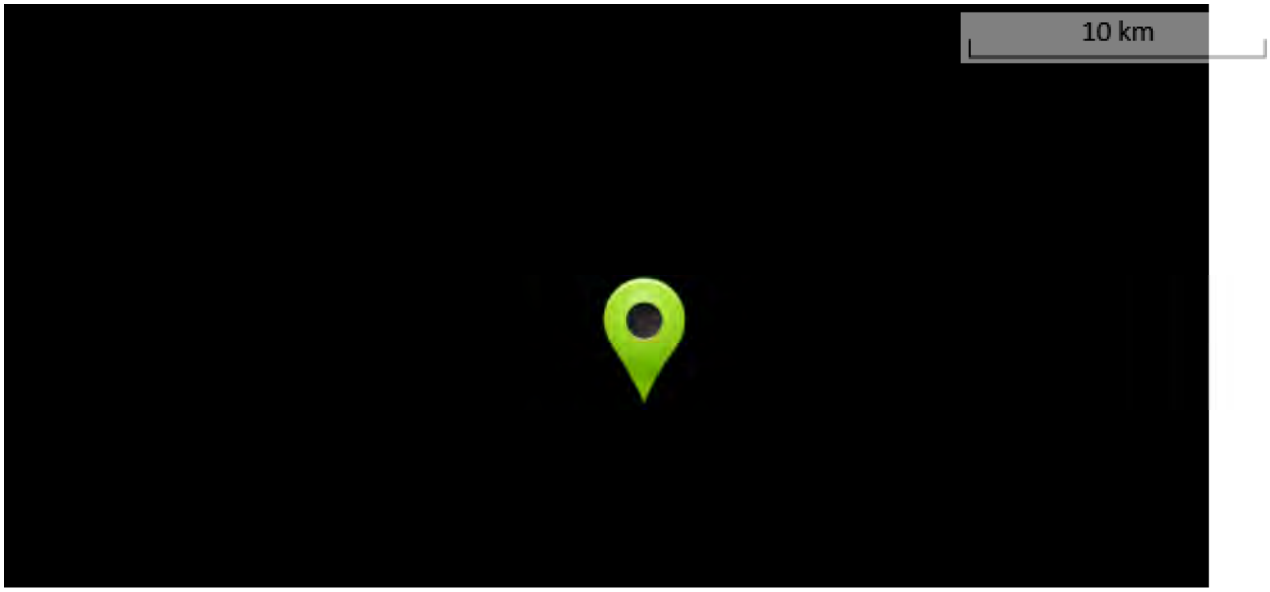
Description:

Helidon Irrigation Check 20250731

Scenario details:

Map of location:

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



Description

Climate information

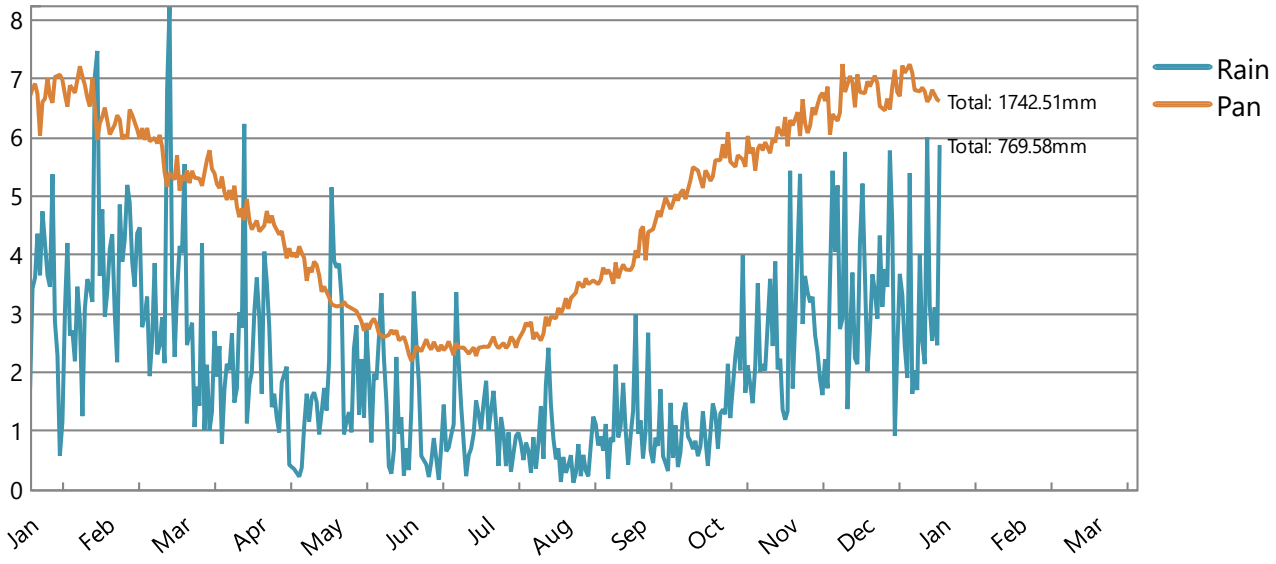
Climate Data Location: Helidon, -27.56°, 152.12°
Run Period: 01/01/1974 to 31/12/2024 (51 years)

Climate statistics

	5th Percentile		50th Percentile		95th Percentile	
Rainfall (mm/year)	(Year 1994)	383.1	(Year 1979)	729.0	(Year 1996)	1271.6
Pan evaporation (mm/year)	(Year 2021)	1486.8	(Year 1997)	1744.1	(Year 1993)	2005.9

Climate data

Daily average across run period:



Description

Wastestream information

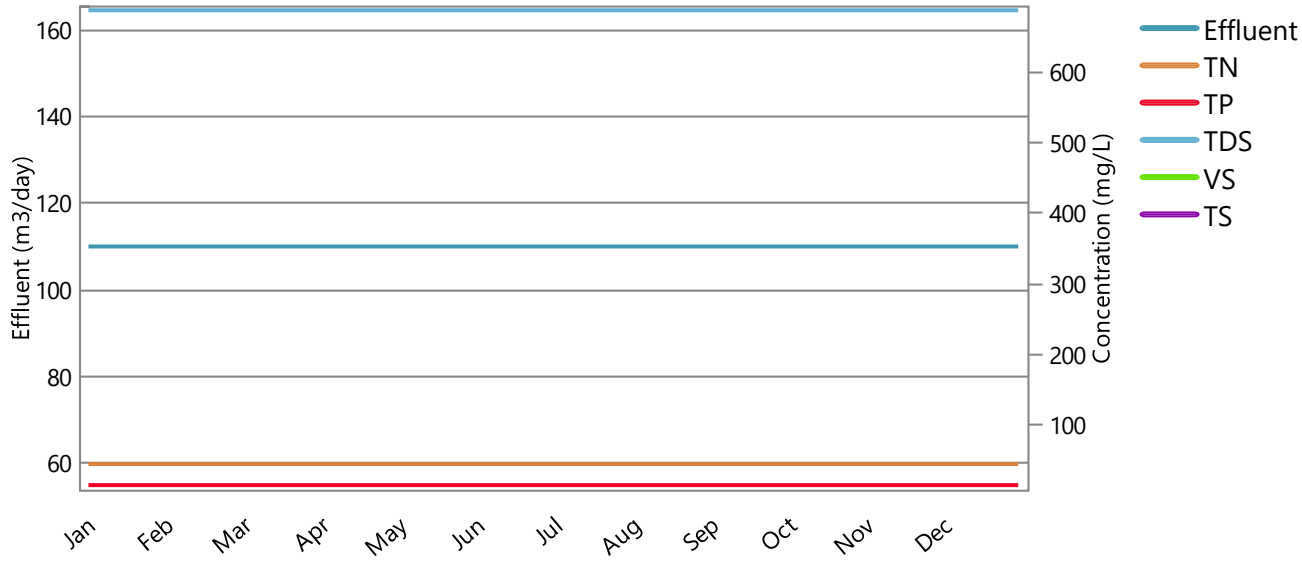
Wastestream Name: - New generic system

Wastestream production description

Daily New generic system data supplied for the whole simulation period. This wastestream is not separately pretreated.

Wastestream

Average Daily Quantity and Flow-Weighted Average Quality:



Wastestream

Effluent Quantity: 40178.04 m3/year or 110.00 m3/day (Min-Max 110.00 - 110.00)

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

	Concentration (mg/L)	Load (kg/year)
Total nitrogen	45.00 (45.00 - 45.00)	1808.01 (1806.75 - 1811.70)
Total phosphorus	15.00 (15.00 - 15.00)	602.67 (602.25 - 603.90)
Total dissolved salts	688.00 (688.00 - 688.00)	27642.49 (27623.20 - 27698.88)
Volatile solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

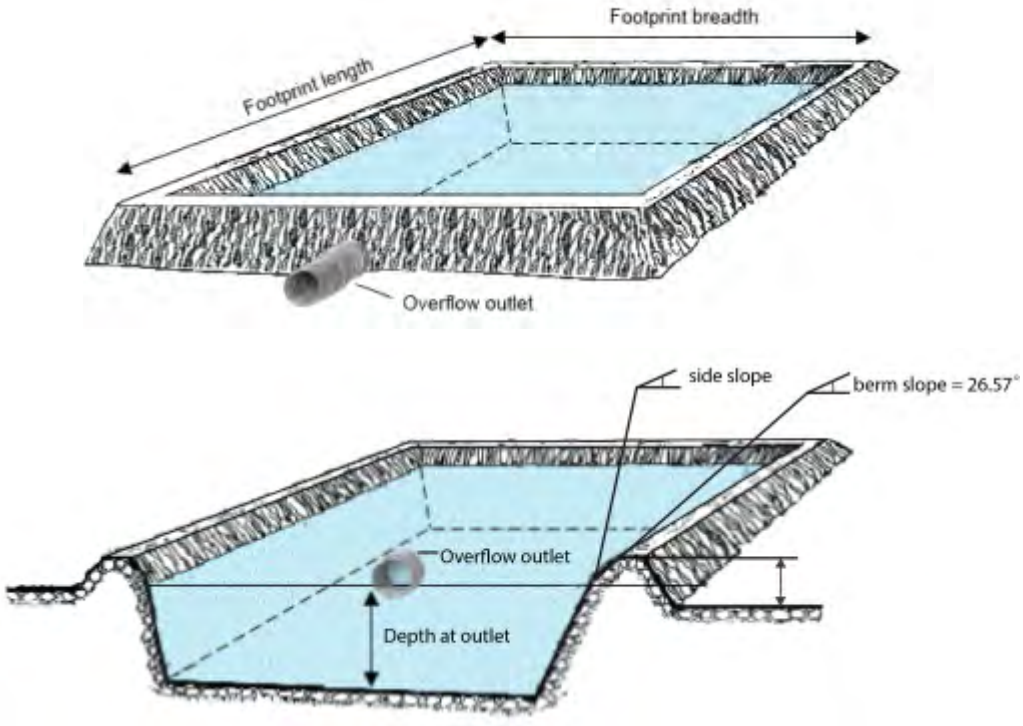
Description

Pond system information

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

Pond system details

	Pond 1
Maximum pond volume (m3)	363.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	3.50
Maximum water surface area (m2)	103.71
Pond footprint length (m)	10.18
Pond footprint width (m)	10.18
Pond catchment area (m2)	103.71
Average active volume (m3)	147.81



Irrigation pump limits

Minimum pump rate per area limit (ML/day/ha)	0.00
Maximum pump rate limit (ML/day)	1.75

Shandying water

Annual allocation of fresh water available for shandying (m3/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	No

Description

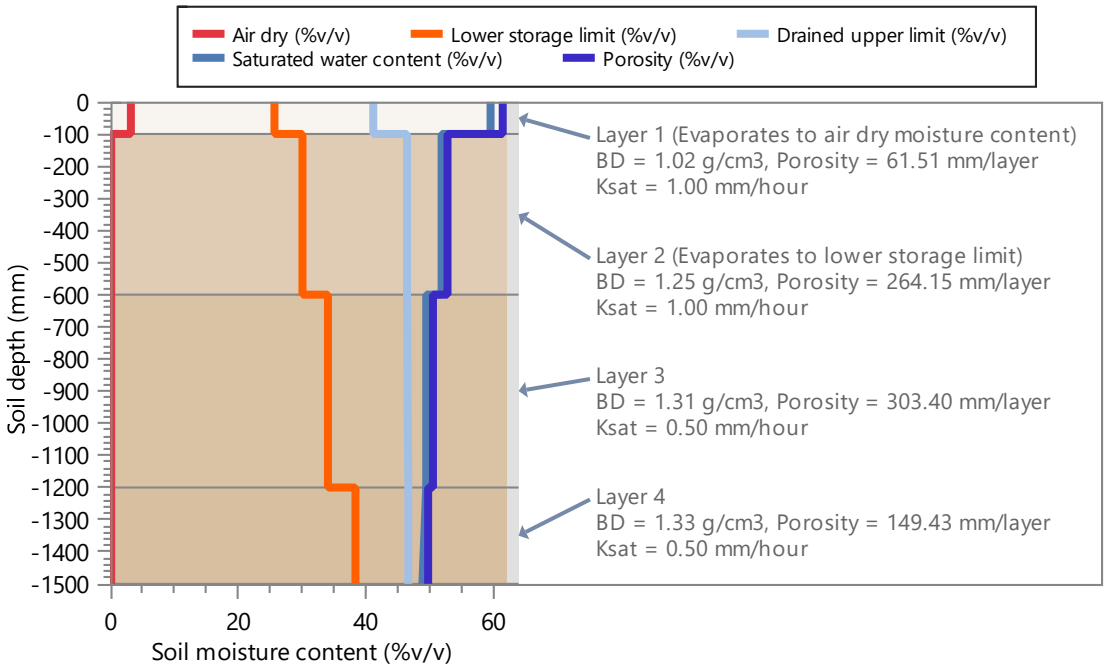
Paddock information

Paddock: New paddock, 7 ha

Soil type: Black vertisol, 1500.00 mm defined profile depth

Profile porosity (mm)	778.49
Profile saturation water content (mm)	762.80
Profile drained upper limit (or field capacity) (mm)	694.00
Profile lower storage limit (or permanent wilting point) (mm)	496.00
Profile available water capacity (mm)	198.00
Profile limiting saturated hydraulic conductivity (mm/hour)	0.50
Surface saturated hydraulic conductivity (mm/hour)	1.00
Runoff curve number II (coefficient)	73.00
Soil evaporation U (mm)	6.00
Soil evaporation Cona (mm/sqrt day)	3.50

Profile



Planting regime: Continuous Rhodes grass pasture

Average monthly cover (fraction) (minimum - maximum)	0.69 (0.64 - 0.76)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.9 x Pan coefficient 1)	0.90
Dead cover (if Mthly Covers) or Tot. cover left after harvest (fraction)	1.00
Potential rooting depth in defined soil profile (mm)	1200.00
Salt tolerance	Tolerant
Salinity threshold (dS/m soil saturation extract)	7.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03

Irrigation rules: New irrigation method

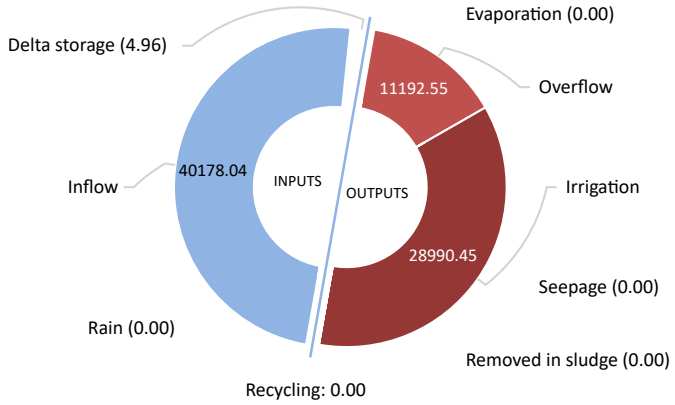
Rule 1. Irrigation triggered when soil water deficit reaches 25.00 mm and rainfall is less than or equal to 15.00 mm
Rule 2. Irrigate up to a soil water content of drained upper limit plus 0.00 mm
Rule 3. Irrigation window from 1/1 to 31/12 including the days specified
Rule 4. A minimum of 1 days must be skipped between irrigation events

Performance

Pond system information

Pond System Configuration: 1 closed (sludge-free) storage tank (wet weather storage pond: 363 m3)

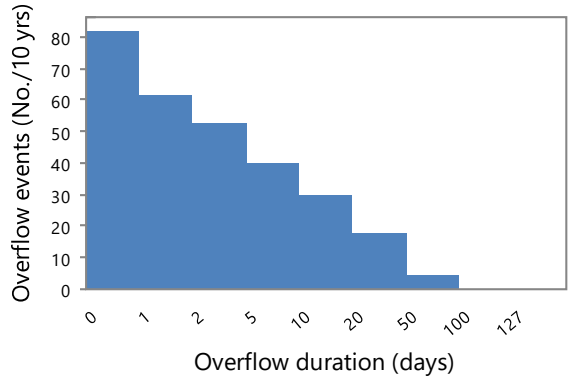
Pond system water balance (m3/year)

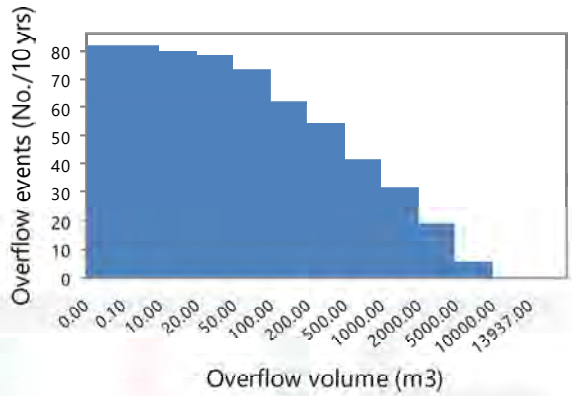


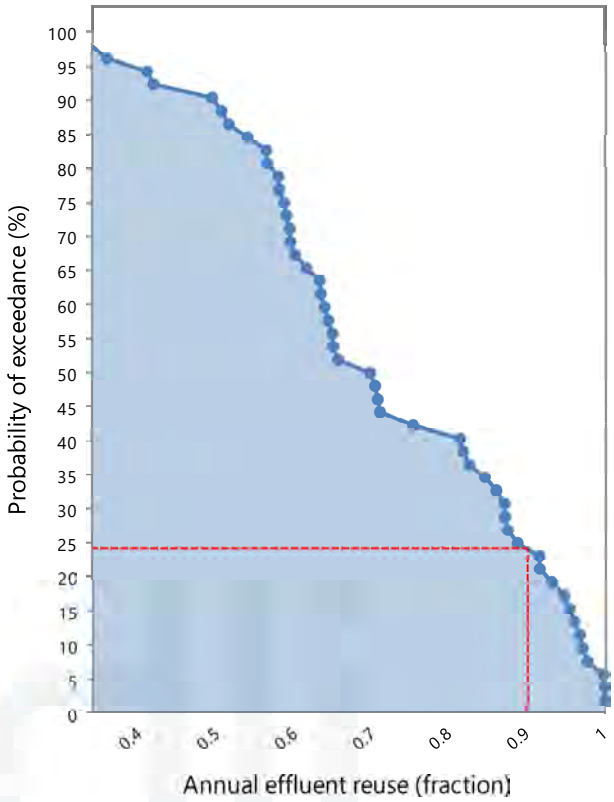
Name	Value
Rain	0.00
Inflow	40178.04
Recycling	0.00
Evaporation	0.00
Overflow	11192.55
Irrigation	28990.45
Seepage	0.00
Removed in sludge	0.00
Delta storage	-4.96

Overflow and reuse diagnostics

Metric	Value
Total volume of overflow (m3/10 years)	111925.49
Total number of overflow events (events/10 years)	81.76
Total number of pond overflow days (days/10 years)	1053.53
Probability of at least 90% effluent reuse (%)	24.18
Effluent reuse (Proportion of inflow + net gain in rain that is irrigated) (fraction)	0.72





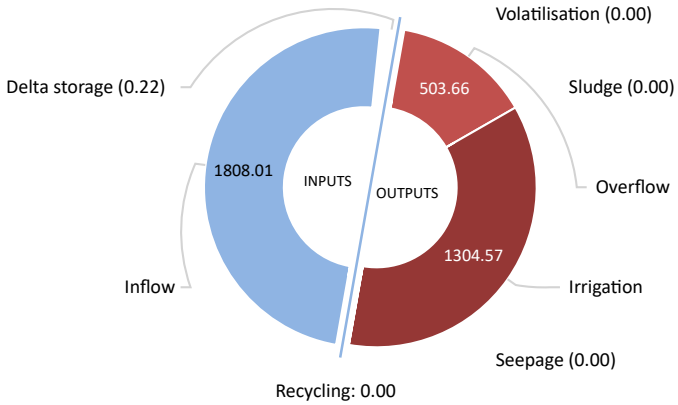


Performance

Pond system information

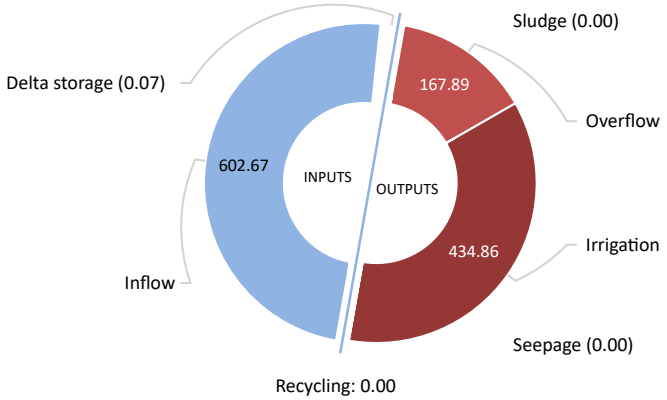
Pond System Configuration: 1 closed (sludge-free) storage tank

Pond system nitrogen balance (kg/year)



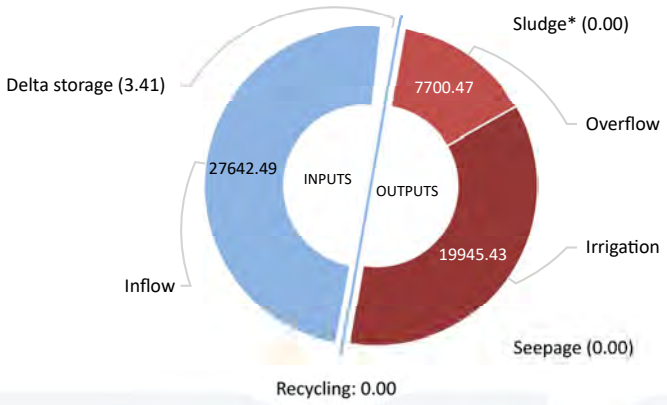
Name	Value
Inflow	1808.01
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	503.66
Irrigation	1304.57
Seepage	0.00
Delta storage	-0.22

Pond system phosphorus balance (kg/year)



Name	Value
Inflow	602.67
Recycling	0.00
Sludge	0.00
Overflow	167.89
Irrigation	434.86
Seepage	0.00
Delta storage	-0.07

Pond system salt balance (kg/year)



Name	Value
Inflow	27642.49
Recycling	0.00
Sludge*	0.00
Overflow	7700.47
Irrigation	19945.43
Seepage	0.00
Delta storage	-3.41

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

Pond system sludge accumulation: 0.00 kg dwt/year

Performance

Pond system information

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

Pond nutrient concentrations and salinity

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	45.00
Average phosphorus concentration of pond liquid (mg/L)	15.00
Average salinity of pond liquid (dS/m)	1.07

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	45.00
Final phosphorus concentration of pond liquid (mg/L)	15.00
Final salinity of pond liquid (dS/m)	1.08

Performance

Water use (assumes 100% irrigation efficiency)

Metric	Value
Pond water irrigated (m3/year)	28990.45
Average shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	28990.45
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 m3/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation quality

Metric	Value
Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	45.00
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	45.00
Average phosphorus concentration of irrigation water (mg/L)	15.00
Average salinity of irrigation water (dS/m)	1.07

Irrigation diagnostics

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

Irrigation triggering and application

No. Days without Irrigation Applied per Year: 236.75 (with day below minimum time set between irrigations [128.53], water demand too small to trigger irrigation [97.76] and rain exceeding specified rainfall threshold [10.45])
No. Days without Irrigation Applied per Year: 236.75 (with not triggered)
No. Days with Irrigation Applied per Year: 128.51 (with supply limited - partial application [123.14] and full application [5.37])
No. Days with Irrigation Triggered per Year: 128.51

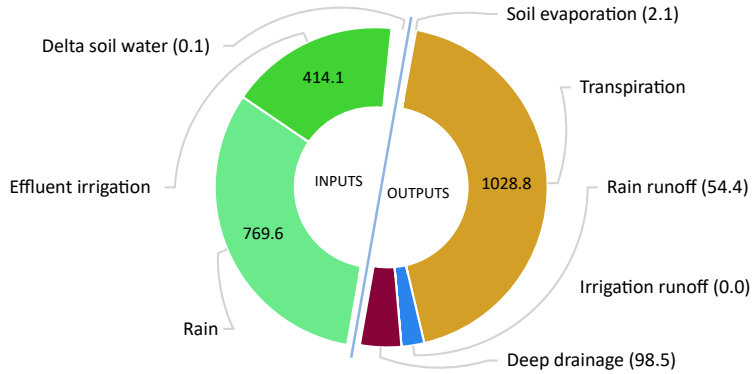
Performance

Paddock information

Paddock: New paddock, 7 ha

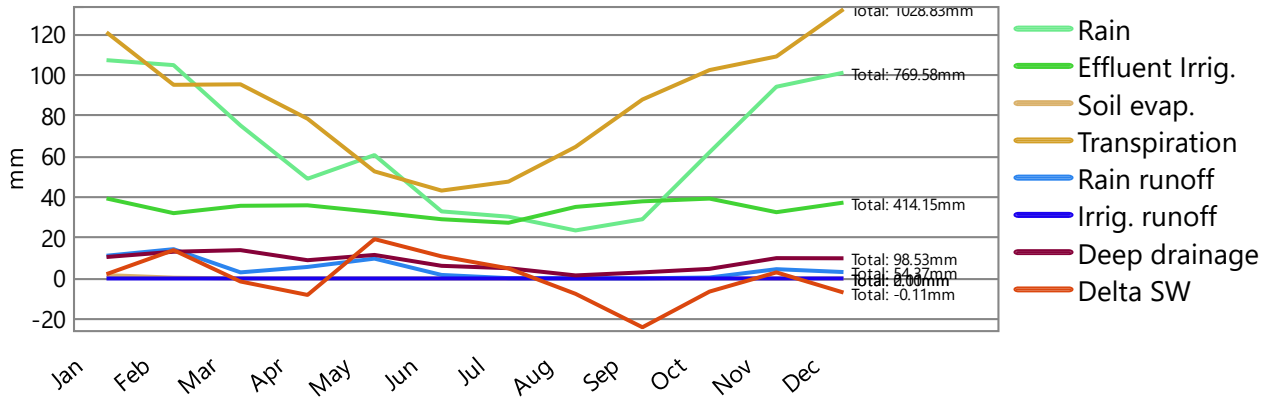
Soil Type: Black vertisol, 173.10 mm PAWC at maximum root depth

Soil water balance (mm/year)

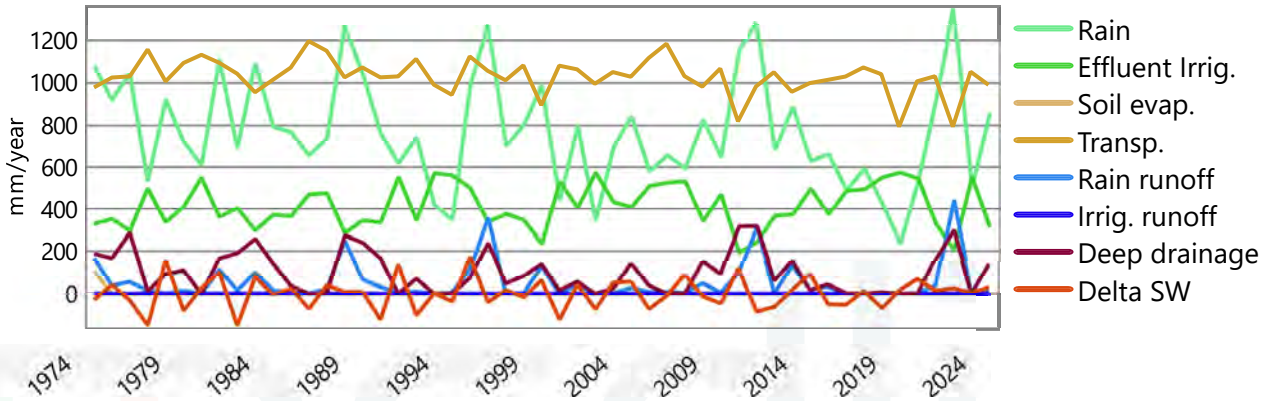


Name	Value
Rain	769.6
Effluent irrigation	414.1
Soil evaporation	2.1
Transpiration	1028.8
Rain runoff	54.4
Irrigation runoff	0.0
Deep drainage	98.5
Delta soil water	-0.1

Average monthly totals (mm)



Average annual totals (mm/year)

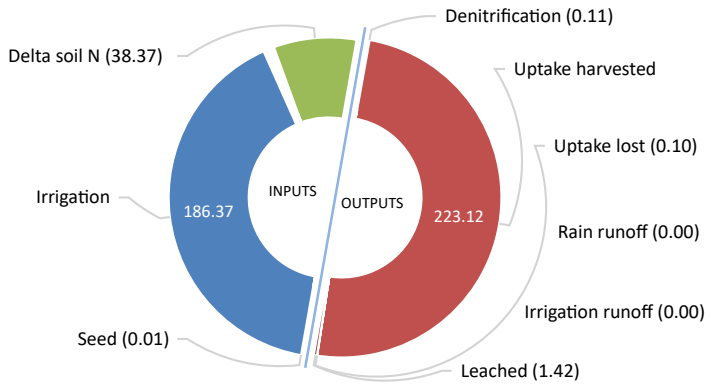


Performance

Paddock information

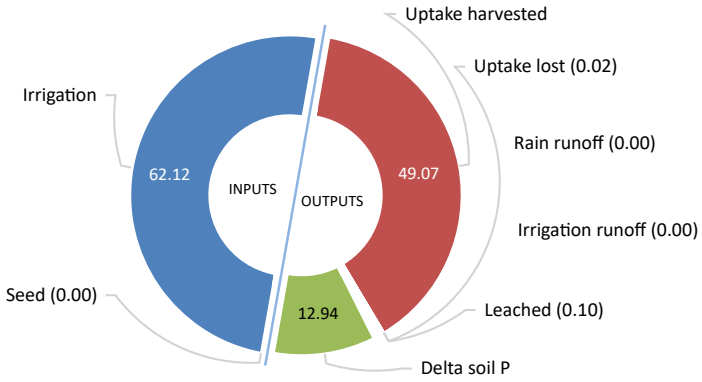
Paddock: New paddock, 7 ha
Soil Type: Black vertisol
Irrigation Ammonia-N Volatilisation Losses (kg/ha/year): 0.00
Proportion of Total Nitrogen in Irrigated Effluent as Ammonium (fraction): 0.76

Soil nitrogen balance (kg/ha/year)



Name	Value
Seed	0.01
Irrigation	186.37
Denitrification	0.11
Uptake harvested	223.12
Uptake lost	0.10
Rain runoff	0.00
Irrigation runoff	0.00
Leached	1.42
Delta soil N	-38.37

Soil phosphorus balance (kg/ha/year)



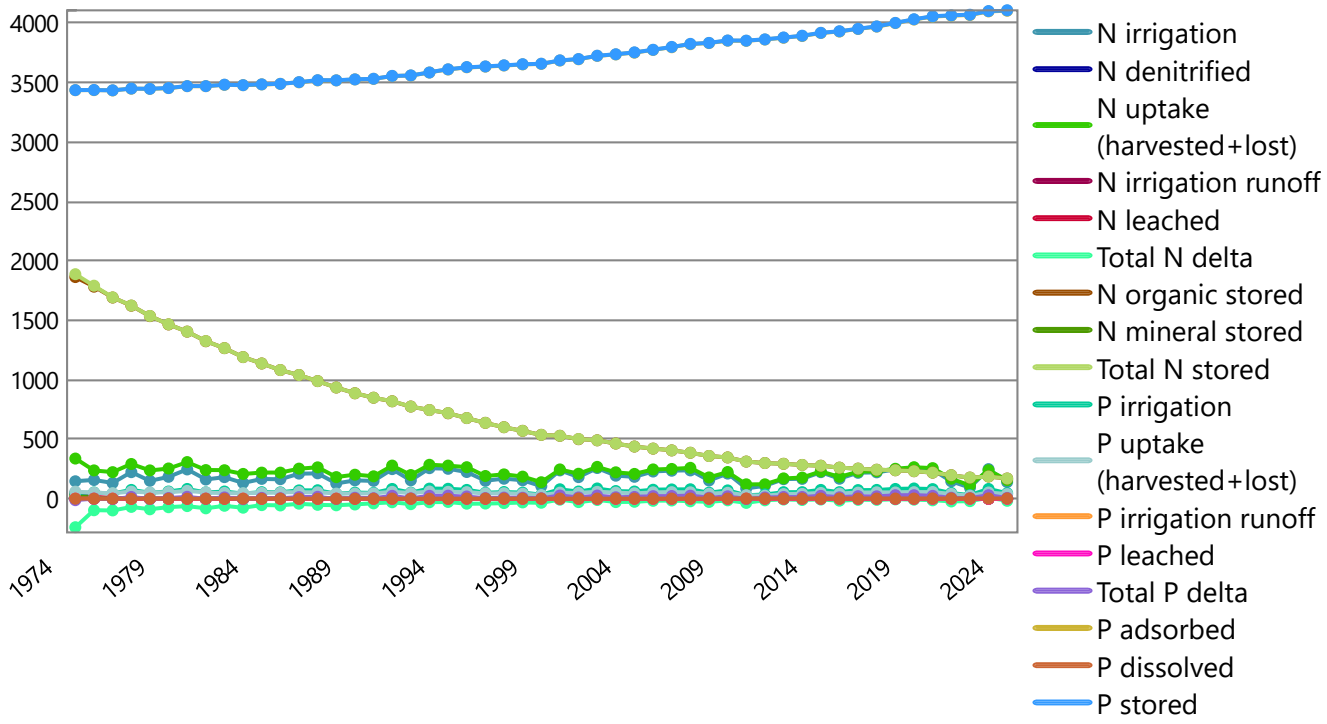
Name	Value
Seed	1.76E-03
Irrigation	62.12
Uptake harvested	49.07
Uptake lost	0.02
Rain runoff	0.00
Irrigation runoff	0.00
Leached	0.10
Delta soil P	12.94

Performance

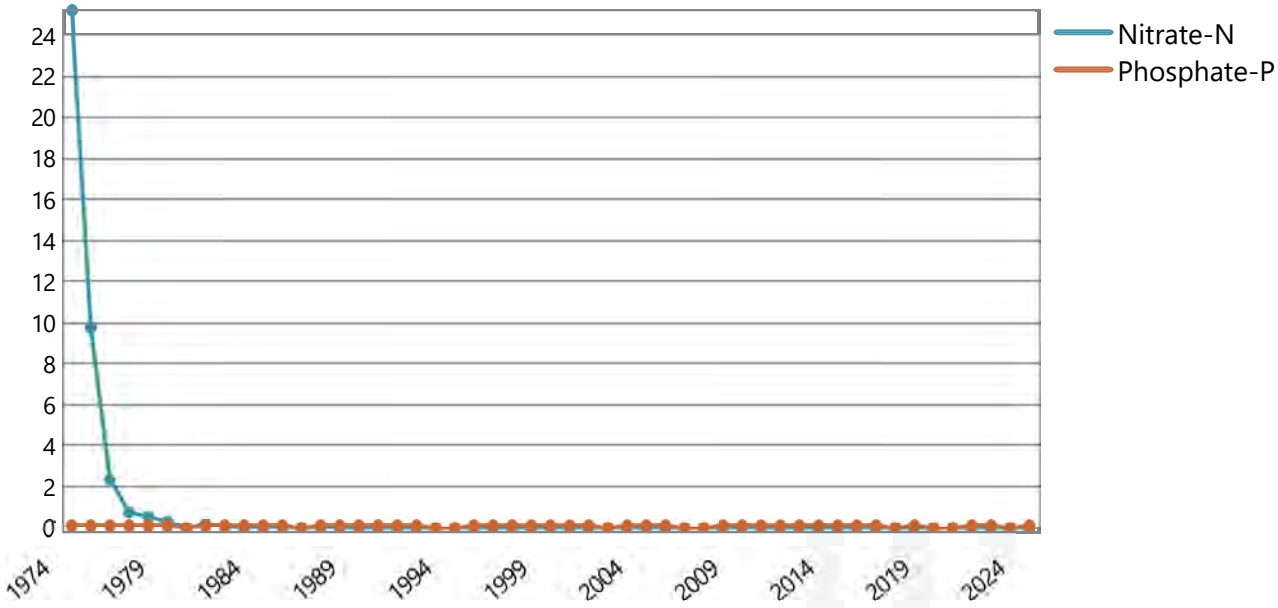
Paddock information

Paddock: New paddock, 7 ha
Soil Type: Black vertisol

Annual nutrient totals (kg/ha)



Annual nutrient leaching concentration (mg/L)



Performance

Paddock information

Paddock: New paddock, 7 ha
Soil Type: Black vertisol
Planting Regime: Continuous Rhodes grass pasture

Plant growth (minimum - maximum)

Metric	Value
Average annual shoot dry matter harvestable yield* (kg/ha/year)	16402.13 (8469.60 - 22154.87)
Average annual shoot dry matter lost (kg/ha/year)	5.27 (0.00 - 45.93)
Average monthly plant (green) cover (fraction)	0.69 (0.64 - 0.76)
Average monthly root depth (mm)	1198.48 (1185.39 - 1200.00)

Plant nutrient uptake (minimum - maximum)

Metric	Value
Average annual shoot nitrogen in harvestable yield* (kg/ha/year)	223.12 (113.27 - 338.13)
Average annual shoot nitrogen lost (kg/ha/year)	0.10 (0.00 - 0.93)
Average annual shoot phosphorus in harvestable yield* (kg/ha/year)	49.07 (25.41 - 66.23)
Average annual shoot phosphorus lost (kg/ha/year)	0.02 (0.00 - 0.14)
Average annual shoot nitrogen concentration (fraction dwt)	0.01 (0.01 - 0.02)
Average annual shoot phosphorus concentration (fraction dwt)	0.003 (0.003 - 0.003)

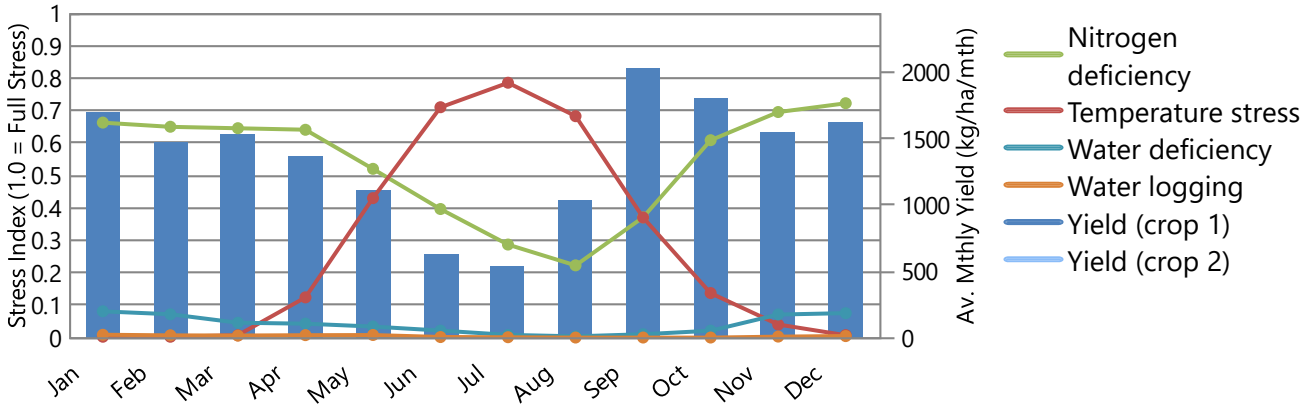
*Harvestable yield is a measure of *net* gain over a nominated period - say monthly. It is the total shoot-dry-matter gain minus any shot-dry-matter loss within a given period. Hence, just like financial investments, negative harvestable yields may occur when the (episodic) losses exceed the gains made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

Performance

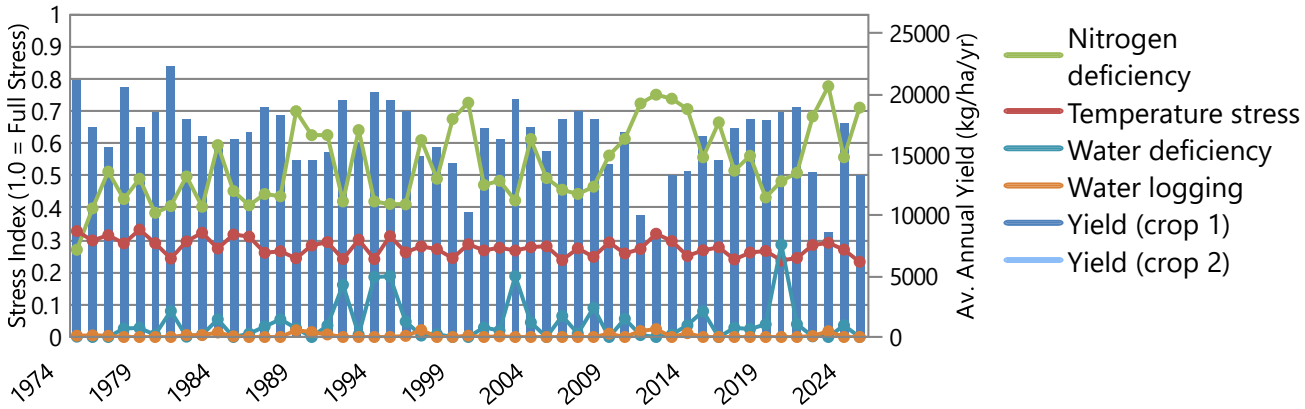
Paddock information

Paddock: New paddock, 7 ha
Soil Type: Black vertisol
Planting Regime: Continuous Rhodes grass pasture

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



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



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

Normal and forced harvest information

No. of Harvests per Year: 2.84 (normal).
No. Days without Crop per Year (no./year): 0.00

Performance

Paddock information

Paddock: New paddock, 7 ha
Soil Type: Black vertisol
Planting Regime: Continuous Rhodes grass pasture

Plant salinity tolerance

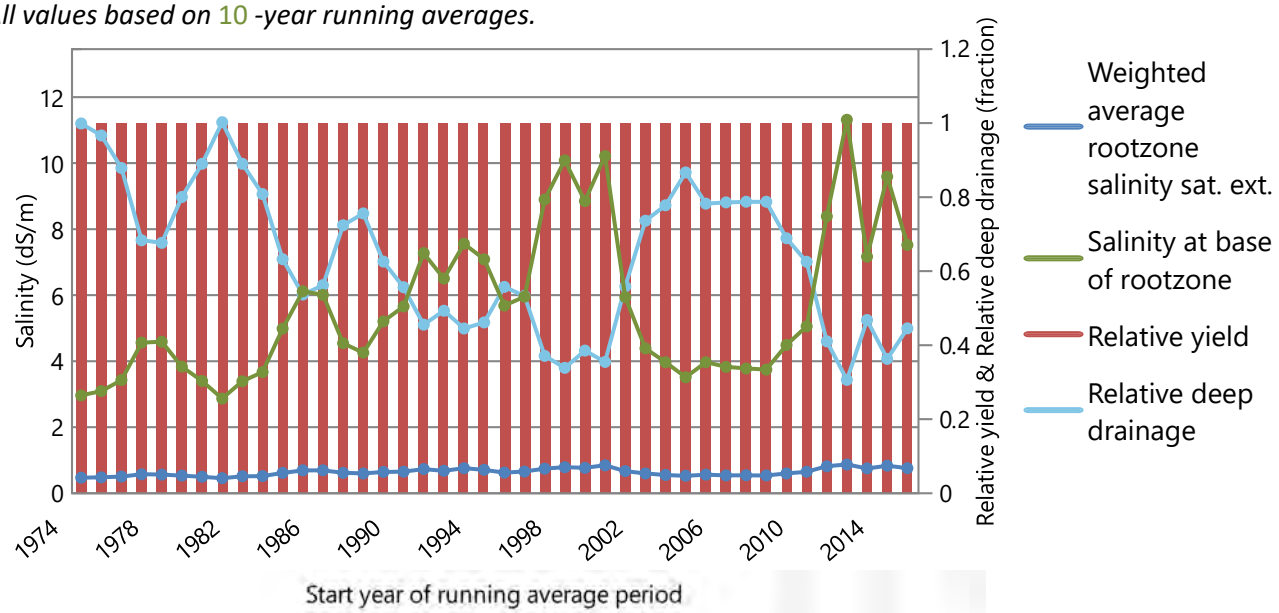
Metric	Value
Salt tolerance	Tolerant
Salinity threshold (dS/m soil saturation extract)	7.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03
No. years assumed for leaching to reach steady-state (years)	10.00

Soil salinity

Metric	Value
Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.42
Salt added by rainfall (kg/ha/year)	137.32
Average annual salt added & leached at steady state (kg/ha/year)	2986.67
Average leaching fraction based on 10 -year running averages (fraction)	0.30
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.64
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	5.66
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

Average annual rootzone salinity and relative yield

All values based on 10 -year running averages.

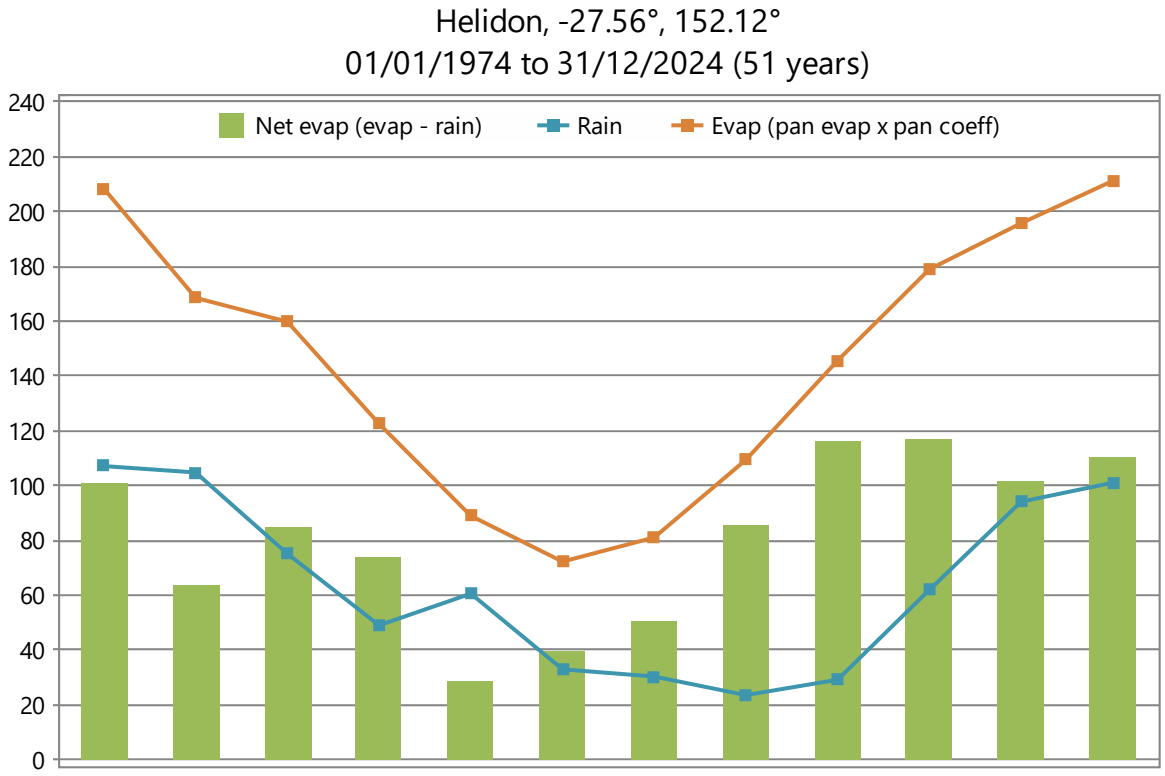


Diagnostics

Scenario information

Enterprise: Helidon RRC

Climate long-term monthly averages (mm)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	107.1	104.8	75.1	49.0	60.6	32.9	30.3	23.6	29.1	61.9	94.1	101.0	769.6
Evap	208.4	168.5	159.8	122.6	89.0	72.2	81.1	109.4	145.6	178.9	195.7	211.2	1742.5
Net evap	101.2	63.8	84.7	73.6	28.4	39.3	50.7	85.9	116.5	117.0	101.6	110.2	972.9
Net evap/day	3.3	2.3	2.7	2.5	0.9	1.3	1.6	2.8	3.9	3.8	3.4	3.6	2.7

Diagnostics

Pond system information

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

Effluent Type: - 40178.04 m3/year or 110.00 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.25 non-zero flow days/year.

Constituent	Concentration (mg/L)	Load (kg/year)
Total nitrogen	45.00 (45.00 - 45.00)	1808.01 (1806.75 - 1811.70)
Total phosphorus	15.00 (15.00 - 15.00)	602.67 (602.25 - 603.90)
Total dissolved salts	688.00 (688.00 - 688.00)	27642.49 (27623.20 - 27698.88)
Volatile solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

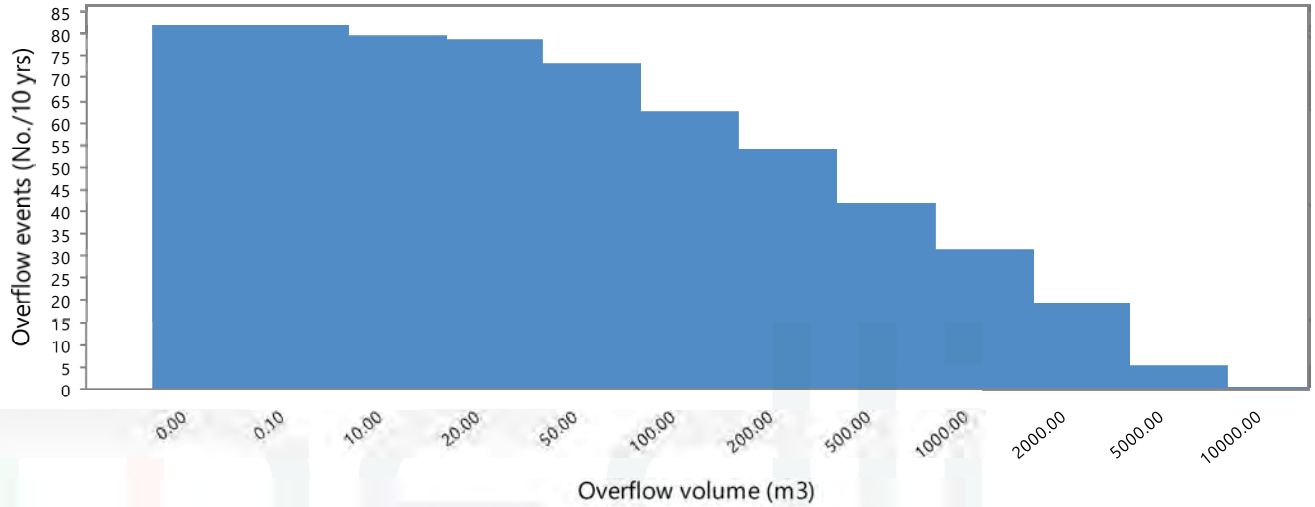
Ammonia-N loss from pond system water surface area: 0.00 kg/m2/year

Last pond (wet weather store): 363.00 m3

Metric	Value
Theoretical hydraulic retention time (days)	3.30
Volume of overflow (m3/year) Average (minimum-maximum)	11192.55 (0.00 - 26219.77)
Volume of overflow per day (m3/day) Average (minimum-maximum)	30.64 (0.00 - 110.00)
No overflow days - Average per year (Total in run period)	105.35 (5373)
No. overflow events per 10 years exceeding threshold of 0.104 m3* (events/10 years)	81.76
Average overflow event recurrence interval (years)	0.12
Average duration of overflow (days)	12.88
Probability of at least 90% effluent reuse (%)	24.18
Effluent reuse (proportion of inflow + net rain gain that is irrigated) (fraction)	0.72
Average salinity (dS/m)	1.07
Salinity on final day of simulation (dS/m)	1.08

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

Volume distribution of the overflow events



Diagnostics

Scenario information

Area irrigated: 7 ha total area

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

	Quantity/year	Quantity/ha/year
Total irrigation applied (m3)	28990.45	4141.49
Total nitrogen applied (kg)	1304.57	186.37
Total phosphorus applied (kg)	434.86	62.12
Total salts applied (kg)	19945.43	2849.35

Shandying

Metric	Value
Annual allocation of fresh water for shandying (m3/year)	0.00
Average shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)
Minimum shandy water is used	No

Irrigation issues

Metric	Value
Number of days without irrigation (days/year)	236.75

Diagnostics

Paddock information

Paddock: - New paddock, 7 ha

Irrigation: New irrigation method with 0% ammonium loss during irrigation

Irrigation Rules
Irrigation triggered when soil water deficit reaches 25.00 mm and rainfall is less than or equal to 15.00 mm
Irrigate up to a soil water content of drained upper limit plus 0.00 mm
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 1 days must be skipped between irrigation events

Soil water balance (mm): Black vertisol, 173.10 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	107.1	104.8	75.1	49.0	60.6	32.9	30.3	23.6	29.1	61.9	94.1	101.0	769.6
Efflt. irrg.	39.3	32.1	35.7	35.9	32.6	29.1	27.4	35.2	37.9	39.2	32.5	37.2	414.1
Soil evap	1.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
Transpn.	120.9	95.1	95.3	78.4	52.6	43.2	47.6	64.6	87.8	102.3	109.0	132.2	1028.8
Rain runoff	11.2	14.4	3.0	5.6	9.8	1.8	0.2	0.1	0.1	0.5	4.6	3.1	54.4
Irr. runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drainage	10.6	13.1	13.9	9.0	11.6	6.3	5.0	1.5	3.0	4.7	10.0	9.9	98.5
Delta SW	2.2	13.9	-1.5	-8.1	19.3	10.8	4.9	-7.5	-23.9	-6.4	3.0	-6.9	-0.1

Soil nitrogen balance: (Concentrations are flow-weighted)

Metric	Value
Average annual nitrogen added in seed (kg/ha/year)	0.01
Average annual nitrogen added from irrigation (kg/ha/year)	186.37
Av. annual soil N removed by uptake (harvest + lost) (kg/ha/year)	223.22 (223.12, 0.10)
Av. annual soil nitrogen removed by denitrification (kg/ha/year)	0.11
Average annual soil nitrogen leached (kg/ha/year)	1.42
Average annual nitrate-N loading to groundwater (kg/ha/year)	1.42
Soil organic-N kg/ha (Initial - Final)	1936.00 - 170.40
Soil inorganic-N kg/ha (Initial - Final)	191.20 - 0.06
Average nitrate-N concentration of deep drainage (Max annual concentration)	
Across all years (mg/L)	1.44 (25.21)
Excluding first year of data (mg/L)	0.51 (9.79)

Soil phosphorus balance: (Concentrations are flow-weighted)

Metric	Value
Average annual phosphorus added in seed (kg/ha/year)	1.76E-03
Average annual phosphorus added from irrigation (kg/ha/year)	62.12
Av. annual soil P removed by uptake (harvest + lost) (kg/ha/yr)	49.09 (49.07, 0.02)
Average annual soil phosphorus leached (kg/ha/year)	0.10
Dissolved phosphorus (kg/ha) (Initial - Final)	0.69 - 2.88
Adsorbed phosphorus (kg/ha) (Initial - Final)	3445.60 - 4103.17
Average phosphate-P concentration in rootzone (mg/L)	0.27
Average phosphate-P concentration of deep drainage (Max annual concentration)	
Across all years (mg/L)	0.10 (0.10)
Last year only (mg/L)	0.10 (N.D.*)
Design soil profile storage life based on average infiltrated water phosphorus concn. of 5.50 mg/L (years)	430.14

* Not determined

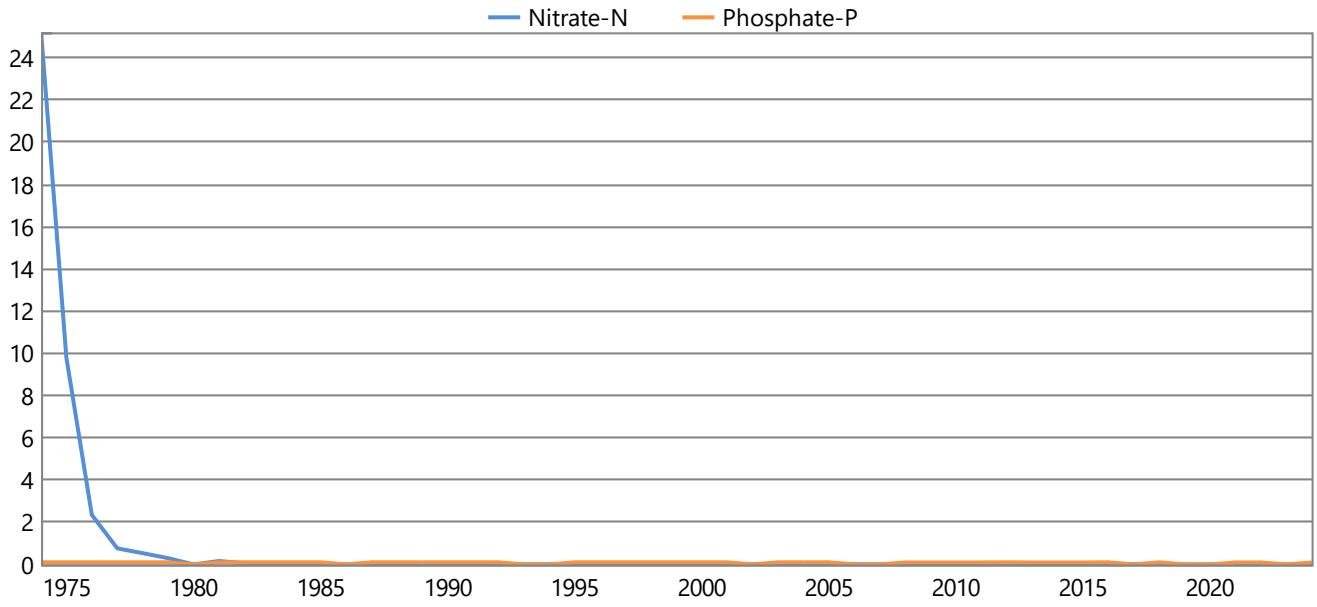
Diagnostics

Paddock information

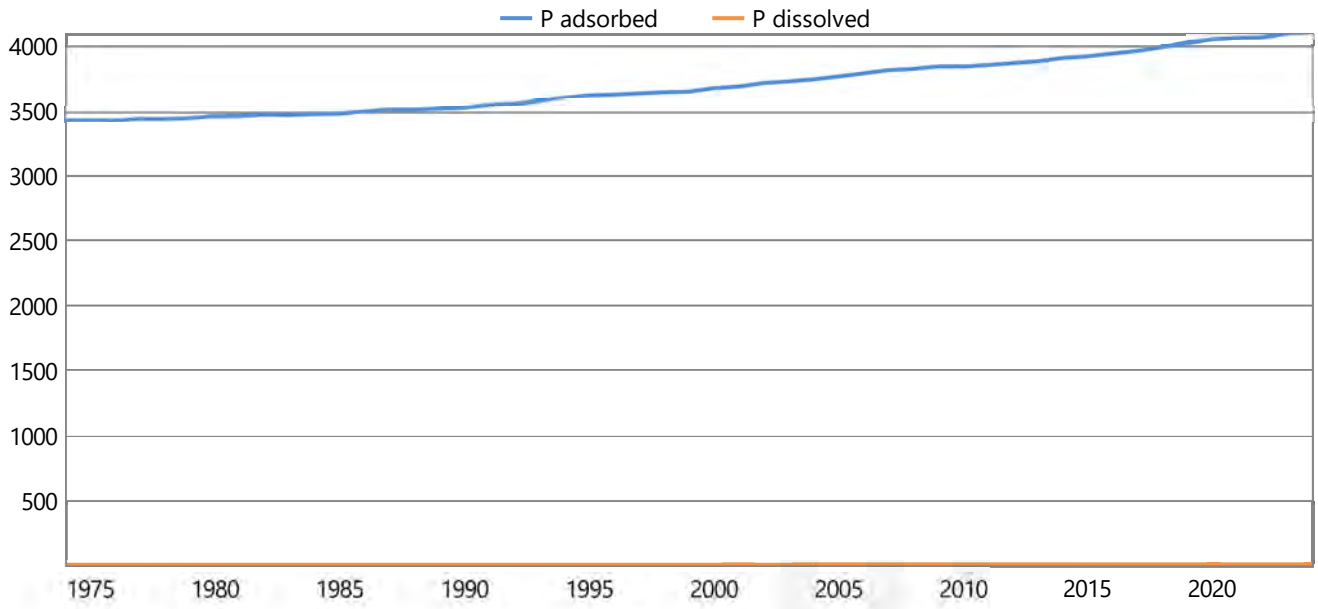
Paddock: New paddock, 7 ha

Irrigation: New irrigation method with 0% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual phosphate-P in soil (kg/ha)



Diagnostics

Paddock information

Paddock: New paddock, 7 ha

Planting Regime: Continuous Rhodes grass pasture

Average plant performance (minimum - maximum)

Metric	Value
Average annual shoot dry matter harvestable yield (kg/ha/year)	16402.13 (8469.60 - 22154.87)
Average annual shoot dry matter lost (kg/ha/year)	5.27 (0.00 - 45.93)
Average monthly plant (green) cover (fraction)	0.69 (0.64 - 0.76)
Average monthly crop factor (fraction)	0.62 (0.58 - 0.68)
Dead cover (if Mthly Covers) or Tot. cover left after harvest (fraction)	1.00
Average monthly root depth (mm)	1198.48 (1185.39 - 1200.00)
Average number of normal harvests per year (no./year)	2.84 (1.00 - 4.00)
Average number of normal harvests for last five years only (no./year)	2.40
Average number of forced harvests per year (no./year)	0.00 (0.00 - 0.00)
Average number of forced harvests for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.53 (0.27 - 0.78)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.02)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.79 (0.50 - 0.92)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.04 (0.00 - 0.08)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.01)
No. days without crop per year. Excludes bare fallow days (days)	0.00

Soil salinity - plant salinity tolerance: Tolerant

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

All values based on 10 -year running averages.

Metric	Value
Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.42
Salt added by rainfall (kg/ha/year)	137.32
Average annual salt added & leached at steady state (kg/ha/year)	2986.67
Average leaching fraction based on 10 -year running averages (fraction)	0.30
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.64
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	5.66
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

Diagnostics

Run information

Messages generated when the scenario was run
********** WASTESTREAM RESULTS **********
TABLE OF QUANTITY AND QUALITY OF EACH RAINFALL-INDEPENDENT WASTESTREAM (AFTER PRETREATMENT AND BEFORE ENTERING ANY SEDIMENTATION BASIN)
_____
Source Volume_m3/yr N conc_mg/L P conc_mg/L TDS conc_mg/L N load_kg/yr P load_kg/yr TDS load_kg/yr
New generic system 40178.0 45.0 15.0 688.0 1808.0 602.7 27642.5
_____
********** END WASTESTREAM RESULTS **********
No. Days without Irrigation Applied per Year: 236.75 (with day below minimum time set between irrigations [128.53], water demand too small to trigger irrigation [97.76] and rain exceeding specified rainfall threshold [10.45])
UNCONDITIONAL FINISH

6.12. Urban Utilities Risk Matrix

Table 2 Urban Utilities Consequence Descriptors

Consequence Category	Least Significant	Minor Significance	Moderate Significance	High Significance	Most Significant
Project Performance Unexpected project expenditure or impact to the successful achievement of project outcomes relating to strategic initiatives.	• Project fails to deliver up to <10% of forecast business benefits • Cost impact of <10% of approved budget Minor delay to the overall project schedule (up to 10% increase)	• Project fails to deliver 10-20% of forecast business benefits • Cost impact of 10-20% of approved budget Minor delay to the overall project schedule (10-20% increase)	• Project fails to deliver 20-30% of forecast business benefits • Cost impact of 20-30% of approved budget Minor delay to the overall project schedule (20-30% increase)	• Project fails to deliver 30-50% of forecast business benefits • Cost impact of 30-50% of approved budget Moderate delay to overall project schedule (30-50% increase)	• Project fails to deliver >50% of forecast business benefits • Cost impact of >50% of approved budget Significant delay to overall project schedule (>50% increase)
Product & Service Disruption Service Disruptions [1] or Operational Disruptions [2] to customers and/or Key Commercial Accounts (KCA) [3], affecting, Critical Customers [4], community facilities, transport connections/routes, or disruptions to SOCI-Critical Components[5]	• Service Disruption to <50 customers • Service Disruption which exceeds 5 hours • 1 Service/Operational Disruption to a single customer in a 2-year period • No Service/Operational Disruption to KCA/Critical Customer No disruption to suburban streets, CBD, major transport connections, or routes	• Service Disruption to 51-100 customers • Service Disruption which exceeds 12 hours 1 Service/Operational Disruption to a single customer in a 1-year period • Minor Service/Operational Disruption to individual KCA/Critical Customer • Closure of a suburban street <5 Complaints [6] resulting from a single event (unrelated to a declared disaster)	• Service Disruption to 101-1,000 customers • Service Disruption which exceeds 24 hours • 2-3 Service/Operational Disruptions to a single customer in a 1-year period • Moderate Service/Operational Disruption to individual KCA/Critical Customer • Closure of multiple suburban streets, or minor disruption (but not closure) to CBD, major transport connections, or routes 5-15 Complaints resulting from a single event, or repeat complaints or requests for review received from >1 customer in relation to an ongoing concern	• Service/Operational Disruption to 1,001-5,000 customers; or • Service Disruption which exceeds 48 hours • 4-9 Service/Operational Disruptions to a single customer in a 1-year period • Shutdown of individual KCA/Critical Customer operations, or Service Disruption to >1 KCA/Critical Customer • Moderate disruption or closure of major transport connections, or routes • 16-25 Complaints resulting from a single event or repeat complaints or requests for review received from 3-5 customers in relation to an ongoing concern Partial interruption to a *single* SOCI-Critical Component	• Service Disruption to >5,000 customers • Service Disruption which exceeds 96 hours • >9 Service/Operational Disruptions to a single customer in a 1-year period • Shutdown of >1 KCA/Critical Customer, or any unplanned disruption to a dialysis customer • Significant or prolonged disruption (including closure) of major transport connections or routes, including any disruption to an airport • >25 Complaints resulting from a single event or repeat complaints or requests for review received from >5 customers in relation to an ongoing concern Partial interruption to *multiple* SOCI-Critical Components, or complete interruption to a *single* SOCI-Critical Component

[1] ***Service Disruption*** *means a customer's water or sewage is disconnected, or customers are otherwise advised/unable to use their water and sewage facilities (e.g., water contamination issue, unable to use sewage facilities due to high water level in the sewer for an extended period).*
[2] ***Operational Disruption*** *means adverse impact caused by Urban Utilities' activities, including restricted access, traffic, or nuisance/amenity (i.e., emission of noise, odour, aerosols, light, particulates, or vibration)*
[3] ***Key Commercial Customers*** *are our highest valued customers (usually over 100,000 kilolitres per annum) that are actively managed by an account manager within the Key Commercial Accounts Team.*
[4] ***Critical Customers*** *are consumers which are dependent on water to carry out their operations in the interest of public safety and health.*
[5] ***SOCI-Critical Components*** *means the physical facilities, systems, assets, supply chains, information technologies and communication networks (as defined under the Security of Critical Infrastructure Act) that are critical to the delivery of Urban Utilities' essential products and services.*
[6] ***Complaint*** *is defined as per Urban Utilities' Complaints Management Policy (POL74). Note: 'complaint' in this context is unrelated to a declared disaster.*

Consequence Category	Least Significant	Minor Significance	Moderate Significance	High Significance	Most Significant
Health, Safety & Wellbeing Urban Utilities' products, services or activities negatively affect the health, safety and well-being of employees, contractors, site visitors, and our communities.	• Very minor injury with no treatment required • Person experiences no discernible stress or apprehension arising from an incident No impact on regular work duties	• Minor injury, first aid treatment required with no lasting impact • Short-term illness with no lasting impact • Person experiences minor stress arising from an incident • A reduction in worker's ability to perform regular work duties in the short term Level 4 near miss (non-High Potential Event[7])	• Injury/illness requiring medical treatment to one or more people • Injury resulting in short-term disability or requiring a suitable duties program • Lost Time Injury (LTI) impact (less than 10 days) or a noticeable reduction in worker's ability to perform regular duties in the immediate future • Person experiences moderate stress arising from an incident • Improvement notice or direction issued by Regulator. • Direct or vicarious exposure to low level unreasonable behaviours (discrimination, bullying, harassment etc) Level 3 High Potential Event (energy release with *some* active barriers/controls)	• Serious injury/illness (notifiable incidents to regulator) requiring treatment or hospitalisation • Major or Multiple injuries resulting in temporary long-term disability or ill health to one or more persons • Significant Lost Time Injury (LTI) impact (10 days or more) • Person experiences major stress arising from an incident • An inability to perform work duties in the medium to long term • Prohibition Notice from Regulator • Direct or vicarious exposure to mid-level unreasonable behaviours Level 2 High Potential Event (energy release with *zero* active barriers/controls)	• Severe injury / illness, resulting in permanent injury / disability or ill health to one or more persons • Single or multiple fatalities • Person experiences extreme stress arising from an incident • An inability to perform work duties in the foreseeable future • Regulator prosecution or fines almost certain Direct or vicarious exposure to high/ extreme level unreasonable behaviours and/or assault
Water Quality & Public Health Urban Utilities' products, services and activities negatively affect the health of our communities beyond our site boundaries	• A water quality incident resulting in: ◦ An isolated instance of zero disinfection ◦ Very minor acute impact or illness, with no treatment required Interruption to a single residence with little to no impact to a customer's ability to sleep, relax or study	• A water quality incident resulting in: ◦ Multiple incidences of zero disinfection or isolated breach of an aesthetic parameter within a zone ◦ Isolated illness requiring first aid treatment only Isolated (single residence) interruption to a customer's ability to sleep, relax or study.	• A water quality incident resulting in: ◦ Zero disinfection across multiple zones, or multiple exceedances of aesthetic parameters within a zone ◦ Isolated illness requiring medical treatment, but with no lasting effects Limited (single street or block) interruption to customers' ability to sleep, relax or study	• A water quality incident resulting in: ◦ Widespread exceedances of an aesthetic parameter across multiple zones, or an isolated exceedance of ADWG health parameter ◦ Isolated illness causing *temporary* long-term disability or ill health ◦ Limited (single street or block) illnesses requiring treatment, with no lasting effects Localised (single catchment or suburb) prolonged interruption to customers' ability to sleep, relax or study	• A water quality incident resulting in: ◦ A Boiled Water or Do Not Drink notice, or widespread exceedances of an ADWG health parameter ◦ Isolated illness causing *permanent* disability, ill health, or fatality ◦ Localised (single catchment or suburb) illnesses requiring treatment, with no lasting effects Widespread (multiple catchments or suburbs) prolonged interruption to customers' ability to sleep, relax or study
Financial Performance Financial losses or unplanned expenditure is incurred by Urban Utilities,	• **Corporate:** unplanned financial cost/debt of <$5M p.a. • **Operational:** incident management, remediation, or	• **Corporate:** unplanned financial cost/debt of $5-10M p.a. • **Operational:** incident management, remediation, or	• **Corporate:** unplanned financial cost/debt of $11-50M p.a. • **Operational:** incident management, remediation, or	• **Corporate:** unplanned financial cost/debt of $51-100M p.a. • **Operational:** incident management, remediation, or	• **Corporate:** Unplanned financial cost/debt of >$100M p.a. • **Operational**: incident management, remediation, or

[7] ***High Potential Event*** *refers to incidents which may have resulted in serious injury/illness and/or a fatality.*

Consequence Category	Least Significant	Minor Significance	Moderate Significance	High Significance	Most Significant
including financial penalties.	impact management costs <10% of agreed budget **Aggregated Losses (across multiple assets):** asset damage or service interruption costs of <$1M p.a.	impact management costs 10-20% of agreed budget **Aggregated Losses (across multiple assets):** asset damage or service interruption costs of $1-5M p.a.	impact management costs 21-30% of agreed budget **Aggregated Losses (across multiple assets):** asset damage or service interruption costs of $6M-10M p.a.	impact management costs 31-50% of agreed budget **Aggregated Losses (across multiple assets):** asset damage or service interruption costs of >$11-50M p.a.	impact management costs >50% of agreed budget **Aggregated Losses (across multiple assets):** asset damage or service interruption costs of >$50M
Environment & Heritage [8] Impacts including harm, public concern, nuisance, administrative offences, and reduction in Environmental Values *Refer to PRO249 for guidance*	• Transient (<1 month) impact to the natural environment (land, water, air, flora, or fauna) • Controlled site, single local temporary impact Damage to items/areas of low cultural or heritage significance	• Temporary (1-6 months) impact to the natural environment (land, water, air, flora, or fauna) • Single local impact/habitat destruction • Duty to notify the regulator of an environmental or heritage event Minor, repairable damage to items/areas of high cultural or heritage significance	• Short-term (6 months-1 year) impact to the natural environment (land, water, air, flora, or fauna) • Localised (single catchment or suburb) impact and some community concerns Significant, but recoverable, damage to items/areas of high cultural or heritage significance	• Medium-term (1-5 years) impact to the natural environment (land, water, air, flora, or fauna) • Localised (single catchment or suburb) impact and a high level of public concern Permanent damage to items/areas of high cultural or heritage significance	• Long term (>5 years) or irreversible impact to the natural environment (land, water, air, flora, or fauna) • Widespread (multiple catchments or suburbs) impact and a high level of public concern Destruction of items/areas of high cultural or heritage significance
Brand & Reputation Urban Utilities' brand or reputation impacted in terms of stakeholder trust in the ability to deliver on reliability, quality, transparency & value for money expectations.	• Standard level of complaints Notification of potential adverse media/ social media coverage.	• Minimal stakeholder concern/interest • Low level community concern Isolated local adverse media/social story	• Adverse reaction among key stakeholders lasting ≤1 week • Suburb-scale community concern • Local adverse media/social media coverage lasting ≤1 week ELT intervention	• Adverse reaction among key stakeholders lasting 1 week to 1 month • Catchment-scale community campaign or action • State/national adverse media/social coverage lasting ≤1 week CEO intervention	• Adverse reaction among key stakeholders lasting 1-3 months • Widespread community action or protest • State/national adverse media/social coverage lasting ≥1 week Board and/or Shareholder intervention
Compliance Risk of regulatory action for breach of obligation (regulation, legal or contractual obligation)	• No regulatory involvement expected [9] • No culpability, where breach could not have been prevented No risk of impact [10]	• Regulator issues requests for additional information to substantiate a potential breach • Low culpability, where breach is inadvertent in nature Minor risk of impact, where impact is transient, localised and/or of low intensity	• Regulator issues financial penalty • Regulator issues formal warning • Moderate culpability, where breach is careless in nature Moderate risk of impact, where impact is temporary to medium-term, localised to medium scale and/or low to medium intensity.	• Court issues financial penalty • Regulator or court issues enforceable undertaking (e.g., mandatory action, Prohibitory Injunction,[11] remedial direction, Protection Order, Evaluation, Transitional Plan, etc.) • High culpability, where breach is intentional/wilful	• Loss of licence to operate • Criminal prosecution, imprisonment of Urban Utilities' officer • Government inquiry with a focus on Urban Utilities • Serious culpability, where breach is intentional/wilful and in contravention of formal directions or warnings

[8] *For further guidance on consequence ratings of environmental health including biodiversity, contamination and other values/ society uses of the environment refer to PRO249*
[9] *The types of likely regulatory action have been linked to the culpability and impact of the breach*

[10] *The compliance component of the consequence matrix has been developed in consideration of PRO249*
[11] ***Prohibitory Injunction*** *means an order made by a court forcing a party to refrain from doing a particular act or thing*

Consequence Category	Least Significant	Minor Significance	Moderate Significance	High Significance	Most Significant
				• Where breach is administrative, information is intentionally concealed Major risk of impact, where impact is long-term, medium to wide-scale and/or of medium to great intensity.	• Where the breach is administrative, information provided is false or misleading Serious risk of impact, where impact is potentially permanent, on a wide-scale and/or of great intensity.

Table 3 Likelihood descriptors

	Threat Likelihood Descriptors			Opportunity Likelihood Descriptors		
	Definition (Qualitative estimates of probability)	**Probability (1 year horizon)**	**Frequency**	**Organisational Capability**	**Organisational Capacity**	**Market Capacity**
Almost Certain	Is expected to occur; almost inevitable. Asset condition rated as "Very Poor" or condition indicates failure or capacity exceedance within 12 months.	> 95%	More frequent than once a year	Sufficient in-house capability exists and can be readily utilised.	Can be done in-house with existing resources.	Internal impacts only or Current market exists, there is existing science in this area and solution has been identified.
Likely	Will occur in most circumstances; not surprised if it happened. Asset condition rated as "Poor" condition indicates failure or capacity exceedance >12 months <24 months.	80% to 95%	Once a year to once every 2 years	In-house capability exists but requires development.	Required resources not available but can be easily acquired.	Emerging market, existing science/ technology needs to be adapted and solution can be envisioned.
Possible	Will occur in a narrow range of circumstances. Asset condition rated as "Fair or Moderate" or condition indicates failure or capacity exceedance >2 years <5 years.	50% to 80%	Once every 2 to once every 10 years	In-house capability is limited and requires recruiting specialist knowledge and capability.	Required resources not available but can be acquired by partnering with external sources.	Emerging market, existing science/ tech needs to be adapted, solution can be envisioned but hurdles expected.
Unlikely	Will occur in specific range of circumstances; surprised if it happened. Asset condition rated as "Good" or condition indicates failure or capacity exceedance >5 years >10 years.	20% to 50%	Once every 10 to once every 20 years	Partner - capability does not exist in-house or is not sufficiently mature and external providers exist and are willing to partner.	Required resources not available and project needs to be outsourced.	New market where some science/ tech exists but is not proven, difficult to envision solution and several hurdles expected.
Rare	Will occur in exceptional circumstances; highly unexpected event. Asset condition rated as "Very Good" or condition indicates failure or capacity exceedance >10 years.	< 20%	Less frequent than once every 20 years	Outsource - capability does not exist and costs to develop in-house outweigh costs of engaging an existing external provider.	Required resources not available and project needs to be outsourced with several parties required to provide input and resources.	New market with a need to discover new science/ tech, difficult to envision solution with significant hurdles expected.

Table 4 Risk matrix

		Likelihood				
		Rare	Unlikely	Possible	Likely	Almost Certain
Consequence	Most Significant	Medium 12	High 17	High 21	Extreme 24	Extreme 25
	High Significance	Medium 8	Medium 14	High 19	High 22	Extreme 23
	Moderate Significance	Low 5	Medium 10	Medium 15	High 18	High 20
	Minor Significance	Low 3	Low 6	Medium 9	Medium 13	High 16
	Least Significant	Low 1	Low 2	Low 4	Medium 7	Medium 11

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UrbanUtilities

TOOGOOLAWAH RESOURCE RECOVERY CENTRE

Minor Amendment application

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1. Introduction

1.1. Purpose of the report

Urban Utilities operates the Toogoolawah Resource Recovery Centre (RRC) under the current Environmental Authority (EA) EPPR00521513 which permits Urban Utilities to operate a number of sewage treatment plants (RRC) under Environmentally Relevant Activity (ERA) 63 including:

- Toogoolawah RRC for ERA 63 (1)(b)(ii) sewage treatment works with a total daily peak design capacity of more than 100 but not more than 1,500EP (no IT or IR).

The purpose of this report is primarily to amend condition LC3 of EPPR00521513 which requires treated sewage effluent given to another party for irrigation purposes must comply with the quality characteristics for release to waters.

The imposition of release to waters parameters on recycled water provided to customers is not commensurate to the risk posed by irrigation. Appropriate treatment and release to land is higher up the management hierarchy for an activity that may affect water outlined in the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (section 14). Therefore, irrigation to land should be the preference over release to waters and presents a lower environmental risk

In addition, Recycled water supplied to the recycled water customer is managed in accordance with the *Public Health Act 2005, Public Health Regulation 2018* and the Guideline for Low Exposure Recycled Water Schemes (the Low Exposure Guideline).

The Low Exposure Guideline provides guidance in the management of recycled water supply to minimise both risks to public health and also risks to the environment, namely to land and waters.

1.2. Application particulars

1.2.1. Eligibility Criteria

ERA 63 activities – Sewage Treatment Works is a prescribed ERA with an ERA standard and eligibility criteria. ERA 63 activities at the Toogoolawah Resource Recovery Centre meet the eligibility criteria for a variation application as the activity falls within its currently licensed threshold of 100 to 1,500EP.

1.2.2. Changes to Standard Conditions

A variation to existing site specific and general conditions in the current Environment Authority is being sought for this amendment. Specifically the existing General Conditions for Esk, Toogoolawah and Kilcoy sites as outlined in Part 2 (C) are being

proposed to be more in line with modern conditions. These conditions have already been the subject of discussion for over a year with the Department as they have been included in the amendment by agreement (streamlining to move to model conditions) that is currently in process for EPPR000521513. In addition, a variation to the existing site-specific conditions for Toogoolawah STP in Part 3 (Q) are being sought in particular those pertaining to effluent quality whereby release to waters limits have been imposed upon recycled water to be provided to a customer.

This application accompanies the Helidon amendment application which has proposed the same General Conditions (as per the amendment by agreement process) for the Helidon RRC. If the Department is in agreement Urban Utilities would like to suggest that the General Conditions that have been the subject of discussion with the Department as part of the Amendment by Agreement process could be included within this amendment application to pertain to all Resource Recovery Centre locations on the Environmental authority EPPR00521513.

Proposed conditions can be found in Section **Error! Reference source not found.**

1.2.3. Impact on Environmental Values

Environmental values for waters are detailed in Section 2.3
The environmental values which are likely to be impacted by this application include:

- Water
- Land

The risk and magnitude of impacts on environmental values has been undertaken and is described in Section 4.
Actions proposed to prevent or minimise adverse impacts on the environmental values are described in Section 3.2.

1.2.4. Waste management

Urban Utilities has a Waste Management Plan for all Sewage Treatment Plants (RRCs) across our territory (MP255). Waste management and mitigation measures for waste are included in Section 1.2.4.

1.2.5. Site Management Plans or Environmental Protection Orders

No Site Management Plans or Environmental Protection Orders are in place at the subject site.

1.2.6. Other Approvals Required

This amendment application is to change the wording of certain conditions related to ERA 63 Activities at the Toogoolawah RRC to make them more appropriate and modernised. No changes in process or infrastructure at the treatment plant is required therefore no other approvals are required.

1.2.7. Amendment Application Threshold

This amendment application will constitute a minor amendment in accordance with ESR/2015/1684 "*Guideline: Major and Minor Amendments*" on the basis that its inclusion will not meet major amendment thresholds under section 3.1.1. ESR/2015/1684 defines **major amendments** as *'an amendment that is not a minor amendment'* under section 3.2. A summary of the amendment thresholds and responses are provided in Table 1.

Table 1 Amendment Threshold and Response

Threshold	Response
a) The amendment is not a change to a standard condition identified in the EA as a standard condition, other than a condition conversion or replacing a standard condition with a standard condition for the ERA; and	There are no standard conditions in relation to water quality release limits for ERA63 activities. The proposed amendment is to vary existing Site-Specific conditions pertaining to the Toogoolawah RRC.
b) The amendment does not significantly increase the level of environmental harm caused by the relevant activity; and	No changes in the current operation of the activity are planned
c) The amendment does not change any rehabilitation objectives in the EA in a way likely to result in significantly different impacts on environmental values than the impacts previously permitted under the EA; and	No existing rehabilitative conditions pertain to this EA.
d) The amendment does not significantly increase the scale or intensity of the relevant activity; and	The proposed amendment will not significantly increase the scale and intensity of the relevant activity.
e) The amendment does not relate to a new relevant resource tenure for the EA that is— (i) a new mining lease; or (ii) a new petroleum lease; or (iii) a new geothermal lease under the *Geothermal Energy Act 2010*; or (iv) a new greenhouse gas injection and storage lease under the *Greenhouse Gas Storage Act 2009*; and	Not applicable.
f) The amendment increases the existing surface area for the relevant activity by 10% or less; and	No increases in surface area of the ERA63 activity which occurs at the Toogoolawah RRC will result from this amendment.
g) The amendment for an EA for a petroleum activity: (i) involves constructing a new pipeline that does not exceed 150km in length; and	Not applicable

(ii) involves extending an existing pipeline by no more than 10% of the existing length of the pipeline; and	

1.3. Declaration

Central SEQ Distributor-Retailer Authority:

- states that if the amendment is made, each relevant activity will comply with the eligibility criteria for the activity; and
- declares that this statement is correct.

2. Site characteristics

2.1. Meteorological data

The closest BOM weather station is 40205 Toogoolawah Post Office located at 51 Gardner Street Toogoolawah which is approximately 1.6km from the Toogoolawah RRC.

2.2. Location and land uses

The treatment plant infrastructure including the lagoons is situated on Lot 1 RP135864 Toogoolawah with the associated vetiver plantation located on the western end of Lot 6 RP159098 (7295 Brisbane Valley Highway Toogoolawah 4313) which is within the Somerset Regional Council local government area.



Figure 1 Toogoolawah RRC Land parcel information

The greater surrounding area of Toogoolawah RRC is mostly rural, with land largely used for crop growing and grazing. The Toogoolawah RRC is surrounded by the skydiving airstrip and agricultural land and grazing land. It discharges into an unnamed gully, a tributary of the Cressbrook Creek.

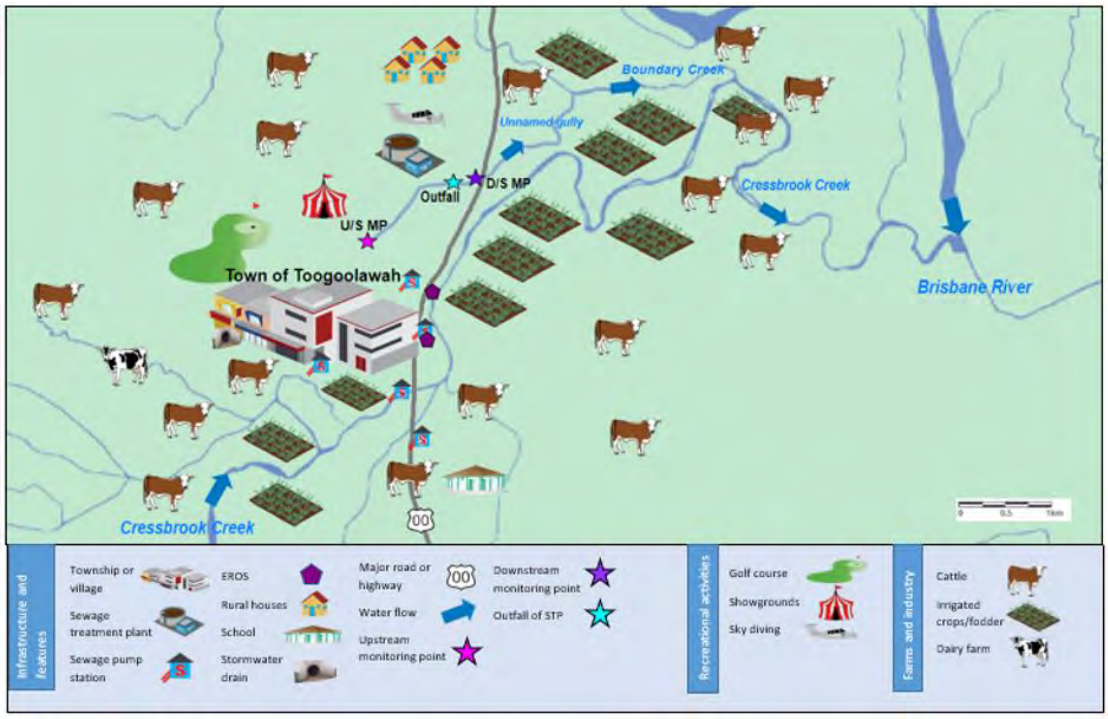


Figure 2 Pictorial information on surrounding land and uses for Toogoolawah RRC from Urban Utilities MP178.

The existing land is classed under State Land Use Mapping as “Waste Treatment and Disposal”. Surrounding land is predominantly mapped as “grazing native vegetation” with areas of “irrigated cropping” and residential zones on the opposite side of the Brisbane Valley Highway.



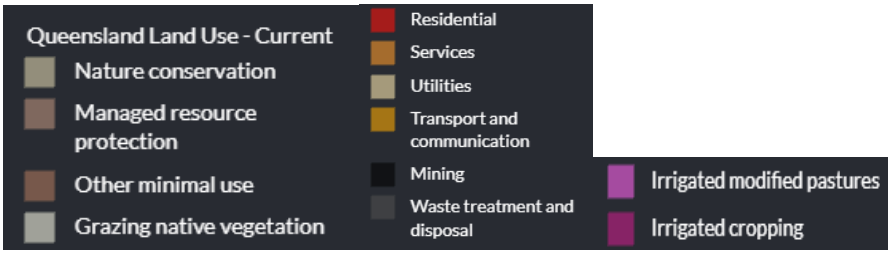


Figure 3 Toogoolawah RRC and surrounds State land uses from Queensland Globe 28/01/2025

2.2.1. Cultural Heritage

In accordance with Queensland Globe Cultural Heritage party boundary the area on the other side of the Brisbane Valley Highway adjacent to the location of the Toogoolawah RRC is determined as lands of the Jinibara People.



Figure 4 Map showing nearby Jinibara land from Queensland Globe (04/02/2025)

2.3. Surface waters

Under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 the environmental values and water quality objectives for waters are listed under Schedule 1. The project area is within Basin 143 and the Environmental Values and water quality objectives are contained within the Upper Brisbane River *Environmental Values and Water Quality Objectives*, published by the department in June 2022.

The following Environmental Values are potentially applicable for the Lower Cressbrook Creek Environmental Value Zone:

Table 2 Environmental Values for Cressbrook Creek

Environmental Value (Aquatic)	Definition
Aquatic Ecosystems 	A community of organisms living within or adjacent to water, including riparian or foreshore area'. (EPP (Water and Wetland Biodiversity), schedule 2) The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways and riparian areas, for example, biodiversity, ecological interactions, plants, animals, key species (such as turtles, platypus, seagrass and dugongs) and their habitat, food and drinking water. Waterways include perennial and intermittent surface waters, groundwaters, tidal and non-tidal waters, lakes, storages, reservoirs, dams, wetlands, swamps, marshes, lagoons, canals, natural and artificial channels and the bed and banks of waterways. (This EV incorporates the 'wildlife habitat' EV used in the South East Queensland Regional Water Quality Management Strategy (SEQRWQMS)). See below for more details on aquatic ecosystems, based on the EPP (Water and Wetland Biodiversity).
Environmental Values (Human)	
Human consumer of aquatic foods 	The suitability of the water for producing aquatic foods for human consumption such as fish, crustaceans and shellfish from natural waterways.
Irrigation 	Suitability of water supply for irrigation, for example, irrigation of crops, pastures, parks, gardens and recreational areas.
Farm supply/use 	Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.
Stock water 	Suitability of water supply for production of healthy livestock.
Aquaculture 	Health of aquaculture species and humans consuming aquatic foods (such as fish, molluscs and crustaceans) from commercial ventures.
Primary recreation 	Means a use that involves the following types of contact with the water—full body contact, frequent immersion by the face and trunk, frequent contact with spray by the face where it is likely some water will be swallowed or inhaled, or come into contact with ears, nasal passages, mucous membranes or cuts in the skin. Examples: diving, swimming, surfing (EPP (Water and Wetland Biodiversity), section 6).
Secondary recreation 	Means a use that involves the following types of contact with the water—contact in which only the limbs are regularly wet, and other contact, including the swallowing of water, is unusual (examples—boating, fishing, wading) or occasional inadvertent immersion resulting from slipping or being swept into the water by a wave. (EPP (Water and Wetland Biodiversity), section 6).

Environmental Value (Aquatic)	Definition
Visual recreation 	Means a use that does not ordinarily involve any contact with the water—for example angling from the shore, sunbathing near water (EPP (Water and Wetland Biodiversity), section 6).
Industrial use 	Suitability of water supply for industrial purposes, for example, food, beverage, paper, petroleum and power industries, mining and minerals refining/processing. Industries usually treat water supplies to meet their needs.
Cultural and spiritual values 	Cultural and spiritual values Means scientific, social or other significance to the present generation or past or future generations, including Aboriginal people or Torres Strait Islanders (EPP (Water and Wetland Biodiversity)), section 6), for example: • custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities • symbols, landmarks and icons (such as waterways, turtles and frogs) • lifestyles (such as agriculture and fishing).

According to the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* the relevant Water Quality Objectives for moderately disturbed upland waters are:

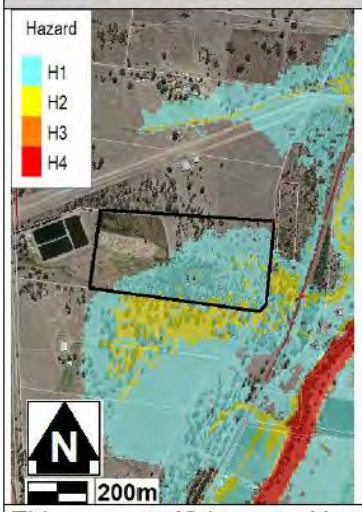
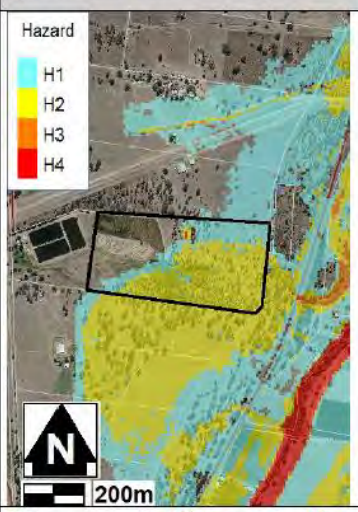
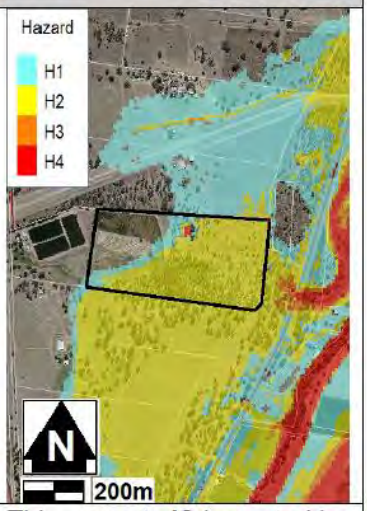
Table 3 Water Quality Objectives Upland Freshlands Moderately Disturbed

Quality	High Flow	Low Flow
Ammonia N	10 µg/L	10 µg/L
Oxidised N	10 µg/L	18 µg/L
Total Nitrogen	320 µg/L	410 µg/L
Filterable Reactive Phosphorus (FRP)	10 µg/L	10 µg/L
Total Phosphorus	30 µg/L	40 µg/L
Chlorophyll a	1 µg/L	1 µg/L
Dissolved Oxygen	90 – 110% saturation	90 – 110% saturation
Turbidity	5 NTU	19 NTU
Total Suspended Solids	3 mg/L	20 mg/L
pH	6.5 -8.2	6.5 -8.2

2.3.1. Flooding

The Toogoolawah RRC site inclusive of the vetiver plantation area lies inside a flood modelled area adopted by Somerset Regional Council as a part of the Toogoolawah Flood Study. The treatment plant grey infrastructure lies beyond the low likelihood flood hazard (H1) overlay with only a small portion of the utilised area of Lot 6 RP159098 subject to flood hazard overlays. A flood information certificate (created 28/01/2025) can be found in Appendix 6.1 along with the Toogoolawah Flood Study 1% AEP map.

Map of flood hazards on and around property : 6RP159098

5% AEP Flood Hazard (High Likelihood)	1% AEP Flood Hazard (Medium Likelihood)	0.2% AEP Flood Hazard (Low Likelihood)
		
This property **IS** impacted by a 5% AEP flood event	This property **IS** impacted by a 1% AEP flood event	This property **IS** impacted by a 0.2% AEP flood event

H1 LOW - self evacuation possible for adults and children, vehicle stability within tolerance for large 4WD.
H2 SIGNIFICANT - working limit for trained safety workers, Vehicle evacuation.
H3 HIGH – Limit of uncompromised stability for adults (dangerous to most) .
H4 EXTREME - in excess of known stability limits

Figure 5 Flood hazard mapping in surrounding areas of Toogoolawah RRC

2.4. Groundwaters

Groundwater is estimated to potentially occur between around 9.1 metres and 16.9 metres below the surface. This is based on the nearest registered groundwater bore RN 14320522 which is a sub-artesian facility located approximately 207 metres North of the Toogoolawah RRC site. The complete bore report for RN 14320522 can be found in Appendix 6.2.



Figure 6 Location of nearest registered groundwater bore (RN14320522) with contours from Queensland Globe 04/02/2025

2.5. Wetlands

No wetlands of significance are in the immediate vicinity and Moreton Bay, a RAMSAR site of international significance occurs around 50-100km downstream.



Figure 7 Wetland Mapping in direct proximity to Toogoolawah RRC

2.6. Geology, soils and acid sulfate soils

The closest Water Bore (RN 14320522) Report (Appendix 6.2) Strata Log indicates a top layer of black soil of around 1.3metres with clay and silty clay underlaying for around 15 metres. Below this a strata of fine sand which has the potential to contain groundwater with Gatton sandstone forming the base. For detailed surface geology mapping see Figure 8 and Table 4 below.



Figure 8 Detailed surface geology mapping for Toogoolawah RRC from Queensland Globe (05/02/2025)

Table 4 Surface geology description

Surface Geology Type	Dominant Rock	Rock Type	Lithological Summary	Age
Rte – Esk formation	Sedimentary Rock	Stratified Unit (including Volcanic and Metamorphic	Polymictic pebble to boulder conglomerate, feldspar sandstone, shale, minor acid tuff.	Middle Triassic

No Acid Sulfate Soils (ASS) or Potential Acid Sulphate Soils occur in the vicinity

2.7. Contaminated land

None of the lots associated with Toogoolawah RRC are listed on the EMR or CLR.

2.8. Flora and fauna

State and Local Flora and Fauna

Some MSES wildlife habitat (SEQ koala habitat) and regulated vegetation occurs nearby.



Figure 9 Matters of State Environmental Significance (wildlife habitat) Toogoolawah RRC



Figure 10 Matters of State Environmental Significance (vegetation and habitat) Toogoolawah RRC

2.8.1. Federally Listed Flora and Fauna

The EPBC Protected Matters Report for Lot 1 RP135864 and Lot 6 RP159098 can be found in Appendix 6.3.

2.9. Sensitive receptors

The land surrounding Toogoolawah RRC is predominantly agricultural with community use areas such as the sky diving club to the North and the showground to the south west. A residential zone lies to the south west of the showgrounds and is approximately 430 metres from boundary of the Toogoolawah RRC site whilst the residential zone to the south east lies over 820metres away.



Figure 11 Distance to nearest sensitive receptor from Toogoolawah RRC to the south west

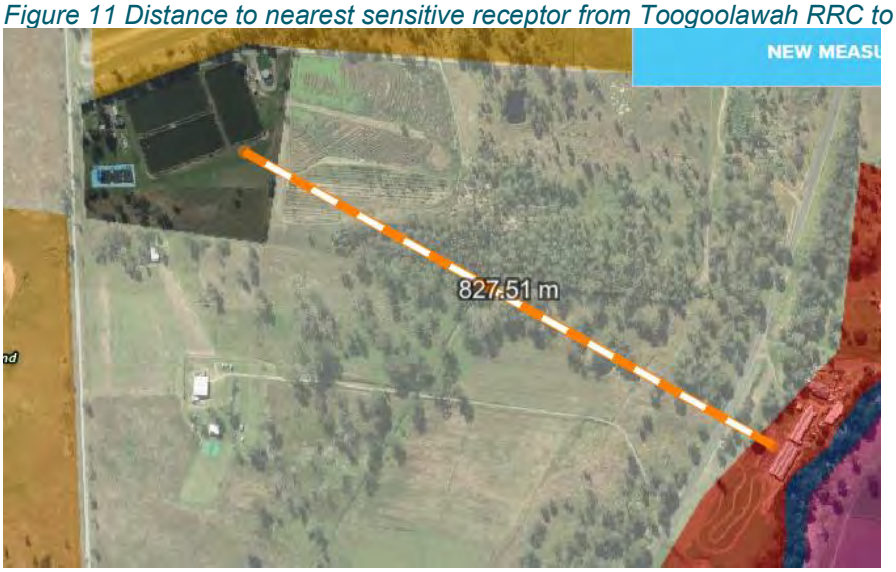


Figure 12 Distance to nearest sensitive receptor from Toogoolawah RRC to the south east

3. Application details

3.1. Design summary

Toogoolawah Resource Recovery Centre is a lagoon-based treatment system with a zero dry-weather discharge licence requirement and a 1100kL/d wet-weather discharge licence requirement. All treated effluent is irrigated onto the vetiver plantation. Lagoons are operated at a low level, and all flows to the recycled water customer are maximised, to minimise discharge on a dry day.

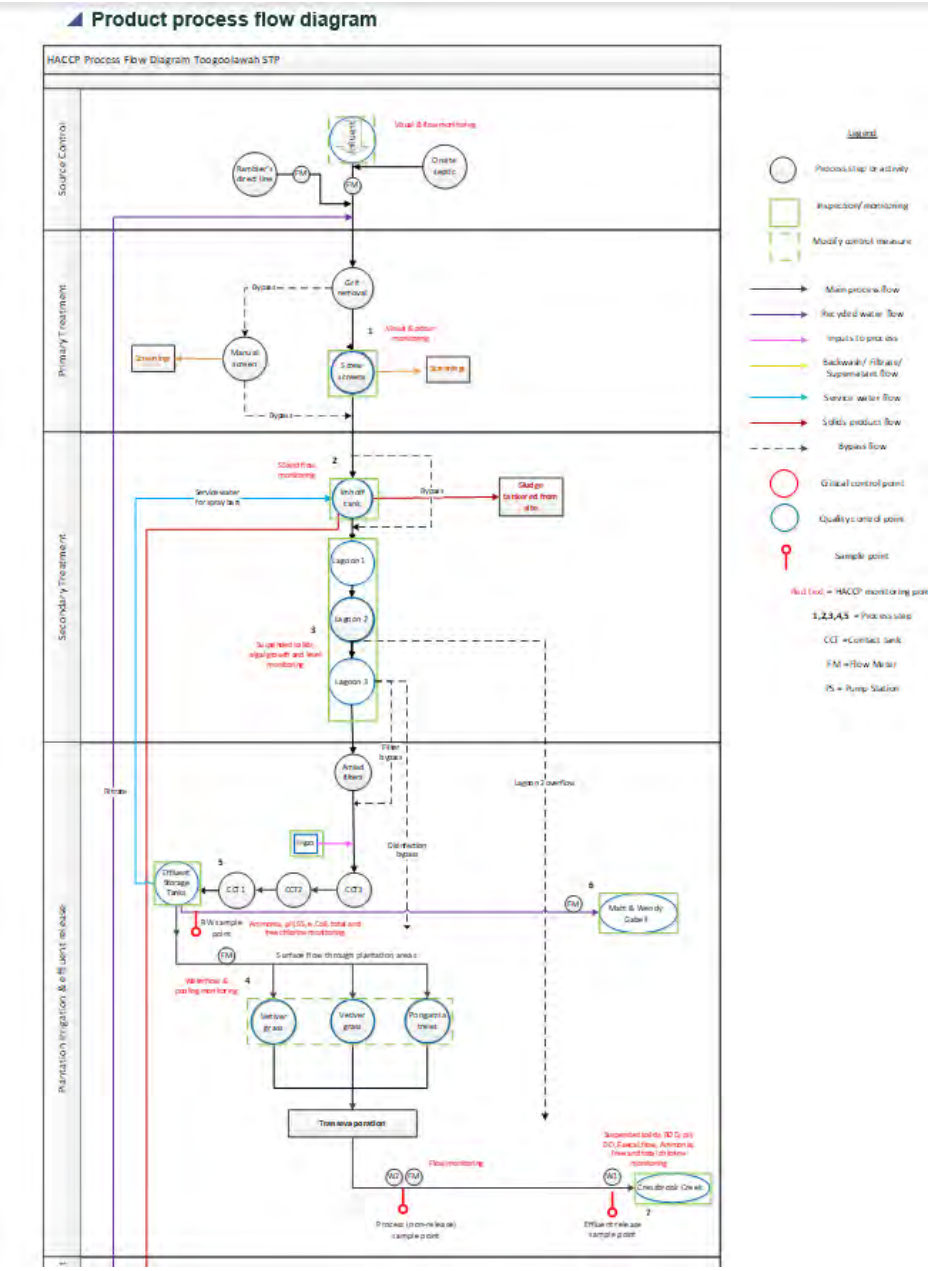


Figure 13 Product Process Flow diagram for Toogoolawah RRC

3.1.1. Operational overview and control philosophy

3.1.1.1. Treatment

Sedimentation of the screened raw sewage occurs via the Imhoff tank before primary effluent overflows a weir to Lagoons 1 and 2. Gross solids collect in the lower section and undergo some anaerobic digestion. Digested sludge can be routinely transferred (via manual valve operation) to the drying beds, however, at present the digested sludge is removed as a liquid by a tanker. Effluent from Lagoon 1 flows to Lagoon 2, then on to Lagoon 3. Effluent from Lagoon 3 discharges to the vetiver plantation. The first lagoon acts as a facultative lagoon. Suspended solids settle to the bottom. Anaerobic conditions at the bottom the lagoon allow for digestion by facultative bacteria in the pond. Conditions at the surface of the pond are aerobic (due to contact with the air) and the facultative bacteria will stabilise dissolved organics within the lagoon. The subsequent lagoons act as polishing lagoons with lower populations of anaerobic microorganisms and a higher proportion of aerobes. Algae growth within the lagoons is important to the process. Algae convert some of the organic load and the CO2 generated by the facultative bacteria under aerobic conditions to dissolved oxygen for consumption in the aerobic zone.

3.1.1.2. Recycled Water

Lagoon 3 effluent is sent through an Amiad filter prior to disinfection via chlorination and then supplied to the recycled water customer.

Tertiary Treatment (Vetiver plantation)

There is a vetiver plantation consisting of two bays of vetiver grass. Effluent for irrigation is supplied to each bay from Lagoon 3. The effluent is controlled manually by the operator. The operator will allow flow to either or both of the bays based on lagoon level and plantation moisture. The purpose of the vetiver plantation is to provide further nutrient removal the effluent as well as consumption of the bulk of the effluent volume by plant uptake and evaporation. The vetiver grass in the plantation is slashed twice per year.

3.1.1.3. Effluent

Under normal operating conditions (dry weather) there is no discharge of effluent to the receiving environment. However, during wet weather events, a discharge of up to 1100 kL per day is allowed. There is an overflow from the south eastern corner of the vetiver plantation. This overflow, when active, allows flow to reach a tributary of Cressbrook Creek. Monitoring of effluent quality is only required during release events.

3.1.2. Emergency protocols and management

In emergency situations Urban Utilities operates in accordance with our Emergency Management Plan (EMP): CER7. In addition to the EMP the Environmental Events Emergency Sub Plan: TCP15 has been developed to outline the triggers for environmental events that have the actual or potential to cause harm.

Urban Utilities has also developed TCP3 Flood Storm Inundation Emergency Management Sub Plan to confirm triggers of a Storm, Flood or High Tide Inundation

Event and to outline the preparedness, responsive and recovery activities to minimise impacts to our assets, our people and our customers to ensure continuity of water and sewage services and to minimise impacts to our customers and the environment.

3.2. Mitigations and management measures

Recycled water supplied to the recycled water customer from the Toogoolawah RRC is managed in accordance with the *Public Health Act 2005, Public Health Regulation 2018* and the Guideline for Low Exposure Recycled Water Schemes (the Low Exposure Guideline).

The Low Exposure Guideline provides guidance in the management of recycled water supply to minimise both risks to public health and also risks to the environment, namely to land and waters.

3.2.1. Management of provided water quality

Urban Utilities determine the quality of recycled water to be supplied to a recycled water customer to ensure that it is fit for purpose. In the case of Toogoolawah RRC, this was assessed to be a Class C recycled water product (*E.coli concentration of less than 1,000 cfu/100mL)*.

Recycled water is monitored on a weekly frequency for conductivity, *E.coli*, free and total chlorine, pH, suspended solids and thermotolerant coliforms. Results from the period 1 January 2019 to 30 June 2025 are presented in Figure 14.

Toogoolawah RRC Recycled Water Quality Summary

For sampling conducted between 1 January 2019 and 30 June 2025

Parameter	Units	No. Samples	Minimum	Average	Maximum
Acetic Acid	mg/L	192	<6	<6	114
Ammonia N	mg/L	233	<0.004	2.42	22.2
Arsenic as As	mg/L	188	<0.007	<0.007	0.35
BOD 5 days @ 20oC	mg/L	221	<5	20	189
Boron as B	mg/L	188	0.018	0.095	0.5
Cadmium as Cd	mg/L	188	<0.001	<0.001	0.05
Calcium as Ca	mg/L	16	17.9	23.7	34.7
Chromium as Cr	mg/L	188	<0.001	<0.001	0.05
COD as O2	mg/L	156	46	196	695
Conductivity at 25C	uS/cm	237	148	791	1873
Copper as Cu	mg/L	188	<0.005	<0.005	0.25
Dissolved O2 - Field	%	21	15.4	56.8	95.3
Dissolved O2 - Field	mg/L	225	<1	6.13	21.85
Escherichia coli	cfu/100mL	230	<1	368	29000
Fluoride by ISE	mg/L	140	<0.05	0.38	4.18
Free Chlorine	mg/L	375	<0.1	0.11	3.36
Lead as Pb	mg/L	182	<0.004	0.005	0.501
Magnesium as Mg	mg/L	24	9.8	13.8	20.5
Manganese as Mn	mg/L	194	0.001	0.121	1.972
Mercury as Hg	ug/L	188	<0.01	0.02	0.5
Nickel as Ni	mg/L	182	<0.01	<0.01	0.1
Ortho Phosphorus as P	mg/L	233	<0.002	3.468	12.8
pH - Field	pH Unit	438	5.8	8.1	10.1
Selenium as Se	mg/L	182	<0.01	<0.01	0.5
Sodium as Na	mg/L	16	59.3	98.2	147
Sodium Absorption Ratio	na	16	2.72	3.96	5.13
Suspended Solids	mg/L	440	<5	64	302
Temperature - Field	C	224	2.1	20	32.1
Total Alkalinity as CaCO3	mg/L	213	42	184	510
Total Chlorine	mg/L	366	<0.1	2.01	6.06
Total Nitrogen as N	mg/L	236	<0.01	10.73	32
Total Phosphorus as P	mg/L	233	<0.01	4.83	13.7
Turbidity	NTU	2	37.9	129.5	221
Zinc as Zn	mg/L	188	<0.005	0.007	0.25

Figure 14 Summary recycled water quality results

3.2.2. Management of customer usage

Urban Utilities has entered into a recycled water contract (executed in 2020 and expiring in 2030) with the recycled water customer which specifies:

- the quality of the recycled water provided;
- permitted uses of the recycled water (refer to Figure 16);
- control measures required to be adopted by the recycled water customer (refer to Figure 16); and
- the customer's obligations to meet their general environmental duty in using the recycled water (refer to Figure 15).

Urban Utilities has a recycled water customer audit program in place which undertakes scheduled audits of customers to ensure conformance with their recycled water contracts. Where non-conformance is identified, Urban Utilities works with our customers to rectify any issues or will cease supply if there are unacceptable risks to public health or the environment.

10.1 Permitted Use

(a) The Customer must use Recycled Water only for the Permitted Use and otherwise in accordance with all applicable Laws and Plans.

(b) Without limiting the Customer's obligations under clause 10.1(a), the Customer:

(i) acknowledges:

(A) It has been made and is aware of and will comply with its general environmental duty under the EP Act and, specifically, that the EP Act imposes:

(1) an obligation on the Customer not to carry out an activity that is likely to cause environmental harm unless all reasonable and practicable measures are taken to prevent or minimise harm; and

(2) a duty on the Customer to notify the Administering Authority of any serious or material environmental harm that is not authorised as provided for under the EP Act; and

(B) that it has been made and is aware of the environmental sustainability issues pertaining to disposal of Recycled Water and the protection of environmental values of Recycled Water and the protection of environmental values of waters developed or referred to by the Administering Authority; and

(ii) must not use Recycled Water for drinking consumption.

Figure 15 Excerpt from Toogoolawah RRC recycled water contract with clauses pertaining to general environmental duty

ITEM 3: PERMITTED USE

The Permitted Use of Recycled Water supplied under this Contract is:

Irrigation of pasture and fodder for beef cattle.

Under no circumstances shall the Customer use the Recycled Water for any purposes other than that stated above without approval in writing from Queensland Urban Utilities such that this Item 3 of Schedule 2 is amended in accordance with this contract.

ITEM 4: On Site Controls, Precautionary Measures

The onsite controls and precautionary measures specified below must be maintained at all times by, and at the cost of, the Customer.

All onsite controls must be inspected prior to supply and are subject to audit or inspection as per clause 14.

(a) Ensure that all employees or other people exposed to the recycled water are instructed in the appropriate health and safety as well as personal hygiene measures appropriate for the Customers use of recycled water.

(b) Display prominent warning signage indicating the use of recycled water on site at designated points of access and storage. Signage should meet the requirements of the Australian Standard AS 1319 - *Safety signs for the occupational environment*.

(c) Ensure compliance with all applicable plumbing requirements, to prevent cross connection with drinking water or accidental ingestion, including all above ground pipes, taps and fittings containing recycled water are coloured Purple or Lilac in accordance with *Australian Standard AS/NZS 3500.5*. The use of lockable valves and fittings where the public has access is recommended.

(d) The use of recycled water is not permitted within any building used for any domestic purpose.

(e) Precautions to ensure recycled water do not contaminate any source of water used as a supply of drinking water (e.g. lake or aquifer). This may require the use of setback distances (the distance from where the recycled water is used and the water body used as a supply of drinking water).

(f) Control irrigation to eliminate runoff or ponding and ensure there is no overspray

(g) Exclude grazing animals from pasture during irrigation and for five days following irrigation

(h) Fodder must be allowed to dry before being supplied as feed

(i) If members of the public may be in the vicinity of the irrigation area the customer must:

  (i) Restrict access, and

  (ii) Include spray drift controls and operate a buffer zone of at least 25m.

(j) Restricted access can be defined as:

  (i) Preventing members of the public from accessing the area where recycled water is being used. This may be achieved through the use of physical barriers, appropriate to the location, that deter access (e.g. uninterrupted fencing with locked gates), or

  (ii) Irrigating at times when there is a very low likelihood of members of the public being present in the area where recycled water is being used.

(k) A spray drift control is an on-site control that minimises spray from drifting beyond the irrigation area. This can be achieved by the use of low-throw sprinklers, vegetation screening (e.g. windbreaks), anemometer switching (to monitor and respond to wind conditions) and other related methods.

Figure 16 Excerpt from Toogoolawah RRC recycled water contract with clauses pertaining to permitted uses and on site control measures

3.2.3. Air and odour management

There is no history of odour issues or odour complaints at the Toogoolawah RRC. There are few sensitive receptors in the vicinity and these are a significant distance away. This amendment application does not constitute any notable change in the operation of the treatment plant and is therefore not anticipated to cause any additional risk in air or odour management.

3.2.4. Greenhouse gas emissions management

As this amendment application does not entail any change in the operation of the Activity at Toogoolawah RRC no impacts to GHG are anticipated.

3.2.5. Water management

Recycled water supplied to the recycled water customer is for the purposes of irrigation of pasture. Recycled water usage by the customer is not intended to enter any natural waters and would only occur through poor management practices or an incident.

Urban Utilities manages the risk of poor management practices through the recycled water contract and specifically through the following control measures:

- ensuring setback distances between the recycled water usage and water bodies are in place;
- controlling irrigation to eliminate runoff and ponding and ensuring there is no overspray; and
- implementation of a spray drift control.

3.2.6. Wetland management

No mapped wetlands of high ecological significance occur near the site as such no impacts to downstream wetlands is anticipated from the activity.

3.2.7. Groundwater management

Groundwater is estimated to occur around 9-16 metres below ground level thus irrigation to land is considered a low risk when considering the impacts to groundwaters. Management of irrigation at the Vetiver location

3.2.8. Noise management

There is no history of noise issues or noise complaints at the Toogoolawah RRC.As the proposed amendment does not change the existing activity, there is no additional noise mitigations required.

3.2.9. Waste management

Urban Utilities has a Waste Management Plan for all Sewage Treatment Plants (RRCs) across our territory (MP255) and an Environmental Waste Standard (STD147). Urban Utilities utilises a waste tracking ID service for the transport of waste. During operation of the activity biosolids will be managed in accordance with Urban Utilities Biosolids Management System. This amendment application does not constitute any change in the operation of the treatment plant and is therefore not anticipated to cause any additional risk in waste management.

3.2.10. Land management

Recycled water is supplied to the recycled water customer and is irrigated to land. To ensure sustainable irrigation is maintained, Urban Utilities require specific control measure are enacted through the recycled water contract:

- controlling irrigation to eliminate runoff and ponding and ensuring there is no overspray.

Recycled water quality is monitored weekly. An assessment of the results show that key parameters are considered to meet the low risk criteria stipulated in the Department's Irrigation Guideline.

4. Environmental impact assessment

Environmental aspects, impacts, risk and mitigations

Environmental aspects and impacts for the activity have been detailed in **Error! R eference source not found.**. This includes an assessment of risk and also identified proposed mitigation measures.

4.1. Environmental objectives and treatments

4.1.1. Air management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Air and odour						
The activity will be operated in a way that protects the environmental values of air.	There is no discharge to air of contaminants that may cause an adverse effect on the environment from the operation of the activity.	No historical odour or air issues associated with this plant	If odour or air complaints are received monitoring will be conducted and values compared to air environmental value trigger limits.	Rare	Least significant	Low 1
	Fugitive emissions of contaminants from storage, handling and processing of materials and transporting of materials within the site are prevented or minimised.	Irrigation through vetiver plantation is at ground level.	Significant buffer distances to sensitive receptors.	Rare	Least significant	Low 1
	Contingency measures will prevent or minimise adverse effects on the environment due to unplanned emissions and shut down and start up emissions of contaminants to air	Activity will be operated in line with existing procedures and protocols.	Odour loggers can be deployed in the event of a complaint or issue.	Rare	Least significant	Low 1
	Releases of contaminants to the atmosphere for dispersion will be managed to prevent or minimise adverse effects on environmental values	Activity will be operated in line with existing procedures and protocols.		Rare	Least significant	Low 1

4.1.2. Water management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Water						
The activity will be operated in a way that protects the environmental values of waters.	There is no actual or potential discharge to waters of contaminants that may cause an adverse effect on an environmental value from the operation of the activity.	Discharge to land through vetiver plantation reduces potential for adverse impacts on the environmental values of water	Irrigation will occur in line with existing procedures and protocols.	Unlikely	Least significant	Low 2
	The storage and handling of contaminants will include effective means of secondary containment to prevent or minimise releases to the environment from spillage or leaks;		Hazardous and dangerous materials are stored on site within areas which have secondary containment.	Rare	Minor significance	Low 3
	Contingency measures will prevent or minimise adverse effects on the environment due to unplanned releases or discharges of contaminants to water	Works and activities will be carried out in line with existing procedures and processes to prevent or minimise adverse impacts on the environment due to unplanned releases.	Urban Utilities Environmental Events Emergency Management Sub Plan covers preparedness, response and recovery actions.	Unlikely	Least significant	Low 2
	The activity will be managed so that stormwater contaminated by the activity that may cause an adverse effect on an environmental value will not leave the site without prior treatment	Lagoons have raised embankments and an overflow weir to vetiver.	The activity will be managed in line with existing procedures and processes.	Unlikely	Least significant	Low 2
	The disturbance of any acid sulfate soil, or potential acid sulfate soil, will be managed to prevent or minimise adverse effects on environmental values	No PASS or ASS are know to occur in the area.		Rare	Least significant	Low 1

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
	Acid producing rock will be managed to ensure that the production and release of acidic waste is prevented or minimised, including impacts during operation and after the environmental authority has been surrendered			Choose a likelihood	Choose a consequence	Choose an item.
	Any discharge to water or a watercourse or wetland will be managed so that there will be no adverse effects due to the altering of existing flow regimes for water or a watercourse or wetland	Discharge is from the vetiver to an overland flow path which is approximately 330metres from a tributary of Cressbrook Creek so no impacts to flow regimes are anticipated.	Irrigation is controlled on site through vetiver and via contractual obligations with the recycled water customer.	Rare	Least significant	Low 1
	For a petroleum activity, the activity will be managed in a way that is consistent with the coal seam gas water management policy, including the prioritisation hierarchy for managing and using coal seam gas water and the prioritisation hierarchy for managing saline waste			Choose a likelihood	Choose a consequence	Choose an item.
	The activity will be managed so that adverse effects on environmental values are prevented or minimised	Release to land reduces potential for adverse effects on environmental values of waters.	Activity will be operated in line with existing procedures and protocols.	Rare	Least significant	Low 1

4.1.3. Wetland management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Wetlands						
The activity will be operated in a way that protects the environmental values of wetlands	There will be no potential or actual adverse effect on a wetland as part of carrying out the activity.	No adverse effects to wetlands are anticipated as a result of this amendment		Rare	Least significant	Low 1
	The activity will be managed in a way that prevents or minimises adverse effects on wetlands	No adverse effects to wetlands are anticipated as a result of this amendment		Rare	Least significant	Low 1

4.1.4. Groundwater management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Groundwater						
The activity will be operated in a way that protects the environmental values of groundwater and any	There will be no direct or indirect release of contaminants to groundwater from the operation of the activity. There will be no actual or potential adverse effect on groundwater from the operation of the activity.	Vegetation can help support and enhance groundwater environments. Groundwater is predicted to occur at a depth of around 9-16 metres below the surface.	Regular groundwater monitoring has been historically undertaken and will continue.	Rare	Least significant	Low 1

associated surface ecological systems	The activity will be managed to prevent or minimise adverse effects on groundwater or any associated surface ecological systems.	No adverse effects are anticipated as a result of this amendment.		Rare	Least significant	Low 1

4.1.5. Noise management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Noise						
The activity will be operated in a way that protects the environmental values of the acoustic environment	Sound from the activity is not audible at a sensitive receptor	No sound from the activity is likely to be audible at any sensitive receptor.		Rare	Least significant	Low 1
	The release of sound to the environment from the activity is managed so that adverse effects on environmental values, including health and wellbeing and sensitive ecosystems, are prevented or minimised.	No adverse effects to the acoustic environment have been previously noted or are anticipated at this site.		Rare	Least significant	Low 1

4.1.6. Waste management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Waste						
Any waste generated, transported, or received as part of carrying out the activity is managed in a way that protects all environmental values.	Waste generated, transported or received is managed in accordance with the waste and resource management hierarchy under the Waste Reduction and Recycling Act 2011.		Works and activities will be carried out in line with existing procedures and processes	Rare	Least significant	Low 1
	If waste is disposed of, it is disposed of in a way that prevents or minimises adverse effects on environmental values.		Urban Utilities utilises the Waste Tracking ID system to track the movement of waste products and biosolids	Rare	Least significant	Low 1

4.1.7. Land management

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
Land						
The activity is operated in a way that protects the environmental values of land, including soils, subsoils, landforms and associated flora and fauna	There is no actual or potential disturbance or adverse effect to the environmental values of land as part of carrying out the activity		Irrigation is appropriately managed through existing procedures and protocols.	Unlikely	Least significant	Low 2
	Activities that disturb land, soils, subsoils, landforms and associated flora and fauna will be managed in a way that prevents or minimises adverse effects on the environmental values of land		Established vetiver plantation provides habitat for animals	Rare	Least significant	Low 1
	Areas disturbed will be rehabilitated or restored to achieve sites— (i) that are safe and stable; and (ii) where no environmental harm is being caused by anything on or in the land; and (iii) that are able to sustain an appropriate land use after rehabilitation or restoration.		If soil testing indicated any adverse the need for soil rehabilitation it will be undertaken.	Rare	Least significant	Low 1
	The activity will be managed to prevent or minimise adverse effects on the environmental			Unlikely	Least significant	Low 2

Environmental Objective	Performance Outcome	Impact Assessment	Mitigation Measures	Likelihood	Consequence	Risk Score
	values of land due to unplanned releases or discharges, including spills and leaks of contaminants;					
	The application of water or waste to the land is sustainable and is managed to prevent or minimise adverse effects on the composition or structure of soils and subsoils		Routine soil and groundwater testing has been conducted every two years and will continue	Unlikely	Least significant	Low 2

5. Environmental Authority Conditions

The conditions proposed below are separated into General and site-specific conditions. The General conditions are derived from those that have been proposed and discussed in the ongoing Amendment by Agreement Process (Streamlining) that Urban Utilities has been going through with the Department. As such my proposal is to remove Part 2(C): General conditions – Esk Toogoolawah and Kilcoy STPs from the current EA and replace it with the below general conditions. These could be applied as a separate section for Esk, Toogoolawah, Kilcoy and Helidon. Alternatively, the General conditions could be applied to all sites as per Urban Utilities discussion with the Department regarding the amendment by agreement (streamlining) process.

Table 5 Proposed changes to standard conditions or existing conditions

New condition	Proposed wording	Justification
	General conditions – Esk, Toogoolawah and Kilcoy (& Helidon) STPs	
	Agency Interest: General	
G1	All reasonable and practicable **measures** must be taken to prevent or minimise environmental harm caused, or likely to be caused by the activities.	As per streamlining
G2	**Contravention of conditions** Unless specifically authorised by a condition of this environmental authority, details of any contravention of a condition of this environmental authority must: a) be reported to the administering authority within 24 hours of becoming aware of the contravention; and b) include the nature and circumstances of the contravention and any immediate actions taken.	As per streamlining noting this is a new requirement for Esk, Toogoolawah and Kilcoy
G3	Any monitoring result that indicates an exceedance of or non-compliance with any approval limit must be reported to the administering authority within 20 business days of completion of analysis.	As per streamlining noting change from 28 days to 20 business days
G4	**Environmental risk management procedures** Written procedures must be developed and implemented by an appropriately qualified person that ensure: a) all potential risks to the environment from the carrying out of the activity are identified and assessed, including: (i) during routine operations; and (ii) outside routine operations (e.g., maintenance, start up and shut down); and (iii) during preparation, rehabilitation, and closure; and (iv) in an emergency (e.g., fire, flood or other natural disaster); and b) for each potential risk identified, any necessary measures to prevent or minimise the potential for environmental harm are implemented; and c) staff understand their obligations under this environmental authority and the Environmental Protection Act 1994; and d) environmental risk management procedures are continually reviewed and improved, based on a reasonable risk-management approach.	As per streamlining replaces conditions with outdated wording for Esk, Toogoolawah and Kilcoy
G5	**Plant and equipment** An **appropriately qualified person** must install, operate, calibrate, and maintain the plant and equipment required to carry out the activity (including monitoring devices) in a proper and effective manner.	As per streamlining – updated wording
G6	Records of installation, calibration and maintenance carried out under condition G6 must be kept.	As per streamlining noting this is only applied to Gatton in the current EA
G7	**Record keeping** Unless otherwise specified by a condition of this environmental authority, records must be: a) kept for the period outlined in *Table 1 – Record keeping requirements*; and b) provided to the administering authority upon request and in the format requested.	As per streamlining and replaces outdated wording in other conditions

	Table 1 – Record keeping requirements Description of records: Retention requirement Monitoring results: Retain for 15 years All other records: Retain for 5 years	
G8	Chemicals and fuels in containers of greater than 15 litres must be stored within a **secondary containment system**.	As per streamlining
G9	**Monitoring and sampling** All monitoring and sampling required by the conditions of this environmental authority must be carried out, interpreted, and recorded by an **appropriately qualified person** in the manner specified by this environmental authority, and in accordance with the methods prescribed in the latest edition of the **administering authority**'s Monitoring and Sampling Manual (available of the Queensland Government website).	As per streamlining
G10	Unless otherwise authorised in writing by the **administering authority**, all laboratory analyses required under this environmental authority must be carried out by a laboratory that has National Association of Testing Authorities (NATA) accreditation for such analyses. The only exception to this condition is for *in situ* **monitoring** of pH, ammonia, dissolved oxygen, electrical conductivity, temperature, turbidity, free and total chlorine.	As per streamlining
G11	An Annual Monitoring Report for each of the locations identified in this environmental authority must be prepared and submitted to the **administering authority** by 30 November each year, for the preceding financial year.	As per streamlining
G12	**Complaints** The following details must be recorded for all complaints received and provided to the administering authority upon request: a. date and time the complaint was received; and b. if authorised by the person making the complaint, their name and contact details; and c. nature and details of the complaint. d. how the complaint was resolved	As per streamlining proposed by Urban Utilities.
G13	When required by the administering authority, monitoring must be undertaken in the manner informed by an appropriately qualified person and within a reasonable timeframe agreed to in writing with the administering authority, to investigate any alleged environmental nuisance or environmental harm caused by the activity.	As per streamlining as counter proposed for version 2 noting this is a new requirement for Esk, Toogoolawah and Kilcoy.
	Agency Interest: Air	
A1	Odours or airborne contaminants from the **activity** must not cause environmental nuisance to any sensitive place or commercial place.	As per streamlining
	Agency Interest: Noise	
N1	Noise generated by the **activity** must not cause environmental nuisance to any sensitive place or commercial place.	As per streamlining
	Agency Interest: Water	
WT1	Other than as permitted by this environmental authority, contaminants from the **activity** must not be released to any **waters**.	As per streamlining

WT2	Releases to **waters** must not produce any slick or other visible evidence of oil or grease, nor contain visible floating oil, grease, scum, litter or other visually objectionable matter.	Like WTC2
WT3	A water receiving environment monitoring program (WREMP) must be: a) designed and implemented by an appropriately qualified person with experience and qualifications in water monitoring, to monitor the effects of the activity on waters; and b) reviewed annually by an appropriately qualified person and certified as being appropriate to monitor the effects of the activity on waters. c) developed using the latest version of the administering authority's Receiving Environment Monitoring Program Guideline (ESR/2016/2399)	Like WTC6
WT4	The WREMP required by condition 4X-WT7 must include at least the following: a) description of potentially affected receiving waters including key communities and background water quality characteristics based on accurate and reliable monitoring data that takes into consideration any temporal variation (e.g. seasonality); and b) description of applicable environmental values and sediment and water quality objectives to be achieved; and c) any relevant reports prepared by other governmental or professional research organisations that relate to the receiving environment within which the WREMP is proposed; and d) water and sediment quality targets within the receiving environment to be achieved, and clarification of contaminant concentrations or levels indicating adverse environmental impacts during the monitoring program. Alternatively, WREMP compliance may be achieved by the holder of this environmental authority becoming and remaining a "contributing member" in regional studies of water quality and ecosystem health which are endorsed by the **administering authorit**y.	Like WTC5 with contemporary wording and sediment added
	Agency Interest: Waste	
W1	All waste generated by the activity must be lawfully reused or recycled, or removed to a facility that can lawfully accept the waste.	As per streamlining
	Agency Interest: Land	
L1	Other than as permitted within this environmental authority, contaminants must not be released to **land**.	As per streamlining
L2	Treated sewage effluent may be released to land within the boundaries of the site for the use of any of the following: a) service water; or b) watering of landscaped areas; or c) research and development projects	As per streamlining
L3	Treated effluent releases to land must be done in accordance with documentation that ensures: a) drainage to groundwater and subsurface flows of contaminants to surface waters are prevented; and b) surface pondage and run-off of effluent is prevented; and c) degradation of soil structure is minimised; and d) soil sodicity and the build-up of nutrients and heavy metals in the soil and subsoil are minimised; and e) spray drift or overspray does not carry beyond effluent disposal areas; and f) effluent irrigation areas are maintained with an appropriate crop in a viable state for transpiration	As per streamlining

	and nutrient uptake; and g) sufficient buffer zones are maintained between irrigation sites and sensitive environmental receptors.	
L4	When weather conditions or soil conditions preclude the release of treated sewage effluent to **land**, effluent must not be irrigated to **land**	
L5	Effluent may be removed from the site and provided to a person with the written consent of that person.	The provision of recycled water to a recycled water customer for irrigation is preferred to release to waters and is managed in line with public health regulation. Note this was to be considered for inclusion as a general condition applied to all sites for streamlining.
L6	Records of treated effluent removed from the site and supplied to a person must be made and kept.	As per streamlining
4X	**TOOGOOLAWAH STP**	Note that 4X was allocated as per alphabetical order of STP sites as proposed in streamlining but may not suit this configuration
	Agency Interest: Water	
4X-WT1	The only contaminants authorised to be released to waters are treated sewage effluent generated by the activity from the discharge location specified in *Part 4X Table 1 – Toogoolawah STP.* Contaminant limits for releases to water when the following requirements are complied with: a) the contaminants being released comply with the release limits for each quality characteristic specified in Part 4X Table 1 – Toogoolawah STP Contaminant limits for releases to water; and b) the contaminants being released are monitored at the monitoring location, and at the minimum monitoring frequency for each quality characteristic specified in *Part 4X Table 1 – Toogoolawah STP Contaminant limits for releases to water.*	

Part 4X Table 1 – Toogoolawah STP Contaminant limits for releases to water

Monitoring location	Discharge location	Quality Characteristic (units)	Release limit				Minimum monitoring frequency
			Minimum	Median	Maximum	Short Term 80th Percentile	
Outlets prior to discharge into a tributary of Cressbrook Creek	**W1** to table drain downslope of vetiver plantation discharging into tributary of Cressbrook Creek -27.074703°, 152.382922°.	BOD_5 (mg/L)	-	-	40	20	monthly
		Free Chlorine (mg/L)	-	-	0.7	-	monthly
		Total Nitrogen TN (mg/L)	-	-	-	-	monthly
		Total Suspended Solids (mg/L)	-	-	60	30	monthly
		Ammonia (mg/L as N)	-	-	-	-	monthly
		Total Phosphorus TP (mg/L)	-	-	-	-	monthly
		pH (pH units)	6.5	-	8.5	-	monthly

		Dissolved Oxygen (mg/L)	2 mg/L	-	-	-	monthly
		Faecal coliforms (cfu/100mL)	-	1000	-	-	monthly

Associated requirements

Faecal coliforms samples are taken as a median value (minimum of 5 samples taken at not less than half-hourly intervals in any one day, with 4 out of the 5 samples containing less than 4000 organisms per 100 mL).

4X-WT2	The total quantity of effluent released from release point W1 from Lot 1 on Plan RP135864 during any wet weather day must not exceed 1100 cubic metres, and must be monitored from the overflow location at the edge of the vetiver plantation area	Same as M3Q9
4X-WT3	There must be no release of contaminants to release point W1 on a dry weather day.	Same as M3Q10
4X-WT4	The holder of this environmental authority must monitor effluent quality during release events to waters. For release events that last longer than 3 days, such monitoring must occur at intervals of no greater than 3 days.	Same as M3Q12
4X-WT5	Monitoring Of Volume of Release The daily quantity of contaminants released must be determined or estimated by an appropriate method, for example, a flow meter.	Same as MPC19
4X-WT6	**Management of Blue-Green Algae** The holder of this environmental authority must implement an effective and appropriate Plan for the Management of Blue-Green Algae for the effluent lagoons, which details how the holder of this environmental authority will manage the actual and potential environmental impacts resulting from any occurrence of blue-green algae outbreaks.	Same as M3Q14
4X-WT7	The Management Plan for Blue-Green Algae must address at least the following matters: (a) weekly inspection to detect the presence of any bloom; (b) notification and reporting if blue-green algae blooms are confirmed; (c) the collection and analysis of samples if a bloom is suspected; and (d) remedial actions.	Same as M3Q15
4X-WT8	The holder this environmental authority must not implement a Management Plan for Blue-Green Algae or amend a Management Plan for Blue-Green Algae where such implementation or amendment would result in a contravention of any conditions of this environmental authority.	Same as
	Agency Interest: Land	
4X- L1	**Contaminant release location** Treated effluents and sewage sludges may be released to the sludge drying beds or, for treated effluents, to designated irrigation areas including the vetiver plantation.	Similar to LC2. Removed “or to a third party” as this is now covered by L5 And includes intent of M3Q1.
4X-L2	Effluent must not be applied to land at a rate, or in a manner, that will cause contamination of groundwater, or cause releases of effluent from the vetiver plantation area, in dry weather.	Same as M3Q2
4X-L3	Vetiver Plantation Area Monitoring Program h) The holder of this environmental authority must develop and implement a program to monitor soil and groundwater in the vetiver plantation area in accordance with condition 4X-L7.	Same as M3Q3
4X-L4	The holder of this environmental authority must submit to the administering authority a report with every second annual monitoring report on the monitoring program, including an assessment of the impact and sustainability of the application of treated effluent to the vetiver plantation area. This report shall include an	Same as M3Q4

	interpretation of the results and conclusions by an appropriately qualified person in the field of effluent land disposal.	
4X-L5	The vetiver grass plantation area must be bunded to exclude stormwater from entering the area and to minimise stormwater runoff being released from the area.	Same as M3Q5
4X-L6	**Soil Monitoring** At not greater than two yearly intervals, the holder of this environmental authority must take representative samples of the soil and subsoil from two sites within the vetiver grass plantation area and from one site outside of the plantation area, and analyse the sample for the quality characteristics specified in *Part 4X: Table 2 – Soil Monitoring Toogoolawah STP*	Same as M3Q6

Table 2 – Soil Monitoring Toogoolawah STP

Quality characteristics	Units	Monitoring frequency
pH	pH scale	Every 2 years
Exchangeable Sodium Percentage (ESP)	%Na	Every 2 years
Exchangeable Cations	meq/100g	Every 2 years
Total Cations	mg/kg	Every 2 years
Specific Conductance or electrical conductivity	µS/cm	Every 2 years
Total Nitrogen	mg/kg	Every 2 years
Phosphorus (extractable)	mg/kg	Every 2 years
Potassium (extractable)	mg/kg	Every 2 years
Total Calcium (exchangeable)	mg/kg	Every 2 years
Total Chloride	mg/kg	Every 2 years
Total Magnesium (exchangeable)	mg/kg	Every 2 years
Total Sodium (exchangeable)	mg/kg	Every 2 years

6. Appendices

6.1. Somerset Regional Council Flood Report

Please note: Printed copies of this document should be verified for currency against online version.

Property Specific Flood Information

Flood Information Certificate

Created: 28/01/2025

Disclaimer

- Council makes no warranty or representation regarding the accuracy or completeness of the flood information provided through this service. The use of the service is entirely at the risk of the user.
- Council will not be liable or responsible on any basis (including negligence) for any expense, loss, damage, cost of liability (indirect or consequential loss) arising from the use (or misuse) of, or reliance on, the information from this service.
- A property that is located within a flood-modelled area does not necessarily mean that flooding has occurred on the property.

Property:	**6RP159098**
Address:	**7295 BRISBANE VALLEY HIGHWAY, TOOGOOLAWAH QLD**

The information supplied in this certificate represents the most current flooding information held by the Somerset Council at the time the certificate was created.

The property is: INSIDE a flood modelled area

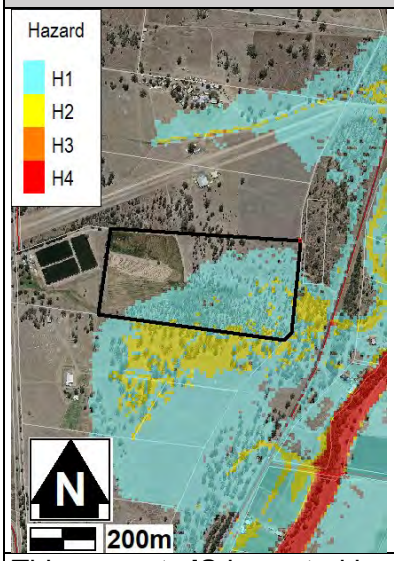
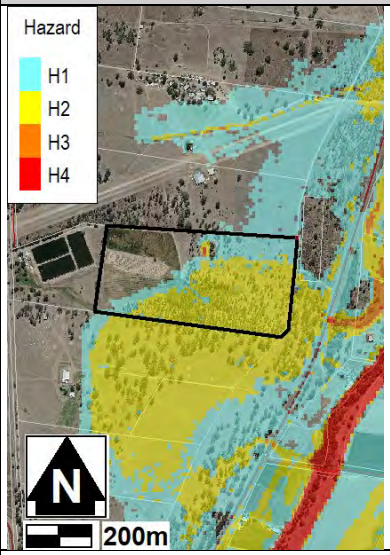
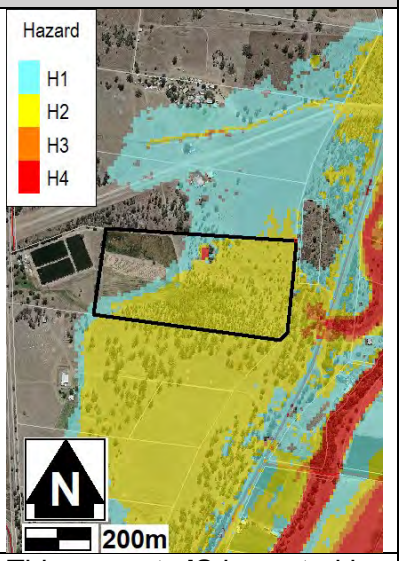
The current flood information adopted by Council for this property includes the following flood studies: Toogoolawah Flood Study

The following flood information (as supplied from the relevant flood study) relates to this property:

Flood Information for 6RP159098			
	5% AEP Flood Event (High Likelihood)	**1% AEP Flood Event (Medium Likelihood)**	**0.2% AEP Flood Event (Low Likelihood)**
Max. Water Level (m AHD)	91.26	91.60	92.00
Min. Water Level (m AHD)	91.04	91.54	91.82
Max. Water Depth (m)	0.87	2.13	2.47
Min. Water Depth (m)	0.00	0.00	0.00
Max. Velocity (m/s)	0.71	1.21	1.20
Min. Velocity (m/s)	0.01	0.01	0.03
Max. Hazard (H1 to H4)	H2	H4	H4
Min. Hazard (H1 to H4)	H1	H1	H1

AEP= annual exceedance probability (see definition on page 4)
ARI = average return interval (a 100yr ARI flood has a 1% chance of occurring in any given year)
Level = elevation of the flood surface above Australian Height Datum (AHD)
Depth is based on LiDAR aerial survey data
Velocity = speed of the flowing flood water
Hazard = Hazard classification is based on the Schedule 4 in the Queensland Reconstruction Authority's Planning for stronger, more resilient floodplains Part 2 – Measures to support floodplain management in future planning schemes.

Map of flood hazards on and around property : 6RP159098

5% AEP Flood Hazard (High Likelihood)	1% AEP Flood Hazard (Medium Likelihood)	0.2% AEP Flood Hazard (Low Likelihood)
		
This property **IS** impacted by a 5% AEP flood event	This property **IS** impacted by a 1% AEP flood event	This property **IS** impacted by a 0.2% AEP flood event

H1 LOW - self evacuation possible for adults and children, vehicle stability within tolerance for large 4WD.
H2 SIGNIFICANT - working limit for trained safety workers, Vehicle evacuation.
H3 HIGH – Limit of uncompromised stability for adults (dangerous to most) .
H4 EXTREME - in excess of known stability limits

Flood Hazard Criteria

The following criteria has been used to calculate the above Flood Hazard risk on the property shown.

	Low	Significant	High	Extreme
Depth	**< 0.5**	**< 2**	**< 2**	**2 +**
Velocity	**< 1.5**	**< 2**	**< 2**	**2 +**
DxV Ratio	**< 0.6**	**0.6 to < 0.8**	**0.8 to < 1.2**	**1.2 +**

Planning and/or Building Controls

Habitable

*The Defined Flood Level for **habitable** rooms of buildings as following –*

- *Where a 1% AEP inundation line has been approved, Council adopts the Defined Flood Level of 1% AEP plus 500mm*
- *Where no 1% AEP inundation line has been approved, Council adopts the highest recorded flood level as the Defined Flood Level*
- *A nominated freeboard of 300mm above the Defined Flood Level.*

*Defined Flood Level for **habitable** rooms of buildings*
Council records show the existing 1% AEP inundation line is the 91.60m AHD level and the minimum Defined Flood Level should be 91.60m + 500mm + 300mm freeboard = 92.40m AHD level.

Non-habitable

*The Defined Flood Level for **non-habitable** rooms of buildings as following –*

- *Where a 1% AEP inundation line has been approved, Council adopts the Defined Flood Level of 1% AEP*
- *Where no 1% AEP inundation line has been approved, Council adopts the highest recorded flood level as the Defined Flood Level*
- *A nominated freeboard of 300mm above the Defined Flood Level.*

*Defined Flood Level for **non-habitable** rooms of buildings*
Council records show the existing 1% AEP inundation line is the 91.60m AHD level and the minimum Defined Flood Level should be 91.60m + 300mm freeboard = 91.90m AHD level.

Vulnerable Uses

*The Defined Flood Level for **vulnerable uses** (see planning scheme for definition) of rooms of buildings as following –*

- *Where a 0.2% AEP inundation line has been approved, Council adopts the Defined Flood Level of 0.2% AEP plus 500mm*
- *A nominated freeboard of 300mm above the Defined Flood Level.*

*Defined Flood Level for **vulnerable uses***
Council records show the existing 0.2% AEP inundation line is the 92.00m AHD level and the minimum Defined Flood Level should be 92.00m + 500mm + 300mm freeboard = 92.80m AHD level.

Definitions	
Annual Exceedance Probability (AEP) *	Flood information is provided for a range of event likelihoods. The likelihood of these events occurring is described in terms of their Annual Exceedance Probability or AEP. AEP described the likelihood of an event with a given magnitude or greater occurring in any given year and is usually expressed as a percentage. The 1% AEP event has a 1 in 100 chance (or 1% chance) of occurring in any given year and location.
Defined flood level (DFL) *	Defined flood level means: a) Where for habitable rooms of buildings: • Level of the 1% AEP flood event plus 500mm where a 1% EP flood inundation line has been approved; or • The highest recorded flood level where no 1% AEP flood event inundation line has been approved. b) Where for vulnerable uses: • Level of the 0.2% AEP flood event plus 500mm c) Where for non-habitable buildings (except for buildings classified under the Building Code of Australia as Class 7a and Class 10): • Level of the 1% AEP flood event where a 1% AEP flood event inundation line has been approved; or • The highest recorded flood level where no 1% AEP flood event inundation line has been approved.
Freeboard *	Freeboard means 300mm above the defined flood level , which accounts for matters such as wave action and localised hydraulic behaviour which may cause a flood level to rise above the defined flood level.

If you have any enquiries regarding this certificate, please feel free to contact the following:

Somerset Regional Council:

Phone: 07 54244 000

Email: mail@somerset.qld.gov.au

GET READY SOMERSET

Somerset Regional Council is committed to strengthening its disaster preparedness and assisting the community to stay strong, connected, and resilient.
It is imperative that as individuals, and as a community, we are ready for all that Mother Nature throws at us.

Be Prepared, Plan Ahead and Stay Informed

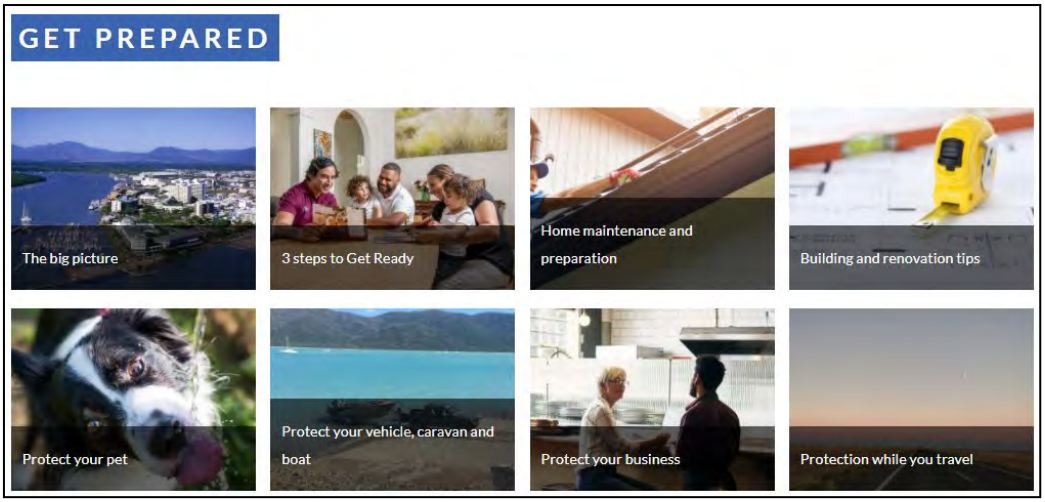
When it comes to extreme weather events in Queensland, it's not a matter of 'if' but 'when'. Queensland is the most natural disaster impacted state in Australia, exposing our communities and infrastructure to repeated damage. The Somerset region is not immune.

As Queenslanders we understand the impacts from natural disasters can include minor inconveniences such as transport delays, needing to use alternative travel routes, collecting children early from school, massive queues at the petrol station or supermarket, and loss of power or internet connection.

get ready QUEENSLAND

And then there are the alarming scenarios like flood waters moving swiftly toward your house, a loved one unable to get home, and leaving behind pets during evacuation.

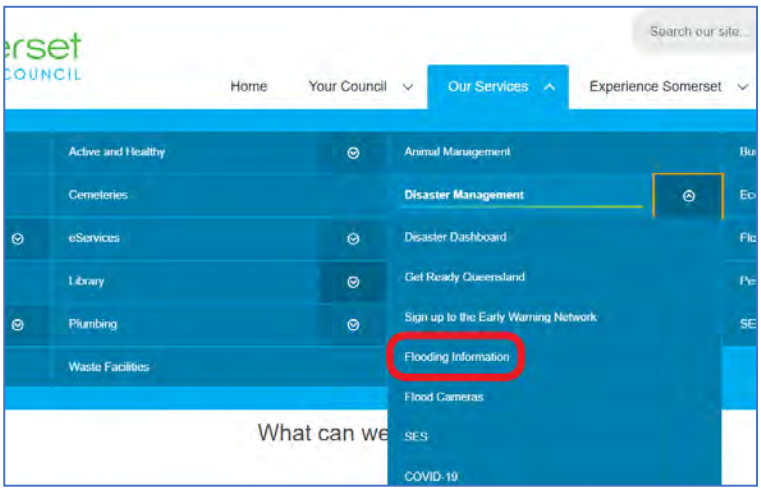
You can't control the weather or when the next disaster will hit Queensland, but you can be aware and prepared. Get Ready Queensland helps you to take the steps to protect what's most important to you. For information on how you can prepare yourself and your family visit **https://www.getready.qld.gov.au/** and Get Ready.



Flooding Information

No two floods are the same and can vary depending on the quantity, duration and location of rain falling on our catchments. There are three main types of flooding experienced in the Somerset region.

- **River flooding** happens when widespread and prolonged rain falls over a river catchment
- **Creek flooding** happens when intense rain falls over a creek catchment causing the creek levels to rise, which often occurs quickly with limited warning
- **Overland flow** happens as water travels over the land during heavy rainfall events and generally occurs over a short period of time.



After heavy rain in your area…

- Keep informed about weather patterns and weather forecasts and act quickly on any advice
- Stay away from rivers, creeks and drains
- Get to higher ground
- Never try to drive, ride or walk-through floodwater.

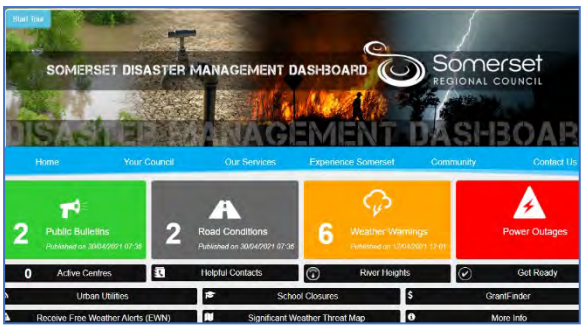
For more information on understanding your flood risk, visit Council's dedicated Flooding information page at **https://www.somerset.qld.gov.au/flooding-information**

Disaster Dashboard

Visit Council's disaster dashboard at **http://disaster.somerset.qld.gov.au/** to be kept up-to-date with information during disasters such as bushfire, flooding and other severe weather events.

While there, sign up to the Early Warning Network where you can receive alerts to you phone and/or email when a weather event may impact your location.

It's free to all Somerset residents.



6.2. Groundwater Bore Report

Please note: Printed copies of this document should be verified for currency against online version.

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
14320522	Sub-Artesian Facility	Abandoned but Still Usable		Gatton	4580 - LOCKYER VALLEY REGIONAL

Details

Description	ROAD RES AJD. POR 49V		
Parish	531 - BLENHEIM		
Original Name			
Driller Name			
Const Method			
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	DNR
Roles	WR Investigation Sub-Artesian Monitoring		

Location

Datum	GDA94	**Basin**	1432
Latitude	27-34-27	**Sub-area**	111
Longitude	152-20-39	**Lot**	
GIS Latitude	-27.57415863	**Plan**	
GIS Longitude	152.3442492		
Easting	435272	**Map Scale**	
Northing	6949797	**Map Series**	M - Metric Series
Zone	56	**Map No**	K2-72902
Accuracy		**Map Name**	
GPS Accuracy		**Prog Section**	
Checked	Yes		

Casing

2 ***records for RN*** **14320522**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	02/07/1987	1	0.00	19.00	Plastic Casing			50
A	02/07/1987	2	12.00	18.00	Perforated or Slotted Casing			50

Strata Logs

7 ***records for RN*** **14320522**

Rec	Top (m)	Bottom	Strata Description

Bore Report

From Year:

		(m)	
1	0.00	1.30	BLACK SOIL
2	1.30	5.60	BROWN CLAY
3	5.60	7.90	GREY CLAY
4	7.90	9.10	BROWN CLAY
5	9.10	14.80	BROWN SILTY CLAY
6	14.80	16.90	FINE SAND
7	16.90	18.00	SANDSTONE

Stratigraphies

2 *records for RN* **14320522**

Source	Rec	Top (m)	Bottom (m)	Strata Description
DNR	1	0.00	16.90	LAIDLEY CREEK ALLUVIUM
DNR	2	16.90	18.00	GATTON SANDSTONE

Aquifers

1 *records for RN* **14320522**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	9.10	16.90	SAND - Sand						Y	UC	LAIDLEY CREEK ALLUVIUM

Pump Tests Part 1

0 *records for RN* **14320522**

Pump Tests Part 2

0 *records for RN* **14320522**

Bore Conditions

0 *records for RN* **14320522**

Elevations

3 *records for RN* **14320522**

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	14/04/1988	89.06	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	SERO

Bore Report

From Year:

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
A	15/04/1988	88.91	SVY	Surveyed	AHD - Aust. Height Datum	R	Reference Point	12612
X	15/04/1988	88.31	SVY	Surveyed	AHD - Aust. Height Datum	N	Natural Surface	12612

Water Analysis Part 1

0 *records for RN* **14320522**

Water Analysis Part 2

0 *records for RN* **14320522**

Water Levels

78 *records for RN* **14320522**

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project	Quality
A	19/04/1988		-9.05	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	03/05/1988		-9.02	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	18/06/1989		-8.56	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	05/07/1989		-8.52	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	22/09/1989		-8.50	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	22/11/1989		-8.49	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	02/02/1990		-8.42	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	22/03/1990		-8.48	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	26/09/1990		-8.05	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	04/02/1991		-8.32	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	30/04/1991		-8.47	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	17/06/1991		-8.48	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	01/09/1991		-8.60	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	01/11/1991		-8.78	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	03/12/1991		-8.88	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality
A	10/03/1992		-8.77	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded	130	Data is of unknown quality

Bore Report

From Year:

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	10/06/1992		-8.45	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	10/09/1992		-8.39	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	23/10/1992		-8.49	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	07/12/1992		-8.49	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	09/02/1993		-8.48	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	13/04/1993		-8.64	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	10/06/1993		-8.75	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	17/08/1993		-8.78	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	12/10/1993		-8.87	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	10/12/1993		-8.97	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	09/02/1994		-9.03	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	26/04/1994		-8.93	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	06/06/1994		-9.09	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	26/09/1994		-9.20	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	28/11/1994		-9.31	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	09/03/1995		-9.18	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	21/06/1995		-9.45	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	20/09/1995		-8.56	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	04/12/1995		-8.20	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	18/03/1996		-2.45	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	11/06/1996		-5.60	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	02/10/1996		-6.36	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	14/12/1996		-6.87	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	26/03/1997		-7.51	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	15/04/1997		-7.65	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Bore Report

From Year:

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	24/09/1997		-8.16	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	12/01/1998		-8.12	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	21/03/1998		-7.99	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	05/07/1998		-8.27	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	11/09/1998		-8.47	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	06/12/1998		-7.60	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	03/06/1999		-5.09	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	08/09/1999		-6.93	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	29/11/1999		-6.47	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	28/02/2000		-6.76	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	29/05/2000		-4.45	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	04/09/2000		-5.76	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	14/12/2000		-7.11	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	27/02/2001		-6.35	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	04/06/2001		-6.04	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	03/09/2001		-5.76	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	04/12/2001		-6.52	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	07/03/2002		-7.14	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	10/07/2002		-7.16	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	14/10/2002		-7.39	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	09/12/2002		-7.57	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	03/03/2003		-8.01	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	27/08/2003		-8.71	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	09/10/2003		-8.66	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	11/12/2003		-7.18	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Bore Report

From Year:

Pipe	Date	Time	Measure (m)	Meas	Point	Remark	Meas	Type	Coll Auth	Coll	Method	Project		Quality
A	23/03/2004		-5.47	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	08/07/2004		-4.65	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	30/08/2004		-5.29	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	08/03/2005		-4.01	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	09/06/2005		-4.10	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	29/05/2006		-5.17	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	11/09/2006		-5.16	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	22/01/2007		-7.03	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	23/03/2007		-6.75	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	14/06/2007		-6.60	R	Reference Point		ACT	Actual	DG	MA	Manual/Hand	GWAN	1	Good - Actual Manual Measurements
A	09/04/2008		-4.33	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality
A	15/12/2009		-5.07	R	Reference Point		NR	Not Recorded	NR	NR	Not Recorded		130	Data is of unknown quality

Wire Line Logs

0 ***records for RN*** **14320522**

Field Measurements

0 ***records for RN*** **14320522**

Special Water Analysis

0 ***records for RN*** **14320522**

Bore Report

From Year:

User Licence and Conditions

Disclaimer

Open Licence (Single Supply)

Permitted use:
- You may use the supplied data for your own purposes (including supply to consultants for a specific consultancy project for you but the consultants must return or destroy the supplied data when the project is finished). You must not sell or distribute the supplied data.
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- You may create and distribute hardcopy and digital products based on or containing the supplied data, provided all the following conditions are met:
- You must display this acknowledgment on the product(s): "Based on or contains data provided by the State of Queensland 2025. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws."
- You must include metadata with the product(s) you create that use or incorporate the supplied data and the metadata must incorporate as a minimum the metadata provided with this supplied data.

Obligations:

- You must not use the data for direct marketing or in breach of the privacy laws.

Ownership:

The State of Queensland is the owner of the intellectual property rights in and to the supplied data or has the right to make this supplied data available.

Disclaimer and indemnity:
You agree to accept all responsibility and risks associated with the use of the supplied data. The State makes no representations or warranties in relation to the supplied data, and, you agree that, to the extent permitted by law, all warranties relating to accuracy, reliability, completeness, currency or suitability for any particular purpose and all liability for any loss, damage or costs (including consequential damage) incurred in any way (including but not limited to that arising from negligence) in connection with any use of or reliance on the supplied data are excluded or limited. You agree to continually indemnify the State of Queensland (and its officers and employees) against any loss, cost, expense, damage and liability of any kind (including consequential damage and liability in negligence) arising directly or indirectly from or related to any claim relating to your use of the supplied data or any product made from the data.

6.3. Protected Matters MNES Report

Please note: Printed copies of this document should be verified for currency against online version.

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 28-Jan-2025

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	38
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	19
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	1
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Moreton bay	50 - 100km upstream from Ramsar site

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community may occur within area
Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat likely to occur within area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area
Cyclopsitta diophthalma coxeni Coxen's Fig-Parrot [59714]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
[Rostratula australis](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
[Stagonopleura guttata](#) Diamond Firetail [59398]	Vulnerable	Species or species habitat may occur within area
[Turnix melanogaster](#) Black-breasted Button-quail [923]	Vulnerable	Species or species habitat likely to occur within area
FISH		
[Neoceratodus forsteri](#) Australian Lungfish, Queensland Lungfish [67620]	Vulnerable	Species or species habitat known to occur within area
MAMMAL		
[Chalinolobus dwyeri](#) Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat may occur within area
[Dasyurus hallucatus](#) Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
[Dasyurus maculatus maculatus (SE mainland population)](#) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
[Macroderma gigas](#) Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area
[Petauroides volans](#) Greater Glider (southern and central) [254]	Endangered	Species or species habitat likely to occur within area
[Petaurus australis australis](#) Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
PLANT		
Arthraxon hispidus		
Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area
Coleus omissus listed as Plectranthus omissus		
[91381]	Endangered	Species or species habitat may occur within area
Dichanthium setosum		
bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Leuzea australis listed as Rhaponticum australe		
Austral Cornflower, Native Thistle [9363]	Vulnerable	Species or species habitat may occur within area
Notelaea lloydii		
Lloyd's Olive [15002]	Vulnerable	Species or species habitat may occur within area
Phebalium distans		
Mt Berryman Phebalium [81869]	Endangered	Species or species habitat may occur within area
Rhodamnia rubescens		
Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat may occur within area
Samadera bidwillii		
Quassia [29708]	Vulnerable	Species or species habitat may occur within area
Thesium australe		
Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
REPTILE		
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Hemiaspis damelii Grey Snake [1179]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area overfly marine area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis		
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat likely to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area overfly marine area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area overfly marine area
Pterodroma cervicalis White-necked Petrel [59642]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat likely to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato)		
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area
Symposiachrus trivirgatus as Monarcha trivirgatus		
Spectacled Monarch [83946]		Species or species habitat may occur within area overfly marine area

Extra Information

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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6.4. Urban Utilities Risk Matrix

Table 6 Urban Utilities Consequence Descriptors

Consequence Category	Least Significant	Minor Significance	Moderate Significance	High Significance	Most Significant
Project Performance Unexpected project expenditure or impact to the successful achievement of project outcomes relating to strategic initiatives.	• Project fails to deliver up to <10% of forecast business benefits • Cost impact of <10% of approved budget Minor delay to the overall project schedule (up to 10% increase)	• Project fails to deliver 10-20% of forecast business benefits • Cost impact of 10-20% of approved budget Minor delay to the overall project schedule (10-20% increase)	• Project fails to deliver 20-30% of forecast business benefits • Cost impact of 20-30% of approved budget Minor delay to the overall project schedule (20-30% increase)	• Project fails to deliver 30-50% of forecast business benefits • Cost impact of 30-50% of approved budget Moderate delay to overall project schedule (30-50% increase)	• Project fails to deliver >50% of forecast business benefits • Cost impact of >50% of approved budget Significant delay to overall project schedule (>50% increase)
Product & Service Disruption Service Disruptions [1] or Operational Disruptions [2] to customers and/or Key Commercial Accounts (KCA) [3], affecting, Critical Customers [4], community facilities, transport connections/routes, or disruptions to SOCI-Critical Components[5]	• Service Disruption to <50 customers • Service Disruption which exceeds 5 hours • 1 Service/Operational Disruption to a single customer in a 2-year period • No Service/Operational Disruption to KCA/Critical Customer No disruption to suburban streets, CBD, major transport connections, or routes	• Service Disruption to 51-100 customers • Service Disruption which exceeds 12 hours 1 Service/Operational Disruption to a single customer in a 1-year period • Minor Service/Operational Disruption to individual KCA/Critical Customer • Closure of a suburban street <5 Complaints [6] resulting from a single event (unrelated to a declared disaster)	• Service Disruption to 101-1,000 customers • Service Disruption which exceeds 24 hours • 2-3 Service/Operational Disruptions to a single customer in a 1-year period • Moderate Service/Operational Disruption to individual KCA/Critical Customer • Closure of multiple suburban streets, or minor disruption (but not closure) to CBD, major transport connections, or routes 5-15 Complaints resulting from a single event, or repeat complaints or requests for review received from >1 customer in relation to an ongoing concern	• Service/Operational Disruption to 1,001-5,000 customers; or • Service Disruption which exceeds 48 hours • 4-9 Service/Operational Disruptions to a single customer in a 1-year period • Shutdown of individual KCA/Critical Customer operations, or Service Disruption to >1 KCA/Critical Customer • Moderate disruption or closure of major transport connections, or routes • 16-25 Complaints resulting from a single event or repeat complaints or requests for review received from 3-5 customers in relation to an ongoing concern Partial interruption to a *single* SOCI-Critical Component	• Service Disruption to >5,000 customers • Service Disruption which exceeds 96 hours • >9 Service/Operational Disruptions to a single customer in a 1-year period • Shutdown of >1 KCA/Critical Customer, or any unplanned disruption to a dialysis customer • Significant or prolonged disruption (including closure) of major transport connections or routes, including any disruption to an airport • >25 Complaints resulting from a single event or repeat complaints or requests for review received from >5 customers in relation to an ongoing concern Partial interruption to *multiple* SOCI-Critical Components, or complete interruption to a *single* SOCI-Critical Component

[1] ***Service Disruption*** *means a customer's water or sewage is disconnected, or customers are otherwise advised/unable to use their water and sewage facilities (e.g., water contamination issue, unable to use sewage facilities due to high water level in the sewer for an extended period).*
[2] ***Operational Disruption*** *means adverse impact caused by Urban Utilities' activities, including restricted access, traffic, or nuisance/amenity (i.e., emission of noise, odour, aerosols, light, particulates, or vibration)*
[3] ***Key Commercial Customers*** *are our highest valued customers (usually over 100,000 kilolitres per annum) that are actively managed by an account manager within the Key Commercial Accounts Team.*
[4] ***Critical Customers*** *are consumers which are dependent on water to carry out their operations in the interest of public safety and health.*
[5] ***SOCI-Critical Components*** *means the physical facilities, systems, assets, supply chains, information technologies and communication networks (as defined under the Security of Critical Infrastructure Act) that are critical to the delivery of Urban Utilities' essential products and services.*
[6] ***Complaint*** *is defined as per Urban Utilities' Complaints Management Policy (POL74). Note: 'complaint' in this context is unrelated to a declared disaster.*

Consequence Category	Least Significant	Minor Significance	Moderate Significance	High Significance	Most Significant
Health, Safety & Wellbeing Urban Utilities' products, services or activities negatively affect the health, safety and well-being of employees, contractors, site visitors, and our communities.	• Very minor injury with no treatment required • Person experiences no discernible stress or apprehension arising from an incident No impact on regular work duties	• Minor injury, first aid treatment required with no lasting impact • Short-term illness with no lasting impact • Person experiences minor stress arising from an incident • A reduction in worker's ability to perform regular work duties in the short term Level 4 near miss (non-High Potential Event[7])	• Injury/illness requiring medical treatment to one or more people • Injury resulting in short-term disability or requiring a suitable duties program • Lost Time Injury (LTI) impact (less than 10 days) or a noticeable reduction in worker's ability to perform regular duties in the immediate future • Person experiences moderate stress arising from an incident • Improvement notice or direction issued by Regulator. • Direct or vicarious exposure to low level unreasonable behaviours (discrimination, bullying, harassment etc) Level 3 High Potential Event (energy release with *some* active barriers/controls)	• Serious injury/illness (notifiable incidents to regulator) requiring treatment or hospitalisation • Major or Multiple injuries resulting in temporary long-term disability or ill health to one or more persons • Significant Lost Time Injury (LTI) impact (10 days or more) • Person experiences major stress arising from an incident • An inability to perform work duties in the medium to long term • Prohibition Notice from Regulator • Direct or vicarious exposure to mid-level unreasonable behaviours Level 2 High Potential Event (energy release with *zero* active barriers/controls)	• Severe injury / illness, resulting in permanent injury / disability or ill health to one or more persons • Single or multiple fatalities • Person experiences extreme stress arising from an incident • An inability to perform work duties in the foreseeable future • Regulator prosecution or fines almost certain Direct or vicarious exposure to high/ extreme level unreasonable behaviours and/or assault
Water Quality & Public Health Urban Utilities' products, services and activities negatively affect the health of our communities beyond our site boundaries	• A water quality incident resulting in: ◦ An isolated instance of zero disinfection ◦ Very minor acute impact or illness, with no treatment required Interruption to a single residence with little to no impact to a customer's ability to sleep, relax or study	• A water quality incident resulting in: ◦ Multiple incidences of zero disinfection or isolated breach of an aesthetic parameter within a zone ◦ Isolated illness requiring first aid treatment only Isolated (single residence) interruption to a customer's ability to sleep, relax or study.	• A water quality incident resulting in: ◦ Zero disinfection across multiple zones, or multiple exceedances of aesthetic parameters within a zone ◦ Isolated illness requiring medical treatment, but with no lasting effects Limited (single street or block) interruption to customers' ability to sleep, relax or study	• A water quality incident resulting in: ◦ Widespread exceedances of an aesthetic parameter across multiple zones, or an isolated exceedance of ADWG health parameter ◦ Isolated illness causing *temporary* long-term disability or ill health ◦ Limited (single street or block) illnesses requiring treatment, with no lasting effects Localised (single catchment or suburb) prolonged interruption to customers' ability to sleep, relax or study	• A water quality incident resulting in: ◦ A Boiled Water or Do Not Drink notice, or widespread exceedances of an ADWG health parameter ◦ Isolated illness causing *permanent* disability, ill health, or fatality ◦ Localised (single catchment or suburb) illnesses requiring treatment, with no lasting effects Widespread (multiple catchments or suburbs) prolonged interruption to customers' ability to sleep, relax or study
Financial Performance Financial losses or unplanned expenditure is incurred by Urban Utilities,	• **Corporate:** unplanned financial cost/debt of <$5M p.a. • **Operational:** incident management, remediation, or	• **Corporate:** unplanned financial cost/debt of $5-10M p.a. • **Operational:** incident management, remediation, or	• **Corporate:** unplanned financial cost/debt of $11-50M p.a. • **Operational:** incident management, remediation, or	• **Corporate:** unplanned financial cost/debt of $51-100M p.a. • **Operational:** incident management, remediation, or	• **Corporate:** Unplanned financial cost/debt of >$100M p.a. • **Operational**: incident management, remediation, or

[7] ***High Potential Event*** *refers to incidents which may have resulted in serious injury/illness and/or a fatality.*

Consequence Category	Least Significant	Minor Significance	Moderate Significance	High Significance	Most Significant
including financial penalties.	impact management costs <10% of agreed budget **Aggregated Losses (across multiple assets):** asset damage or service interruption costs of <$1M p.a.	impact management costs 10-20% of agreed budget **Aggregated Losses (across multiple assets):** asset damage or service interruption costs of $1-5M p.a.	impact management costs 21-30% of agreed budget **Aggregated Losses (across multiple assets):** asset damage or service interruption costs of $6M-10M p.a.	impact management costs 31-50% of agreed budget **Aggregated Losses (across multiple assets):** asset damage or service interruption costs of >$11-50M p.a.	impact management costs >50% of agreed budget **Aggregated Losses (across multiple assets):** asset damage or service interruption costs of >$50M
Environment & Heritage [8] Impacts including harm, public concern, nuisance, administrative offences, and reduction in Environmental Values *Refer to PRO249 for guidance*	• Transient (<1 month) impact to the natural environment (land, water, air, flora, or fauna) • Controlled site, single local temporary impact Damage to items/areas of low cultural or heritage significance	• Temporary (1-6 months) impact to the natural environment (land, water, air, flora, or fauna) • Single local impact/habitat destruction • Duty to notify the regulator of an environmental or heritage event Minor, repairable damage to items/areas of high cultural or heritage significance	• Short-term (6 months-1 year) impact to the natural environment (land, water, air, flora, or fauna) • Localised (single catchment or suburb) impact and some community concerns Significant, but recoverable, damage to items/areas of high cultural or heritage significance	• Medium-term (1-5 years) impact to the natural environment (land, water, air, flora, or fauna) • Localised (single catchment or suburb) impact and a high level of public concern Permanent damage to items/areas of high cultural or heritage significance	• Long term (>5 years) or irreversible impact to the natural environment (land, water, air, flora, or fauna) • Widespread (multiple catchments or suburbs) impact and a high level of public concern Destruction of items/areas of high cultural or heritage significance
Brand & Reputation Urban Utilities' brand or reputation impacted in terms of stakeholder trust in the ability to deliver on reliability, quality, transparency & value for money expectations.	• Standard level of complaints Notification of potential adverse media/ social media coverage.	• Minimal stakeholder concern/interest • Low level community concern Isolated local adverse media/social story	• Adverse reaction among key stakeholders lasting ≤1 week • Suburb-scale community concern • Local adverse media/social media coverage lasting ≤1 week ELT intervention	• Adverse reaction among key stakeholders lasting 1 week to 1 month • Catchment-scale community campaign or action • State/national adverse media/social coverage lasting ≤1 week CEO intervention	• Adverse reaction among key stakeholders lasting 1-3 months • Widespread community action or protest • State/national adverse media/social coverage lasting ≥1 week Board and/or Shareholder intervention
Compliance Risk of regulatory action for breach of obligation (regulation, legal or contractual obligation)	• No regulatory involvement expected [9] • No culpability, where breach could not have been prevented No risk of impact [10]	• Regulator issues requests for additional information to substantiate a potential breach • Low culpability, where breach is inadvertent in nature Minor risk of impact, where impact is transient, localised and/or of low intensity	• Regulator issues financial penalty • Regulator issues formal warning • Moderate culpability, where breach is careless in nature Moderate risk of impact, where impact is temporary to medium-term, localised to medium scale and/or low to medium intensity.	• Court issues financial penalty • Regulator or court issues enforceable undertaking (e.g., mandatory action, Prohibitory Injunction,[11] remedial direction, Protection Order, Evaluation, Transitional Plan, etc.) • High culpability, where breach is intentional/wilful	• Loss of licence to operate • Criminal prosecution, imprisonment of Urban Utilities' officer • Government inquiry with a focus on Urban Utilities • Serious culpability, where breach is intentional/wilful and in contravention of formal directions or warnings

[8] *For further guidance on consequence ratings of environmental health including biodiversity, contamination and other values/ society uses of the environment refer to PRO249*
[9] *The types of likely regulatory action have been linked to the culpability and impact of the breach*

[10] *The compliance component of the consequence matrix has been developed in consideration of PRO249*
[11] ***Prohibitory Injunction** means an order made by a court forcing a party to refrain from doing a particular act or thing*

Consequence Category	Least Significant	Minor Significance	Moderate Significance	High Significance	Most Significant
				• Where breach is administrative, information is intentionally concealed Major risk of impact, where impact is long-term, medium to wide-scale and/or of medium to great intensity.	• Where the breach is administrative, information provided is false or misleading Serious risk of impact, where impact is potentially permanent, on a wide-scale and/or of great intensity.

Table 7 Likelihood descriptors

	Threat Likelihood Descriptors			Opportunity Likelihood Descriptors		
	Definition (Qualitative estimates of probability)	**Probability (1 year horizon)**	**Frequency**	**Organisational Capability**	**Organisational Capacity**	**Market Capacity**
Almost Certain	Is expected to occur; almost inevitable. Asset condition rated as "Very Poor" or condition indicates failure or capacity exceedance within 12 months.	> 95%	More frequent than once a year	Sufficient in-house capability exists and can be readily utilised.	Can be done in-house with existing resources.	Internal impacts only or Current market exists, there is existing science in this area and solution has been identified.
Likely	Will occur in most circumstances; not surprised if it happened. Asset condition rated as "Poor" condition indicates failure or capacity exceedance >12 months <24 months.	80% to 95%	Once a year to once every 2 years	In-house capability exists but requires development.	Required resources not available but can be easily acquired.	Emerging market, existing science/ technology needs to be adapted and solution can be envisioned.
Possible	Will occur in a narrow range of circumstances. Asset condition rated as "Fair or Moderate" or condition indicates failure or capacity exceedance >2 years <5 years.	50% to 80%	Once every 2 to once every 10 years	In-house capability is limited and requires recruiting specialist knowledge and capability.	Required resources not available but can be acquired by partnering with external sources.	Emerging market, existing science/ tech needs to be adapted, solution can be envisioned but hurdles expected.
Unlikely	Will occur in specific range of circumstances; surprised if it happened. Asset condition rated as "Good" or condition indicates failure or capacity exceedance >5 years >10 years.	20% to 50%	Once every 10 to once every 20 years	Partner - capability does not exist in-house or is not sufficiently mature and external providers exist and are willing to partner.	Required resources not available and project needs to be outsourced.	New market where some science/ tech exists but is not proven, difficult to envision solution and several hurdles expected.
Rare	Will occur in exceptional circumstances; highly unexpected event. Asset condition rated as "Very Good" or condition indicates failure or capacity exceedance >10 years.	< 20%	Less frequent than once every 20 years	Outsource - capability does not exist and costs to develop in-house outweigh costs of engaging an existing external provider.	Required resources not available and project needs to be outsourced with several parties required to provide input and resources.	New market with a need to discover new science/ tech, difficult to envision solution with significant hurdles expected.

Table 8 Risk matrix

		Likelihood				
		Rare	Unlikely	Possible	Likely	Almost Certain
Consequence	Most Significant	Medium 12	High 17	High 21	Extreme 24	Extreme 25
	High Significance	Medium 8	Medium 14	High 19	High 22	Extreme 23
	Moderate Significance	Low 5	Medium 10	Medium 15	High 18	High 20
	Minor Significance	Low 3	Low 6	Medium 9	Medium 13	High 16
	Least Significant	Low 1	Low 2	Low 4	Medium 7	Medium 11

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