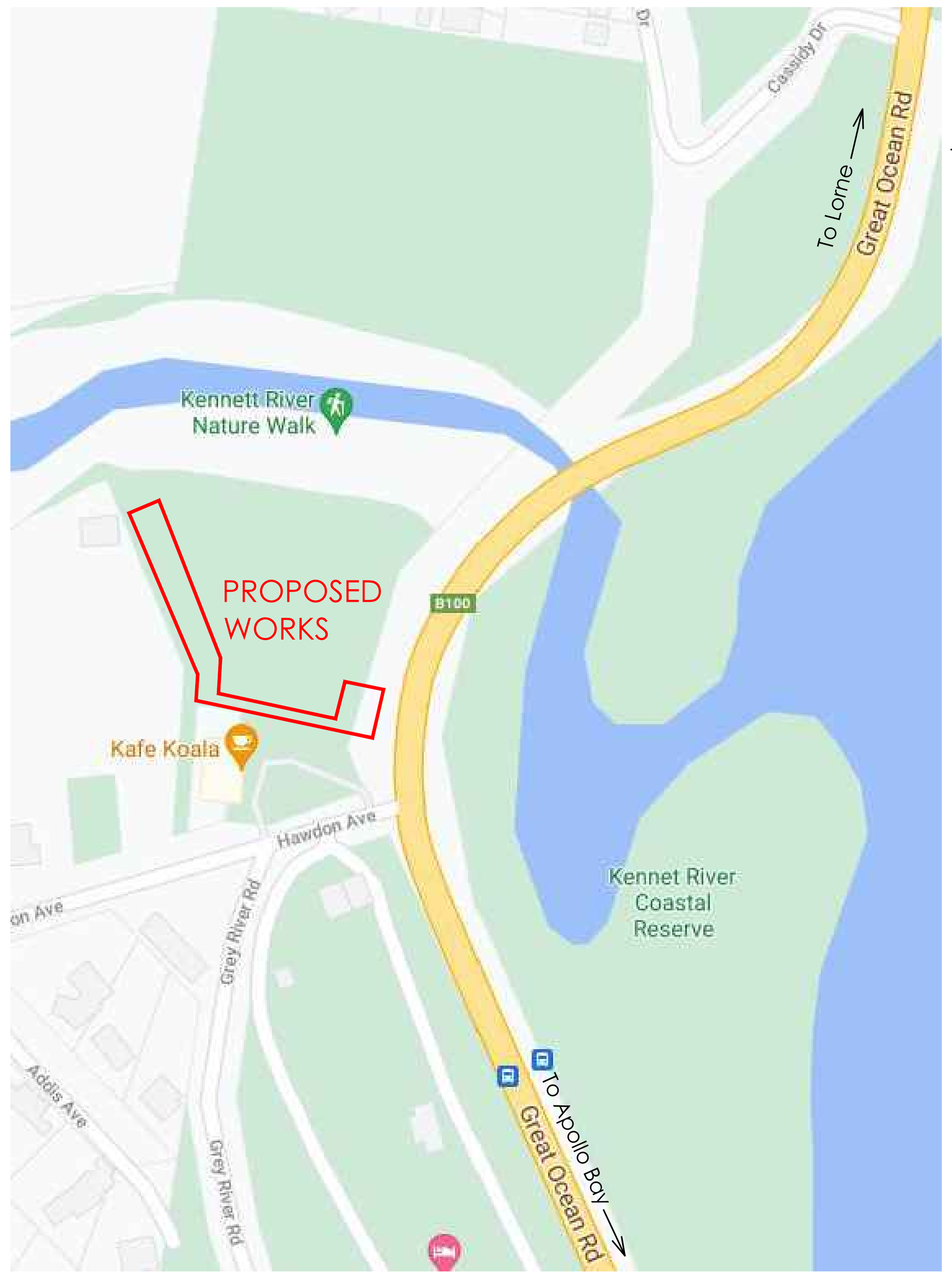
Colac Otway Shire | Geelong City Deal

Kennett River Tourism Infrastructure Improvements

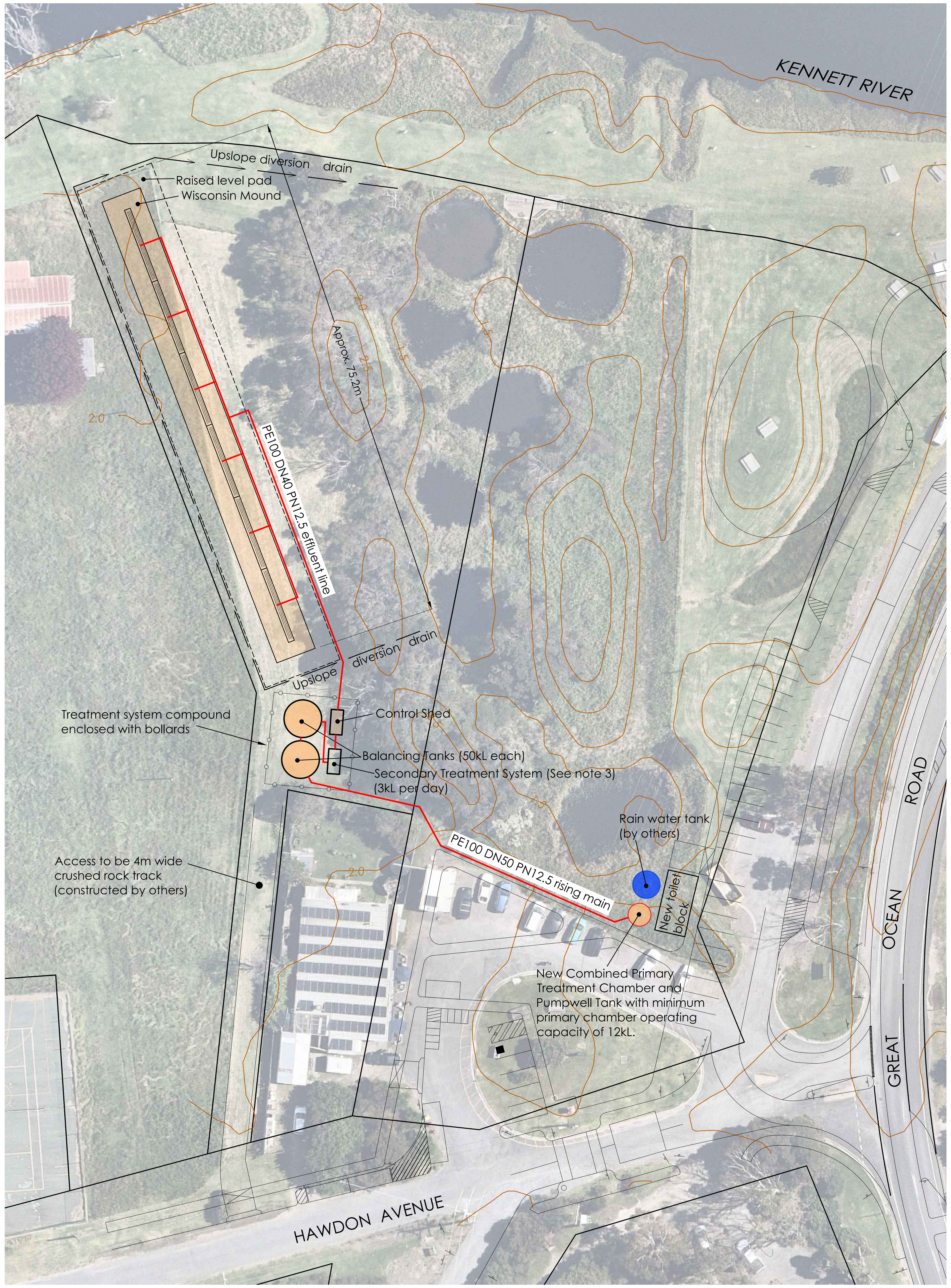
Wastewater Treatment Plant Design Package

Contents

240225-ENG-001-C



SITE LOCALITY PLAN



EFFLUENT TREATMENT PLAN

DIAL 1100 BEFORE YOU DIG

Notes:

1. New On-site Treatment System
   - New Primary Treatment Tank (Septic Tank) with minimum capacity of 12kL.
   - Minimum combined capacity of 100kL for Flow Balancing Tanks prior to Secondary Treatment System.
   - New Secondary Treatment System (3kL per day capacity).
   - All tank lids are to be secure and watertight (e.g. Gatic or similar) to prevent public access and meet flood requirements.
   - All electrical equipment not designed to be waterproof is to be above the 1% AEP Design Flood Level of 3.2m AHD.

2. Effluent Land Application Area (LAA)
   - New Pressure Dosed Wisconsin Mound
   - Total Basal Area approximately 432m2 (72m x6m)
   - Total Mound Height 1.4m above existing ground level
   - Importation of approximately 224 m^3 of good quality sand fill to ensure the base of the mound's distribution bed is at or above the 5% AEP Design Flood Level of 2.8m AHD.

3. Secondary treatment system shown indicatively. Contractor to specify, supply and install suitable 3kL/day secondary treatment system in accordance with the design specification (D.0428.001). Tenderers to provide detail of proposed secondary treatment system footprint and layout within tender submission to be approved by Principal as part of tender assessment.

4. Refer to the Design Specification (D.0428.001) for further design and construction information.
5. Provision of adequate power supply and power connection to all treatment facility components is the responsibility of the Contractor. Approximate power requirements for electrical equipment is outlined in DWC document "D.0428.001".
6. All sanitary drainage and electrical conduits are to be installed in accordance with AS3500 & AS3600 respectively.
7. All disturbed areas to have topsoil re-instated to 100mm and seeded with Kikuyu grass at a rate of 1kg/100m².
8. No excavation is to be left open and unattended at any time. Excavations of depth 1.5m or deeper require confirmation of notification of Worksafe Victoria prior to any such work commencing. Dial Before You Dig searches are to be undertaken before commencement of any work.

100mm AT FULL SIZE

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REV.	DATE	AMENDMENT	DRAWN	CHECK	DESIGN	VERIFY
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C	10/08/2021	MINOR NOTATION AMENDMENTS	MS	CB	DWC	CB

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ABN 62 129 445 398

CLIENT: DWC DECENTRALISED WATER CONSULTING

PROJECT DESCRIPTION: KENNETT RIVER TOURISM INFRASTRUCTURE IMPROVEMENTS (GEELONG CITY DEAL)

SURVEYED: survey data supplied by client.

DATUM: GDA94 M.G.A. ZONE 54 A.H.D.

PROJECT: KENNETT RIVER PUBLIC TOILET FACILITY

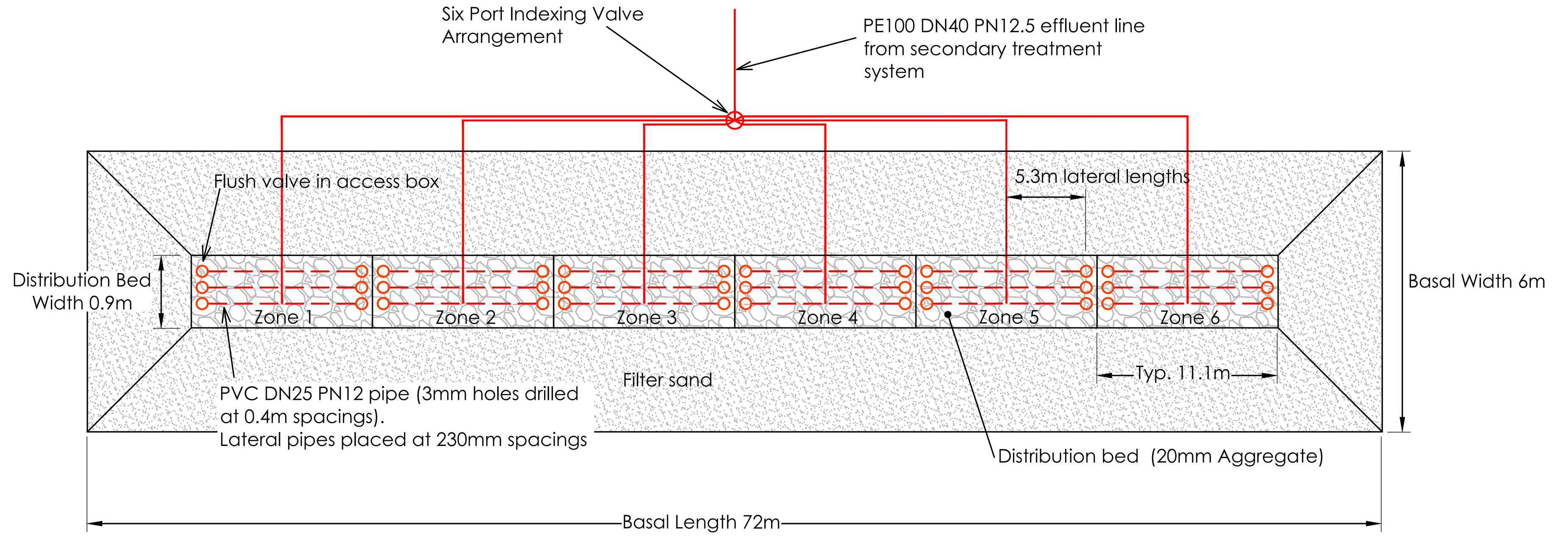
PLAN TITLE: COVER SHEET AND PLAN VIEW EFFLUENT TREATMENT DESIGN

PROJECT No.	DISCIPLINE	NUMBER	REV.
240225	ENG	101	C

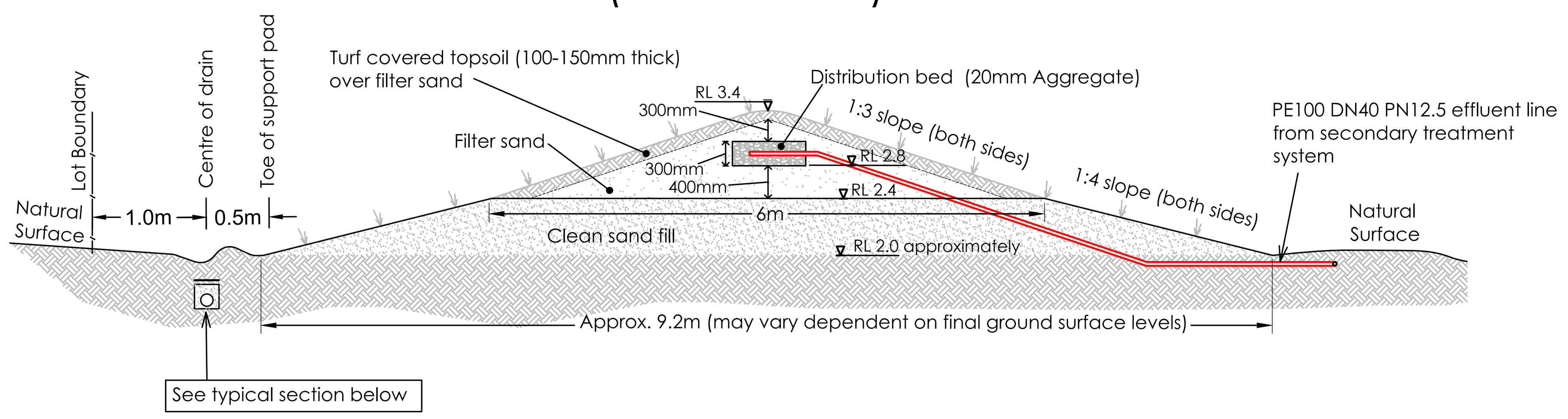
Plotted By: marks Plot Date: 11/08/21 - 00:38 Cad File: C:\Users\marks\appdata\local\temp\AcPublish_3048\240225-ENG-001-C.dwg

240225-ENG-001-C

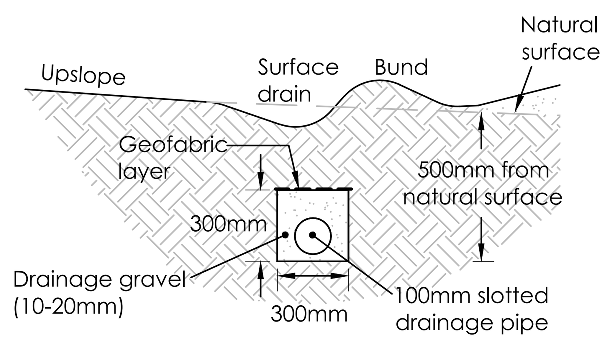
PLAN VIEW OF WISCONSIN MOUND
(Not to scale)



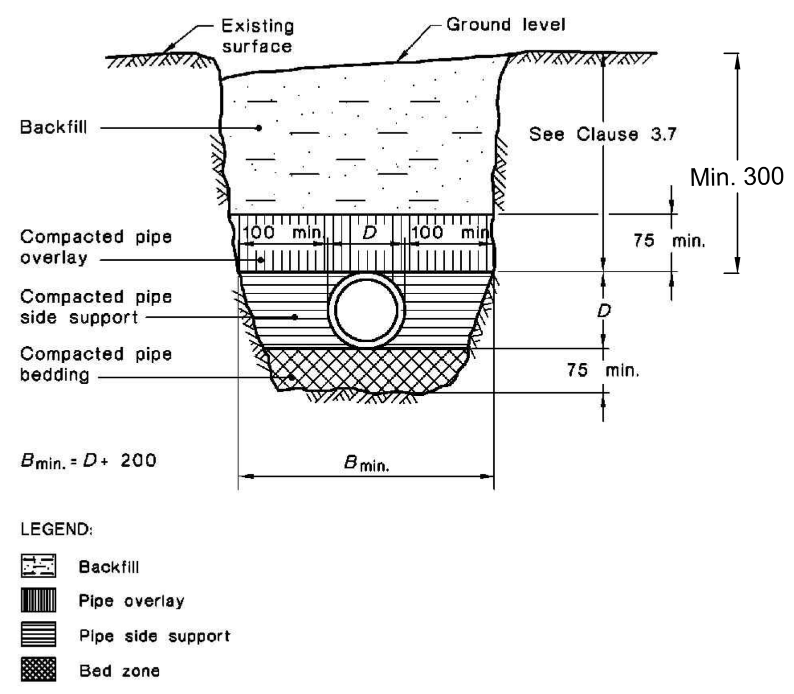
CROSS SECTION OF WISCONSIN MOUND (FACING NORTH)
(Not to scale)



TYPICAL SECTION OF DIVERSION DRAIN AROUND HIGH SIDE OF WISCONSIN MOUND
(Not to scale)



PIPE BEDDING DETAILS



EROSION/SEDIMENT CONTROLS

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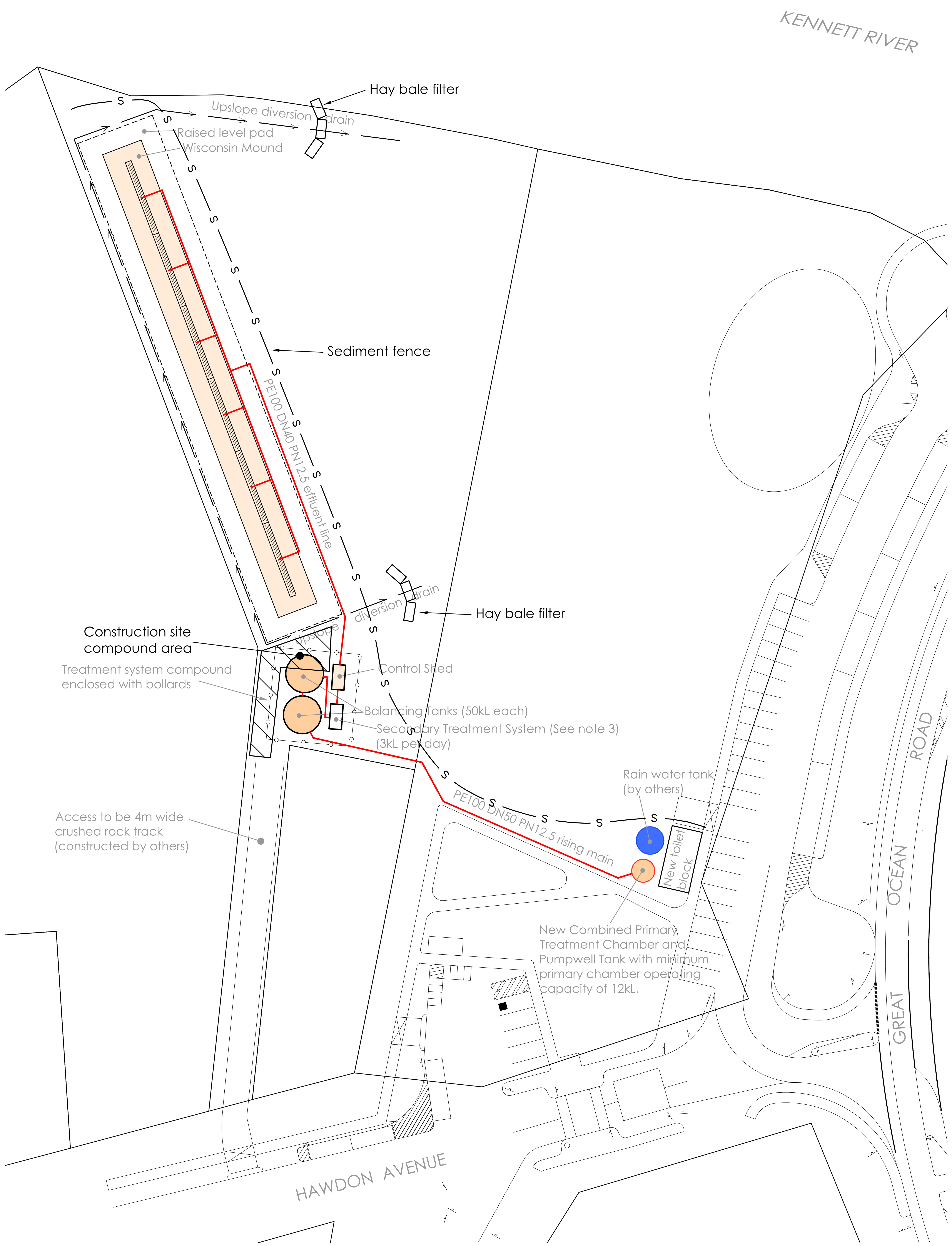

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CLIENT

DWC — DECENTRALISED WATER CONSULTING

PROPERTY DESCRIPTION

KENNETT RIVER TOURISM INFRASTRUCTURE IMPROVEMENTS (GEELONG CITY DEAL)

SURVEYED: survey data supplied by client.

DATUM: GDA94 M.G.A. ZONE 54 A.H.D.

PROJECT: KENNETT RIVER PUBLIC TOILET FACILITY

PLAN TITLE: WISCONSIN MOUND DIAGRAMS AND EROSION/SEDIMENT CONTROLS

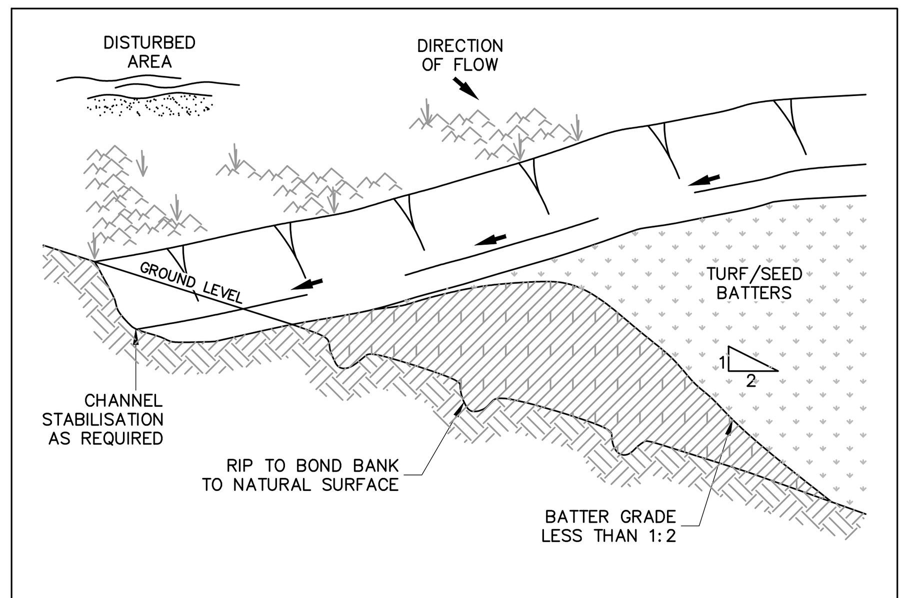
PROJECT No.		DISCIPLINE		NUMBER	REV.
240225	–	ENG	–	102	C

Plotted By: marks Plot Date: 11/08/21 – 00:38 Cad File: C:\Users\marks\appdata\local\temp\AcPublish_3048\240225-ENG-001-C.dwg

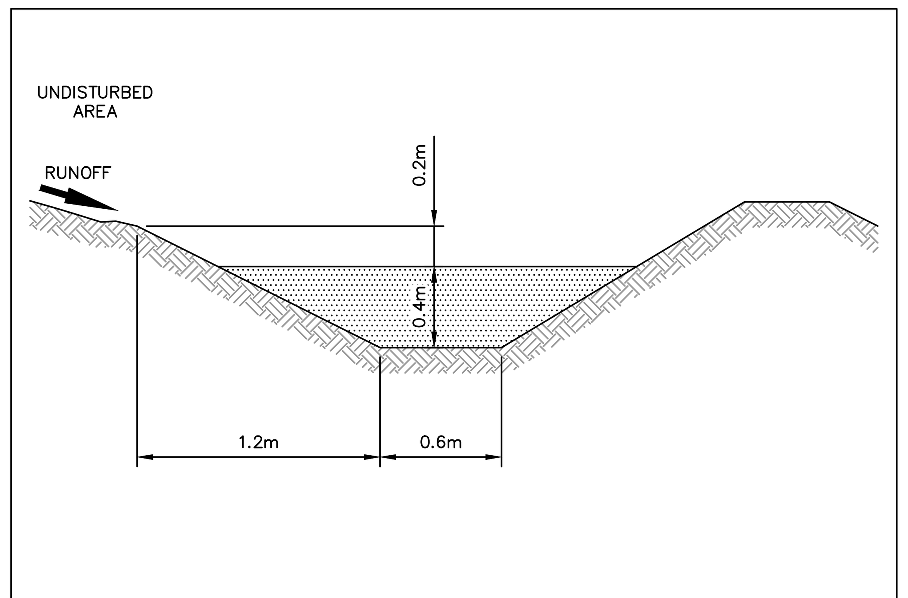
240225-ENG-001-C

EROSION & SEDIMENT CONTROL NOTES:

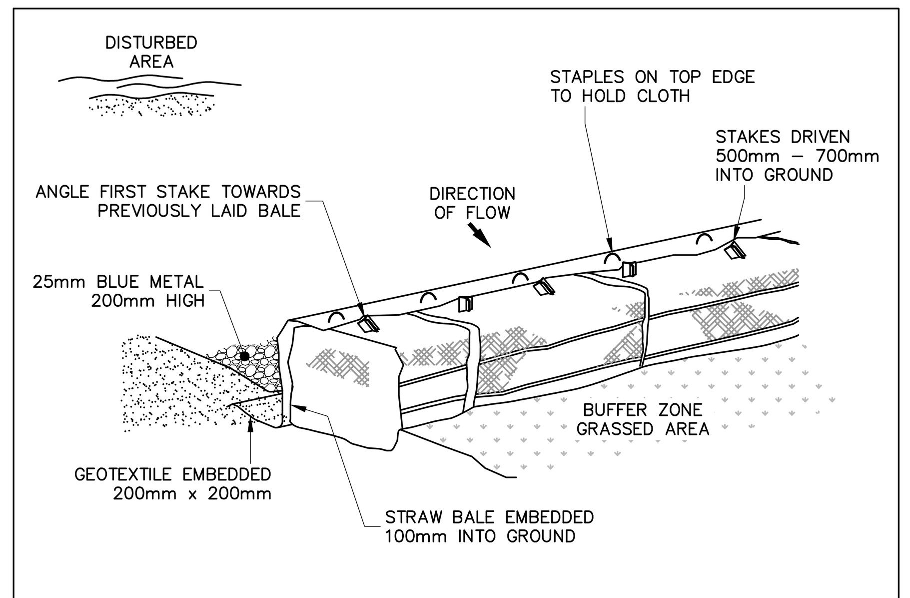
1. BARRIER FENCING TO BE INSTALLED TO DELINEATE ALL NO GO AREAS PRIOR TO COMMENCEMENT OF WORKS.
2. ALL TOPSOIL IN SITE REGRADING AREAS AND ROAD RESERVES TO BE STOCKPILED AS DETERMINED ON SITE OR AS SHOWN
3. ALL TOPSOIL TO BE REMOVED BY EITHER EXCAVATOR OR SCRAPER AND MOVED DIRECTLY TO STOCKPILE LOCATION
4. STOCKPILE AREA TO BE FULLY FENCED WITH SILT PROOF FABRIC AT ALL TIMES
5. IMPORTED MATERIAL TO BE PLACED DIRECTLY INTO SITE REGRADING AREAS. IMPORTED MATERIAL IS NOT TO BE STOCKPILED
6. STOCKPILES ARE TO BE REMOVED AS SOON AS PRACTICABLE AND SITES REINSTATED IMMEDIATELY
7. ALL AREAS DISTURBED DURING CONSTRUCTION ARE TO BE RE-INSTATED AND SEEDED IMMEDIATELY
8. SEEDING/REVEGETATION TO BE CARRIED OUT IN ACCORDANCE WITH COLAC OTWAY SHIRE'S MANUAL OF ENGINEERING STANDARDS.
   USE OF A SEED MIX THAT VARIES FROM THE GUIDELINES TO BE APPROVED BY COUNCIL PRIOR TO USE.
9. ALL SITE REGRADING IS TO BE CARRIED OUT UNDER THE SUPERVISION OF A QUALIFIED GEOTECHNICAL ENGINEER
10. SILT FENCES AND STRAW BALING TO BE PLACED WHERE DIRECTED BY COUNCIL'S ENGINEER AND MAINTAINED AT ALL TIMES
11. WHERE PRACTICAL CATCHDRAINS OR SMALL LEVIES ARE TO BE CONSTRUCTED TO MINIMISE EXTERNAL RUNOFF ENTERING THE SITE
12. DISTURBED AREAS TO BE KEPT TO A MINIMUM.
13. CONTROL CLEAN WATER FROM ABOVE THE SITE, THROUGH THE SITE AND AROUND THE SITE.
14. KEEP CLEAN WATER SEPARATE FROM DIRTY WATER.
15. PROTECT ALL DISTURBED AREAS FROM EROSION.
16. MINIMISE SEDIMENTATION.
17. MAINTAIN ALL EROSION AND SEDIMENT CONTROL MEASURES UNTIL COMPLETE REHABILITATION IS ACHIEVED.
18. OBTAIN COUNCIL'S PERMISSION BEFORE CLEARING OF ANY TREES.
19. AN ONSITE MEETING WITH COUNCIL'S SOIL CONSERVATION CONSULTANT PRIOR TO COMMENCEMENT OF WORK WILL BE REQUIRED
20. MAXIMUM HEIGHT OF TOPSOIL STOCKPILE IS TO BE 2.0 METRES.
21. MAXIMUM SIDE SLOPE OF STOCKPILES TO BE 2H:1V
22. ADJACENT ROADS TO BE KEPT CLEAN. ANY MATERIAL IS TO BE REMOVED, USING STREET SWEEPER, AT LEAST TWICE A WEEK OR AS DIRECTED BY SUPERINTENDENT.
23. TEMPORARY SEDIMENT BASIN OUTLETS TO BE PROVIDED WITH 3 METRE x 3 METRE D50=300mm ROCK SCOUR PROTECTION APRONS CONSTRUCTED IN ACCORDANCE WITH METHODS DETAILED ON SHEET 441.



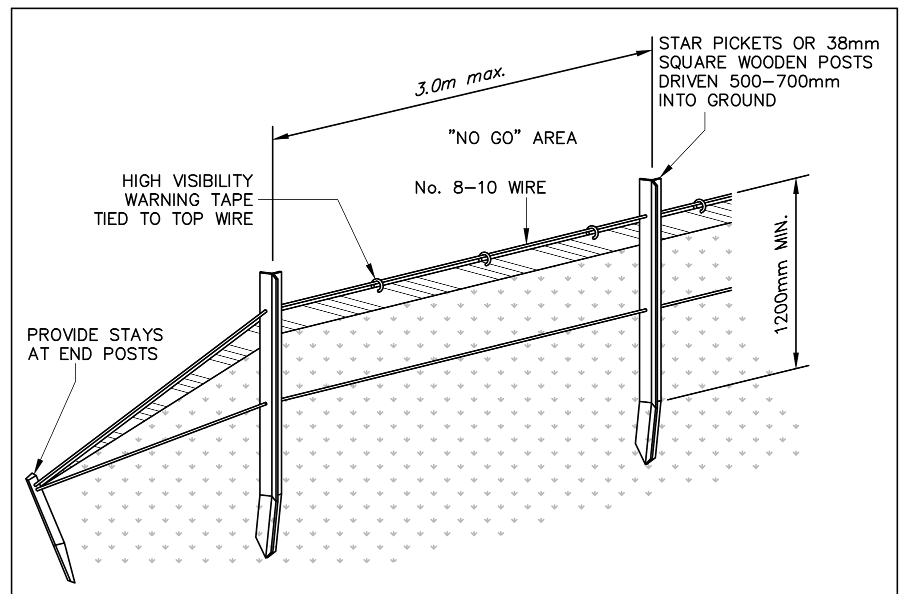
DIVERSION DRAIN



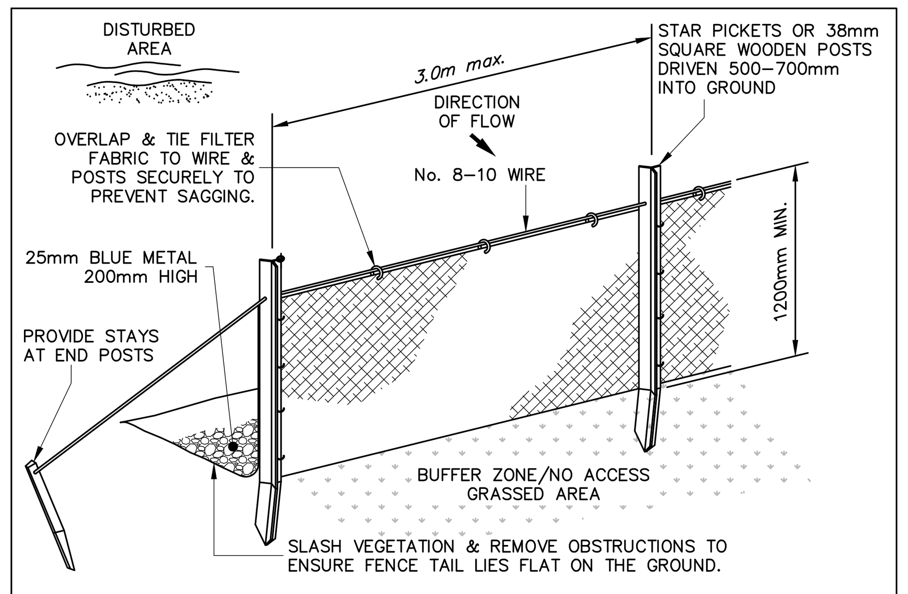
DIVERSION DRAIN SECTION



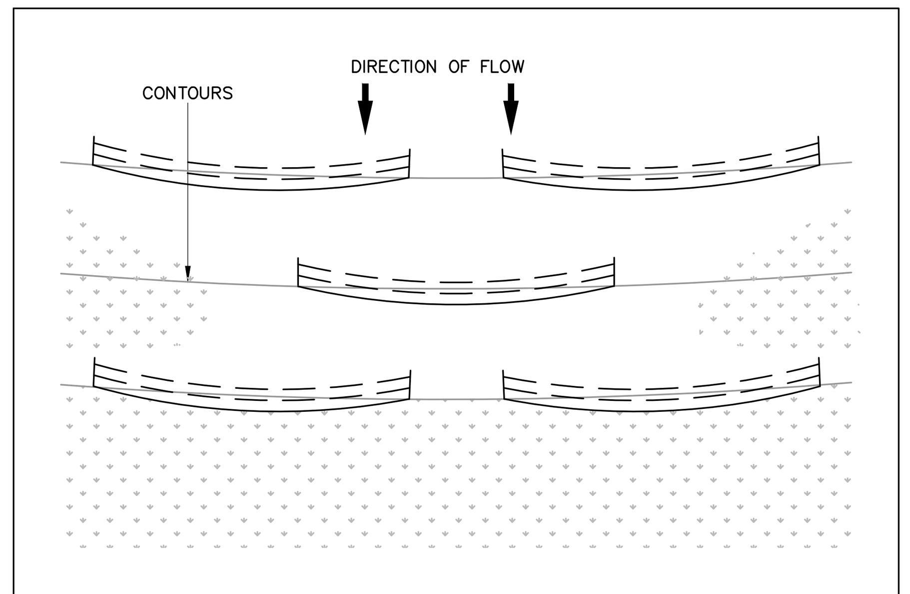
STRAW BALE & GEOTEXTILE FENCE



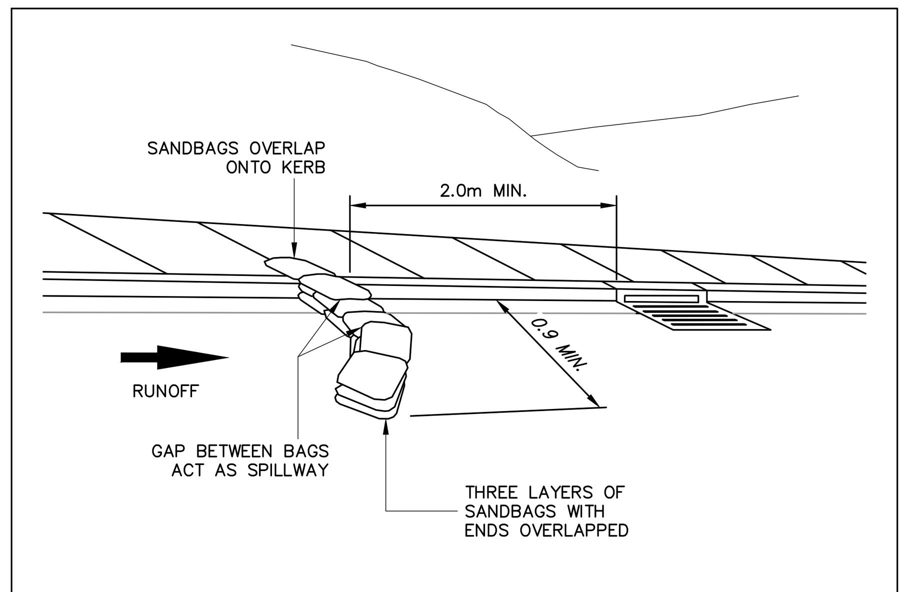
BARRIER FENCE



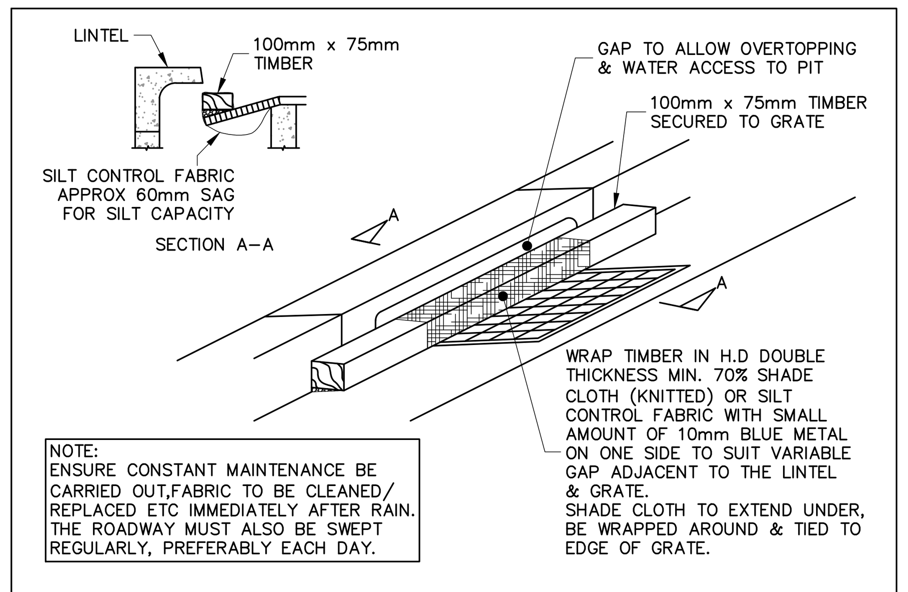
SILT FENCE



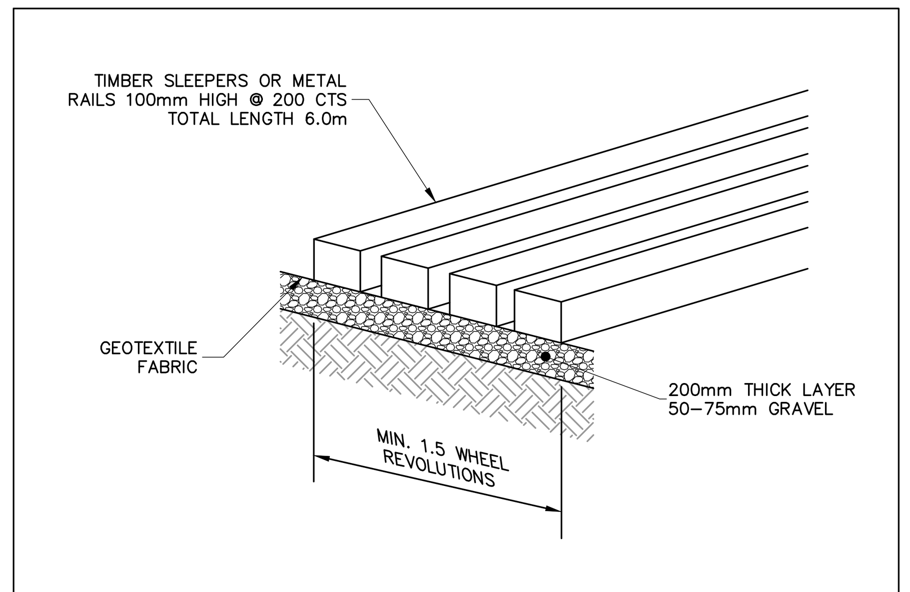
SILT FENCE CONFIGURATION



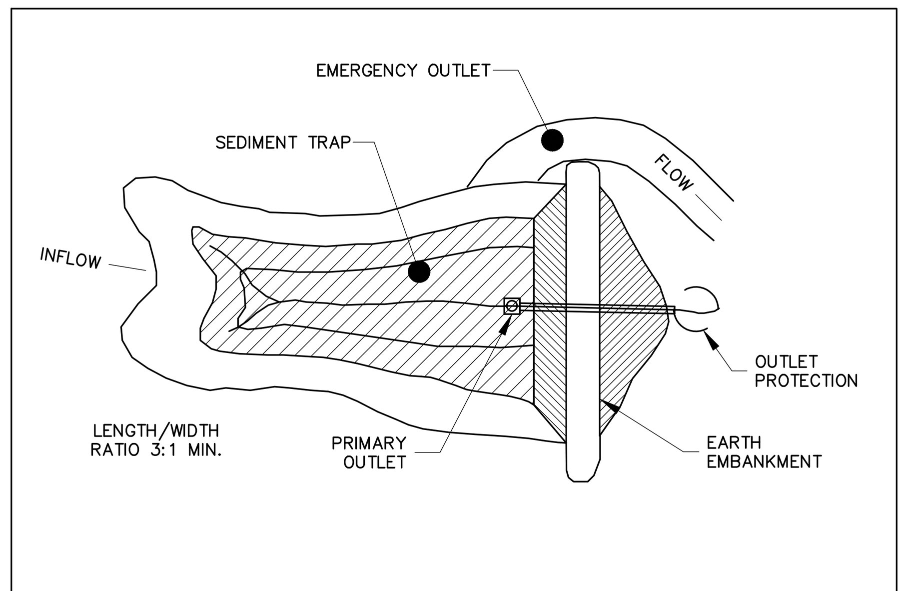
SANDBAG KERB INLET SEDIMENT TRAP



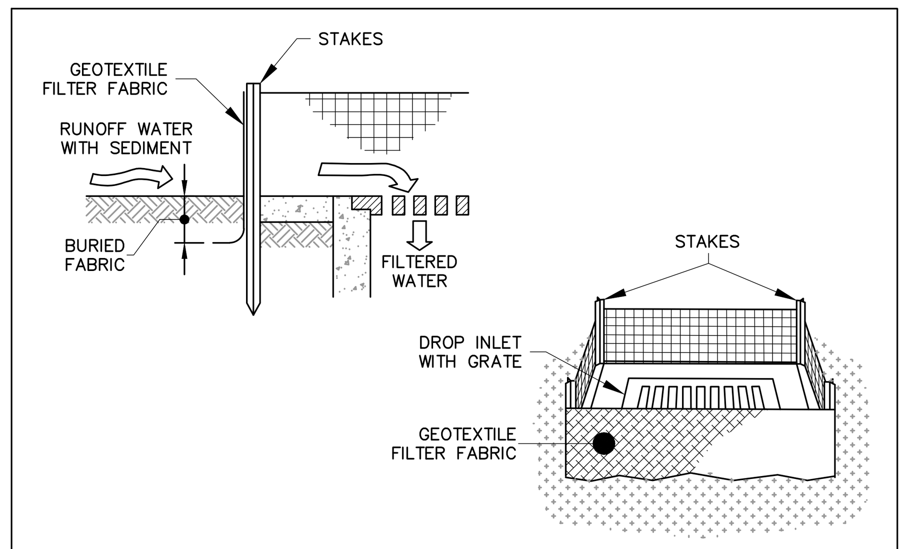
KERB INLET CONTROL



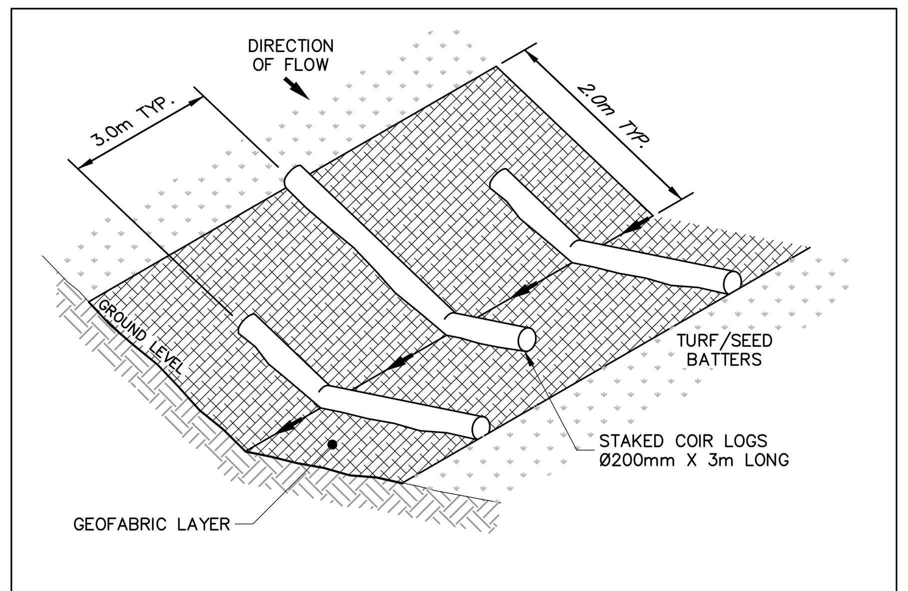
SHAKER RAMP



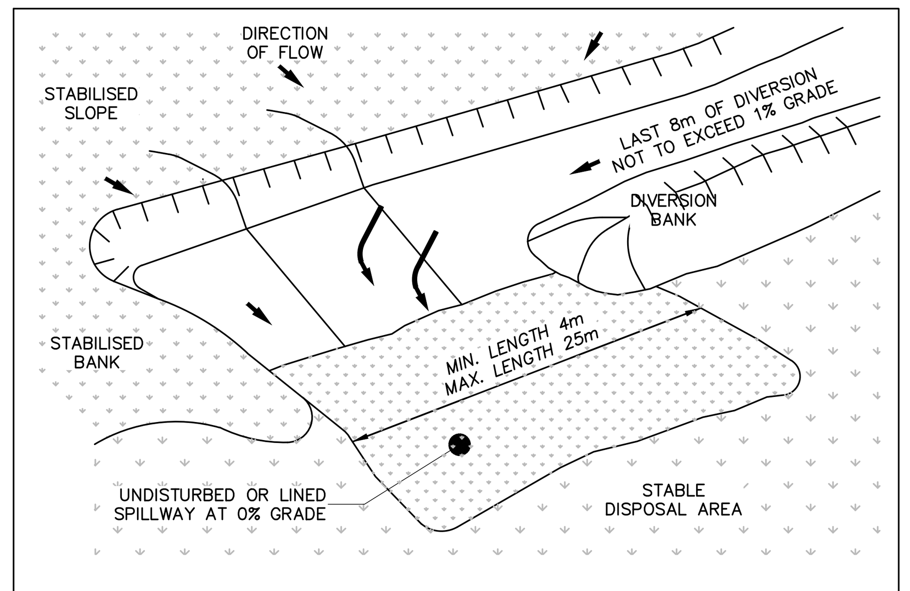
PLAN VIEW OF TYPICAL SEDIMENT BASIN



GEOTEXTILE FILTER FABRIC DROP INLET SEDIMENT TRAP



BATTER INTERFACE TREATMENT



LEVEL SPREADER

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SCALES

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CLIENT
DWC
DECENTRALISED WATER CONSULTING

PROPERTY DESCRIPTION
KENNETT RIVER TOURISM INFRASTRUCTURE IMPROVEMENTS (GEELONG CITY DEAL)

PROJECT
KENNETT RIVER PUBLIC TOILET FACILITY

PLAN TITLE
EROSION AND SEDIMENT CONTROL DIAGRAMS

SURVEYED	DATUM		PROJECT No.	DISCIPLINE	NUMBER	REV.
survey data supplied by client.	GDA94 M.G.A. ZONE 54	A.H.D.	240225 –	ENG –	103	C

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DECENTRALISED WATER CONSULTING

Wastewater Design Specification: Kennett River Public Toilets

Version 3

23/08/2021

Document Control Sheet

Decentralised Water Australia Pty Ltd trading as Decentralised Water Consulting Unit 2, 12 Channel Road Mayfield West NSW 2304 02 4960 2627 enquires@decentralisedwater.com.au	Document	D.0428.001.02_Osdesign_Specification_Kennettriveramenities
	Title	Wastewater Design Specification: Kennett River Public Toilets
	Project Manager	Ben Asquith
	Author(s)	Deni Hourihan
	Client	Colac Otway Shire Council
	Client Contact	Chris Baker
	Client Reference	

Revision / Checking History

Revision History	Date	Checked By		Issued By	
0	7 July 2021	BAA		DH	
1	13 August 2021	BAA		DH	
2	23 August 2021	BAA		DH	

Limitations

This report and the associated services performed by Decentralised Water Consulting (DWC) relate solely to the scope, budget, time and access constraints as set out in the engagement agreement and quotation between DWC and the Client. DWC accept no liability for any use or reliance on this Report for any purpose not documented in this agreement and quotation by the Client. It has been prepared for the exclusive use of the Client and DWC accepts no liability for any use of or reliance upon this report by any third party.

The outcomes and recommendations contained in this report may have relied upon a range of information and data sources including information and discussions with the client, field investigations (limited to those described in this report), publicly available information and other sources. DWC have not verified the accuracy of third party data and any inaccuracies or inadequacies may influence the accuracy of our findings. Similarly, both the inherent variability of environmental and ground conditions and the passage of time can lead to changes in ground conditions and other factors which may affect the accuracy of our findings. The Client should seek advice from DWC on the accuracy of findings after more than six months has passed or where changes in relevant conditions are known to have occurred. Data and information collected during field investigations should not be taken as accurate and complete for all depths and locations across the site.

The report and services have been completed in accordance with relevant industry standards, guidelines and government legislation as of the date of publication unless stated otherwise. Where an engineering design is included, this design has been based on site and construction plans as provided by the Client and/or their representative and documented in the report. DWC accepts no liability for the impact of any changes to site conditions and / or building layout and extents on our design where DWC were not notified of the changes prior to completing our services. Additional costs may be incurred where work has already been completed.

Table of Contents

1 Introduction

This Design Specification has been prepared for Colac Otway Shire Council (Council) to support the construction of the Kennett River Public Toilets On-site Wastewater Management System. It is to be read in conjunction with the following additional materials.

- Drawing Set 240225-ENG-001-A
- Septic Tank Permit (Number to be inserted)
- Bill of Quantities 0428.001.00
- Any broader construction specifications provided by Council.
- The Conditions of Contract between the two parties.

Table 1 Summary of Site Information

Site Information	
Property/Site	**Kennett River Public Toilets** **Kennett River (VIC) Township**
Owner	Colac Otway Shire Council (Council)
Description of existing / current site	A proposed Public Toilet facility located along the Great Ocean Road and within the Kennett River Township. Council have provided sewage pump-out records for the current temporary Kennett River toilets (2019-2020) and an estimation of the expected peak visitations (932 persons per day). This information was used to develop a design wastewater flow which has assumed: Average daily use of 413 persons; Average daily use during holiday season of 632 persons; and Maximum daily use of 1,300 persons.
Water Supply	River (via storage tank)

Table 2 Summary of Proposed Wastewater Management Option

Facility Activities to be Serviced	The proposed Public Toilets to be located adjacent to the Great Ocean Road and within the Kennett River Township.
Wastewater Generation Volumes	Information provided to DWC from Council (including expected occupancy and pump-out records) was used to develop and calibrate a wastewater flow profile for the Public Toilets. The assumed daily wastewater generation rates are as follows: **Raw Wastewater Inflow:** Average Flow – 2.5 kL/day 95^{th} Percentile – 7.5 kL/day Peak Flow – 7.8 kL/day **Flow Balanced Outputs (to Secondary Treatment System):** Average Flow – 2.5 kL/day 95^{th} Percentile – 3.0 kL/day Peak Flow – 3.0 kL/day
Treatment Requirements	A primary treatment chamber with 12kL capacity and pumpwell with 8kL total volume. Secondary treatment system with a minimum treatment capacity of 3,000 L/day with disinfection required.
Storage (Flow Balancing) Requirements	A minimum of 100 kL of flow balance storage is required. To be provided via two of 50kL above ground steel tanks with liner suitable for storage of treated effluent.
Effluent Land Application Area	Installation of a pressure dosed Wisconsin Mound with the following specifications: - Total mound basal area of 432 m^2 (72m L x 6m W); and - Total distribution bed area of 60 m^2 (67m L x 0.9m W); and - Total mound height of 1.0m. Due to the flood prone nature of the site, the importation of 400mm of good quality fill (sand) is required prior to mound construction to ensure that the point of effluent injection (i.e. the base of the distribution bed) is at or above the 5% AEP Design Flood Level (2.8 mAHD). The fill pad is to have an area of ~692 m^2 (75.2m L x 9.2m W)

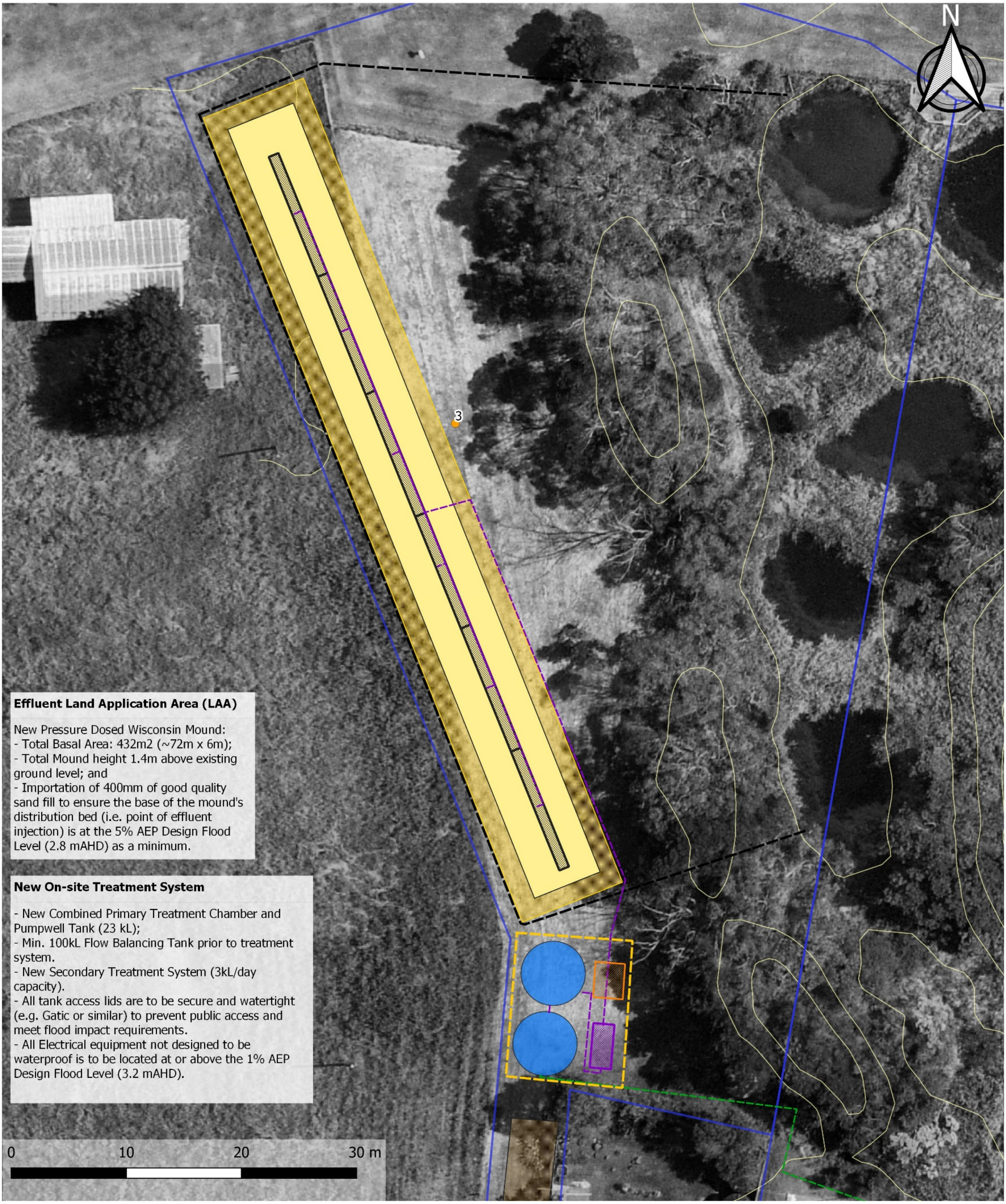


Figure 3 Detailed On-site Wastewater Management Plan - Kennett River Public Toilets

Legend

- Transfer Main (from Septic Tank at Toilet Block)
- Treatment System Compound (approx.)
- Effluent Mainline
- Flow Balance Tanks (Total 100kL)
- Secondary Treatment System Footprint (approx.)
- Shed
- Wisconsin Mound (431m2)
- New Upslope Diversion Drainage (Curtain Drain)
- Mound Distribution Bed
- Mound Distribution Zones
- Mound Raised Pad
- Elevation Contours (approx. 0.5m)
- Test Pits

DECENTRALISED WATER CONSULTING

2 Preliminary and General

2.1 Statutory Requirement

2.1.1 Responsibility

Before commencing construction, the Contractor should ascertain the requirements of all local and service authorities, including but not limited to:

- Colac Otway Shire Council
- VicRoads (permits for road openings and lane/road closures)
- Office of Chief Electrical Inspector (permits for work under or in close proximity to power lines)
- Environment Protection Authority and Department of Sustainability and Environment (protection of vegetation, sediment control, discharge to waterways etc.)
- Aboriginal Affairs Victoria
- Corangamite Catchment Management Authority
- Other affected service authorities

2.1.2 Permits

The Contractor shall submit a copy of each permit to the Superintendent's representative at least 24 hours before any work is commenced in the affected areas.

2.1.3 Statutory Requirements

For work carried out in road reserves and/or adjacent to existing water, telephone, or other mains or services, the Contractor must comply with the statutory requirements of the authorities responsible for maintenance of those road reserves, mains or services.

3 Standards

All materials and works completed under this contract shall be in accordance with the following (where applicable):

- EPA Victoria *Code of Practice Onsite Wastewater Management* (Publication 891.4 2016).
- EPA Victoria *Code of Practice for Small Wastewater Treatment Plants*
- Plumbing Code of Australia 2015 (as amended).
- All relevant Australian Standards.

3.1 Australian Standards

Unless otherwise specified by Council, and where applicable, materials and workmanship shall be in accordance with the relevant standard of the Standards Association of Australia. A standard applicable to the Works shall be the edition last published prior to the closing date for tenders unless otherwise specified. Overseas standards and other standard documents named in the Specification shall be applicable in the same manner as Australian Standards to relevant materials and workmanship.

Copies of any standards quoted or referred to in the Specification shall be kept on the site if so specified or directed. Works shall comply with all relevant Australian Standards. A list of relevant Primary and Subsidiary Australian Standards has been provided in Appendix A. The relevant Australian Standards to this project and scope of work is not limited to the standards listed.

4 Overview and Sequence of Works

The Kennett River Public Toilets On-site Wastewater Upgrade is to consist of the following broad works and sequence.

1. Site Establishment and Services Location

Establish plant and access to STP compound and Mound area (suitable for delivery of bulk materials), Work Health and Safety requirements along with location and mark out of existing services. Finalise sanitary drainage design and seek approval.

2. Construct Raised Level Wisconsin Mound Pad

Import required soil and construct the proposed Wisconsin Mound level Pad.

3. Construct New Land Application System (Wisconsin Mound)

Mark out appropriate mound installation area and install the Wisconsin Mound. Leaving pressure dosing laterals exposed for squirt height check. Construct surface and subsurface cut-off drain.

4. Install Combined Septic Tank and Pumpwell and Construct New Sanitary Drainage System

Install 22.5-23 kL combined tank as shown on plans. Fit out with duty/standby pump set, float switches. Electrical connection and test. Sanitary drainage subject to detailed design by the successful contractor in accordance with AS3500 and the National Plumbing Code.

5. Construct Transfer Main from Pumpwell to Treatment Compound

Supply and install PE100 DN50 PN12.5 main as shown on plans.

6. Construct Wastewater Treatment System

Construct stable pad for flow balance tanks, install tanks, Secondary Treatment System, control shed, services, pumps and controls as per Section 8 of this specification. Establish treatment compound.

7. Connect and Commission New Treatment Plant

Connect new sanitary drainage and commission the primary treatment, flow balancing and new secondary treatment system. Install bollards.

8. Final Commissioning and Testing

Connect Wisconsin Mound LAA to treatment system and test. Complete top of Mound and turf. Effluent quality sampling. Certification of relevant works.

5 Site Establishment and Sanitary Drainage

A site establishment meeting is to be undertaken with the principal to establish and confirm a set out of works, Work Health and Safety (WHS) requirements and site access requirements. Existing services checks using a certified service locator are to inform the final construction layout.

5.1 Collection

- New sanitary drainage is required to enable raw wastewater to be conveyed from the new Kennett River Public Toilets to the primary treatment tank which will be located just behind the facility to allow gravity fall. Effluent will be pumped from the primary treatment tank to the flow balance tanks located in the treatment compound located to the north west. As discussed in Section 0, the drainage alignment is to be confirmed by the contractor.
- All sanitary drainage work to be completed by a licensed drainlayer in accordance with the Plumbing Code of Australia (PCA) and AS3500.
- All wastewater shall be directed to the new treatment system (i.e. all greywater and blackwater fixtures).
- A certificate of compliance shall be submitted upon completion of the work.

5.2 Provision of Services

Power and water services need to be made available to the treatment system:

- Electricity supply is required at the Primary Treatment tank and treatment system compound to power the control panel, pumps, blowers and Ultra Violet (UV) disinfection unit required as part of the treatment system. It is estimated that the peak power demand will be in the order of ~80 Amps and ~3.1 kW. However, the exact power requirements are highly dependent on the exact equipment selected by the contractor (the abovementioned power requirement is approximate only).
- Access to a water tap is required in the vicinity of the treatment compound. This may be available through an existing tap and will need to be confirmed.
- It is the responsibility of the contractor to confirm the power supply requirements with respect to current and demand based on the final selection / design of electrical components. This includes any power supply upgrades required from Powercor to enable operation of the system. All electrical design and works must be undertaken in accordance with the Australian Wiring Rules (AS3000:2018) by a licenced electrical contractor.

6 Design Works to be Undertaken by the Contractor

The Contractor is to undertake the following design and procurement works:

- Propose a suitable secondary treatment system which can meet the requirements of this Design Specification, the Wastewater Management Report (*R.0428.001*) and any conditions of approval as required by Council. The tender submission must include the following.
    - Design drawings and specifications for the system
    - Adequate process design information to confirm its suitability for producing the required effluent quality based on the 3,000 L/day capacity (this can be in the form of independent certification by a JAS-ANZ accredited body).
    - Technical data sheets for all mechanical and electrical components.
    - Estimated power consumption of the system
    - A copy of the Operation and Maintenance Manual for the system that documents the minimum required maintenance based on the manufacturers requirements or any independent certification.
- Configure the treatment system compound such that the proposed Flow Balance Tanks are kept in the same configuration as shown on Figure 3 and DWG 0428-002. The arrangement of the secondary treatment system and UV System is to be determined by the contractor through submission of a detailed design layout of the compound.
- Determine the required control shed size and concrete slab structural requirements (inc. thickness, reinforcement requirements etc).

7 Construction Hold Points

There are a number of construction hold points whereby the current construction progress must be inspected by Council (or a Council representative) before works can be progressed further. The contractor shall provide Council with sufficient notice for inspection (two days prior to inspection). The project hold points include the following:

- After site layout / marking of the proposed treatment compound (inc. shed), tanks and Wisconsin Mound;
- The proposed fill material for the fill pad and the filter sand for the Wisconsin Mound are to be approved by Council prior to importation / transportation to site;
- After the fill pad material has been imported and stockpiled onsite (to ensure the soil is appropriate and in accordance with this Design Specification);
- Upon establishment of the fill pad;
- Upon construction of the Wisconsin Mound distribution bed with dosing laterals still visible (i.e. prior to completely filling the distribution bed with gravel). This is to allow Council to check that the distribution bed and dosing laterals have been adequately installed and to conduct hydraulic (pump) testing demonstrating adequate squirt height and even distribution of effluent;
- Upon completion of the Wisconsin Mound (with turf covered topsoil);
- Upon installation of the Combined Primary Treatment Chamber and Pumpwell Tank;
- After commissioning of the treatment system.

8 Treatment System

DWC completed a *Wastewater Management Options Assessment* report (R.0428.03) for Council which outlines the chosen on-site wastewater management system for the site. The installed secondary treatment system must have capacity to treat wastewater flows of up to 3,000 L/day and be capable of meeting the following design criteria (as a minimum). Influent constituent concentrations can be assumed to be consistent with *AS1546.3:2017*.

Table 3 Design Criteria – Secondary Treatment System

Parameter	Unit	Design Value	Min. Target Requirement
Biochemical Oxygen Demand (BOD_5)	mg/L	20	90th Percentile
Total Suspended Solids (TSS)		30	90th Percentile
E.coli	cfu/100mL	10	90th Percentile
Disinfection required	n/a	Yes	

General Items

The treatment system compound is to house the flow balance tanks, secondary treatment system, UV disinfection system and the electrical control panel. As such, the compound will need to consist of the following:

- The treatment system shall be installed in the approximate area identified in Figure 2. The final / exact location is to be agreed between the contractor and Colac Otway Shire Council during set out and prior to any works.
- All access lids shall be adequately sealed to prevent stormwater ingress and be at least 100mm above finished ground level. Lockable (Gatic or similar) shall be used on all manholes and access lids.
- All electrical and mechanical components are to be readily accessible for maintenance or replacement.
- All electrical and control equipment is to be installed above the 1% AEP Design Flood Level within a small control shed (lockable). It is envisaged that this shed will be approximately 2.5 x 2.6 metres on a poured in situ concrete slab and be of steel construction. The contractor shall determine the exact shed size and slab characteristics (including required slab thickness, concrete quality, reinforcement requirements and area).

- The UV disinfection unit and control panel(s) shall be installed in the proposed shed (to prevent deterioration of components).
- The installation of dressed cypress pine bollards (150mm x 150mm) bollards to prevent the new secondary treatment system from being driven over. The bollards are to be anchored into the ground via concrete footings (25 Mpa premixed concrete).
- Access and safe parking for maintenance vehicles and a 25 kL septage / effluent tanker (in case of emergencies) is required. The tanker must be able to safely park within reach of their vacuum pump hose. This should be possible based on the access pathway (to treatment system compound). However, access for pump-out of the primary treatment tank must be accommodated (accessed via the proposed car park).
- Any changes to the treatment system location and configuration should also be confirmed as suitable by Council or DWC.

Pumps and Distribution Lines

Pumps

- Submersible duty/standby vortex pumps are to be installed in the Pump Chamber of the Combined Primary Treatment and Pumpwell Tank. Power supply should be via 240v plug and an IP68 rated GPO to enable removal by non-licenced operators. The required duty is 80-100 L/min at a total dynamic head of 5-6 metres. Davey D40V (or similar) is an example of a suitable pump.
- A transfer pump will be required to transfer primary treated effluent from the Flow Balance tanks to the inlet of the secondary treatment system. It is the responsibility of the contractor to nominate this pump to meet the specific requirements of the treatment system. It is anticipated that this will consist of either a submersible pump on a stainless steel chain or a suction pump.
- Submersible duty/standby treated effluent pumps are to be installed on a plinth within the irrigation chamber of the proposed secondary treatment system. A Davey D53A/B has been chosen as a suitable pump for this design given the Wisconsin Mound hydraulic design (transfer main diameter etc) outlined in Section 9. Alternative pumps will be considered subject to approval by Council.
- Pump plinths are to be 200mm thick/tall (i.e. keeping the pump 200mm off the base of the tank) and have side lengths (or diameter) of ~350mm (for single pump plinths). Where duty/standby pumps are to sit on the same plinth, the plinth should have side lengths / diameter of ~700mm. This will prevent the pump from disturbing any solids settled at the base of the tank.

Distribution Lines

- The Rising Main connecting the Primary Treatment /Pumpwell Tank to Flow Balance Tank 2 is to be DN50 PE100 PN12.5.
- The Effluent Mainline pumping secondary treated effluent to the Wisconsin Mound is to be DN40 PE100 PN12.5.

Specifications to Accompany the Design Drawings

The following Preliminary Design drawings have been prepared for the treatment system. Final detailed design and component selection is the responsibility of the installer.

Table 4 Drawing Index

Drawing Number	Title	Page
0428-001	Treatment System Process Schematic	13
0428-002	General Treatment Compound Arrangement	14
0428-003	Combined Primary Tank and Pumpwell Configuration	15
0428-004	Flow Balance Tank 2 Component Configuration	16
0428-005	Treatment System Controller Schematic	17

The following design specifications should be read in conjunction with the Drawings.

- The Primary Treatment chamber in the Combined Tank is to have a minimum operating capacity of 12 kL and is to be sealed to prevent stormwater intrusion. Primary treated effluent will be pumped from the second chamber of this tank to the first Flow Balance Tank located in the treatment system compound. Refer to DWG 0428-002 for tank configuration. The Combined Primary Treatment Chamber and Pumpwell Tank is to be built / installed into the raised pad for the toilet block (forming a partially inground tank). The Primary Treatment Tank is to have a minimum invert level of 2.5 mAHD (accepting sewage from the public toilet) based on a toilet floor level of 3.2m AHD. It should be noted that this invert level has been calculated assuming the worst possible drainage pathway (i.e. from fixtures at the front or eastern side of the toilet block). The contractor is to determine the minimum tank invert level once the final toilet block plans have been provided.
- The proposed Flow Balance tanks are to be above ground steel type with an internal liner suitable for storage of treated effluent. Two 50kL tanks are to be connected via a low level tank

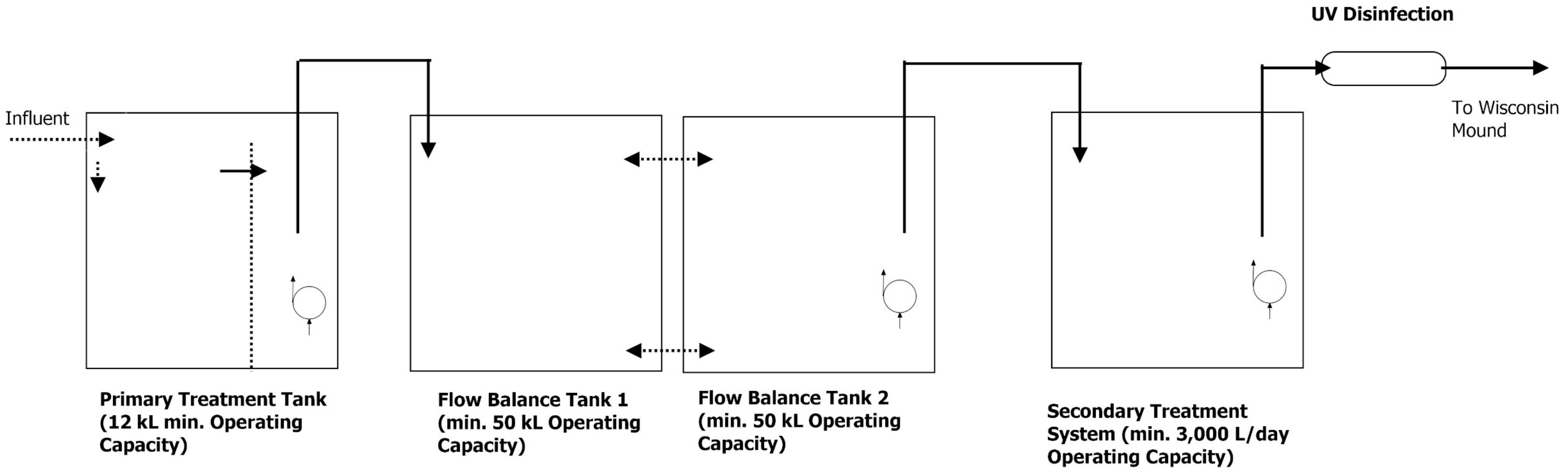
connection made up of 100mm DWV pipe with flexible coupling so they act as one storage tank (total storage of 100 kL).

- An additional high level connection is to be installed to allow tank connectivity in the event that the low level is blocked. The high level connection pipe is to be of DWV piping and the diameter may be suitably smaller than 100mm if the installer determines it is fit for purpose. Refer to DWG 0428-004 for further information.
- A level pad shall be constructed in accordance with the tank manufacturers requirements. This typically requires a stable pad with crushed rock base but specific requirements must be confirmed by the contractor.
- Allowance shall be made for any structural or geotechnical assessments deemed necessary for tank stability by the tank manufacturer.
- The Flow Balance Tanks are to be installed without permanent access ladders or footholds and the access lid must be lockable. Temporary ladders will be used to access the tanks for maintenance purposes.
- Both tanks shall be fitted with activated carbon (or similar) odour filters on one way air vents to manage odour.
- The new secondary treatment system is to have a minimum operating capacity of 3,000 L/day based on domestic influent characteristics consistent with AS1546.3 2017.
- Effluent is to be time dosed from Flow Balance Tank 2 as shown in DWG 0428-002 to the inlet of the new secondary treatment system. A duty / standby pump configuration should be adopted. Alternative pump configurations may be considered and detailed must be submitted with the tender for approval.
- The irrigation chamber of the secondary treatment system will contain a pump triggered by float switch (note: this will depend on the required configuration to operate the UV unit) to pump final effluent flows to the Land Application Area after passing through the UV disinfection system. For further information refer to DWG 0428-001 and DWG-0428-002.
- Installation of an Ultraviolet disinfection system is required as part of the works. The installer is to select a UV unit capable of meeting the following requirements.
    - Suitable for use with secondary effluent with a TSS <30mg/L and UVT of 60%.

      Capable of providing adequate inactivation of pathogens based on a nitrified secondary effluent to meet the target faecal coliform concentration of <30 cfu/100ml in 90% of samples.
    - A hydraulic capacity that matches the flow rate of the irrigation pump.

    - Capacity for a remote alarm to notify the responsible operator / Council of disinfection failure.

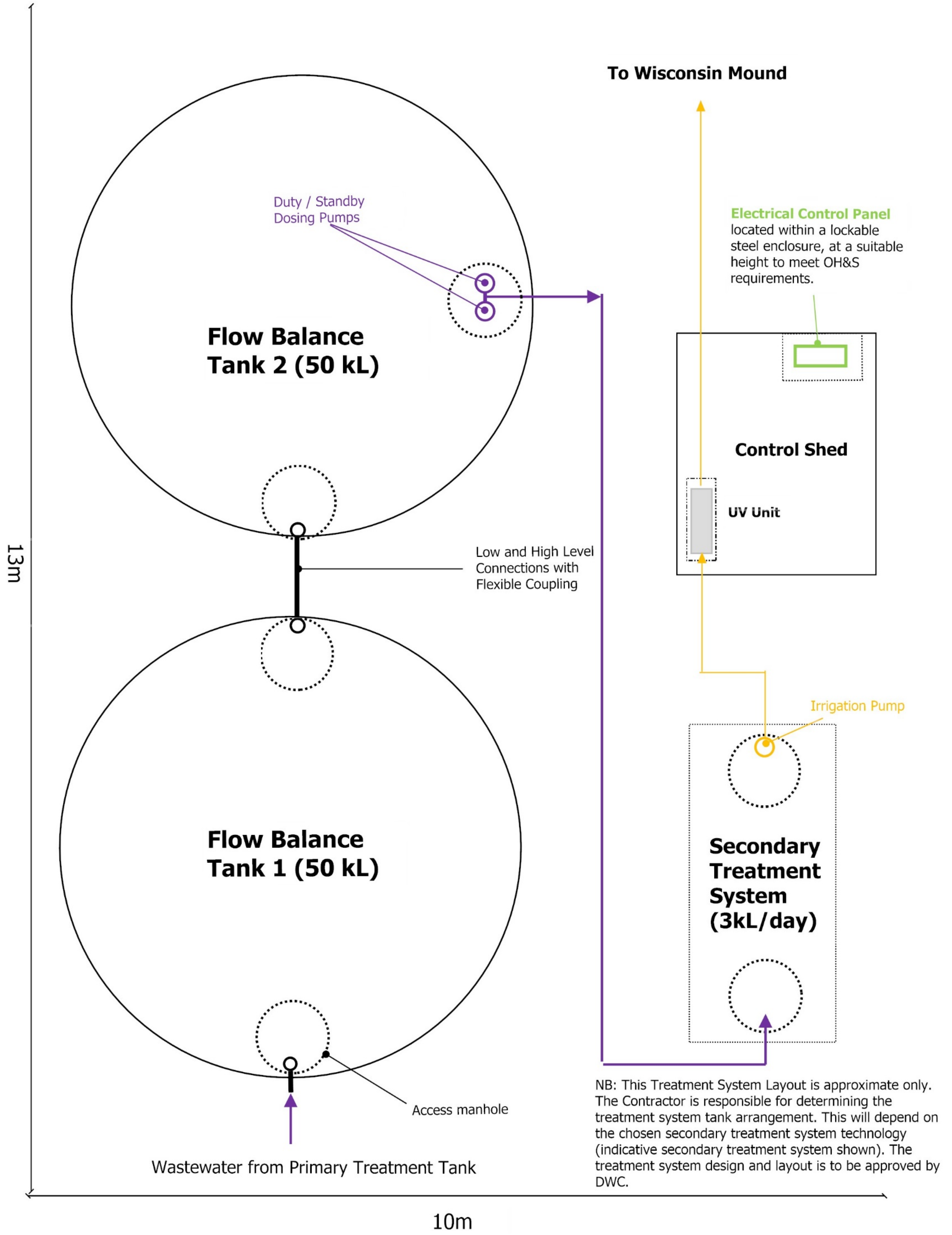
- Details of the proposed UV disinfection unit shall be provided with the tender for assessment.



NB: Timer controlled duty/standby pumps in Flow Balance Tank 2 to dose the secondary treatment system at a max. rate of 3 kL/day

NTS

TITLE: Treatment System Process Schematic **CLIENT:** Colac Otway Shire Council **PROJECT:** Kennett River Public Toilets On-site Wastewater Treatment System	**DRAWING NO:** 0428-001-00 **Sheet:** 1 of 1 **Scale:** NTS	**REV:** A **Drawn:** DH **Checked:** BAA		DWC DECENTRALISED WATER CONSULTING



NB: This Treatment System Layout is approximate only. The Contractor is responsible for determining the treatment system tank arrangement. This will depend on the chosen secondary treatment system technology (indicative secondary treatment system shown). The treatment system design and layout is to be approved by DWC.

TITLE: General Treatment Compound Arrangement	**DRAWING NO:** 0428-002-00	**REV:** A	COPYRIGHT The concepts and information contained in this document are the copyright of Decentralised Water Consulting. Use or copying of the document in whole in part without the written permission of DWC constitutes an infringement of copyright
CLIENT: Colac Otway Shire Council	**Sheet:** 1 of 1	**Drawn:** DH	
PROJECT: Kennett River Public Toilets On-site Wastewater Treatment System	**Scale:** NTS	**Checked:** BAA	

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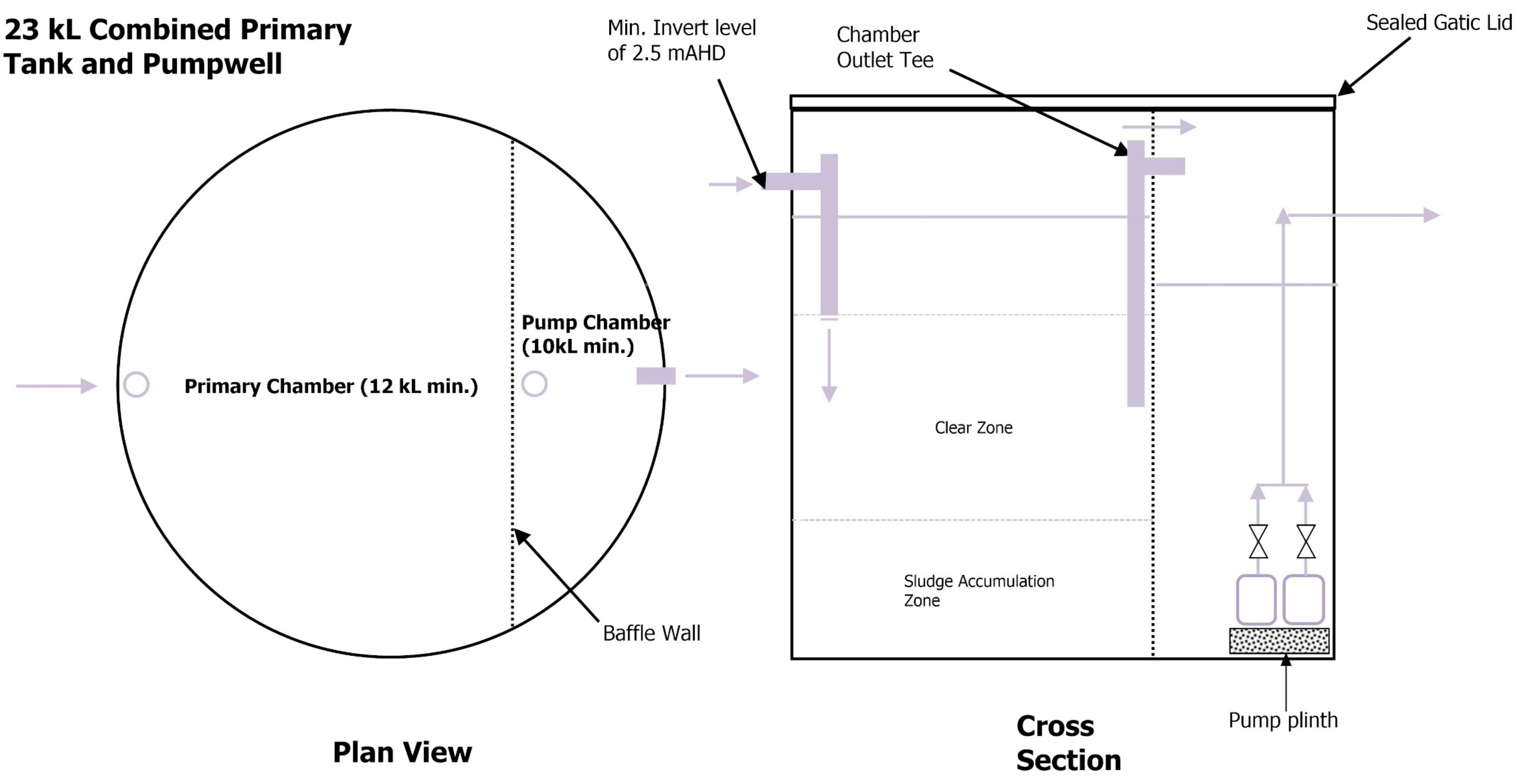
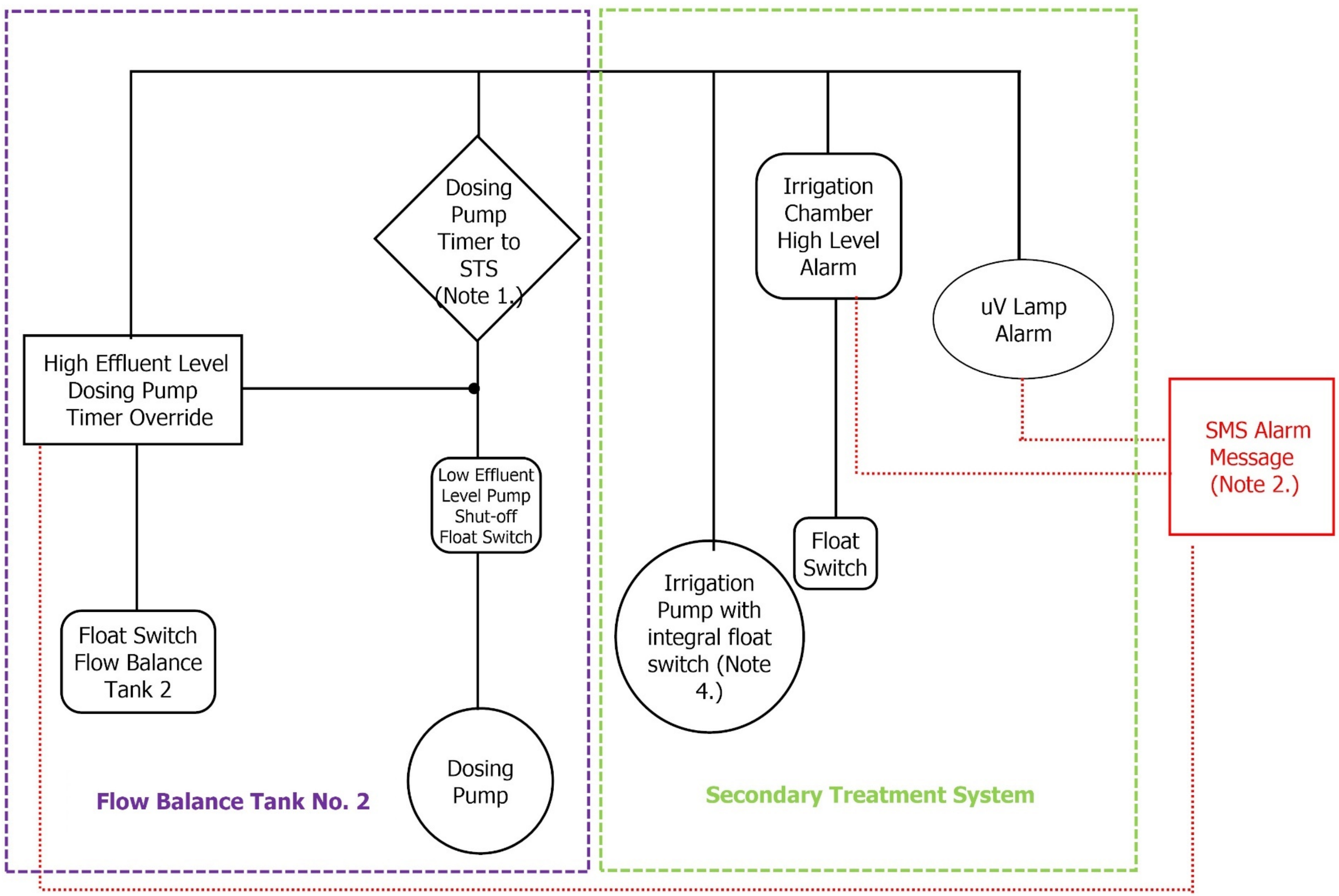
23 kL Combined Primary Tank and Pumpwell



Tank volumes stated are not absolute and may be varied by +/- 5%

TITLE: Combined Primary Tank and Pumpwell Configuration	**DRAWING NO:** 0428.003.00	**REV:** A	COPYRIGHT The concepts and information contained in this document are the copyright of Decentralised Water Consulting. Use or copying of the document in whole in part without the written permission of DWC constitutes an infringement of copyright	DECENTRALISED WATER CONSULTING
CLIENT: Colac Otway Shire Council	**Sheet:** 1 of 1	**Drawn:** SJ		
PROJECT: Kennett River Public Toilets On-site Wastewater Treatment System	**Scale:** NTS	**Checked:**		



Notes:

1. As a min., timers shall be locally programmable / adjustable. Options for remote control will be considered.

2. Basic SMS indication which fault i.e. irrigation high level, Balance Tank high level and uV Lamp failure.

3. External (to panel) electrical components to be non hard wired to the panel i.e. pumps connected via a three pin plug and socket to allow components to be replaced by non-licensed personnel

4. Irrigation pump arrangement to be discussed / confirmed with STS supplier and installer

TITLE: Treatment System Controller Schematic	**DRAWING NO:** 0428-005-00	**REV:** A	
CLIENT: Colac Otway Shire Council	**Sheet:** 1 of 1	**Drawn:** SJ	
PROJECT: 0428 Kennett River Public Toilets On-site Wastewater Treatment System	**Scale:** NTS	**Checked:** BAA	

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9 Land Application System

The Wisconsin Mound has been chosen as an appropriate method of land application to accept and dispose of treated effluent from the treatment systems.

- Design basis for the mound is provided in Table 5.
- Hydraulic design parameters are provided in Table 6 (note: subject to final checking by contractor).
- Details for the gravel and sand materials are presented in Table 7.
- The mound construction details are provided in Table 8.
- The volume of mound and level pad construction materials are provided in Table 9.
- Lime is to be applied to the base of the fill pad at a rate of 0.5 kg/m^2.
- Wisconsin Mound zoning configuration drawings are provided in attached drawing suite.
- All disturbed areas are to be reinstated with 100mm of seeded topsoil and Kikuyu seed at a rate of 1kg/100m^2.

An as-built of the whole treatment system (including Wisconsin Mound, treatment system tankage etc) is to be provided by the contractor to Council.

Table 5 Mound and Fill Pad Design Details

Design Parameters		Value	Units
Design discharge volume		3000	L/day
Design basal loading rate		8	mm/day
Design linear loading rate		45	L/m/day
Depth of sand below gravel bed		0.4	m
Mound batter slope		3:1	-
Gravel absorption bed dimensions	Length	67	m
	Width	0.9	m
	Thickness	0.3	m
	Area	**60**	**m^2**
Wisconsin Mound dimensions	Length	72	m
	Width	6	m

Design Parameters		Value	Units
	Height	1.0 (additional 0.4m fill pad beneath the mound – making the finished height 1.4m)	m
	Downslope width	2.6	m
	Upslope width	2.6	m
	Endslope width	2.6	m
	Area	**432**	**m²**
Fill Pad Dimensions	Length	**75.2**	**m**
	Width	**9.2**	**m**
	Area	**692**	**m²**
	Height	0.4	**m**
	Side Slope	4:1	**-**

Table 6 Lot 2 Mound Hydraulic Design Parameters

Hydraulic Design Parameters		Value	Units
Flow rate		120	L/min
Residual pressure @ farthest orifice		1.5	m
Min. scouring velocity		3	m/s
Max. variability in squirt height along laterals		$\pm$15	% (variation)
Duty pump head		~16	m
Pump rating		0.84	kW
Effluent dosing manifold design detail	Number of hydraulic zones	6	-
	Point of feed	Centre	-
	Number laterals per zone	6 (3 either side of header pipe)	-
	Lateral spacing	0.23	m
	Lateral length either side of header	5.3	m
	Number holes per lateral	13	-

Hydraulic Design Parameters		Value	Units
	Hole size	3	mm
	Holes spacing on laterals	0.4	m
	Lateral pipe size	DN25 uPVC	-
	Lateral housing pipe size	DN100 slotted pipe or equivalent	-
	Submain (header) pipe size	DN25 uPVC	-
Mainline pipework detail	Length of mainline	43	m
	Mainline pipe size	DN40 PE100 PN12.5	m
	Indexing valve required	Yes (Fimco 6 port indexing valve). To be installed in valve box for ease of access.	-
Flush points per hydraulic zone		6 (3 either side of the header pipe)	
Suitable pump type		Davey D53 or equivalent	-

Table 7 Mound Gravel/Sand/Grass Design Parameters

Design Parameter	AS1547 Section Reference	Description
Gravel absorption bed	N3.3.3	Depth: 300mm Size: 20mm washed drainage aggregate
Internal filter sand specifications	N3.3.2	Depth: 400mm minimum Effective Size: 0.25 to 1.0mm Coefficient of Uniformity: < 4 Fines: <3% (smaller than 0.074mm) as per AS1547:2012
Topsoil cover	N3.3.6	Depth over side/end batters: 100 to 150mm Depth over gravel distribution bed: 300mm
Turf	N3.3.6	Suitable grass cover to be established immediately on completion of construction. Grass to be maintained until established.

Table 8 Mound Construction and Installation Detail

Element	AS1547 Reference	Details
Site protection and preparation	N3.1 N3.2	• The location of the mound must be protected form vehicular movement to minimise compaction. It is recommended that bollards be placed at the end of the access track. • A level fill pad is to be constructed to a min. level of 2.4 mAHD. The site Digital Elevation Model (DEM) information suggests that this will require the fill pad to be constructed to a total depth of 400mm. Refer to Table 9 for fill volume requirements. The pad is to be constructed of good quality sand or sandy loam. Prior to delivery of the fill pad material to site, the details of the proposed materials are to be provided to Council for approval. • The imported fill material for the fill pad is to be inspected by a suitably qualified person to determine its suitability prior to construction of the fill pad. • All disturbed areas are to be reinstated with 100mm of seeded topsoil.
Pipework including LPED dosing manifold	M10.2 M10.3 M13 N3.3.4	Pipes and fittings must: • Be rated to withstand 150% of the shut-off head of the pump. • Be semi-flexible and robust. • Be permanently buried and fixed. • Comply with AS4129 (fittings for polyethylene pipes), AS4130 (polyethylene pipes for pressure applications) and AS1477 (PVC pipes & fittings for pressure applications). • Buried pipework must be marked by using underground marking tape to AS2648 or indicated by signage such as '*Sewage effluent pipework installed below, DO NOT DIG*'. • All surface boxes shall be provided with lilac-coloured lids to indicate their use with treated effluent. LPED manifold design and construction: • The pressurised dosing manifold shall consist of 25mm PVC pipe PN12 with 3mm holes drilled (and deburred) at the nominated centres facing upward. Each LPED lateral shall be fitted with a 90mm slotted PVC or agricultural pipe. Note: the squirt height must be tested prior to covering with the outer pipe.

Element		AS1547 Reference	Details
Valves	Non-return	M10.3(a) Installation guidelines	• Non-Return valves must be installed on the transfer main and effluent mainline to prevent wastewater returning into the primary treatment tank and secondary treatment system once pumps are shutoff. The valve is generally located at the tank.
	Air/vacuum		• Air / vacuum valves must be installed in each zone or where required due to topography or system design.
	Flush		• Flush valves (either manual or automatic) must be installed in each zone at end of each lateral as 90 bed with ball valve in small irrigation box
Upslope surface water controls		M9.3	• Construct a surface/subsurface diversion drains upslope of the irrigation area where there is potential for water impacts. Refer to attached drawing suite for drawing details.
Marking		M13	• The presence of buried pipes shall: (a) Be indicated, for example, using underground marking tape to AS/NZS 2648.1; or (b) Be indicated by signage, prominently displayed with the words: 'Sewage effluent pipework installed below. DO NOT DIG.'
LAA design compliance		M7.2 T5.2.2	• Alteration to the design of the land application area must be approved by the designer.
Pre-commissioning and Commissioning checks		6.2.5 N3.3.5 N4	Pre-commissioning tests shall include: • Filling the pump chamber and starting the pump. • Checking the LPED manifold to ensure uniformity in distribution (±15% variation) and adequate squirt height (~1m). • Checking the pipework and all fittings for leaks via pressure testing. • Testing the high water level alarm. • The on-site system shall be inspected, checked and commissioned according to 6.2.5.

Table 9 Volume of Wisconsin Mound Construction Materials

Component	Material	Volume (m^3)
Mound	Filter Sand	137
	Distribution Bed Gravel	18
	Topsoil Cover	45
Raised Pad on which to construct mound	Pad	224
Total		424

10 Commissioning and Proof of Performance

All treatment system components, including valves, pumps, float switches, alarms and the PLC are to be tested in accordance with manufacturer's requirements and be confirmed to be fully operational. Proof of Performance Testing of the treatment system is to be completed upon commissioning to confirm that the treatment system is meeting the water quality requirements of this specification (as outlined in Table 3). This is to include the collection of influent and effluent samples once per week for four (4) weeks and analysis of the following.

- Biochemical Oxygen Demand BOD;
- Total Suspended Solids TSS;
- Electrical Conductivity;
- pH; and
- E.coli.

The sampling is to be collected by an independent party and analysis shall be completed at a NATA accredited laboratory. Results will be submitted to Council once received.

Where a component fails to operate as intended or designed, the contractor is to contact the manufacturer and / or rectify the construction / installation issue so that the component (and treatment system as a whole) operates as specified.

The treatment system (including all tankage, secondary treatment system and Wisconsin Mound) is to be signed off by Council once it is proven to be installed and constructed in accordance with this document.

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Wastewater Management Report: Kennett River Public Toilets

Version 3 Report

23/08/2021

Document Control Sheet

Decentralised Water Australia Pty Ltd trading as Decentralised Water Consulting Unit 2, 12 Channel Road Mayfield West NSW 2304 0408 023 265 enquires@decentralisedwater.com.au	Document	R.0428.03.02_Kennettriveramenities_Wastewatermanagementreport
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	Project Manager	Ben Asquith
	Author(s)	Deni Hourihan
	Client	Colac Otway Shire Council
	Client Contact	Chris Baker
	Client Reference	

Revision / Checking History

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0	7 July 2021	BAA		DH	
1	13 August 2021	BAA		DH	
2	23 August 2021	BAA		DH	

Limitations

This report and the associated services performed by Decentralised Water Consulting (DWC) relate solely to the scope, budget, time and access constraints as set out in the engagement agreement and quotation between DWC and the Client. DWC accept no liability for any use or reliance on this Report for any purpose not documented in this agreement and quotation by the Client. It has been prepared for the exclusive use of the Client and DWC accepts no liability for any use of or reliance upon this report by any third party.

The outcomes and recommendations contained in this report may have relied upon a range of information and data sources including information and discussions with the client, field investigations (limited to those described in this report), publicly available information and other sources. DWC have not verified the accuracy of third party data and any inaccuracies or inadequacies may influence the accuracy of our findings. Similarly, both the inherent variability of environmental and ground conditions and the passage of time can lead to changes in ground conditions and other factors which may affect the accuracy of our findings. The Client should seek advice from DWC on the accuracy of findings after more than six months has passed or where changes in relevant conditions are known to have occurred. Data and information collected during field investigations should not be taken as accurate and complete for all depths and locations across the site.

The report and services have been completed in accordance with relevant industry standards, guidelines and government legislation as of the date of publication unless stated otherwise. Where an engineering design is included, this design has been based on site and construction plans as provided by the Client and/or their representative and documented in the report. DWC accepts no liability for the impact of any changes to site conditions and / or building layout and extents on our design where DWC were not notified of the changes prior to completing our services. Additional costs may be incurred where work has already been completed.

TABLE OF CONTENTS

1 Introduction

This Wastewater Management Report (WMR) has been prepared by Decentralised Water Consulting (DWC) for Colac Otway Shire Council (Council) to assist in the design and approval of a new on-site wastewater management system to service the proposed Kennett River Public Toilets. The proposed Kennett Reiver Public Toilets are to be located along the Great Ocean Road within the Kennett River Township.

The proposed development includes upgrade to the Great Ocean Road and upgrade of the existing access road to the proposed toilet facility (accessed via Hawdon Avenue and the Great Ocean Road). The upgraded access road is to include additional car parking for both small vehicles and mini buses to cater for anticipated stopping tourists.

A Land Capability Assessment (LCA) was completed by AGR GeoSciences (AGR) in September 2020 ('*20H539LCA Factual Report*') to inform an options evaluation process by DWC to identify potential effluent management options and determine the most suitable location for any proposed Land Application Area (LAA). Two locations were identified and assessed, with 'Site 1' being located on the east side of the existing wetland and west of the Great Ocean Road, and 'Site 2' being located on the west side of the existing wetland (manmade) and east of privately owned cleared land. The assessment included the progression of three test pits, soil logging, soil sampling and collection of site information (including photographs).

DWC completed an 'Initial Wastewater Management Options Evaluation' ('*L.0428*.001') which included the outcomes of the LCA completed by AGR. The Options Evaluation determined that of the two sites assessed as part of the AGR investigation, 'Site 2' is the most suitable for land treatment of effluent.

The evaluation identified three (3) potential on-site wastewater management solutions:

- Option 1 – Installation of a new on-site wastewater management system which includes secondary treatment and pressure dosing of a Wisconsin Mound;
- Option 2 – Pumping raw wastewater from the new Toilet Block to the existing treatment system located at the nearby Holiday Park; and
- Option 3 – Hybrid option which includes installing a new treatment system near the new public toilets (as per Option 1) and transferring the treated effluent to the existing Holiday Park Land Application Area (trenches).

Given the uncertainty of the performance of the existing Holiday Park treatment system, the location of the trenches within currently used campsites and the requirement of a clear governance model to determine maintenance of assets, Option 1 was determined to be the preferred solution by Council. As such, only Option 1 has been included in this WMR.

Council have provided previous records of sewage pump-out records for the current temporary Kennett River Toilets (2019-2020) and an estimation of peak visitation (~930 persons per day). DWC were then able to develop a design wastewater management flow profile which is representative of the highly variable and seasonal wastewater flows which will be experienced by the proposed facility. The average wastewater volume generated by the facility is estimated to be 2,500 L/day with a 90th percentile of 4,700 L/day. The flows discharged into the proposed treatment and land application systemwill be capped at a maximum flow balanced output of 3,000 L/day. Consequently, the volume of sewage received and discharged from the secondary treatment system will not exceed 5,000 L/day. As such an EPA Works Approval is not required and the approval of this system is the responsibility of Council under a Septic Tank Permit under the *Environment Protection Act*.

DWC have completed this Wastewater Management Report (WMR) and Design Specification (D.0428.001) to demonstrate compliance of the proposed onsite wastewater management system (Option 1) with Council and Victorian regulatory requirements.

The location of the site is shown in Figure 1. In addition, the proposed water management system is outlined in Figure 2.

1.1 Site Information

Details of the site are summarised in Table 1. A summary of the proposed wastewater management system is provided in Table 2.

Table 1 Summary of Site Information

Site Information	
Property/Site	**Kennett River Public Toilets** **Kennett River (VIC) Township**
Owner	Colac Otway Shire Council (Council)
Description of existing / current site	A proposed Public Toilet facility located along the Great Ocean Road and within the Kennett River Township. Council have provided sewage pump-out records for the current temporary Kennett River toilets (2019-2020) and an estimation of the expected peak visitations (932 persons per day). This information was used to develop a design wastewater flow which has assumed: Average daily use of 413 persons; Average daily use during holiday season of 632 persons; and Maximum daily use of 1,300 persons.
Water Supply	River (via storage tank)

Table 2 Summary of Proposed Wastewater Management System

Facility Activities to be Serviced	The proposed Public Toilets to be located adjacent to the Great Ocean Road and within the Kennett River Township.
Wastewater Generation Volumes	Information provided to DWC from Council (including expected occupancy and pump-out records) was used to develop and calibrate a wastewater flow profile for the Public Toilets. The assumed daily wastewater generation rates are as follows: **Raw Wastewater Inflow:** Average Flow – 2.5 kL/day 90^{th} Percentile – 4.7 kL/day Peak Flow – 7.8 kL/day **Flow Balanced Outputs:** Average Flow – 2.5 kL/day 90^{th} Percentile – 3.0 kL/day Peak Flow – 3.0 kL/day
Treatment Requirements	A minimum 12 kL capacity primary treatment capacity (achieved via 23 kL Combined Primary Chamber and Pumpwell Tank) and 3,000 L/day secondary treatment system (minimum operating capacities) with disinfection is required.
Storage (Flow Balancing) Requirements	A minimum of 100 kL of flow balance storage (tanks) receiving primary treated effluent is required.
Effluent Land Application Area	Installation of a pressure dosed Wisconsin Mound with the following specifications: - Total basal area of 432 m^2 (72m L x 6m W); and - Total distribution bed area of 60 m^2 (67m L x 0.9m W); and - Total mound height of 1.0m. Due to the flood prone nature of the site, the importation of 400mm of good quality fill (sand) is required to ensure that the point of effluent injection (i.e. the base of the distribution bed) is at or above the 5% AEP Design Flood Level (2.8 mAHD). The fill pad is to have an area of ~692 m^2 (75.2m L x 9.2m W)

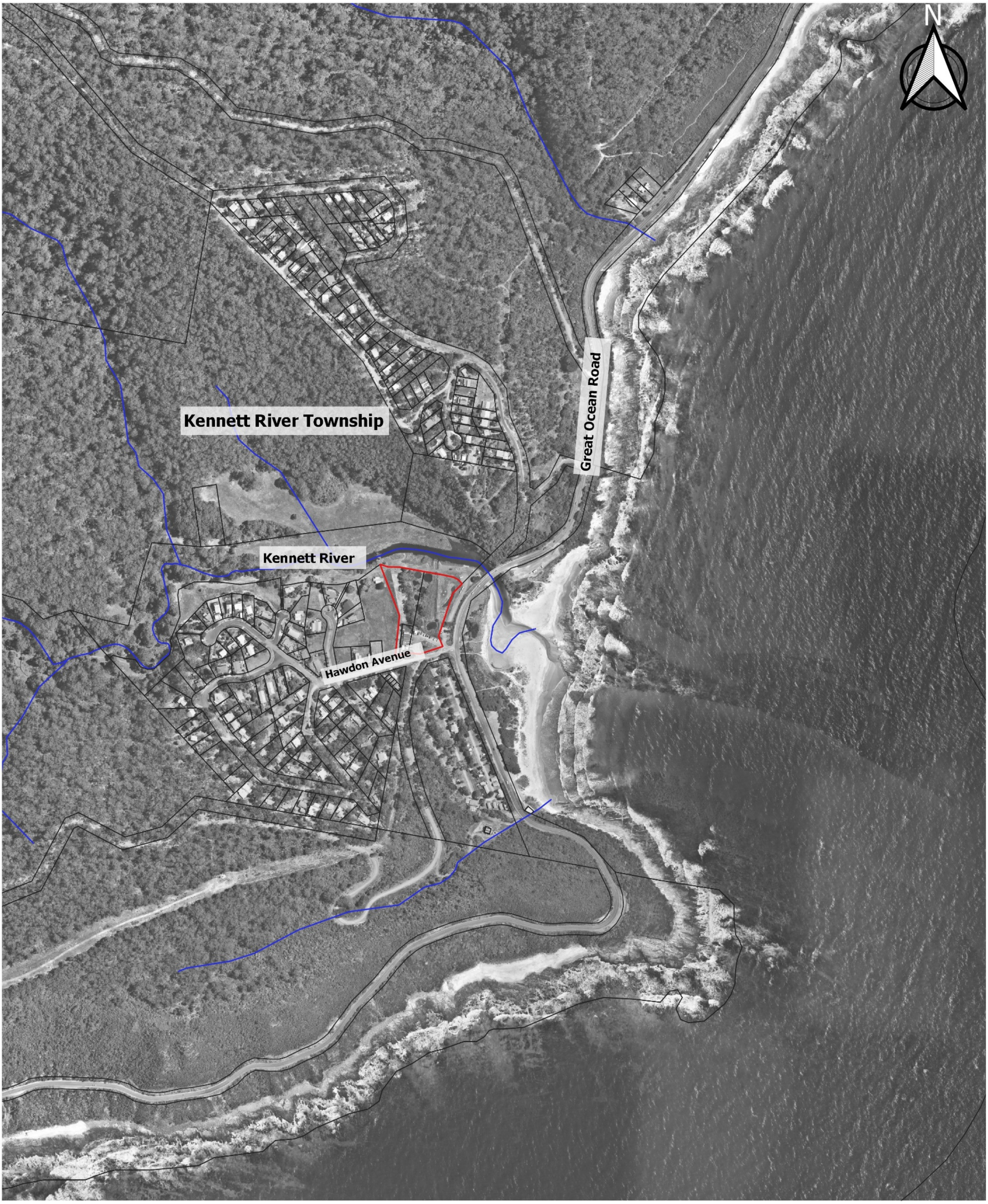

Figure 1 Site Locality - Kennett River Public Toilets

Legend

Site Locality

Property Boundaries

Watercourses

DWC

DECENTRALISED WATER CONSULTING

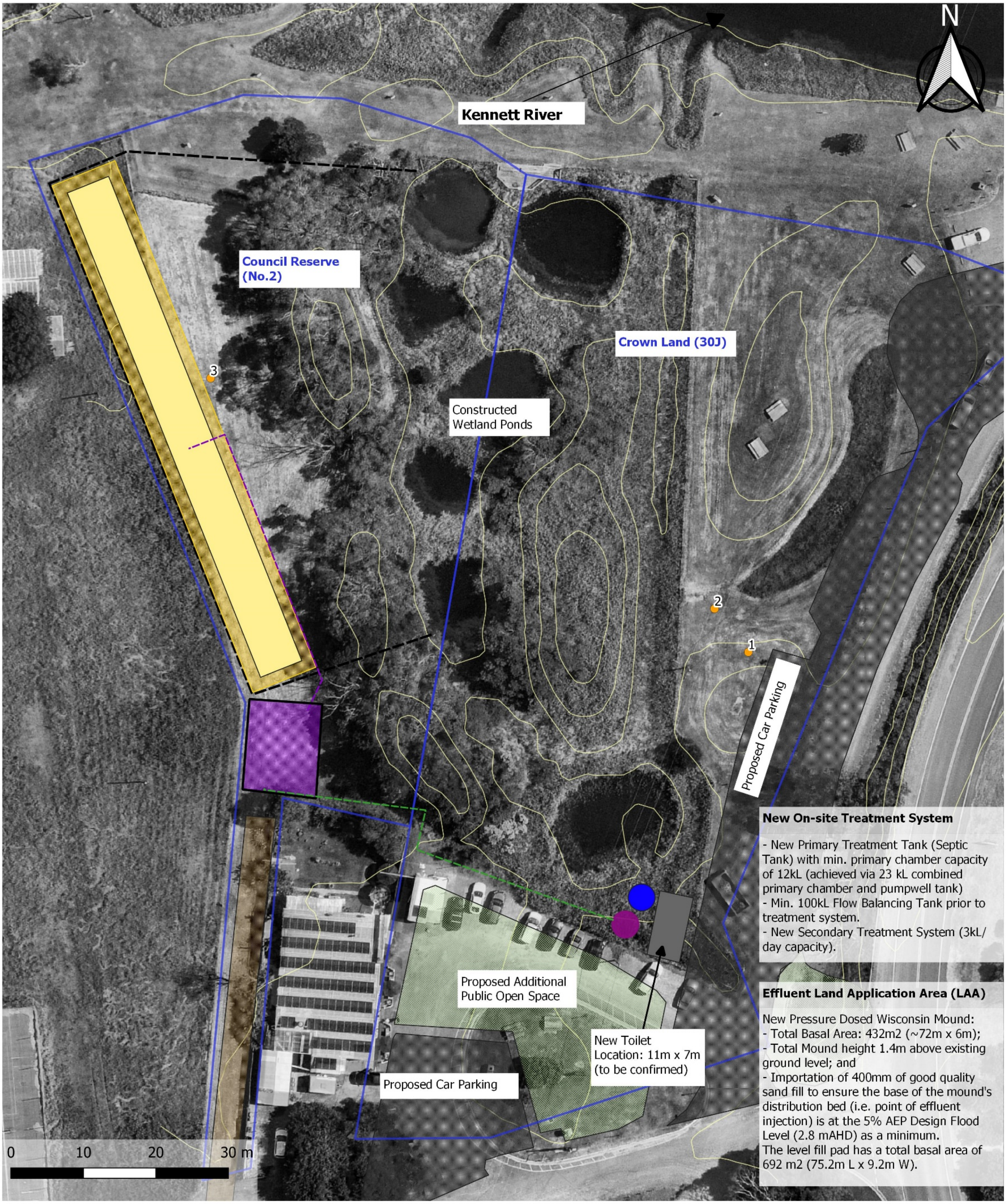

Figure 2 On-site Wastewater Management Plan - Kennett River Public Toilets

Legend

- Proposed Public Toilets
- Rainwater Tank
- Primary Treatment Tank
- Effluent Mainline
- Treatment System Compound (approx.)
- New Upslope Diversion Drainage (Curtain Drain)
- Raised Pad
- Wisconsin Mound
- Proposed Car Park
- Proposed Public Open Space
- Test Pits
- Elevation Contours (approx. 0.5m)
- Rising Main

DECENTRALISED WATER CONSULTING

2 Performance Objectives

On-site systems with flow rates less than 5,000 litres a day are the responsibility of Council which issue permits for the construction, installation, and alteration of on-site systems under the *Environment Protection Act*.

2.1 Colac Otway Shire Council

The following documents are relevant to on-site wastewater management in the Colac Otway Shire Council area and have been considered as part of this assessment:

- Colac Otway Shire Domestic Wastewater Management Plan (2015)
- Colac Otway Shire Planning Scheme (2020)

There is a need to ensure environmental and human health risks are managed in the most appropriate manner for the site. The upgraded Kennett River public toilets are an important community asset which are used by not only the community but a large number of travellers using the Great Ocean Road.

State Environmental Protection Policy (Waters)

This Policy provides a framework to protect and improve the quality of Victoria's waters with regard to the environmental protection principles set out in the Environment Protection Act (1970). Where reticulated sewerage is not reasonably practical, it must be ensured that sewage can be sustainably managed within property boundaries.

The Environment Protection Authority (EPA) Code of Practice for Onsite Wastewater Management (CoP) provides standards and guidance to ensure the management of on-site wastewater protects public health and the environment for wastewater flows up to 5,000L/day.

On-site Wastewater System Approval

The design, operation and management of on-site systems are supported by a number of standards and guidelines, in particular:

- EPA Code of Practice – Onsite Wastewater Management, Publication 891.4 (2016);
- MAV Land Capability Assessment Framework (2014) – replacing EPA Publication 746.1;
- AS/NZS 1547:2012 Onsite Domestic Wastewater Management;
- AS/NZS 3500:2003 Plumbing and Drainage.

Since July 2016 EPA no longer award a Certificate of Approval to individual on-site wastewater systems. EPA now approves system types subject to certification by a JAS-ANZ accredited body against the following Australian Standards;

- AS/NZS 1546.1 Septic tanks
- AS/NZS 1546.2 Waterless composting toilets
- AS/NZS 1546.3 Aerated wastewater treatment systems
- AS/NZS 1546.4 Domestic greywater treatment systems (draft)

Council Permits

For sites with flows up to 5,000 L/day, Council issues permits to system owners for the installation, use, maintenance and monitoring of site-specific wastewater treatment systems. These permits are defined below:

- A Septic Tank Permit to Install/Alter is issued once Council is satisfied an application nominating a preferred system meets the requirements of the CoP, Council and *AS1547 and* is a system type approved by the EPA; and
- A Septic Tank Certificate to Use is issued once Council is satisfied the treatment system and recycling / disposal system have been installed in accordance with the Council Permit.

3 Land Capability Assessment

A Land Capability Assessment (LCA) was undertaken for the three potential locations of the proposed public toilets. This site and soil assessment was undertaken by AGR Geosciences Pty Ltd (AGR) on 26th August 2020.

Three (3) soil test pits were excavated on the western and eastern regions adjacent to the constructed wetlands. Test Pit Three (TP3) was excavated within the footprint of the proposed Wisconsin Mound and as such is the most representative soil horizon for this study. Five discrete soil horizons (which were representative of the overall soils observed) were sent to Groundswell Laboratories for laboratory analysis, three of which were soil horizons from TP3.

The collected site and soil data were utilised to finalise the LCA for potential LAA locations in accordance with the EPA Code of Practice and MAV Land Capability Framework (in addition to *AS1547:2012*).

Additionally, Council recently commissioned Cardno to complete a flood study to investigate the 5% AEP Design Flood Levels in the location of the proposed on-site wastewater treatment system ('*20623-01 Kennett River – 5%AEP – Memorandum*'). The study found that the 5% AEP Design Flood Level is 2.8mAHD in the location of the proposed Wisconsin Mound. Considering the existing elevation in this area is ~2.0m AHD, the importation of 400mm of good quality sand fill will be required to ensure the point of effluent injection (i.e. the base of the mound distribution bed) is at the flood level (as a minimum).

The key outcomes of the land capability assessments are presented in Table 3 for the three locations and the complete LCA is presented in Appendix A.

Table 3 Land Capability Assessment Summary (New Public Toilets)

Criteria	Details	Comment / Action
Available Area (AA) for on-site effluent management.	Photographic evidence and a desktop analysis identified that there is limited area available for on-site land treatment of effluent. The two areas available near the proposed toilet block site include the area directly east of the wetland adjacent to the privately owned property and the area to the west of the wetland where stormwater run-off from the road is currently directed. The area to the west of the wetland was determined to the be the most suitable location for on-site wastewater management (due to run-on potential and significant earthworks required to reshape the eastern area).	Ensure the Land Application Area is raised such that the minimum on-site wastewater flood level can be achieved (5% AEP Design Flood Level). If this is not known, the system should be raised such that the point of effluent injection is a minimum of 600mm from the ground level where groundwater ponds (as per *AS1547:2012*).
Climate	Excess rainfall over evaporation for approximately six months of the year means soils are likely to stay relatively moist during this period (April-September).	Adopt a conservative Design Loading Rate (DLR). Utilise a raised system with enhanced Evapo-transpiration (ET) and unsaturated depth of soil for treatment and attenuation.

Criteria	Details	Comment / Action
Drainage	Poor to very poor drainage conditions. Extensive hydrophilic vegetation is present at the site and there is significant ponding and saturated surface areas in both investigation areas.	Avoid low lying areas for installation of land treatment systems. Adopt a conservative DLR.
Soil	Soils in the eastern investigation area consist of moderately structured clay loam over weakly structured light to heavy clays. Soils in the western investigation area comprise moderately structured clay loam over silty clay with a fine sandy loam B2 horizon from 900-1,500mm. Significant mottling was present in all test pits and blue and grey gleying was present in the eastern investigation area. The soil laboratory results indicated that the soils are sodic across the whole site and are very strongly to extremely acidic in the western portion of the site.	Adopt conservative design loading rate and ensure setback distances to Kennett River and the stormwater wetlands can be achieved (as per CoP). Apply lime at a rate of 0.5 kg/m^2 to base of the mound fill pad to reduce acidity and risk of soil dispersion.
Groundwater	Test Pit 3 encountered water ingress at 800mm. However, photographic evidence identified that groundwater often reaches the soil surface in low lying areas of the site.	Adopt conservative DLR and ensure the point of effluent injection is a minimum of 600mm from the high episodic groundwater level (as per *AS1547:2012*).
Fill	Raised fill 'mounds' are present in the eastern investigation area and have been formed with excavated clay soils from the man-made wetland.	Avoid installing the proposed LAA in this area. Adopt conservative DLR if any portion of the proposed Land Application Area is to be installed on these areas (clay is likely to have been worked and as a result the permeability has been reduced).
Sensitive Receiving Environments	This western investigation area is located within 30-60m of the high-water mark of Kennett River. The eastern investigation area is located within 70m of the highwater mark of the Kennett River and 50-60m to the Kennett River estuary. Kennett River may be used as a stock water source for the adjacent Holiday Park. There is a man-made wetland located within the central portion of the reserve (between the two investigation areas). The site is also located within an Environmental Significance Overlay (ESO) and Environmental Management Overlay (EMO).	Maximise setback distances to receiving environments. Adopt a conservative DLR. Complete daily numerical modelling and groundwater plume modelling to determine the impacts of the proposed on-site wastewater treatment systems.
Flood Inundation Frequency	The coastal reserve is located in the 1% AEP Design Flood area and a Land Subject to Inundation overlay. The proposed Wisconsin Mound is located below the 5% AEP Design Flood Level.	Import 400mm of good quality sand fill and install beneath the proposed Wisconsin Mound. This will ensure that the point of effluent injection (i.e. the base of the mound distribution bed) is at the 5% AEP Design Flood Level.

3.1 Available Area for Land Application

The site and soil assessment has identified that the most suitable area available for land treatment of effluent is the area to the west of the existing manmade stormwater wetlands and adjacent to the privately owned properties. This area is sufficiently sized to allow the installation of the proposed Wisconsin Mound and maintain a minimum 24m setback to Kennett River and 18m setback to the stormwater ponds (achieving the required 3m setback to stormwater drains as per the CoP *891.4*). Given the expected high water quality treatment of the proposed system and the only minor reduction in setback to Kennett River (30m required under CoP), the setback distances to these receiving environments is considered acceptable and appropriate. Suitable area for alternative land application options is not available.

DWC has completed detailed impact assessment modelling of the proposed system to demonstrate that ecosystem and human health objectives can be achieved and that the available setbacks are appropriate and sustainable.

3.2 Outcomes of Land Capability Assessment

The site is subject to a number of major constraints to on-site wastewater management including low permeability, highly acidic and sodic clay soils, flood prone land, being located in close proximity to Kennett River and having very limited area available for on-site wastewater management. Notwithstanding, the proposed effluent management area is adequate to enable estimated design wastewater flows from the proposed Kennett River Public Toilets to be sustainably managed through land treatment within the proposed LAA.

3.2.1 Consideration of Alternative Effluent Management Options

The following land capability-oriented observations were used to inform the options assessment for managing wastewater from the proposed facility. Further detail can be found in the previous Options Evaluation and Section 4.1 of this report.

- There are no available areas within the Kennett River township that can be considered suitable for beneficial reuse of recycled water by irrigation.
- The climate in Kennett River also effectively precludes beneficial reuse.
- Whilst the land containing the existing absorption trenches for the caravan park is sandier and more elevated, it drains to the beach via groundwater seepage. The risk of pathogen and nutrient leaching onto the beach area is already high and would be exacerbated by addition of peak flows from the proposed facility.
- It would also be more likely to be a pathway for direct human contact in comparison with the proposed Wisconsin Mound.

- High level treatment and discharge to waters would not be a viable option for this facility due to the very small scale of the treatment system, highly fluctuating flows, sensitivity of the receiving environment and community acceptance. DWC consider it a less sustainable option.

3.2.2 Management Controls Arising from LCA

DWC has identified the following management controls to address the constraints identified:

- Development of a calibrated design basis that accommodates and balances the measured variability in wastewater flows;
- Adoption of standard buffer distances as per EPA CoP;
- Raised Land Application Area to ensure flood and groundwater inundation risks are adequately managed.
- Installation of a Secondary Treatment System with disinfection and land treatment via a pressure dosed Wisconsin Mound to ensure enhanced Evapo-transpiration and a tertiary level of treatment prior to leaving the Mound;
- Application of lime at a rate of 0.5 kg/m^2 to base of the proposed Wisconsin Mound fill pad to reduce acidity and risk of soil dispersion.
- Inclusion of flow balancing to cap discharges and significantly improve treatment reliability;
- Implementation of remote monitoring to notify Council and the designated system manager / operator of high tank levels and potential operational issues; and
- Installation of an Ultraviolet disinfection system with remote alarm to notify Council of disinfection failure.

4 Design Basis

Council provided monthly sewage pump-out records for the current temporary Kennett River toilets (2019-2020) along with an estimation of expected peak visitation (1,085 persons per day). This information is provided in Appendix B. Additionally, Council have since indicated that they expect peak visitations to be slightly lower (in the order of ~932 persons per day), adding further contingency to the design. A contingency of 30% has been applied given uncertainty and therefore a total peak 1,300 persons / day has been assumed in design. This information was utilised to develop an estimated wastewater flow profile for the proposed options.

Flow balancing storage was designed to balance out the peak visitation periods, which occur during the Christmas, Easter holiday and to a lesser extent, other school holiday periods (based on available information). Flow balance tankage is a cost-effective means of balancing out the large peaks that typically occur for tourist locations such as Kennett River, as it ensures the treatment and land application systems do not need to be sized for significant peaks that only occur for short periods in the year, with typical daily flows being significantly lower.

It is not recommended practice to oversize a treatment system to meet the peak flow of a facility receiving highly fluctuating inflows. Many conventional treatment processes are not designed to operate effectively when subject to large fluctuations in hydraulic and organic load regardless of their peak design capacity. This in turn increases risk of treatment failure and operational risk associated with a high reliance on human inputs for a small, isolated plant.

The flow balance tank has been sized to provide a capped maximum flow of 3,000L/day to make sure the new treatment facility performs reliably and does not need to be oversized for 95% of the year.

The wastewater generation rate assumed for persons using the facility is 6 Litres per person based on the EPA *Code of Practice for Onsite Wastewater Management* (891.4). A recent previous public toilet project undertaken for Corangamite Shire Council (Lismore) identified a *measured* rate of 5 litres per person which supports the suitability of the EPA Code of Practice value.

An indicative annual usage profile was developed by setting the peak usage to reflect the 1,300 persons per day on peak days (e.g. weekends during January) and applying typical variations to reflect the seasonal variability in expected toilet usage. To ensure the design reflects the Kennett River scenario, variation in monthly design flow volumes have been calibrated using the sewage pump out records.

The detailed outcomes of this calibration process are provided in Appendix B with the key outcomes summarised in Figure 3. Some key outcomes of the design flow calibration process are as follows:

- The annual design wastewater volume is approximately 20% higher than the 2019 measured wastewater volumes.
- Peak daily volumes are based on the new car park configuration and the maximum capacity for bus and car movement.
- The resulting peak school holiday usage assumptions are 20-50% higher than total monthly pump out volumes. This is considered appropriate given the improved car parking and toilet facilities.
- This conservative approach to peak periods will provide a higher degree of confidence in the ability of the system to cope with the uncertainty of fluctuating inflows.

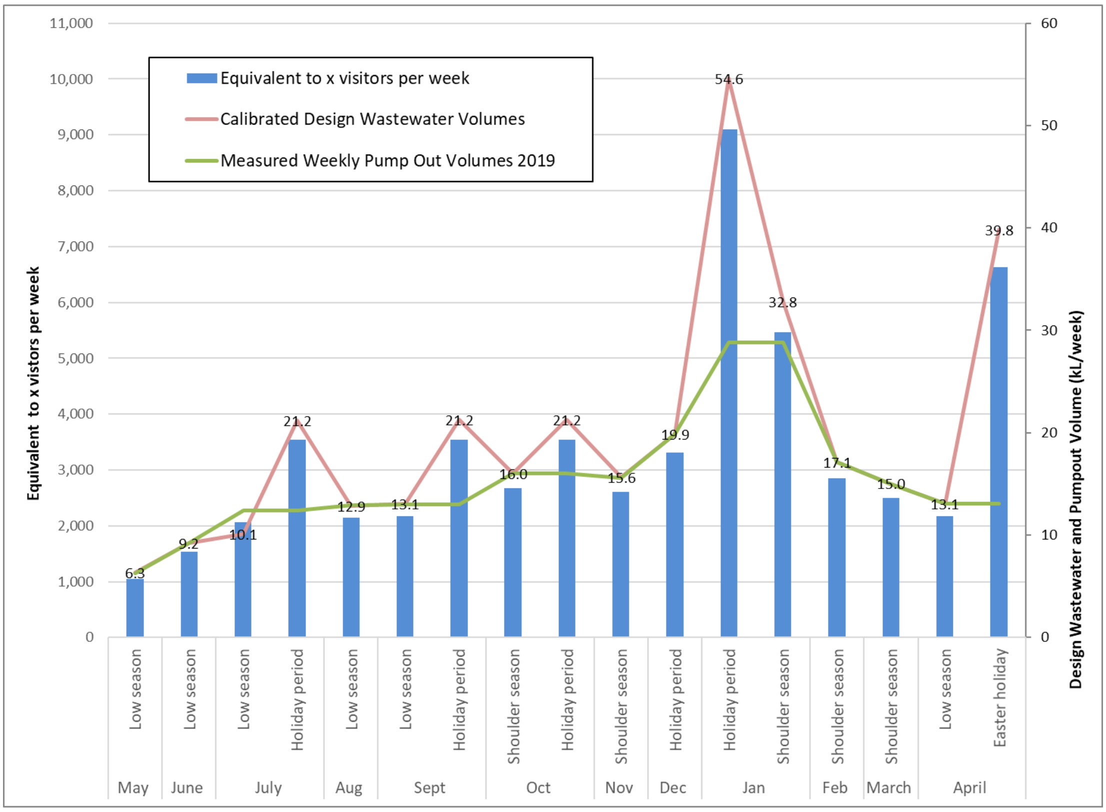

Figure 3 Wastewater Flow and Visitation Summary

The calibrated design wastewater flow profile produced a daily time series of inflows that was then used to size the flow balancing storage. This process involved an iterative trade off between tank sizing, available area for land application and logical treatment system capacities (i.e. based on available proprietary treatment unit capacities). Figure 4 shows the outcomes of the flow balancing assessment based on a 3,000 L/day discharge rate and a new 100 kL flow balance tank.

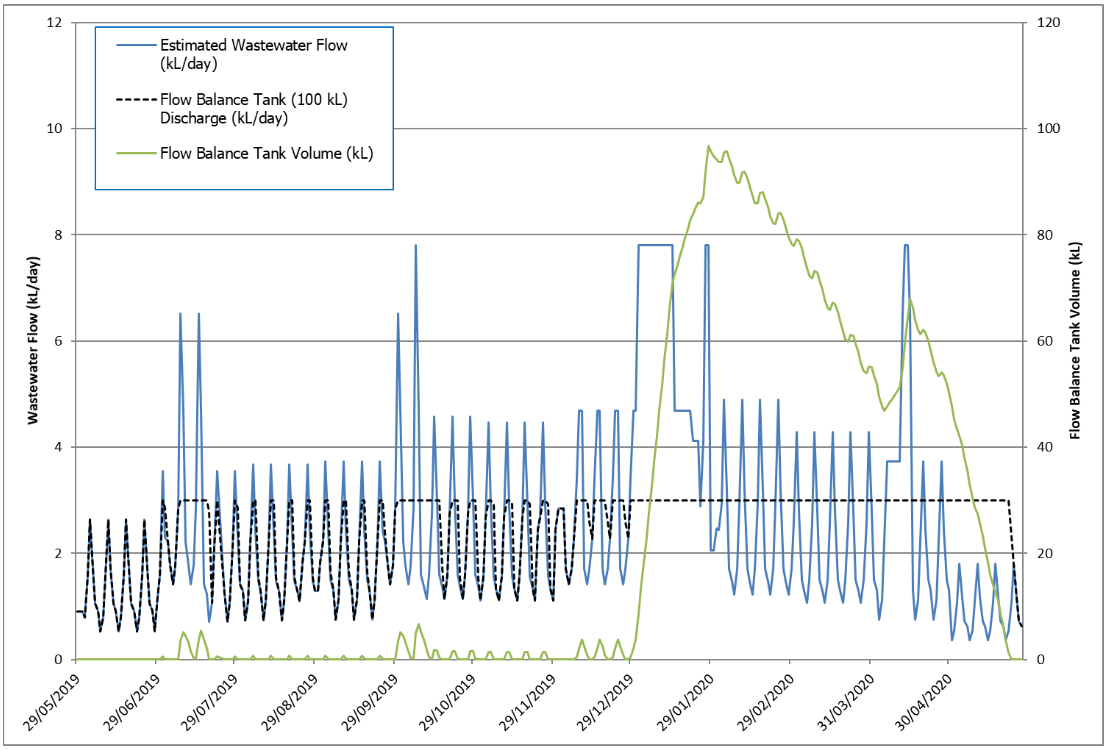

Figure 4 Estimated Wastewater Flow Profile (with Balancing Tank)

Table 4 summarises key statistics for both the raw sewage inflows and balanced discharge to the inlet of the secondary treatment system. The benefit of flow balancing can clearly be seen both in terms of capping daily flows and reducing the variability. Under the design flow balancing arrangement, the treatment system and Wisconsin Mound will receive between 2-3 kL/day on 73% of days per year. Provision of 100 kL of flow balancing storage also provides significant contingency to manage uncertainty in short term fluctuations in flows.

Table 4 Raw Wastewater Inflow and Flow Balanced Wastewater Discharge Statistics

Statistic	Raw Wastewater Inflow (L/day)	Flow Balanced Input to Secondary Treatment System and Wisconsin Mound (L/day)
Minimum	360	530
Average	2,480	2,480
Median	1,760	3,000
90^{th}%ile	4,680	3,000
95^{th}%ile	7,480	3,000
Maximum	7,800	3,000

4.1 Potential Wastewater Management Options

Three (3) key potential options for the site were investigated based on information provided and discussions with Council. These options are summarised in Table 5. Connection to existing reticulated sewer is not viable for the site given the significant distance from the nearest connection point. Based on the wastewater options evaluations, Council's preferred option for the site was a new secondary on-site wastewater management system with land treatment via a pressure compensating Wisconsin Mound. As previously discussed in Section 3.2.1, effluent management by beneficial reuse is not a viable option for this site due to the climate and lack of suitable reuse opportunities. Discharge to water is highly unsuitable given the proximity of Kennett River estuary and the nearby extraction point for drinking water for the caravan park. These options have not been considered further.

Table 5 Review of Key Potential Wastewater Management Options

No.	Option	Option Summary	Pros	Cons	Progress?
1	New Secondary Treatment System – Pressure Dosed Wisconsin Mound	Installation of a new secondary treatment system with sufficient flow balancing for controlled dosing of a new Wisconsin Mound.	• Provides new self-contained system without reliance on existing Holiday Park wastewater system (reduced level of uncertainty or risk in using existing infrastructure). • Mound able to be tucked away out of access from the public behind the constructed wetlands. • Minimised transfer costs as treatment system and Mound can be located adjacent to the proposed amenities (does not need to be pumped to Holiday Park system).	• Available areas for the proposed Wisconsin Mound are subject to flooding impacts due to lower lying elevation and proximity to waterway (flood modelling currently being undertaken for Council). • Located in proximity to Kennett River (notwithstanding the minimum 24 metres setback able to be achieved as per EPA CoP) and adjacent to constructed wetlands. • Engineered upslope surface and subsurface diversion drainage required due to landscape position and surface water run-on potential. • Information on the Holiday Park suggests water is exacted from the river for the Holiday Park water supply (will be considered further as part of system design finalisation).	Preferred On-site Wastewater Management Solution
2	Connection to the Existing Holiday Park System	Pumping raw wastewater from the new Toilet Block to the existing treatment system located at the nearby Holiday Park; and	• Allows existing treatment infrastructure to be used (reducing potential costs subject to upgrade works). According to previous Works Approval (2007) a flow allowance of 3kL/day was made for future public toilets. • Current Holiday Park land application area (LAA) appears to have been upgraded to total ~800m2 ETA trenches. Therefore the existing LAA appears to be potentially adequate based on currently available information on wastewater flows as discussed above. • Existing LAA is located above flood impacted area. Permeability (sandy) soils are more free draining and located further away from environmental receptors (Kennett River, high groundwater, etc.)	• Uncertainly regarding current Diston treatment system capacity and performance. System audit and performance testing would be required if it was to be used. • The existing Diston system is highly likely to require an upgrade given current uncertainly – as a minimum greater upfront primary treatment and flow balancing tankage would likely be necessary in addition to collection of actual (metered) wastewater generation data. • It appears that temporary caravan sites are located on top of the existing ETA trenches (during peak seasons). This is understandable given the site constraints, however this has the potential to damage trenches over the long term. • Highly permeable soils with limited attenuation capacity with plume flows towards beach area – potential health and ecosystem impacts from heavily loaded absorption trenches of unknown condition. • Issues surrounding responsibility, particularly in the event of any	Not considered further – Council determined this option to be unsuitable.

No.	Option	Option Summary	Pros	Cons	Progress?
				system failure (particularly ETA trenches). Arrangement required between COS Council and Otway Coastal Committee.	
3	Secondary Treatment – Subsurface Irrigation	Hybrid option which includes installing a new treatment system near the new public toilets (as per Option 1) and transferring the treated effluent to the existing Holiday Park Land Application Area (trenches).	• Allows existing treatment infrastructure to be used (reducing potential costs subject to upgrade works). According to previous Works Approval (2007) a flow allowance of 3kL/day was made for future public toilets. • Current Holiday Park land application area (LAA) appears to have been upgraded to total ~800m2 ETA trenches. Therefore the existing LAA appears to be potentially adequate based on currently available information on wastewater flows as discussed above. • Existing LAA is located above flood impacted area. Permeability (sandy) soils are more free draining and located further away from environmental receptors (Kennett River, high groundwater, etc.)	• Uncertainly regarding current Diston treatment system capacity and performance. System audit and performance testing would be required if it was to be used. • The existing Diston system is highly likely to require an upgrade given current uncertainly – as a minimum greater upfront primary treatment and flow balancing tankage would likely be necessary in addition to collection of actual (metered) wastewater generation data. • It appears that temporary caravan sites are located on top of the existing ETA trenches (during peak seasons). This is understandable given the site constraints, however this has the potential to damage trenches over the long term. • Issues surrounding responsibility, particularly in the event of any system failure (particularly ETA trenches). Arrangement required between COS Council and Otway Coastal Committee.	Not considered further – Council determined this option to be unsuitable.

Based on available information for the existing wastewater system and the site, connection to the Holiday Park system is not considered the preferred option. Key factors;

- Current land application area is not adequate and would require upgrade. The AGR LCA report indicates that available area is limited.
- Previous Diston report indicates the allowance for future public toilets connected to the system is less than expected from recent pump-out records from Council.

4.2 Effluent Quality

Standard domestic wastewater quality has been assumed for wastewater generated at the Kennett River Public Toilets. The new treatment system should be capable of treating to secondary quality and this has been assumed in the design. The treatment performance criteria outlined in Table 6 were assumed for the new system.

Table 6 Design Criteria – Secondary Treatment System

Parameter	Unit	Design Value	Min. Target Requirement
Biochemical Oxygen Demand (BOD_5)	mg/L	20	90th Percentile
Total Suspended Solids (TSS)		30	90th Percentile
E.coli	cfu/100mL	10	90th Percentile
Disinfection required	n/a	Yes	

Secondary quality with disinfection was considered appropriate due to the land capability constraints and proximity of the stormwater wetlands and River. This will allow the Wisconsin Mound to perform a tertiary treatment function. Mounds operate as enhanced intermittent sand filters due to the plant uptake function and increased Evapo-transpiration. The performance of mounds in this regard has been verified in the field in Australia (Geary *et al*, 2008 and Whitehead and Geary, 2009).

4.3 Land Application

The proposed land application method is the installation of one (1) pressure dosed Wisconsin Mound with a total of six (6) hydraulic zones. Design sizing calculations for the LAA were completed in accordance with the EPA Code of Practice, MAV LCA Framework, *AS/NZS 1547:2012* and Converse and Tyler (2000).

Additionally, daily numerical modelling was undertaken to ensure the proposed Design Loading Rate (DLR) is sustainable and doesn't result in undesirable soil moisture conditions (e.g saturated soils / soggy soils for significant portions of the year), excessive groundwater mounding or pollutant export.

Key design parameters are summarised in Table 7. The calculations are provided in Appendix B. Performance modelling is presented in 5.

Table 7 Individual Wisconsin Mound Design Sizing Parameters and Outcomes

Parameter	Value	Basis
Average effluent design flow	**2.5 kL/day**	12 kL min. operational primary treatment capacity (achieved via 23 kL combined primary treatment chamber and pumpwell tank) and 100 kL min. operational flow balance tank capacity (achieved via 2 x 50kL tanks).
Maximum balanced effluent design flow	**3.0 kL/day**	
Design Loading Rate	8 mm/day	AS1547:2012: Cat.4-5 Soil (Mound – conservative)
Actual Loading Rate	5.8 mm/day	Based on average discharge to the LAA.
Median Effluent Quality - Total Nitrogen	35 mg/L	Standard secondary effluent
Median Effluent Quality - Total Phosphorus	12 mg/L	
Crop nitrogen uptake	200 kg/ha/year	25% of typical mixed grass (to account for reduced clippings removal and soil health).
Crop phosphorus uptake	20 kg/ha/year	
P sorption capacity	140 mg/kg	Based on laboratory analysis (at 70% sorbed).
Depth of soil for P-sorption	0.8 m	Based on Test Pits and including 400mm fill.
Bulk density	1.4 g/cm^2	Typical
Soil P sorption effectiveness	75%	Typical
Nitrogen lost to soil processes	20%	Geary and Gardner (1996)
Crop factors (Pan factors)	0.4-0.7	DECC (2004)
Climate data	Apollo Bay	SILO Data

4.4 Outcomes

Based on the design sizing presented above and in Appendix B, the following design basis is considered capable of meeting the environmental and health protection objectives of Council and the EPA.

Table 8 Design Basis for Proposed Wisconsin Mound

Parameter	Details (per mound)
Number of mounds	1
Natural Slope Across Basal Area	1%
Recommended Basal Loading Rate	8 mm/day
Recommended Linear Loading Rate	45 L/m/day
Recommended Mound Batter Slope	3H:1V
Design Effluent Quality	Secondary
Raised clean filter sand depth (with surface properly prepared)	400mm
Distribution bed thickness	300mm
Basal Width	6.0 m
Basal Length	72 m
Basal Area	432 m^2
Total Height	1.0 m
Downslope Toe Length	4.7 m

The proposed LAA is sized to deliver an average effective Design Loading Rate (DLR) of ~5.8 mm/day, which is considered acceptable given the available soil depth and proposed raised nature of the mound. To assist in managing the uncertainty associated with seasonal usage, it is recommended that a draw offline and standpipe be installed to enable tanker removal of liquid effluent during short term peak occupancy periods in the rare occurrence that design flows are exceeded.

Daily long-term modelling of performance has been undertaken using MEDLI (documented in Section 5). Results demonstrate that the proposed system is capable of meeting environmental and human health protection measures and the requirements of the *Environment Protection Act.*

Refer to the Design Specification (D.0428.001) for further information.

5 Performance Modelling and Impact Assessment

A performance modelling and off-site impact assessment has been undertaken to ensure that the proposed wastewater treatment system is performing effectively and that performance objectives can be achieved. This assessment included daily numerical modelling using MEDLI and effluent plume modelling of nutrients and pathogens.

Due to the Corangamite Catchment Management Authorities (CCMAs) concerns regarding the man-made stormwater wetlands, DWC have used this receiving environment as the basis for the modelling analysis. However, it should be recognised that Kennett River is the most sensitive receiving environment in proximity to the proposed treatment system.

5.1 Daily Performance Modelling

The off-site impact assessment includes an assessment of the potential impact of the proposed system on existing "background" water quality and human health. The two properties on which the proposed Wastewater Treatment System is located have been assumed as the area contributing to these "background" loads for conservatism. DWC has completed daily modelling for the proposed wastewater system to demonstrate the high level of environmental and health performance in accordance with EPA and Council requirements.

Equations outlined in *Fletcher et al* (2004) were used to calculate rainfall-runoff processes to derive the 'background' hydraulic and nutrient loads associated with sources other than wastewater. Water and nutrient modelling of the proposed wastewater system was undertaken using *Model for Effluent Disposal by Land Irrigation (MEDLI)*. MEDLI is a nationally recognised wastewater management modelling tool and has been used to derive average annual hydraulic and nutrient loads from the wastewater treatment system to surface and subsurface export routes.

A mass balance calculation was then performed utilising both the calculated 'background' loads and the nutrient loads resulting from the wastewater treatment system (derived using MEDLI) to assess the environment / health performance of the proposed wastewater treatment system.

5.2 On-site System Performance

5.2.1 MEDLI Model Description

Water, nutrient and salt modelling was undertaken using *Model for Effluent Disposal using Land Irrigation* (MEDLI). MEDLI V2 is a water and nutrient mass balance model originally developed by the Queensland Department of Natural Resources and Mines (now DERM) and the CRC for Waste Management and Pollution Control (Gardner and Davis, 1998). It is now managed by the Department of Science, Information Technology and Innovation (DSITI) with Version 2 being used for this project. It is capable of simulating storage pond dynamics, irrigation scheduling, plant growth, transpiration and nutrient uptake, soil water and nutrient dynamics and salinity on a daily time step over long periods (up to 100 years). MEDLI is widely accepted throughout Australia as the most technically robust tool for simulating the operation of effluent or recycled water irrigation.

5.2.2 Model Construction

Modelling parameters were developed based on the design parameters summarised in Section 2, system design configurations detailed in the Design Specification (D.0428.001) and bio-physical data sourced from field and desktop investigations. Detailed inputs and outputs of MEDLI modelling can be found in Appendix B. Key input sources and assumptions are provided in Table 9.

Table 9 Summary of MEDLI Inputs and Assumptions

Input	Value / Assumption	Source
Climate data	Interpolated rainfall, pan evaporation, temperature, humidity and solar radiation.	SILO Data Drill
Wastewater Inputs and Irrigation Method	See Design Basis for details.	Section 4, Design Specification and Appendix C
Soil Parameters	Based on in-situ soil profile (TP3) as identified in the AGR Geosciences Pty Ltd LCA (*'20H539LCA Factual Report'*) and laboratory analysis. Where specific parameters were not identified during the assessment, these parameters were inferred from published sources based on texture and structure.	Section 2 and Appendix A Hazelton and Murphy (2007) Gardner and Davis (1998) AS1547:2012 AGR Geosciences (2020)
Horizontal Drainage Rate	Estimated using the Darcy Flux equation based on observed soil profile and surface gradients.	Refer to Appendix B
Crop Inputs	Adopted MEDLI default parameters for Kikuyu and assumed limited harvesting (mowing).	MEDLI User Guide (2015)

5.2.3 Wastewater Modelling Results

A summary of MEDLI mass balance modelling results for the proposed wastewater management system is provided in the table below. The results represent *attenuated* average annual loads discharging from the site. Site specific attenuation rates were determine as discussed in Section 5.4.

It can be seen that a high level of water quality protection can be achieved with attenuated MEDLI results having a very low increase on background loads. Additionally, modelling results showed zero surface surcharge from the effluent management area across the year. As such, a high level of water quality treatment is achieved by the proposed wastewater treatment system.

Table 10 Summary of Attenuated MEDLI Results

Average Annual Concentration			Average Annual Load		
TN (mg/L)	**TP (mg/L)**	**Virus (MPN/100mL)**	**TN (kg)**	**TP (kg)**	**Virus (MPN)**
0.017	0.007 (effectively zero)	<1 (total die-off)	0.013	0.006 (effectively zero)	75,147

5.3 Site Hydrology and Water Quality

Equations outlined in Fletcher *et al* (2004) were used to calculate rainfall-runoff processes to derive the 'background' hydraulic and nutrient loads associated with sources other than wastewater. These are summarised below.

Table 11 Background Flow and Pollutant Load Data

Data Input	Value	Unit	Source
Site Area	1.197	ha	Cadastre
Average Annual Rainfall	1,065	mm	Calculated from SILO / MEDLI input data
Volumetric Rainfall-Runoff Coefficient	0.25	-	Derived from Figure 2.3 (and subsequent equations) in Fletcher et al (2004)
Average Annual Runoff	265	mm	Calculated from average annual rainfall and runoff coefficient
Property Average Annual Runoff	3.17	ML	Calculated runoff based on total site area
TN Load	5	kg/ha/yr	Figure 2.20 in Fletcher *et al* (2004) for 0% imperviousness
TP Load	0.5	kg/ha/yr	Figure 2.19 in Fletcher *et al* (2004) for 0% imperviousness

A rainfall runoff coefficient of 0.25 was derived using Figure 2-3 from Fletcher et al (2004). Thus, based on the mean annual rainfall and the site area of 1.197 ha, total runoff from the site / nature strip area was calculated to be approximately 0.25 ML/yr. Results are summarised below and indicate that in general nitrogen and phosphorus export from the study site is largely dominated by these non-wastewater sources. Thus, the proposed on-site systems are not likely to be a substantial contributor to nitrogen or phosphorus loads based on these results.

Table 12 Summary of Background Load Calculations

Flow	Average Annual Concentration		Average Annual Load	
(ML/yr)	TN (mg/L)	TP (mg/L)	TN (kg)	TP (kg)
3.17	1.89	0.19	5.99	0.60

5.4 Pollutant Attenuation

Pollutant attenuation factors were applied to on-site system (MEDLI) loads prior to inclusion in a mass balance. Site specific attenuation factors were determined to determine the potential impact of viruses, nitrates and phosphorus.

Simplistic two-dimensional groundwater modelling has been undertaken to estimate the potential transport and fate of nutrients and pathogens discharging below the root zone as deep drainage. A steady state analytical approach using the Domenico Equation was adopted for nitrogen / pathogens while the time variant approach was adopted for phosphorus. The Domenico equation calculates pollutant concentration at a given point from a finite, planar, continuous source of pollutant under steady state (i.e. equilibrium) conditions. The time variant approach accounts for the uptake and accumulation of pollutants in the soil over time and identifies potential for excess accumulation. A full description of the equation is provided in Alvarez and Illman (2006).

Effluent plume models are provided in Appendix B. The results are summarised in the following table. It can be seen that negligible off-site impacts are expected and water quality targets can be achieved under all scenarios tested. The long term nutrient loads are expected have a negligible increase on background loads (<1% increase).

The ANZECC target is expected to be reached within 14m for phosphorus and within 20m for nitrogen, and as such this target will be achieved prior to groundwater plumes reaching Kennett River. Additionally, the ANZECC target for phosphorus can be achieved prior to groundwater plumes reaching the man-made stormwater wetlands. The ANZECC low risk trigger is a highly conservative target representative of pristine water conditions and meeting this target prior to any receiving environment indicates that a very high level of water treatment is being achieved. Considering that the wetlands were man made and capture / store stormwater from the road, it is not realistic for the ANZECC low risk trigger to be achieved for the wetlands (nor is it essential for Kennett River). However, the results indicate that the effluent reaching these via groundwater plumes will be of good quality and will not degrade the water quality within this receiving environment.

Long-term virus plume modelling indicates adequate viral die-off subject to effective performance of the proposed secondary treatment system. For virus export modelling, the minimum distance required to achieve total viral dieoff (<0.5 MPN/L in the modelling) was evaluated and determined to be approximately 1m from the LAA. As such, it can reasonably be assumed that to impact for both nutrients and pathogens on water quality in the stormwater wetlands (~18m from the proposed Wisconsin Mound) is expected.

Table 13 Summary of Effluent Plume Modelling Outcomes

Parameter	Scenario	Result	Interpretation
Phosphorus	Average Annual	14m setback	Distance required to achieve ANZECC Low Risk Trigger for TP.
		>500 years	No breakout / excess accumulation expected at the stormwater wetlands during operational life of system.
Nitrate	Average Annual	20 setback	Distance required to achieve ANZECC Low Risk Trigger for TN.
Virus[1]	Average annual	1m setback	Based on secondary treatment and partial disinfection failure with median decay rate. Total die-off achieved approximately 1m from the LAA.

1. *Refer to Table 15 for virus sensitivity testing*

5.5 Hydraulic Performance

MEDLI modelling confirmed that no surface surcharge is expected by the proposed system. This indicates that the long-term hydraulic failure from the land application area is considered negligible and the proposed long-term DLR of ~5.8 mm/day is therefore considered acceptable.

Steady state groundwater mounding analysis was also undertaken using the Hantush (1967) calculation methods due to increased potential groundwater recharge from the proposed Wisconsin Mound. The long-term maximum mounding across the LAA was found to be a maximum **~110mm increase** in existing groundwater levels directly beneath the mound. This is considered acceptable given the constraints present to on-site wastewater management and the limited area available.

5.6 Off-site Impacts

A mass balance calculation was performed utilising both the calculated 'background' loads (derived from *Fletcher et al* (2004)) and the nutrient loads resulting from the wastewater treatment system (derived using MEDLI) to assess the environment / health performance of the proposed wastewater treatment systems. The results are shown in the table below, where it can be seen that a <1% increase on background loads is expected (very high water quality treatment achieved).

Table 14 Final Off-site Impact Assessment Results (Background + Wastewater)

Average Annual Concentration			Average Annual Load[1]		
TN (mg/L)	TP (mg/L)	Virus (MPN/L)	TN (kg)	TP (kg)	Virus (MPN)
1.53	0.60	<1	6.00 (0.21%)	0.60 (0.92%)	75,147

Note 1: Percentage in brackets is the increase in existing background loads (conservative attenuation).

Sensitivity testing of viral die off and attenuation was undertaken as part of groundwater plume modelling. It can be seen that a high level of protection is provided by the proposed system under all scenarios. Even under the worst case scenario (very low probability), total viral die-off is expected 17m from the proposed Mound and prior to groundwater plumes reaching the stormwater wetlands and Kennett River. As such, the outcomes of the viral plume modelling are considered effective and acceptable.

Table 15 Virus Sensitivity Testing Summary

Scenario	Plume Distance	Interpretation
Effective secondary treatment and with partial disinfection failure (8 MPN/L) at 50th%ile decay rate.	1m	Adequate secondary treatment and partial disinfection at median viral decay from literature[1].
Adequate secondary treatment and complete disinfection failure (80 MPN/L) at 50th%ile decay.	2m	Complete disinfection failure and adequate secondary treatment at conservative viral decay rate[1].
Complete treatment system failure (800 MPN/L) at 90th%ile decay rate[2].	17m	Complete treatment system failure at conservative viral decay rate[1]. **Worst Case Scenario – Low Probability**

1. All scenarios other than the median viral decay test assumed the 90th percentile (worst case or lowest) virus decay rates from literature (Yates *et al* 1985 and Schijven *et al* 2009).
2. 95th percentile virus concentration in raw sewage from EPHC (2006).

The results show that average annual loads for nitrogen, phosphorous and viruses for the proposed on-site system meet the site-specific performance objectives (ANZECC low risk trigger and total viral die-off) prior to groundwater plumes reaching the stormwater wetlands. Additionally, the increase on background loads is expected to be <1% This requires achievement of the following effluent quality targets (annual median).

- TN = ≤35 mg/L
- TP = ≤12 mg/L
- Disinfection (UV)

Average annual virus concentrations in the effluent portion of study area discharge are <1 MPN/100mL for the proposed system. This suggests off-site viral health risks can be considered minor to low risk.

6 Operation, Maintenance and Monitoring

An overarching Operation, Monitoring and Maintenance (OM&M) Plan will be required that sets out all OM&M activities, their frequencies and performance measures that need to be met. The contractor and manufacturer of any proprietary treatment components will also be required to provide Council with an Owner's Manual that documents responsibilities for individual component operation. Key activities are likely to include the following.

- Quarterly (depending on technology) service of the Secondary Treatment System components by an approved service technician in accordance with the details set out in the owner's and service manual;
- Monitoring and (minimum) maintenance / cleaning of UV tubes to ensure adequate disinfection;
- Regular testing of the alarm systems;
- Inspection of the Wisconsin Mound systems to confirm that they are operational. Dosing laterals should be flushed during this inspection;
- Monitoring of sludge and scum levels in the septic tank and removal by tanker as required;
- Monthly mowing of Wisconsin Mound, including the removal of clippings (Council); and
- It is recommended that 2-3 groundwater monitoring piezometers are installed downslope of the mound for periodic sampling for nutrients and pathogenic indicators. Details to be refined in the OM&M Plan.

7 References

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Appendix A: Site and Soil Assessment Material

11/9/2020

Decentralised Water Consulting
Att: Jack Sharples

RE: Land Capability Assessment for Kennett River Costal Reserve

Dear Jack,

AGR Geosciences Pty Ltd (AGR) was engaged by Decentralised Water Consulting to undertake fieldwork and data collection for the Land Capability Assessments of two sites within the Kennett River Coastal Reserve on the Great Ocean Road, Kennett River. The first area under investigaiton (Site 1) is located on the east side of the exisiting wetland and west of the Great Ocean Road. The second area under investigaiton (Site 2) is located on the west side of the existing wetland and east of privately owned cleared land.

AGR attended the site on Wednesday 26th August 2020 to supervise test pit excavation and undertake soil logging, soil sampling and collect site information. A description of the site characteristics is preseted in Table 1.

Table 1: Site Overview

Allotment	Coastal reserve on the Great Ocean Road adjacent to the banks of the Kennett River. Open space, wetlands and picnic facilities are located within the coastal reserve.
Ground cover	Thick covering of grass in opens space areas. Dense wetland reeds within the wetland area.
Trees	Groups of native trees and shrubs on the west and north-west side of the wetland and within the centre of the wetland area.
Topography	Alluvial terraces of the Kennett River proximal to coastal foothills of the Otway Ranges Variable slope directions across the investigation area due to wetland construction and anthropogenic fill mounds. Alluvial terraces are low lying and virtually flat.
Run-on and Run-off	Run-on is directed into the western investigation area from low footing hills and alluvial terraces to the west of the coastal reserve. Run-on from the Koala Café car park is directed into the wetland separating the two investigation areas. Run on from the Great Ocean Road is directed to the west and into the eastern investigation area.
Surface drainage	Poor to very poor drainage conditions. Extensive hydrophilic vegetation around the site. Significant ponding and saturated surface areas in both investigation areas on the east and west sides of the wetland.

Ground condition	Very moist to wet surface conditions and moist to very moist subsurface conditions at the time of the investigation. Water table not encountered during test pit excavation however test pits were subjected to significant near surface inflows and seepage of perched surface water.
Adjacent properties	River estuary and riparian reserve to the north east, caravan park to the south and rural lifestyle properties to the west.
Aspect	The investigation area on the east side of the wetland has a generally easterly aspect. To the west of the wetland the general aspect is to the west and north-wets.
Exposure to sun and wind	The eastern investigation area is open to full sun and high wind exposure. The western investigation area is open to afternoon sun and westerly winds. The area is partially sheltered and shaded from the north and the east.
Slope / form / gradient	Slope forms across the two investigation areas are generally concave and convergent. Slope gradients are very low and generally almost flat. Fill mounds on the west side of the wetland direct surface run off to the wets into the low-lying investigation area. Fill mounds within the picnic area to the east of the wetland concentrate surface run off into a small drainage line between two mounds.
Surface waters	The western investigation area is located within 30-60m of the high-water mark of the Kennett River. The eastern investigation area is located within 70m of the highwater mark of the Kennett River and 50-60m to the Kennett River estuary. The entire coastal reserve is located within a 100y flood ARI and a Land Subject to Inundation Overlay.
Rock Outcrops	No rock outcrops were observed in either investigation area.
Fill soils	Fill mounds occupy the eastern investigation area. Fill consists of excavated clay soils from the man-made wetland.
Other features	Car parking and a fishing jetty area located within the north-east corner of the coastal reserve. Picnic tables are spread across the eastern investigation area. The Koala Café is located on Hawdon Avenue immediately south of the western investigation area.

Three test pits were excavated to depths ranging from 2000mm to 2300mm using a mini excavator in the locations marked on the Site Investigaiton Plan in Appendix I.

Test Pit excavations revealed the following soil profiles:

Eastern Investigaiton Area (Site 1)

- Clay Loam and Light to Medium Clay FILL varying in depth form 800mm to 1900mm thick, dark grey-brown with 10-20% orange mottling and blue, grey gleying at depth. Occasional clay fissures and a weak soil structure. Infrequent pockets of sandstone rock fragments up to 10-20% cobble to boulder size, overlying;

- Dark grey-black, highly plastic, organic alluvial CLAY with a heavy clay texture and a weak soil structure, overlying;

- Grey-brown and 5-10% orange mottled silty CLAY with a light medium clay texture and a weak to massive soil structure.

Western Investigaiton Area (Site 2)

- Layerd alluvial soils consisting of:

- Grey clayey SILT with a clay loam texture and a moderate soil sturcutre, overlying;

- Pale grey-brown and 10-20% oranage mottling with 5-10% variable grey mottling, silty CLAY textured soil with a weak to moderate soil structure and abundant root channels and clay fissures, grading into;

- A very moist, pale grey weakly structured clayey, sandy SILT with a fine sandy loam texture, grading into;

- A very moist grey-brown and 10-20% orange mottled silty CLAY with a light clay texture and a weak to massive soil structure.

Samples were collected from each discrete soil layer and representative samples were sent for laboratory analysis of pH, Electrical Conductivity (EC), Sodicity (ESP), Cation Exchange Capacity (CEC), Sodium Absorption Ratio (SAR), Emerson Aggregate Classification and Phosphorous Sorption Index (PSI).

Table 2: Summary of Collected Soil Samples

Sample Id	Test Pit	Depth	Soil Type	Lab Analysed	Analyite
1	1	100mm	Clay Loam FILL	No	-
2	1	400mm	Light Medium Clay FILL	Yes	All
3	1	1100mm	Gleyed Lght Medium Clay FILL	No	-
4	1	2000mm	Heavy Clay	No	-
5	2	900mm	Heavy Clay	Yes	All
6	2	1200mm	Light Medium Clay	No	-
7	3	200mm	Clay loam	Yes	Excluding PSI
8	3	500mm	Light Clay	Yes	All
9	3	1100mm	Sandy Loam	Yes	Excluding PSI

Included with this report is a Site Investigation Plan showing all key site features and test pit locations, full logs of excavated test pits and analytical results of laboratory soil analysis conducted by Groundswell Laboratories in South Melbourne.

I trust this information is suitable to your requirements. Should any futher information be requied please make sure to contact our office using the details below.

Yours Sincerely,

DAVID J HORWOOD
BAppSc (Geology); MAusIMM CP (Geo)
SENIOR ENGINEERING GEOLOGIST

AusIMM
THE MINERALS INSTITUTE
CHARTERED PROFESSIONAL
GEOLOGY
David Horwood

Appendix I: Site Investigation Plan

Appendix II: Test Pit Logs

AGR GeoSciences

Client:	Colac Otway Shire	Test Site	No. 1
Project Address:	Kennett River Coastal Reserve	Field work Completed By:	David Horwood
Reference No:	20H539LCA	Field Work Date:	25.8.2020

Depth	Excavatoin Method	Graphic Log	Horizon	Material Description		Texture	Structure	Shade	Colour	Mottles	Moisture	Coarse Fragments	Boundary Type	Sample
100				Fill	Clayey Silt	CL	Md	Dk	Gy		M	<10%		1
200													Clear	
300				Fill	Slightly Silty Clay	LMC	Wk	Dk	Gy / Br	Or 10-20%	M	<10%		
400				Trace	Sand									2
500	Excavator			Category	6 Medium to Heavy clays									
600				With	HW Sandstone Rock Fragments							10-20%		
700					cobble to boulder size									
800														
900														
1000														
1100										Bl 10-20%	VM			3
1200										Gy 10-20%				
1300										Bl 20-50%	VM			
1400										Gy 10-20%				
1500				With	HW Sandstone Rock Fragments							10-20%		
1600					cobble to boulder size									
1700														
1800														
1900													Sharp	
2000					Clay	HC	Wk	Dk	Gy / Bk		SM			4
2100				Category	6 Medium to Heavy clays									
2200				EOH										
2300														
2400														
2500														

Comment:

Texture:						**Moisture:**		**Structure:**	
S	Sand	ZL	Silty Loam	SiC	Silty Clay	D	Dry	Gr	(Single) Grained
LS	Loamy Sand	SCL	Sandy Clay Loam	LC	Light Clay	SM	Slightly Moist	Mas	Massive
CS	Clayey Sand	CL	Clay Loam	LMC	light Med Clay	M	Moist	Wk	Weakly Structured
SL	Sandy Loam	ZCL	Silty Clay Loam	MC	Medium Clay	VM	Very Moist	Md	Mod Structured
FSL	Fine Sandy Loan	FSCL	Fine Sandy Clay Loam	HC	Heavy Clay	W	Wet	St	Strongly Structure
L	Loam	SC	Sandy Clay						

Colour: Dk Dark Lt Light Bk Black Br Brown Gy Grey Or Orange Yl Yellow Re Red Bl Blue Gn Green

Groundwater ▼	**Boundary Type:**	Sharp <5mm	Abrut 5-20mm	Clear 20-50mm
Sample: 1		Gradual 50-100mm	Diffues >100mm	

AGR GeoSciences

Client:	Colac Otway Shire	Test Site	No. 2
Project Address:	Kennett River Coastal Reserve	Field work Completed By:	David Horwood
Reference No:	20H539LCA	Field Work Date:	25.8.2020

Depth	Excavatoin Method	Graphic Log	Horizon	Material Description		Texture	Structure	Shade	Colour	Mottles	Moisture	Coarse Fragments	Boundary type	Sample
100	Excavator			Fill	Clayey Silt	CL	Md	Dk	Gy		M	<10%		
200													Clear	
300				Fill	Slightly Silty Clay	LMC	Wk	Dk	Gy / Br	Or 10-20%	M	<10%		
400				Trace	Sand									
500				Category	6 Medium to Heavy clays									
600				With	HW Sandstone Rock Fragments							10-20%		
700														
800													Sharp	
900					Clay	HC	Wk	Dk	Gy / Bk		M	nil		5
1000				Category	6 Medium to Heavy clays									
1100													Clear	
1200					Slightly Silty Clay	LMC	Wk		Gy / Br	Or 5-10%	M	nil		6
1300				Trace	Sand									
1400				Category	6 Medium to Heavy clays									
1500														
1600														
1700														
1800														
1900														
2000														
2100														
2200														
2300														
2400				EOH										
2500														

Comment: occasional fissures

Texture:						**Moisture:**		**Structure:**	
S	Sand	ZL	Silty Loam	SiC	Silty Clay	D	Dry	Gr	(Single) Grained
LS	Loamy Sand	SCL	Sandy Clay Loam	LC	Light Clay	SM	Slightly Moist	Mas	Massive
CS	Clayey Sand	CL	Clay Loam	LMC	light Med Clay	M	Moist	Wk	Weakly Structured
SL	Sandy Loam	ZCL	Silty Clay Loam	MC	Medium Clay	VM	Very Moist	Md	Mod Structured
FSL	Fine Sandy Loan	FSCL	Fine Sandy Clay Loam	HC	Heavy Clay	W	Wet	St	Strongly Structured
L	Loam	SC	Sandy Clay						

Colour: Dk Dark Lt Light Bk Black Br Brown Gy Grey Or Orange Yl Yellow Re Red Bl Blue Gn Green

Groundwater ▼	**Boundary Type:**	Sharp <5mm	Abrut 5-20mm	Clear 20-50mm
Sample: 1		Gradual 50-100mm	Diffues >100mm	

AGR GeoSciences

Client:	Colac Otway Shire	Test Site	No. 3
Project Address:	Kennett River Coastal Reserve	Field work Completed By:	David Horwood
Reference No:	20H539LCA	Field Work Date:	25.8.2020

Depth	Excavatoin Method	Graphic Log	Horizon	Material Description		Texture	Structure	Shade	Colour	Mottles	Moisture	Coarse Fragments	Boundary type	Sample
100	Excavator				Clayey Silt	CL	Md		Gy		M	<10%		
200				Category	4 Clay loams									7
300													Abrupt	
400					Silty Clay	SiC	Wk	Lt	Gy / Br	Or 10-20%	M	nil		
500				Category	5 Light clays					Gy 5-10%				8
600														
700				With	Roots		Md							
800														
900													Diffuse	
1000					clayey sandy silt	FSL	Wk	Lt	Gy		VM	<10%		
1100				With	Roots									9
1200				Category	2 Sandy loams									
1300														
1400														
1500													Diffuse	
1600					Silty Clay	SiC	Wk	Lt	Gy / Br	Or 10-20%	VM	nil		
1700				Trace	Sand					Gy 5-10%				
1800				Category	5 Light clays									
1900														
2000														
2100				EOH										
2200														
2300														
2400														
2500														

Comment:
layerd alluvial sediments
occasional fissures
significant root channels
high ingress of surface water at 800mm

Texture:

S	Sand	ZL	Silty Loam	SiC	Silty Clay
LS	Loamy Sand	SCL	Sandy Clay Loam	LC	Light Clay
CS	Clayey Sand	CL	Clay Loam	LMC	light Med Clay
SL	Sandy Loam	ZCL	Silty Clay Loam	MC	Medium Clay
FSL	Fine Sandy Loan	FSCL	Fine Sandy Clay Loam	HC	Heavy Clay
L	Loam	SC	Sandy Clay		

Moisture:

D	Dry
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet

Structure:

Gr	(Single) Grained
Mas	Massive
Wk	Weakly Structured
Md	Mod Structured
St	Strongly Structured

Colour: Dk Dark Lt Light Bk Black Br Brown Gy Grey Or Orange Yl Yellow Re Red Bl Blue Gn Green

Groundwater ▼
Sample: 1

Boundary Type: Sharp <5mm Abrut 5-20mm Clear 20-50mm Gradual 50-100mm Diffues >100mm

Appendix III: Laboratory Analysis Results

Groundswell Laboratories

" A New Force in Analytical Testing"

CERTIFICATE OF ANALYSIS

Client Name :	AGR GeoSciences Pty Ltd	**Groundswell Batch # :**	GS20659
Client Address :	PO Box 178, Mount Clear VIC 3350	**Project Name :**	Kennett River Coastal Reserve, Kennett River
Client Phone # :	0412 105 026	**Project # :**	20H539LCA
Client Fax # :	---	**Date Samples Received :**	1/09/2020
Project Manager :	Dave Horwood	**Sample Matrix :**	Soil
E-mail :	office@agrgeo.com.au	**Sample # Submitted :**	5
Project Sample Manager :	Dave Horwood	**Groundswell Quote # :**	Not Applicable
E-mail :	office@agrgeo.com.au	**Date CofA Issued :**	12/09/2020

Paul Woodward
Managing Director
paul@groundswelllabs.com.au

Reference AF56.Rev4 Date Issued : 19/5/2014

Soil Analysis Results

Client Sample ID			Sample 2	Sample 5	Sample 7	Sample 8	Sample 9	Sample 9
Laboratory Sample Number			**GS20659-1**	**GS20659-2**	**GS20659-3**	**GS20659-4**	**GS20659-5**	**GS20659-5**
Date Sampled			**26/08/2020**	**26/08/2020**	**26/08/2020**	**26/08/2020**	**26/08/2020**	**26/08/2020**
Analytes	**Units**	**LOR**						**Duplicate**
pH	pH Units	0.1	8.0	6.6	4.9	4.3	3.7	3.7
Electrical Conductivity @ 25°C	dS/m	0.005	0.074	0.213	0.167	0.226	0.446	0.373
Phosphorus Sorption Index	mg P sorbed / Kg soil	1	135	138	---	146	---	---
Exchangeable Calcium	mg/Kg	1	1710	3580	626	335.0	133.0	104.0
Exchangeable Magnesium	mg/Kg	1	1230	1610	317	240	153	152
Exchangeable Potassium	mg/Kg	1	79	202	121	103	89	91
Exchangeable Sodium	mg/Kg	1	552	648	266	250	367	377
Exchangeable Calcium	meq/100g	0.1	8.6	17.9	3.1	1.7	0.7	0.5
Exchangeable Magnesium	meq/100g	0.1	10.1	13.3	2.6	2.0	1.3	1.3
Exchangeable Potassium	meq/100g	0.1	0.2	0.5	0.3	0.3	0.2	0.2
Exchangeable Sodium	meq/100g	0.1	2.4	2.8	1.2	1.1	1.6	1.6
Calcium:Magnesium		0.1	0.84	1.35	1.20	0.85	0.53	0.41
CEC	MEQ%	0.1	21.3	34.5	7.2	5.0	3.8	3.7
ESP	%	0.1	11.3	8.2	16.1	21.8	42.6	45.0
Sodicity Rating	---	---	Sodic	Sodic	Strongly Sodic	Strongly Sodic	Strongly Sodic	Strongly Sodic
SAR		0.01	0.56	0.51	0.48	0.57	1.15	1.23

Reference AF56.Rev4 Date Issued : 19/5/2014

Comments :

1- pH & electrical conductivity determined & reported on a 1:5 soil:water extraction

2- CEC determined by soil chemical method 15B1 'Exchangeable bases and cation exchange capacity - 1M amonium chloride at pH 7.0,no pre-treatment for soluble salts'

3- ESP, sodicity rating & SAR determined by calculation using the exchangeable cation results

Soil Analysis Results

Client Sample ID			Sample 2	Sample 2		Sample 5	Sample 5
Laboratory Sample Number			**GS20659-1**	**GS20659-1**		**GS20659-2**	**GS20659-2**
Date Sampled			**26/08/2020**	**26/08/2020**		**26/08/2020**	**26/08/2020**
Analytes	**Units**	**LOR**					
Sample Type	---	---	Air Dried Aggregates	Re-moulded Ped		Air Dried Aggregates	Re-moulded Ped
Emerson Aggregate Class - 2 Hours	---	---	Slaking / Some Dispersion	Slaking / Some Dispersion		Slaking / Some Dispersion	Slaking / Some Dispersion
Emerson Class Number	---	---	Class 2	Class 2		Class 2	Class 2
Emerson Aggregate Class - 20 Hours	---	---	Slaking / Some Dispersion	Slaking / Complete Dispersion		Slaking / Some Dispersion	Slaking / Some Dispersion
Emerson Class Number	---	---	Class 2	Class 1		Class 2	Class 2
Addition of 1M HCl	---	---	---	---		---	---
1:5 Soil:Water 10 minute extraction	---	---	---	---		---	---
Emerson Class Number	---	---	---	---		---	---

Reference AF56.Rev4 Date Issued : 19/5/2014

Comments :

1- Classification conducted in accordance with Emmerson 'A classification of soil aggregates based on their coherence in water', 1967 & AS1289.C8.1-1980

Soil Analysis Results

Client Sample ID			Sample 7	Sample 7		Sample 8	Sample 8
Laboratory Sample Number			**GS20659-3**	**GS20659-3**		**GS20659-4**	**GS20659-4**
Date Sampled			**26/08/2020**	**26/08/2020**		**26/08/2020**	**26/08/2020**
Analytes	**Units**	**LOR**					
Sample Type	---	---	Air Dried Aggregates	Re-moulded Ped		Air Dried Aggregates	Re-moulded Ped
Emerson Aggregate Class - 2 Hours	---	---	Slaking / Some Dispersion	Slaking / Some Dispersion		Slaking / Some Dispersion	Slaking / No Dispersion
Emerson Class Number	---	---	Class 2	Class 2		Class 2	Class 7
Emerson Aggregate Class - 20 Hours	---	---	Slaking / Some Dispersion	Slaking / Some Dispersion		Slaking / Some Dispersion	Slaking / No Dispersion
Emerson Class Number	---	---	Class 2	Class 2		Class 2	Class 7
Addition of 1M HCl	---	---	---	---		---	Slaking / No Dispersion
1:5 Soil:Water 10 minute extraction	---	---	---	---		---	Carbonate & Gypsum Absent
Emerson Class Number	---	---	---	---		---	Class 6

Reference AF56.Rev4 Date Issued : 19/5/2014

Comments :

1- Classification conducted in accordance with Emmerson 'A classification of soil aggregates based on their coherence in water', 1967 & AS1289.C8.1-1980

Soil Analysis Results

Client Sample ID			Sample 9	Sample 9			
Laboratory Sample Number			**GS20659-5**	**GS20659-5**			
Date Sampled			**26/08/2020**	**26/08/2020**			
Analytes	**Units**	**LOR**					
Sample Type	---	---	Air Dried Aggregates	Re-moulded Ped			
Emerson Aggregate Class - 2 Hours	---	---	Slaking / Some Dispersion	Slaking / Some Dispersion			
Emerson Class Number	---	---	Class 2	Class 2			
Emerson Aggregate Class - 20 Hours	---	---	Slaking / Some Dispersion	Slaking / Some Dispersion			
Emerson Class Number	---	---	Class 2	Class 2			
Addition of 1M HCl	---	---	---	---			
1:5 Soil:Water 10 minute extraction	---	---	---	---			
Emerson Class Number	---	---	---	---			

Reference AF56.Rev4   Date Issued : 19/5/2014

Comments :

1- Classification conducted in accordance with Emmerson 'A classification of soil aggregates based on their coherence in water', 1967 & AS1289.C8.1-1980

Inorganics Quality Control Report

Client Sample ID							
Laboratory Sample Number							
QC Parameter			Method Blank		Laboratory Control Standard (LCS)		
			Method Blank	Within GSL Acceptance Criteria (<LOR) (Pass/Fail)	LCS (%R)	LCS (%R) Acceptance Criteria	Within GSL Acceptance Criteria (Pass/Fail)
Analyte	**Units**	**LOR**					
pH	pH units	0.1	NA	NA	6.99	7.00 ± 0.1 pH Unit	Pass
Conductivity	dS/m	0.005	<0.005	Pass	99%	80-120%	Pass
Exchangeable Calcium	mg/Kg	1	<1	Pass	107%	70-130%	Pass
Exchangeable Magnesium	mg/Kg	1	<1	Pass	111%	70-130%	Pass
Exchangeable Potassium	mg/Kg	1	<1	Pass	85%	70-130%	Pass
Exchangeable Sodium	mg/Kg	1	<1	Pass	108%	70-130%	Pass
CEC	MEQ%	0.1	NA	NA	NA	NA	NA
ESP	%	0.1	NA	NA	NA	NA	NA
SAR	---	0.01	N A	NA	NA	NA	NA

Reference AF56.Rev4 Date Issued : 3/11/2010

Comments :

1- Exchangeable cations LCS values based on independent water standards

2- NA = Not Applicable

Groundswell laboratories

116 Moray Street, South Melbourne, Victoria, 3205.
Ph (03) 8669 1450 Fax (03) 8669 1451 (M) 0416 203 845 e-mail : admin@groundswelllabs.com.au

Sample Receipt Notice

Client Name	AGR GeoSciences Pty Ltd
Client Project Manager	Dave Horwood
Client e-mail	office@agrgeo.com.au
Client Address	PO Box 178, Mount Clear VIC 3350
Client Phone	0412 105 026
Project Name	Kennett River Coastal Reserve, Kennett River
Project Number	20H539LCA
CofC Serial Number	Not detailed
Purchase Order Number	Not detailed
Date Sampled / Sampling Period	26-08-20
Date Samples Received	01-09-20
Date Sample Receipt Notice Issued	01-09-20
Date Analytical Report Due	08-09-20
Groundswell Batch Number	GS20659
Groundswell Quote Number	Not Applicable
Groundswell Sample Receipt Contact	Penny McIntosh
E-mail	admin@groundswelllabs.com.au
Groundswell Reporting Contact	Paul Woodward
E-mail	paul@groundswelllabs.com.au
Reporting Requirements	Standard
Sample Condition	Sample chilled upon receipt at laboratory Samples were received in good condition COC received with samples & samples detailed on the COC match those received Analytical request on the CofC clear Samples were received in appropriate containers, and appropriately preserved Samples were received within the THT's adopted by Groundswell
Comments	PSI test requested on samples 2, 5, 8 only
Subcontracted Analysis	
Secondary Laboratory Analysis	

Thanks for choosing Groundswell Laboratories

AGR ASSESSING GEOLOGICAL RISK

AGR GeoSciences Pty Ltd

27 August 2020

Our Reference: 20H539LCA

Groundswell Laboratories
116 Moray Street
SOUTH MELBOURNE VIC 3205
0416 203 845

Groundswell Batch: GS20659

Dear Sir/Madam,

Re: Kennett River Coastal Reserve, Kennett River

Please perform the following soil tests:

i Emerson Aggregate Class
ii Cation Exchange Capacity
iii Electrical Conductivity (EC)
iv pH
v Sodicity – Exchangeable Sodium Percentage (ESP)
vi Sodium Absorption Ratio (SAR)
vii Phosphorous Sorption Index (PSI) – Samples 2, 5 and 8 only

For the following five (5) samples from three (3) location:

DATE	SAMPLE	TEST SITE	DEPTH (mm)	MATERIAL	LAB ID
26/8/2020	2	1	400	Clay	GS20659 -1
26/8/2020	5	2	900	Clay	-2
26/8/2020	7	3	200	Loam	-3
26/8/2020	8	3	500	Clay	-4
26/8/2020	9	3	1100	Sandy loam	-5

Yours sincerely

Dave Horwood
Managing Director
BAppSc (Geology), Dipl. NRM, MAusIMM CP(Geo)

Appendix B: Design Calculations and Performance Modelling

Kennett River Public Toilet

Water Balance

Parameter	Unit	Background	MEDLI	MEDLI + background	% Increase from Existing Conditions
Total Flow	ML/yr	3.17	0.751	3.9	23.73%
TN	kg/yr	5.99	0.013	6.00	0.21%
	mg/L	1.89	0.017	1.53	
TP	kg/yr	0.60	0.005	0.60	0.92%
	mg/L	0.19	0.007	0.15	
Total Virus	MPN/yr	N/A	75,147	75,147	
	MPN/100mL	N/A	0.0100		

Kennett River Public Toilet	*Attenuated*			*Unattenuated*		
	432 m2			432 m2		
	5.8 mm/day			5.8 mm/day		
Mean Annual Overflow (m3) =	0			0		
Mean Annual Overflow N (g) =	0			0		
Mean Annual Overflow P (g) =	0			0		
Mean Annual Overflow V (MPN) =	0			0		
Mean Annual Surface Runoff (m3) =	0			0		
Mean Annual Surface N (g) =	0			0		
Mean Annual Surface P (g) =	0			0		
Mean Annual Surface V (MPN) =	0	*Conservative*		0		
Mean Annual Deep Drainage (m3) =	751.467024	30%		1073.52	*Ave. Annual Value*	
Mean Annual Deep Drainage N (g) =	12.56023454	99.9%		11357.88731	10.58	mg/L
Mean Annual Deep Drainage P (g) =	5.485709275	99.9%		6011.736192	5.6	mg/L
Mean Annual Deep Drainage V (MPN) =	75146.7	10.000	MPN/L			

Number of LAAs	1
Mean Deep Drainage (mm/yr)	2485.01
LAA (m2)	432
Mean Deep Drainage (m3/yr)	**1073.52**

Parameter	Mean Annual Total	Mean Annual Total
Total Flow (ML)	0.7515	1.0735
TN (kg)	0.0126	11.3579
TP (kg)	0.0055	6.0117
Total Virus (MPN)	75,147	-

TN (mg/L)	0.017	10.580
TP (mg/L)	0.007	5.600
Total Virus (MPN/100ml)	0.0100	0.000

Stormwater

Background Loads			
Property Area	1.197	ha	**Conservative**
	TP	**TN**	
Fletcher et al (2004) values (Figures 2.19 & 2.20 - 0% impervious)	0.5	5	kg/ha/yr
Total Site Load	**0.60**	**5.99**	**kg/yr**
On-site System Loads			
On-site Modelling Results	**0.005**	**0.013**	**kg/yr**
Net Load Increase	**1%**	**0%**	
	ok	ok	

Total Annual Runoff

Mean Annual Rainfall	1065	mm
Annual Runoff Fraction	**0.25**	
Total Annual Runoff	**265**	mm
Total Site Runoff	**3.17**	ML/yr

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Parameter	Variable	Value	Unit	Source
Contaminant		**Nitrate-N ANZECC**		from Level 1
Target Concentration	C_T	**1.50E-02**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 2 directions**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.78E+00	mg/l	*From MEDLI (deep drainage)*
Half life for degradation of contaminant in water	$t_{1/2}$	4.95E+02	days	*Conservative (495 days)*
Calculated decay rate	λ	1.40E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	7.20E+01	m	*Width of LAA*
Plume thickness at source	Sy	5.80E-03	m	*Based on DLR across LAA*
Saturated aquifer thickness	da	8.00E+00	m	*Water NSW GW Data*
Bulk density of aquifer materials	ρ	1.60E+00	g/cm^3	*Illman and Alvarez (2006)*
Effective porosity of aquifer	n	1.00E-01	fraction	*Illman and Alvarez (2006)*
Hydraulic gradient	i	1.00E-02	fraction	*Based on Slope to WC*
Hydraulic conductivity of aquifer	K	8.00E+00	m/d	*Based on Conductivity of Aquifer*
Distance to compliance point	x	2.40E+01	m	*Distance to Stormwater Wetland*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.83E+04	days	*time variant options only*

Parameters values determined from options

Parameter	Variable	Value	Unit	Source
Partition coefficient	Kd	2.70E-01	l/kg	*see options*
Longitudinal dispersivity	ax	2.40E+00	m	*see options*
Transverse dispersivity	az	2.40E-01	m	*see options*
Vertical dispersivity	ay	2.40E-02	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	2.70E-01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc.n}$		l/kg
Sorption coefficient for ionised species	$K_{oc.i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.70E-01	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.40E+00	1.81E+00	m
Transverse dispersivity	**az**	0.00E+00	2.40E-01	1.81E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.40E-02	1.81E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

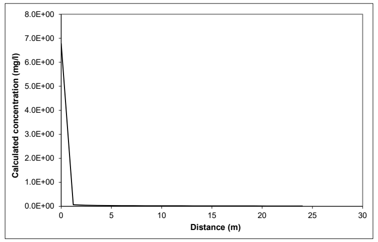
Calculated Parameters

	Variable		
Groundwater flow velocity	v	8.00E-01	m/d
Retardation factor	Rf	5.32E+00	fraction
Decay rate used	λ	1.40E-03	d^{-1}
Rate of contaminant flow due to retardation	u	1.50E-01	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.17E-02	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**5.77E+02**	

Remedial Targets

Remedial Target		**8.66E+00**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state				
Distance to compliance point		**24**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.17E-02**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Coolongolook
Completed by:	Deni Hourihan
Date:	6/05/2019
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	6.8E+00
1.2	6.47E-02
2.4	4.52E-02
3.6	3.65E-02
4.8	3.13E-02
6.0	2.77E-02
7.2	2.50E-02
8.4	2.29E-02
9.6	2.12E-02
10.8	1.97E-02
12.0	1.85E-02
13.2	1.75E-02
14.4	1.65E-02
15.6	1.57E-02
16.8	1.50E-02
18.0	1.43E-02
19.2	1.37E-02
20.4	1.32E-02
21.6	1.27E-02
22.8	1.22E-02
24.0	1.17E-02

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Phosphate**		from Level 1
Target Concentration	C_T	**1.50E-02**	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Time Variant — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 2 directions**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.19E+00	mg/l	*From MEDLI (Deep Drainge)*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+05	days	*Assume no biodegradation*
Calculated decay rate	λ	6.93E-06	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	7.20E+01	m	*Width of LAA*
Plume thickness at source	Sy	5.80E-03	m	*Based on DLR across LAA*
Saturated aquifer thickness	da	8.00E+00	m	*Water NSW Groundwater Data*
Bulk density of aquifer materials	ρ	1.60E+00	g/cm^3	*Illman and Alvarez (2006)*
Effective porosity of aquifer	n	1.00E-01	fraction	*Illman and Alvarez (2006)*
Hydraulic gradient	i	1.00E-02	fraction	*Based on site gradient*
Hydraulic conductivity of aquifer	K	8.00E+00	m/d	*Based on conductivity of aquifer*
Distance to compliance point	x	1.40E+01	m	*Distance to Stormwater Wetland*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	*50 yrs*
Time since pollutant entered groundwater	t	1.83E+04	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.34E+01	l/kg	*see options*
Longitudinal dispersivity	ax	1.40E+00	m	*see options*
Transverse dispersivity	az	1.40E-01	m	*see options*
Vertical dispersivity	ay	1.40E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	8.00E-01	m/d
Retardation factor	Rf	5.36E+02	fraction
Decay rate used	λ	6.93E-06	d^{-1}
Rate of contaminant flow due to retardation	u	1.49E-03	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.37E-02	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**3.07E+02**	

Remedial Targets

Remedial Target	**4.60E+00**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Time Variant			
Distance to compliance point	**14**	**m**	
Concentration of contaminant at compliance point C_{ED}/C_0	**1.37E-02**	**mg/l**	Domenico - Time Variant
after	**1.8E+04**	**days**	

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	3.34E+01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc.n}$		l/kg
Sorption coefficient for ionised species	$K_{oc.i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.34E+01	l/kg

Define dispersivity (click brown cell and use pull down list)

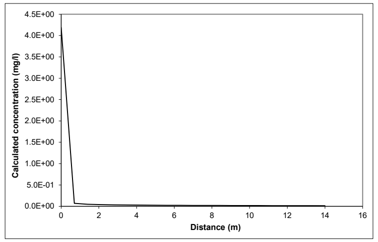
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.40E+00	1.15E+00	m
Transverse dispersivity	**az**	0.00E+00	1.40E-01	1.15E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.40E-02	1.15E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Environment Agency



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	0
Completed by:	Deni Hourihan
Date:	5/05/2019
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Time Variant
From calculation sheet

Distance	**Concentration**
	mg/l
0	**4.2E+00**
0.7	**6.90E-02**
1.4	**4.86E-02**
2.1	**3.95E-02**
2.8	**3.41E-02**
3.5	**3.04E-02**
4.2	**2.76E-02**
4.9	**2.55E-02**
5.6	**2.37E-02**
6.3	**2.23E-02**
7.0	**2.10E-02**
7.7	**1.99E-02**
8.4	**1.90E-02**
9.1	**1.81E-02**
9.8	**1.73E-02**
10.5	**1.66E-02**
11.2	**1.59E-02**
11.9	**1.53E-02**
12.6	**1.47E-02**
13.3	**1.42E-02**
14.0	**1.37E-02**

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Environment Agency

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Parameter	Variable	Value	Unit	Source
Contaminant		Virus		from Level 1
Target Concentration	C_T	5.00E-01	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state | Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to pollutants in all phases (e.g. field derived value

Parameter	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	8.00E+00	mg/l	Average Disinfection Conditions
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+00	days	Median Decay (6 days)
Calculated decay rate	λ	1.16E-01	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	7.20E+01	m	Width of LAA
Plume thickness at source	Sy	5.80E-03	m	Based on DLR across LAA
Saturated aquifer thickness	da	8.00E+00	m	From Soil profile
Bulk density of aquifer materials	ρ	1.60E+00	g/cm^3	Hazelton & Murphy (2007)
Effective porosity of aquifer	n	1.00E-01	fraction	Hazelton & Murphy (2007)
Hydraulic gradient	i	1.00E-02	fraction	Based on contours (average slope to creek)
Hydraulic conductivity of aquifer	K	8.00E+00	m/d	Average weighted vertical conductivity
Distance to compliance point	x	1.00E+00	m	Distance Required to achieve target
Distance (lateral) to compliance point perpendicular to flow direction	z	[redacted]	m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	Kd	3.00E-01	l/kg	see options
Longitudinal dispersivity	ax	1.00E-01	m	see options
Transverse dispersivity	az	1.00E-02	m	see options
Vertical dispersivity	ay	1.00E-03	m	see options

Calculated Parameters

Parameter	Variable	Value	Unit
Groundwater flow velocity	v	8.00E-01	m/d
Retardation factor	Rf	5.80E+00	fraction
Decay rate used	λ	1.16E-01	d^{-1}
Rate of contaminant flow due to retardation	u	1.38E-01	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.90E-01	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**4.21E+01**	

Remedial Targets

Remedial Target	**2.10E+01**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	**1**	**m**	
Concentration of contaminant at compliance point C_{ED}/C_0	**1.90E-01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Parameter	Variable	Value	Unit
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	3.00E-01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	[redacted]	fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.00E-01	l/kg

Define dispersivity (click brown cell and use pull down list)

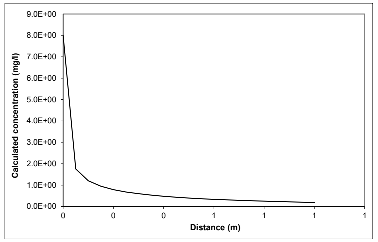
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.00E-01	0.00E+00	m
Transverse dispersivity	**az**	0.00E+00	1.00E-02	0.00E+00	m
Vertical dispersivity	**ay**	0.00E+00	1.00E-03	0.00E+00	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report ax = 0.83(log$_{10}$x)$^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	0
Completed by:	Deni Hourihan
Date:	6/05/2019
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	8.0E+00
0.1	1.76E+00
0.1	1.20E+00
0.2	9.47E-01
0.2	7.90E-01
0.3	6.80E-01
0.3	5.97E-01
0.4	5.32E-01
0.4	4.79E-01
0.5	4.34E-01
0.5	3.96E-01
0.6	3.64E-01
0.6	3.35E-01
0.7	3.09E-01
0.7	2.87E-01
0.8	2.67E-01
0.8	2.48E-01
0.9	2.32E-01
0.9	2.17E-01
1.0	2.03E-01
1.0	1.90E-01

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Environment Agency

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Parameter	Variable	Value	Unit	Source
Contaminant		Virus		from Level 1
Target Concentration	C_T	5.00E-01	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — Equations in HRA publication

Approach for simulating vertical dispersion: Simulate vertical dispersion in 2 directions

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to pollutants in all phases (e.g. field derived value

Parameter	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	8.00E+01	mg/l	*Average Secondary Conditions*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+00	days	*Median Decay (6 days)*
Calculated decay rate	λ	1.16E-01	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	7.20E+01	m	*Width of LAA*
Plume thickness at source	Sy	5.80E-03	m	*Based on DLR across LAA*
Saturated aquifer thickness	da	8.00E+00	m	*From Soil profile*
Bulk density of aquifer materials	ρ	1.60E+00	g/cm^3	*Hazelton & Murphy (2007)*
Effective porosity of aquifer	n	1.00E-01	fraction	*Hazelton & Murphy (2007)*
Hydraulic gradient	i	1.00E-02	fraction	*Based on contours (average slope to creek)*
Hydraulic conductivity of aquifer	K	8.00E+00	m/d	*Average weighted vertical conductivity*
Distance to compliance point	x	2.00E+00	m	*Distance Required to achieve target*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.00E-01	l/kg	*see options*
Longitudinal dispersivity	ax	2.00E-01	m	*see options*
Transverse dispersivity	az	2.00E-02	m	*see options*
Vertical dispersivity	ay	2.00E-03	m	*see options*

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	3.00E-01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc.n}$		l/kg
Sorption coefficient for ionised species	$K_{oc.i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.00E-01	l/kg

Define dispersivity (click brown cell and use pull down list)

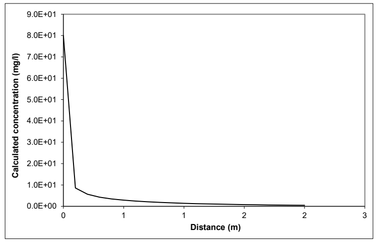
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.00E-01	4.58E-02	m
Transverse dispersivity	**az**	0.00E+00	2.00E-02	4.58E-03	m
Vertical dispersivity	**ay**	0.00E+00	2.00E-03	4.58E-04	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	8.0E+01
0.1	8.57E+00
0.2	5.64E+00
0.3	4.29E+00
0.4	3.45E+00
0.5	2.87E+00
0.6	2.44E+00
0.7	2.10E+00
0.8	1.82E+00
0.9	1.60E+00
1.0	1.41E+00
1.1	1.25E+00
1.2	1.11E+00
1.3	9.92E-01
1.4	8.89E-01
1.5	7.98E-01
1.6	7.19E-01
1.7	6.48E-01
1.8	5.85E-01
1.9	5.30E-01
2.0	4.80E-01

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Calculated Parameters

Parameter	Variable	Value	Unit
Groundwater flow velocity	v	8.00E-01	m/d
Retardation factor	Rf	5.80E+00	fraction
Decay rate used	λ	1.16E-01	d^{-1}
Rate of contaminant flow due to retardation	u	1.38E-01	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.80E-01	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.67E+02**	

Site being assessed:	0
Completed by:	Deni Hourihan
Date:	6/05/2019
Version:	1

Remedial Targets

Remedial Target	**8.34E+01**	**mg/l**	For comparison with measured groundwater concentration.

Domenico - Steady state

Distance to compliance point **2** **m**

Concentration of contaminant at compliance point C_{ED}/C_0 **4.80E-01** **mg/l** Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Virus		from Level 1
Target Concentration	C_T	5.00E-01	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 2 directions**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	8.00E+02	mg/l	*Worst Case Conditions*
Half life for degradation of contaminant in water	$t_{1/2}$	4.30E+01	days	*Conservative Decay Rate (43 Days)*
Calculated decay rate	λ	1.61E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	7.20E+01	m	*Width of LAA*
Plume thickness at source	Sy	5.80E-03	m	*Based on DLR across LAA*
Saturated aquifer thickness	da	8.00E+00	m	*From Soil profile*
Bulk density of aquifer materials	ρ	1.60E+00	g/cm^3	*Hazelton & Murphy (2007)*
Effective porosity of aquifer	n	1.00E-01	fraction	*Hazelton & Murphy (2007)*
Hydraulic gradient	i	1.00E-02	fraction	*Based on contours (average slope to creek)*
Hydraulic conductivity of aquifer	K	8.00E+00	m/d	*Average weighted vertical conductivity*
Distance to compliance point	x	1.70E+01	m	*Distance Required to achieve target*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.00E-01	l/kg	*see options*
Longitudinal dispersivity	ax	1.70E+00	m	*see options*
Transverse dispersivity	az	1.70E-01	m	*see options*
Vertical dispersivity	ay	1.70E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	8.00E-01	m/d
Retardation factor	Rf	5.80E+00	fraction
Decay rate used	λ	1.61E-02	d^{-1}
Rate of contaminant flow due to retardation	u	1.38E-01	m/d
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.46E-01	mg/l
Attenuation factor (two way vertical dispersion, CO/CED)	**AF**	**1.80E+03**	

Remedial Targets

Remedial Target	**8.98E+02**	**mg/l**	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	**17**	**m**	
Concentration of contaminant at compliance point C_{ED}/C_0	**4.46E-01**	**mg/l**	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	3.00E-01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc.n}$		l/kg
Sorption coefficient for ionised species	$K_{oc.i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.00E-01	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

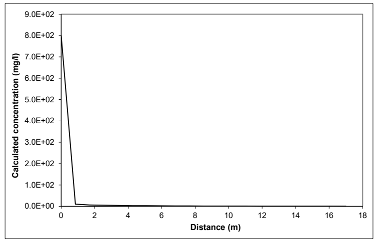
		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.70E+00	1.37E+00	m
Transverse dispersivity	**az**	0.00E+00	1.70E-01	1.37E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.70E-02	1.37E-02	

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Environment Agency



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared
with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	0
Completed by:	Deni Hourihan
Date:	6/05/2019
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	**Concentration**
	mg/l
0	**8.0E+02**
0.9	**1.00E+01**
1.7	**6.50E+00**
2.6	**4.87E+00**
3.4	**3.88E+00**
4.3	**3.18E+00**
5.1	**2.67E+00**
6.0	**2.27E+00**
6.8	**1.95E+00**
7.7	**1.69E+00**
8.5	**1.47E+00**
9.4	**1.29E+00**
10.2	**1.13E+00**
11.1	**1.00E+00**
11.9	**8.86E-01**
12.8	**7.87E-01**
13.6	**7.00E-01**
14.5	**6.23E-01**
15.3	**5.57E-01**
16.2	**4.98E-01**
17.0	**4.46E-01**

Water Table Mounding calculated based on Hantush 1967, WRR

Enter data in green cells as per their yellow labels, other values will be computed from those entries.

Results are highlighted in pink.

Zmax Beneath Center of Entire Drain Field (L*W)

Meters and Days	Length of Drain Field Subunit	Width of Drain Field Subunit		Separation between Drain Field Subunits	Fraction of Drain Field Subunit that is Trench Area	Horizontal Hydraulic Conductivity	Specific Yield use 0.001 to approximate steady state at 10 years	time use 10 years to approximate steady state		
	l_s	w_s		Sp	f_A	K_h	Sy	time		
	m	m		m		m/day	none	days		
	72	6		0	1	3	0.001	3650		
Number of subunits, n	L m	W m	q effective in subunit ls x ws m/day	q in trenches m/day	q' effective on LxW m/day	Q liters/day	Zmax 12 iterations m	Initial Saturated Thickness m	alpha	beta
1	72	6	0.0056	0.0056	0.0056	2410.2	0.109	8	0.001923182	0.000160265
0	72	0	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	0	#DIV/0!	#DIV/0!
0	72	0	#DIV/0!	#DIV/0!	#DIV/0!	0	#DIV/0!	0	#DIV/0!	#DIV/0!
0	72	0	#DIV/0!	#DIV/0!	#DIV/0!	0	#DIV/0!	0	#DIV/0!	#DIV/0!
0	72	0	#DIV/0!	#DIV/0!	#DIV/0!	0	#DIV/0!	0	#DIV/0!	#DIV/0!

copy an entire row from above and insert copied cells above this line
to evaluate various loading rates and numbers of subunits

Water Table Rise on Side Slope

Uses Subunit Geometry and Material Properties from Zmax Table

	L	W	q effective in subunit ls x ws	q in trenches	q' effective on LxW	Q l/day	Zsx 12 iterations	Distance from Center of Drain Field in Long Dimension (x in figure)	Distance from Center of Drain Field in Wide Dimension (y in figure)	Initial Saturated Thickness
Number of subunits, n	m	m	m/day	m/day	m/day	liters/day	m	m	m	m
1	72	6	0.0056	0.0056	0.0056	2410.2	0.109	0	0	8
0	72	0	#DIV/0!	#DIV/0!	#DIV/0!	0	#DIV/0!	9	61	0
0	72	0	#DIV/0!	#DIV/0!	#DIV/0!	0	#DIV/0!	9	61	0
0	72	0	#DIV/0!	#DIV/0!	#DIV/0!	0	#DIV/0!	9	61	0
0	72	0	#DIV/0!	#DIV/0!	#DIV/0!	0	#DIV/0!	9	61	0

copy an entire row from above and insert copied cells above this line
to evaluate various loading rates and numbers of subunits at various distances x,y from the center of the drain field

MEDLI REPORT - FULL RUN

Enterprise: **Kennett River Public Toilets**

Description:
New Public Toilets to Service Tourists at Kennett River (located along Great Ocean Road)

Client: **Colac Otway Shire Council**

MEDLI User: Deni Hourihan

Scenario Details:
Proposed Toilet Block to service tourist along the Great Ocean Road.
The system has been designed to service up to 1300 visitors (on peak days).

DESCRIPTION

Climate Data: Kennett River, -38.65°, 143.85°

Run Period: 01/01/1968 to 31/12/2018 51 years, 0 days

Climate Statistics:

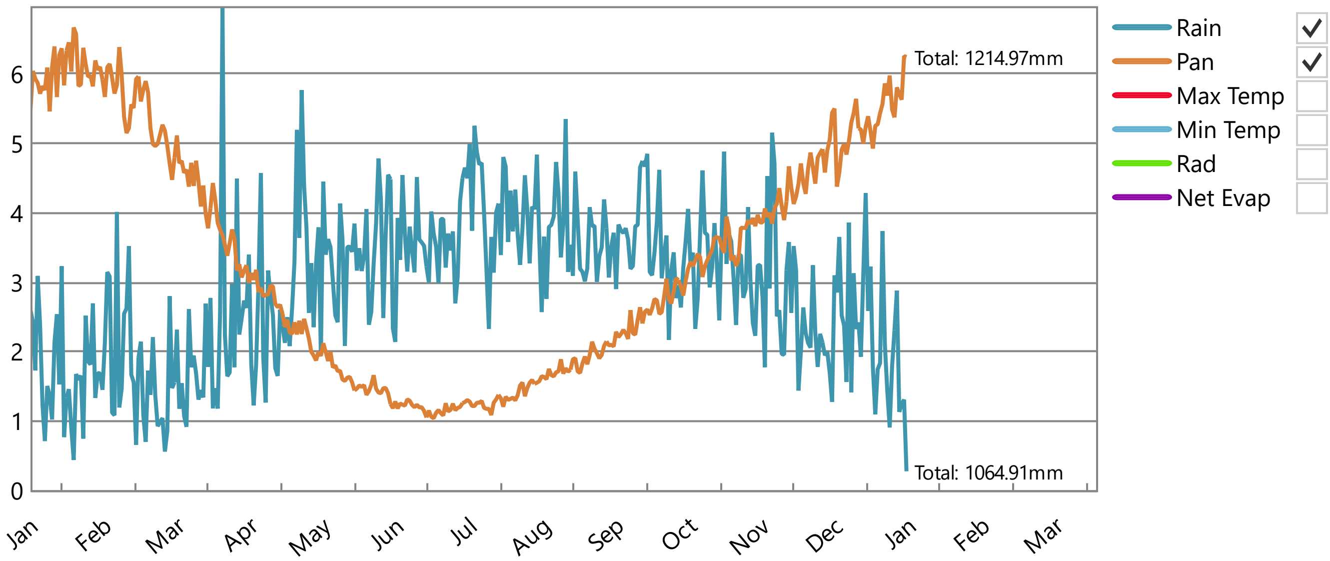
	5th Percentile	50th Percentile	95th Percentile
Rainfall (mm/year)	820	1043	1356
Pan Evaporation (mm/year)	1093	1220	1319

Climate Data:

■ Chart ☐ Table

☐ Monthly ■ Daily

Daily Average Across Run Period



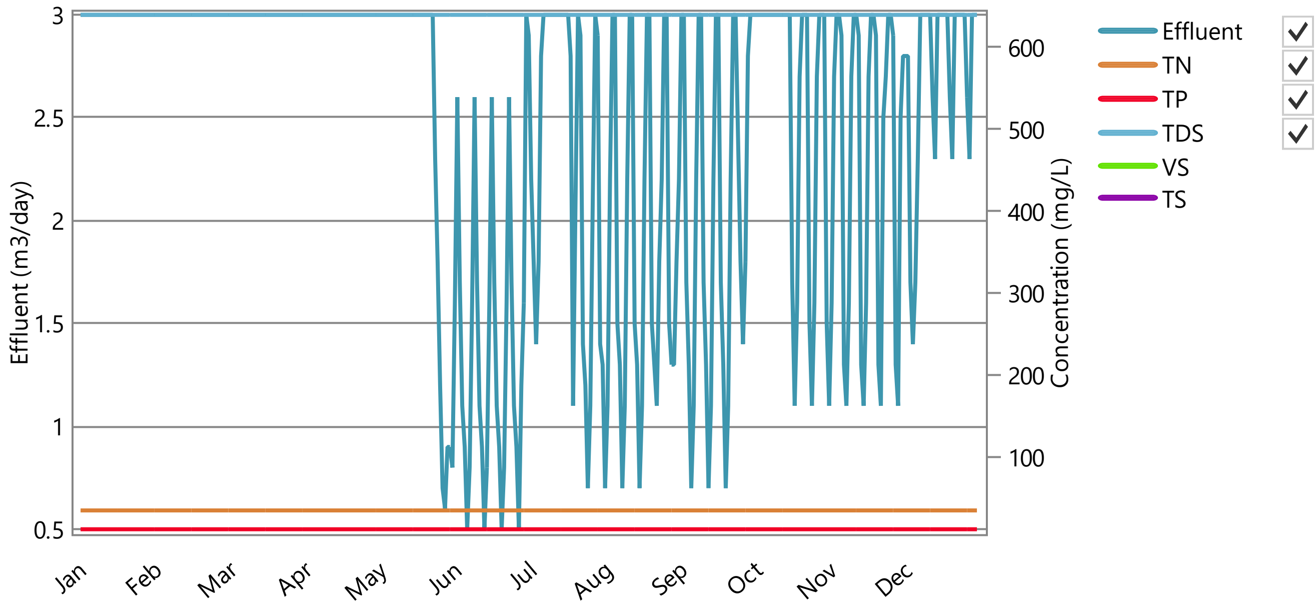
DESCRIPTION

Effluent type: New Generic System

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:

Chart Table



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: 905.06 m3/year or 2.48 m3/day (Min-Max: 0.50 - 3.00)

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

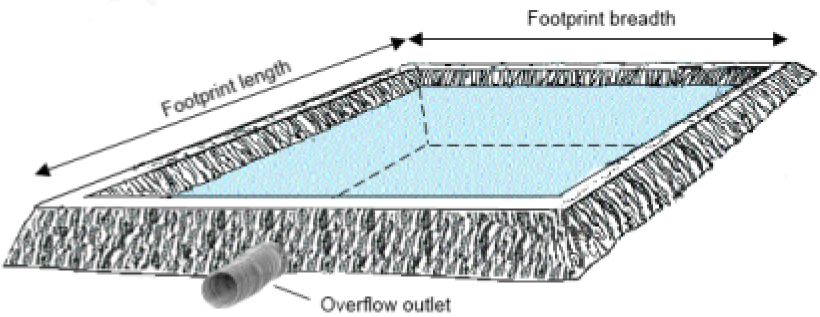
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	35.00 (35.00 - 35.00)	31.68 (31.65 - 31.76)
Total Phosphorus	12.00 (12.00 - 12.00)	10.86 (10.85 - 10.89)
Total Dissolved Salts	640.00 (640.00 - 640.00)	579.24 (578.75 - 580.67)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

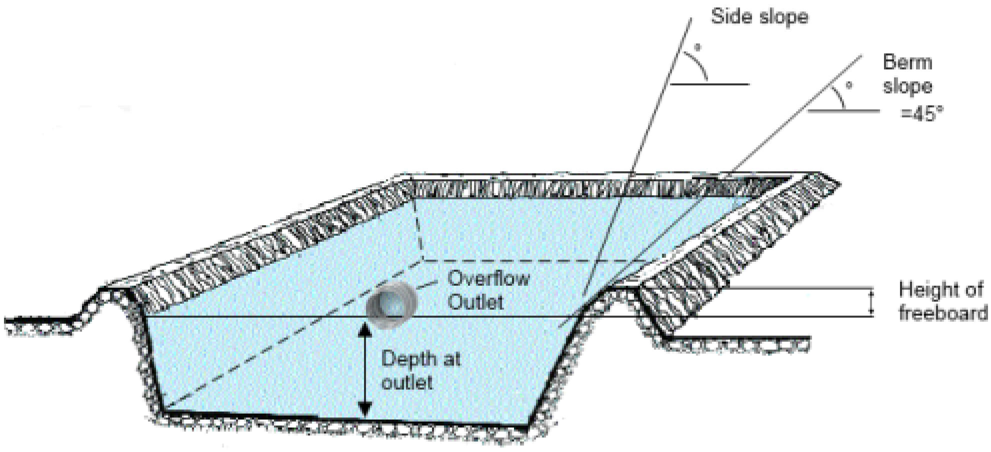
DESCRIPTION

Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (m3)	100.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	1.50
Maximum water surface area (m2)	66.67
Pond footprint length (m)	8.16
Pond footprint width (m)	8.16
Pond catchment area (m2)	66.67
Average active volume (m3)	29.20





Irrigation pump limits:

Minimum pump rate limit (ML/day)	0.00
Maximum pump limit	As scheduled

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

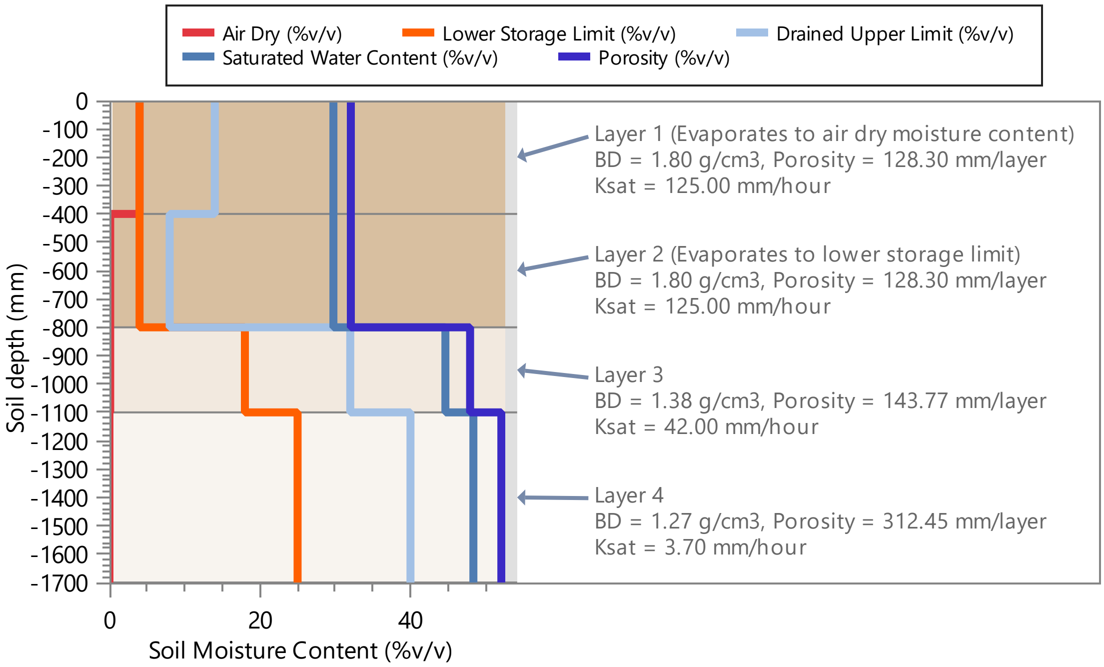
DESCRIPTION

Land: Kennett River

Area (m2): 432.00

Soil Type: Kennett River Wisconsin Mound, 1700.00 mm defined profile depth

Profile Porosity (mm)	712.83
Profile saturation water content (mm)	662.16
Profile drained upper limit (or field capacity) (mm)	424.00
Profile lower storage limit (or permanent wilting point) (mm)	236.00
Profile available water capacity (mm)	188.00
Profile limiting saturated hydraulic conductivity (mm/hour)	3.70
Surface saturated hydraulic conductivity (mm/hour)	125.00
Runoff curve number II (coefficient)	90.00
Soil evaporation U (mm)	8.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Kikuyu 1 Pasture

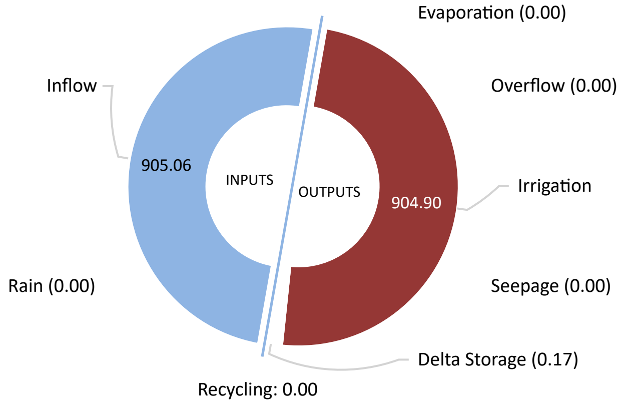
Average monthly cover (fraction) (minimum - maximum)	0.85 (0.83 - 0.88)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 0.8)	0.64
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Maximum potential root depth in defined soil profile (mm)	1200.00
Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03

PERFORMANCE

Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: **100 m3**

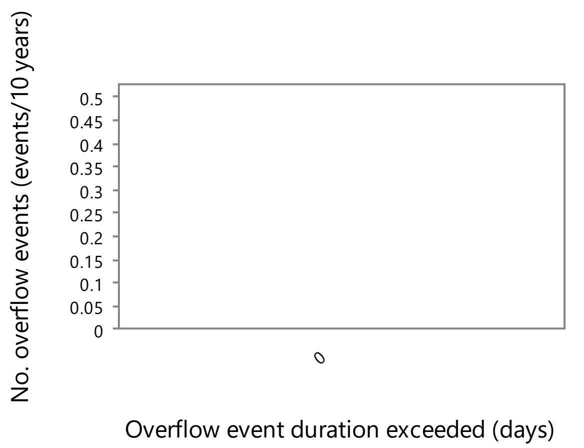
Pond System Water Balance (m3/year)

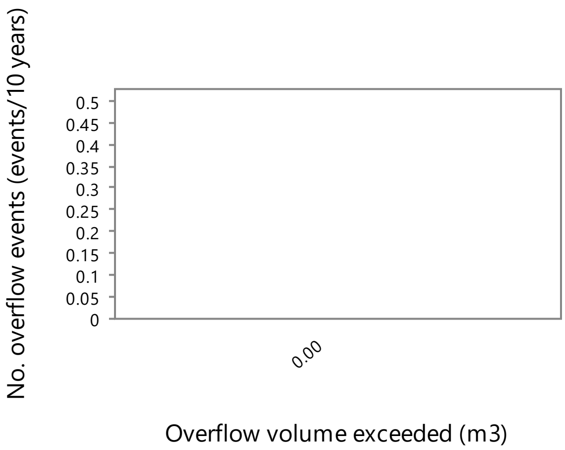


Name	Value
Rain	0.00
Inflow	905.06
Recycling	0.00
Evaporation	0.00
Overflow	0.00
Irrigation	904.90
Seepage	0.00
Delta Storage	0.17

Overflow Diagnostics

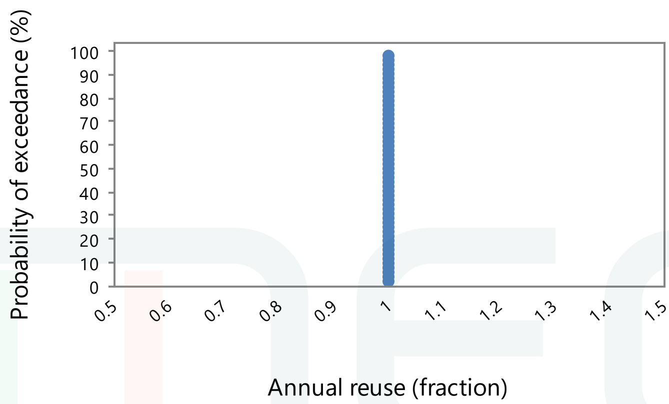
Volume of overflow (m3/year)	0.00
No. days pond overflows (days/year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% reuse (fraction)	1.00





Export plot

Export plot



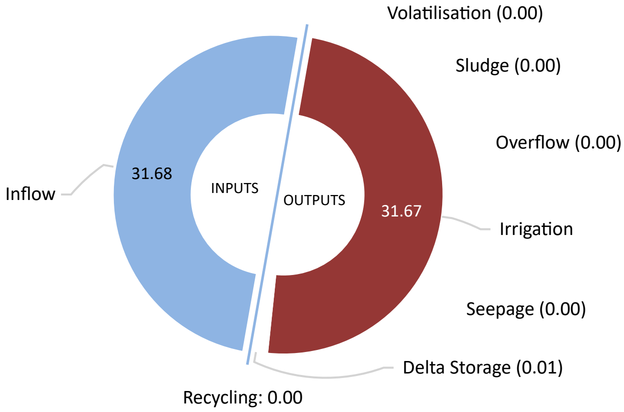
Export plot

PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

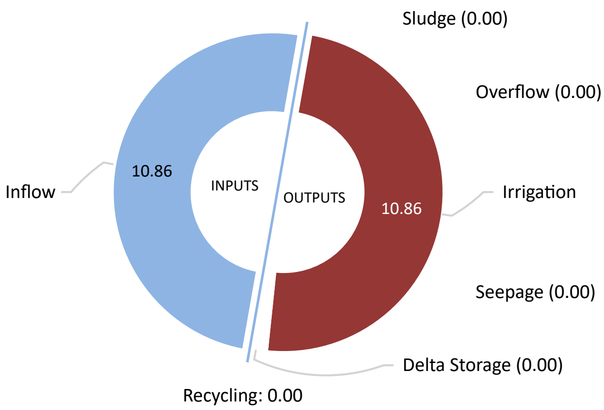
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



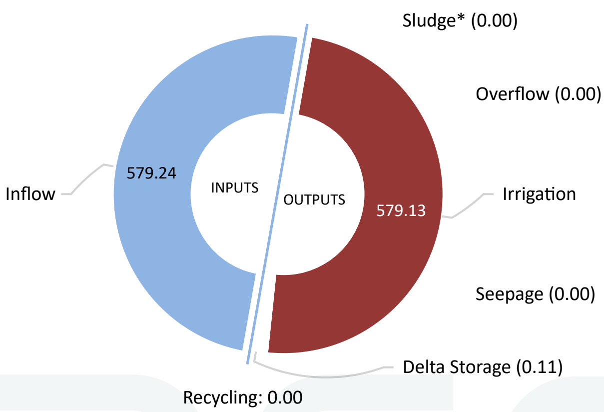
Name	Value
Inflow	31.68
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	31.67
Seepage	0.00
Delta Storage	0.01

Phosphorus Balance (kg/year)



Name	Value
Inflow	10.86
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	10.86
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)



Name	Value
Inflow	579.24
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	579.13
Seepage	0.00
Delta Storage	0.11

* Salt removal in sludge is not calculated from the pond salt balance. However if salt could be assumed to be present in the sludge at the same concentration as in the pond supernatant (up to a maximum of salt added in inflow) - then salt accumulation in the sludge could be 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	35.00
Average phosphorus concentration of pond liquid (mg/L)	12.00
Average salinity of pond liquid (dS/m)	1.00

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	35.00
Final phosphorus concentration of pond liquid (mg/L)	12.00
Final salinity of pond liquid (dS/m)	1.00

PERFORMANCE

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (m3/year)	904.90
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	904.90
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)	35.00
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	34.30
Average phosphorus concentration of irrigation water (mg/L)	12.00
Average salinity of irrigation water (dS/m)	1.00

Irrigation Diagnostics:

Proportion of Days irrigation occurs (fraction)	1.00

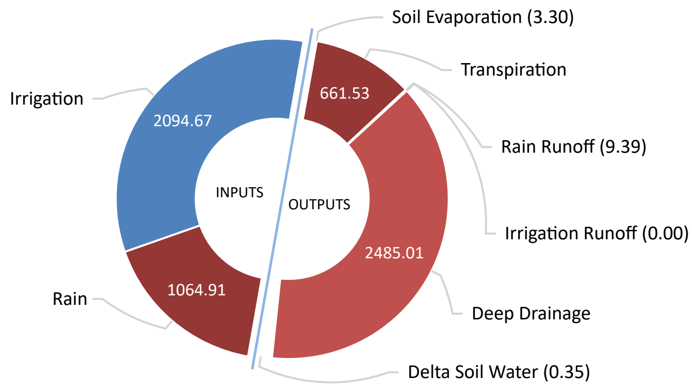
PERFORMANCE

Land Performance - Soil Water

Paddock: Kennett River, 432 m2
Soil Type: Kennett River Wisconsin Mound, 113.00 mm PAWC at maximum root depth

Land Water Balance (mm/year):

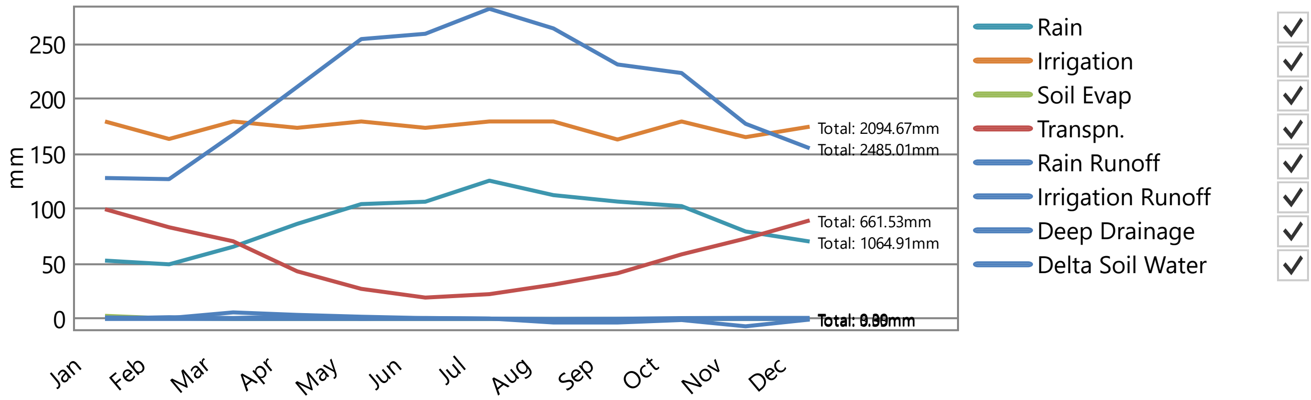
■ mm/year ☐ % Total inputs



Name	Value
Rain	1064.91
Irrigation	2094.67
Soil Evaporation	3.30
Transpiration	661.53
Rain Runoff	9.39
Irrigation Runoff	0.00
Deep Drainage	2485.01
Delta Soil Water	0.35

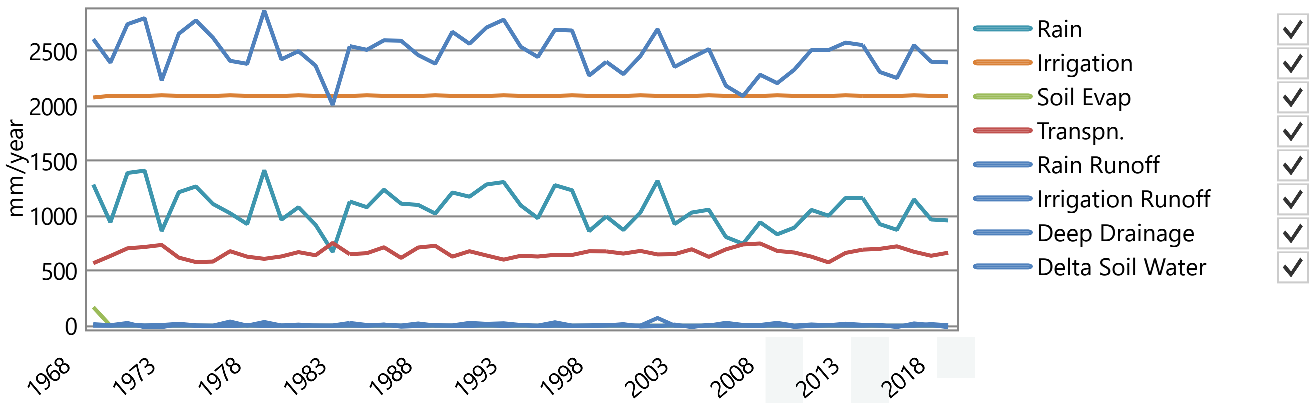
Average Monthly Totals (mm):

■ Chart ☐ Table



Average Annual Totals (mm/year):

■ Chart ☐ Table



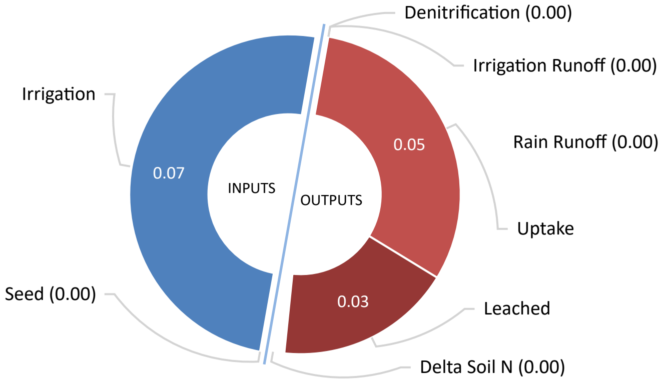
PERFORMANCE

Land Performance - Soil Nutrient

Paddock: Kennett River, 432 m2 **Soil Type: Kennett River Wisconsin Mound**

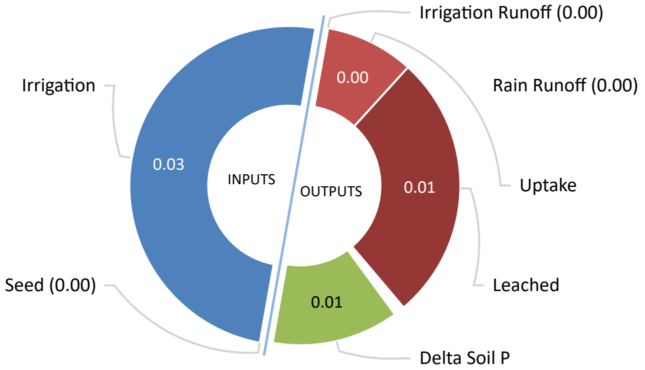
Irrigation ammonium volatilisation losses (kg/m2/year): 0.00
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.20

Land Nitrogen Balance (kg/m2/year)



Name	Value
Seed	2.06E-06
Irrigation	0.07
Denitrification	0.00
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	0.05
Leached	0.03
Delta Soil N	5.85E-05

Land Phosphorus Balance (kg/m2/year)



Name	Value
Seed	1.76E-07
Irrigation	0.03
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	4.61E-03
Leached	0.01
Delta Soil P	0.01

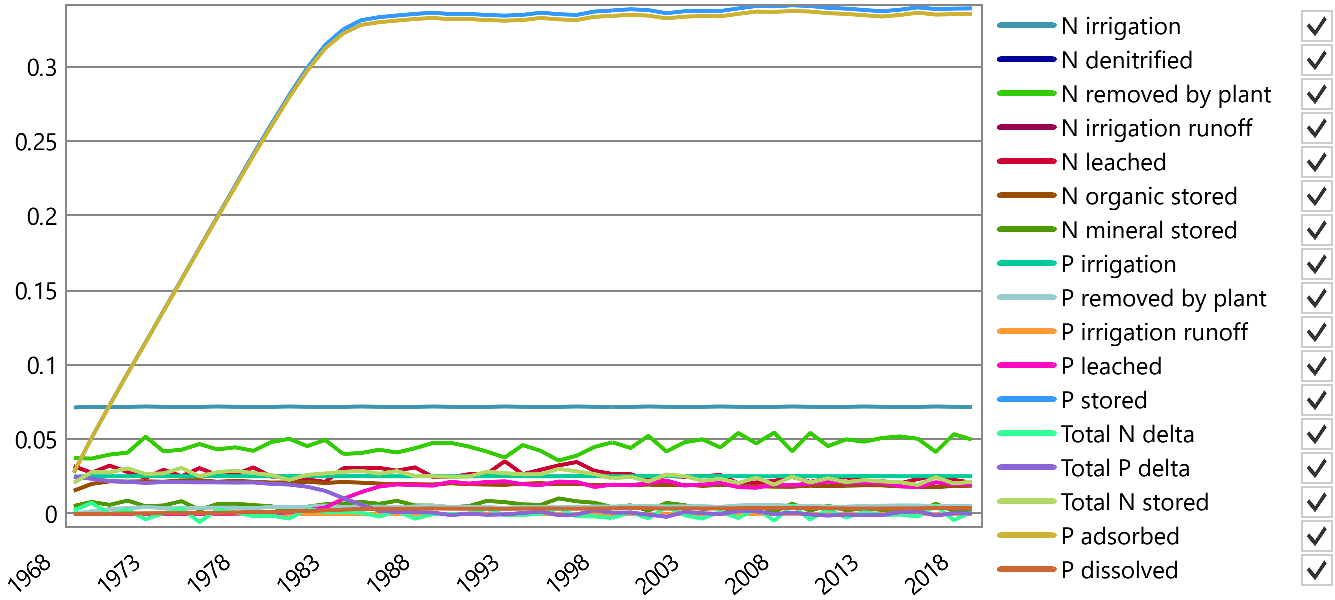
PERFORMANCE

Land Performance - Soil Nutrient

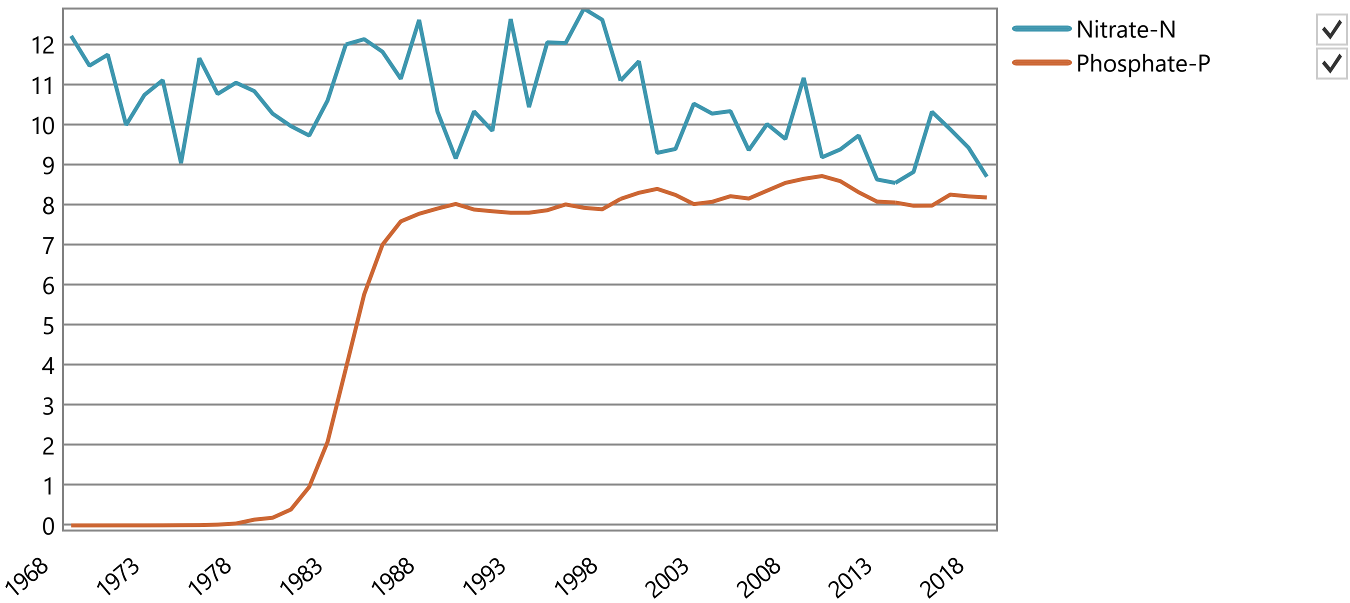
Paddock: Kennett River, 432 m2

Soil Type: Kennett River Wisconsin Mound

Annual Nutrient Totals (kg/m2):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

Plant Performance and Nutrients

Paddock: Kennett River, 432 m2

Soil Type: Kennett River Wisconsin Mound

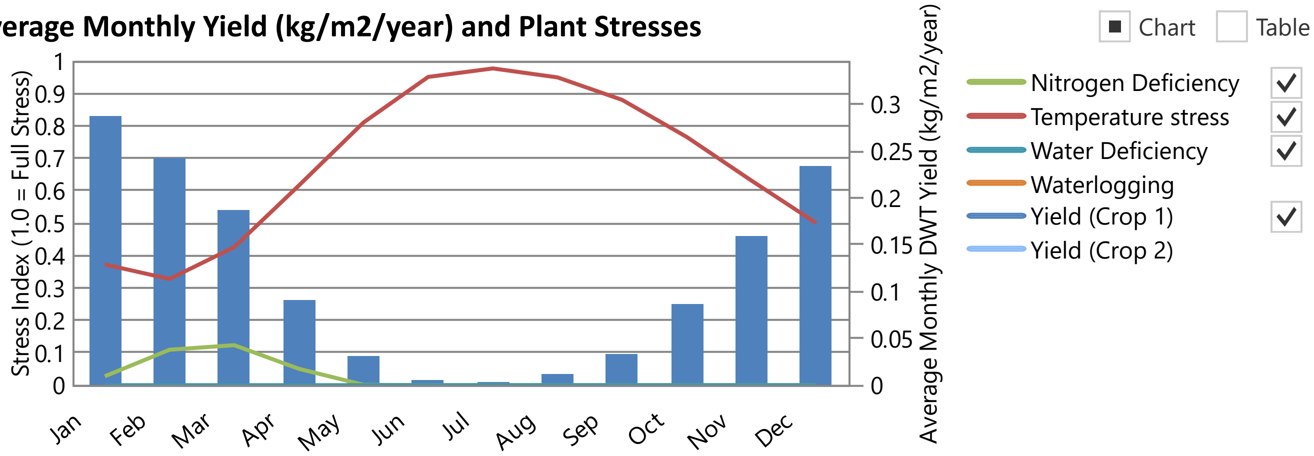
Plant: Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/m2/year)	1.37 (1.07 - 1.71)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.85 (0.83 - 0.88)
Average monthly root depth (mm) (minimum - maximum)	1198.22 (1182.24 - 1200.00)

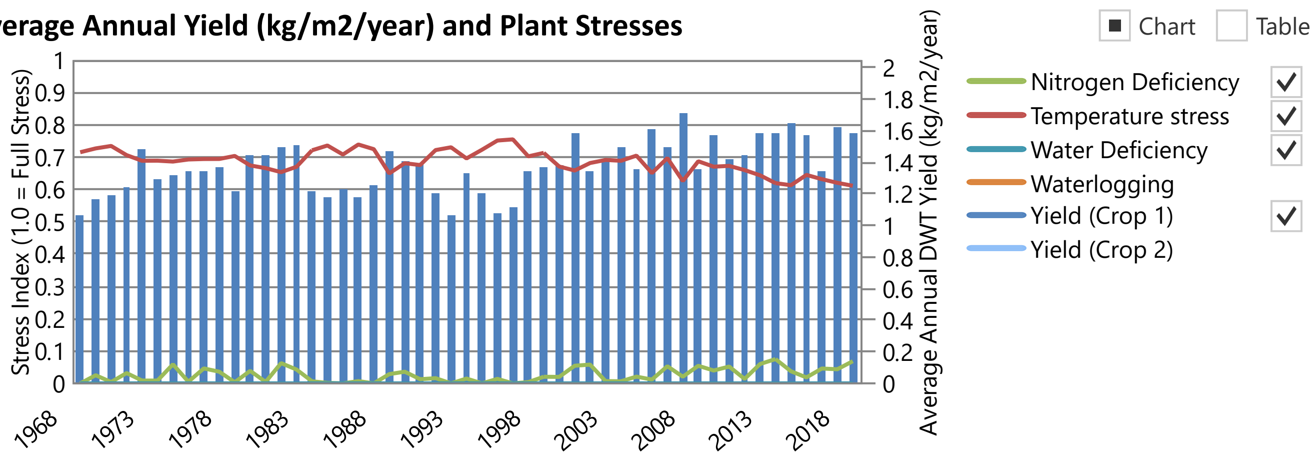
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/m2/year)	0.05 (0.04 - 0.05)
Average annual net phosphorus removed by plant uptake (kg/m2/year)	0.00 (0.00 - 0.01)
Average annual shoot nitrogen concentration (fraction dwt)	0.03 (0.03 - 0.04)
Average annual shoot phosphorus concentration (fraction dwt)	0.004 (0.000 - 0.005)

Average Monthly Yield (kg/m2/year) and Plant Stresses



Average Annual Yield (kg/m2/year) and Plant Stresses



No. of harvests/year: 2.47 (normal)
No. days without crop/year (days/year): 0.00

PERFORMANCE

Land Performance

Paddock: Kennett River, 432 m2

Soil Type: Kennett River Wisconsin Mound

Plant: Continuous Kikuyu 1 Pasture

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

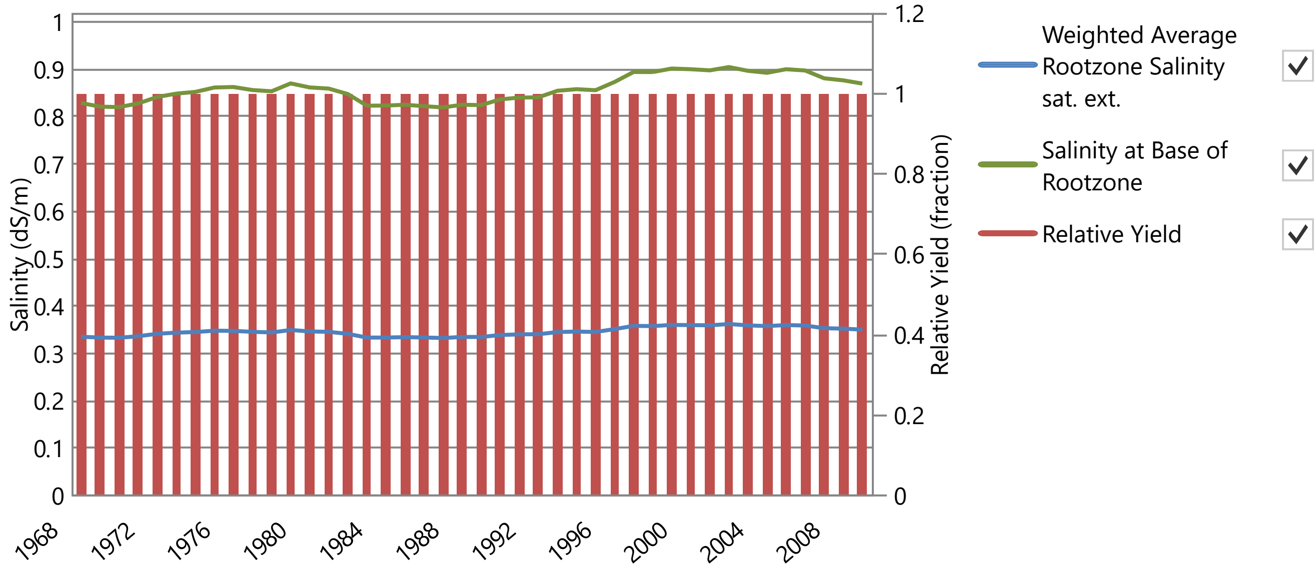
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.68
Salt added by rainfall (kg/m2/year)	0.02
Average annual effluent salt added & leached at steady state (kg/m2/year)	1.36
Average leaching fraction based on 10 year running averages (fraction)	0.89
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.35
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.86
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



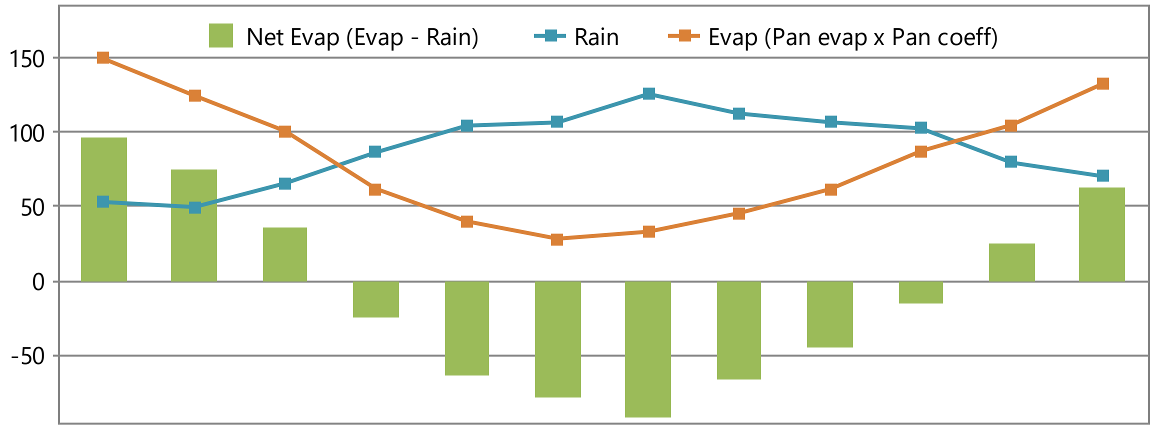
DIAGNOSTICS

Sustainability Diagnostics: Kennett River Public Toilets

Averaged Historical Climate Data Used in Simulation (mm)

Location: Kennett River, -38.65°, 143.85°

Run Period: 01/01/1968 to 31/12/2018 51 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	53.1	49.7	65.7	86.6	104.6	106.7	125.9	112.7	106.9	102.7	79.6	70.5	1064.9
Evap	149.7	124.9	101.0	62.0	40.1	28.4	33.1	45.7	61.8	87.4	105.1	132.8	972.0
Net Evap	96.6	75.1	35.2	-24.6	-64.5	-78.3	-92.8	-67.1	-45.1	-15.3	25.5	62.3	-92.9
Net Evap/day	3.1	2.7	1.1	-0.8	-2.1	-2.6	-3.0	-2.2	-1.5	-0.5	0.8	2.0	-0.3

DIAGNOSTICS

Sustainability Diagnostics: Kennett River Public Toilets

Pond System: 1 closed storage tank

New Generic System - 905.06 m3/year or 2.48 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

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

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	35.00 (35.00 - 35.00)	31.68 (31.65 - 31.76)
Total Phosphorus	12.00 (12.00 - 12.00)	10.86 (10.85 - 10.89)
Total Dissolved Salts	640.00 (640.00 - 640.00)	579.24 (578.75 - 580.67)
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)

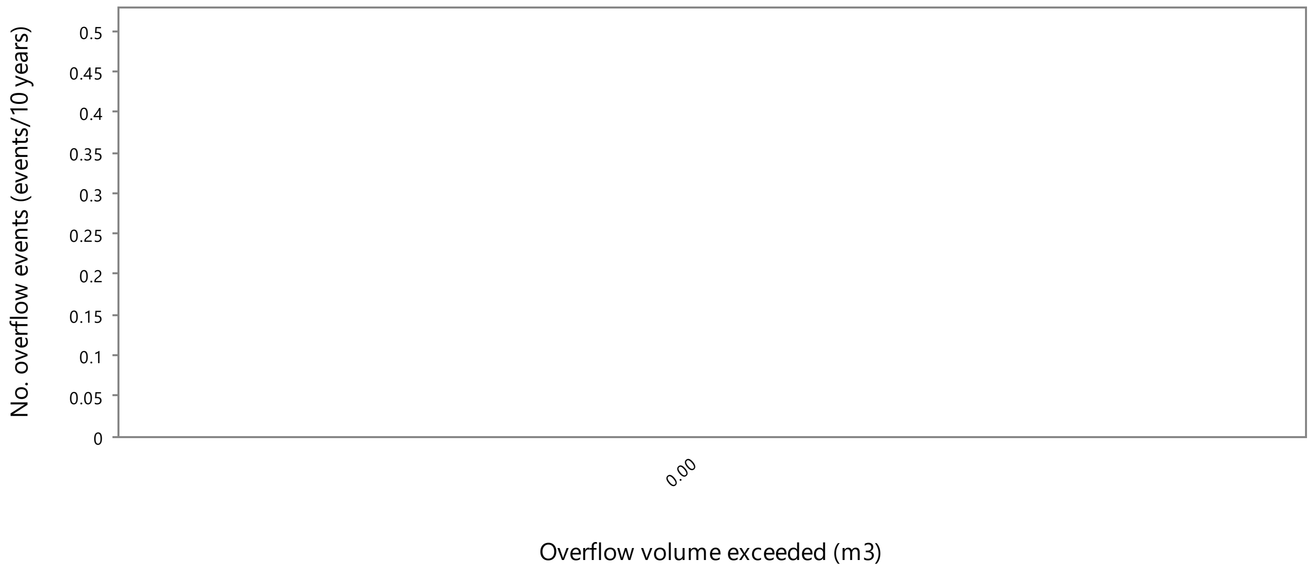
Last pond (Wet weather store): 100.00 m3

Theoretical hydraulic retention time (days)	40.36
Average volume of overflow (m3/year)	0.00
No. overflow events per year exceeding threshold* of 0.07 m3 (no./year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% effluent reuse (fraction)	1.00
Average salinity of last pond (dS/m)	1.00
Salinity of last pond on final day of simulation (dS/m)	1.00
Ammonia loss from pond system water area (kg/m2/year)	0.00

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

Overflow exceedance:

■ Chart ☐ Table



Export plot

DIAGNOSTICS

Sustainability Diagnostics: Kennett River Public Toilets

Irrigation Information

Irrigation: 432 m2 total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/m2/year
Total irrigation applied (m3)	904.90	2.09
Total nitrogen applied (kg)	31.04	0.07
Total phosphorus applied (kg)	10.86	0.03
Total salts applied (kg)	579.13	1.34

Shandying

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

Irrigation Issues

Proportion of Days irrigation occurs (fraction)	1.00

DIAGNOSTICS

Sustainability Diagnostics: Kennett River Public Toilets

Paddock Land: Kennett River: 432 m2

Irrigation: Flood with 0.1% ammonium loss during irrigation

Irrigation triggered every 1 days
Irrigate a fixed amount of 5.80 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): Kennett River Wisconsin Mound, 113.00 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	53.1	49.7	65.7	86.6	104.6	106.7	125.9	112.7	106.9	102.7	79.6	70.5	1064.9
Irrigation	179.8	163.9	179.8	174.0	179.8	174.0	179.8	179.8	163.4	179.8	165.5	175.1	2094.7
Soil Evap	2.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
Transpn.	99.9	83.5	70.7	43.4	27.4	19.4	22.6	31.2	41.6	58.8	73.2	89.8	661.5
Rain Runoff	0.5	1.6	0.9	2.2	0.1	0.9	0.3	0.0	0.2	0.8	1.0	0.9	9.4
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	128.3	127.3	167.9	211.3	254.8	259.7	282.4	264.5	231.7	223.9	177.7	155.4	2485.0
Delta	1.4	0.8	6.0	3.7	2.0	0.7	0.4	-3.2	-3.2	-1.0	-6.7	-0.5	0.3

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/m2/year)	0.07
Average annual soil nitrogen removed by plant uptake (kg/m2/year)	0.05
Average annual soil nitrogen removed by denitrification (kg/m2/year)	0.00
Average annual soil nitrogen leached (kg/m2/year)	0.03
Average annual nitrate-N loading to groundwater (kg/m2/year)	0.03
Soil organic-N kg/m2 (Initial - Final)	0.01 - 0.02
	0.01 - 2.58E-03
Average nitrate-N concentration of deep drainage (mg/L)	10.58
Max. annual nitrate-N concentration of deep drainage (mg/L)	12.90

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/m2/year)	0.03
Average annual soil phosphorus removed by plant uptake (kg/m2/year)	4.61E-03
Average annual soil phosphorus leached (kg/m2/year)	0.01
Dissolved phosphorus (kg/m2) (Initial - Final)	0.00 - 3.64E-03
Adsorbed phosphorus (kg/m2) (Initial - Final)	2.62E-03 - 0.34
Average phosphate-P concentration in rootzone (mg/L)	6.57
Average phosphate-P concentration of deep drainage (mg/L)	5.60
Max. annual phosphate-P concentration of deep drainage (mg/L)	8.72
Design soil profile storage life based on average infiltrated water phosphorus concn. of 7.98 mg/L (years)	12.99

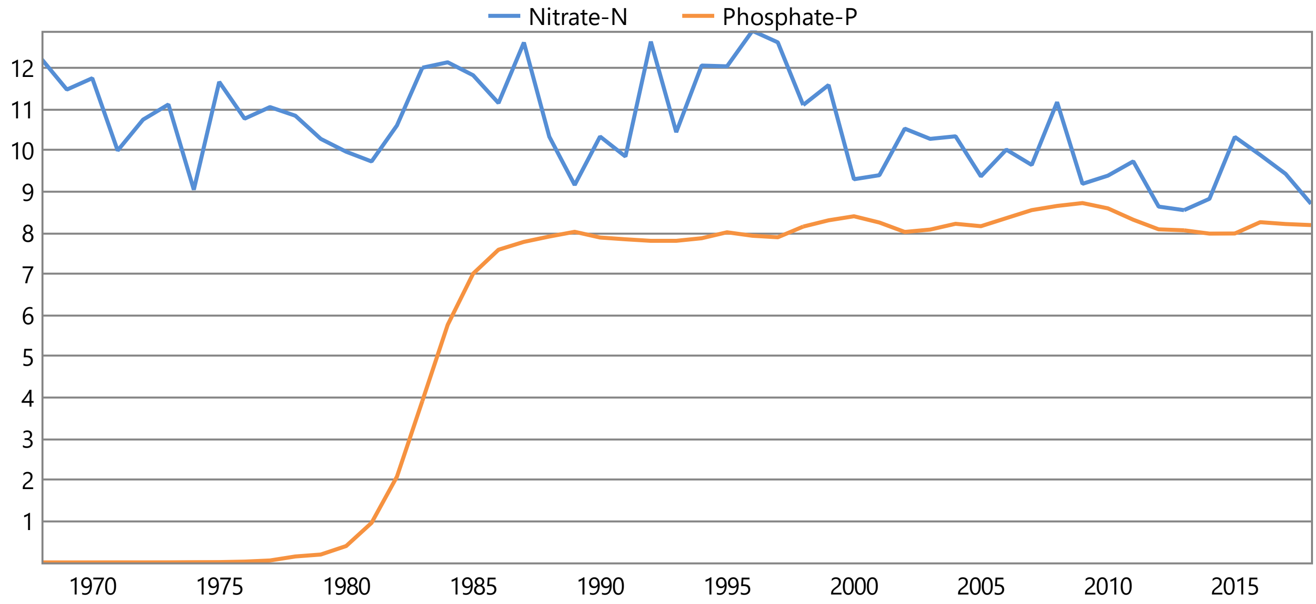
DIAGNOSTICS

Sustainability Diagnostics: Kennett River Public Toilets

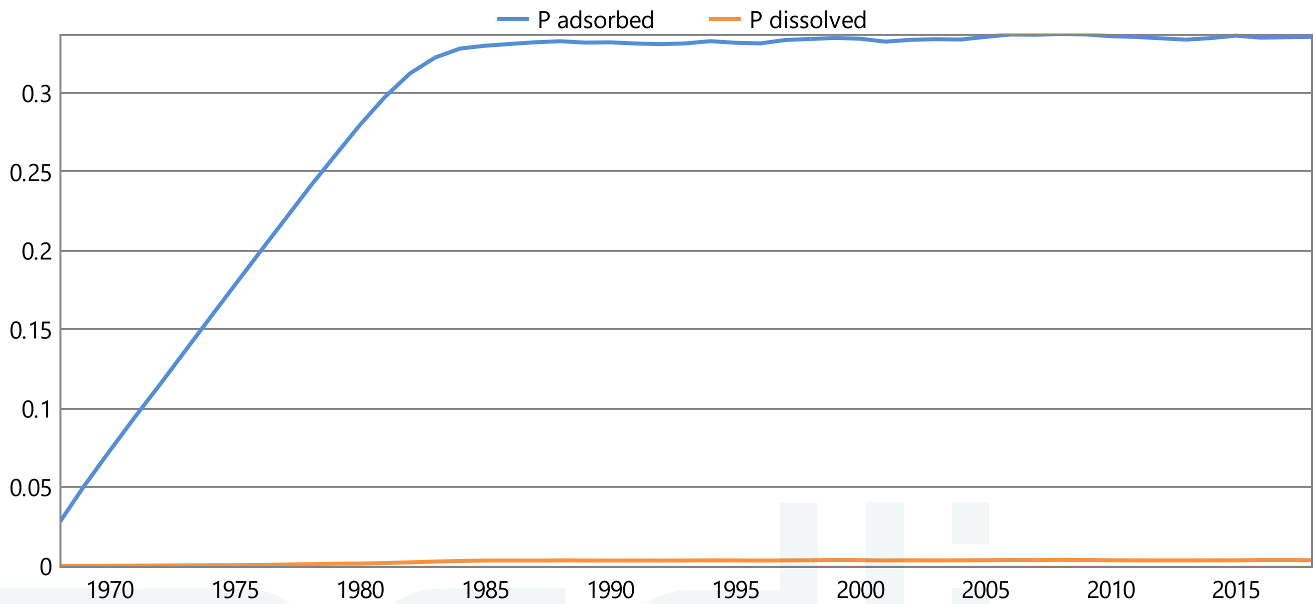
Paddock Land: Kennett River: 432 m2

Irrigation: Flood with 0.1% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/m2)



DIAGNOSTICS

Sustainability Diagnostics: Kennett River Public Toilets

Paddock Plant Performance: Kennett River: 432 m2

Average Plant Performance (Minimum - Maximum): Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/m2/year)	1.37 (1.07 - 1.71)
Average monthly plant (green) cover (fraction)	0.85 (0.83 - 0.88)
Average monthly crop factor (fraction)	0.55 (0.53 - 0.56)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	1198.22 (1182.24 - 1200.00)
Average number of normal harvests per year (no./year)	2.47 (1.00 - 3.00)
Average number of normal harvests for last five years only (no./year)	2.80
Average number of crop deaths per year (no./year)	0.00 (0.00 - 0.00)
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)	0.03 (0.00 - 0.08)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.37 (0.21 - 0.57)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.98 (0.89 - 1.00)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	0.00

Soil Salinity - Plant salinity tolerance: Moderately tolerant

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

All values based on 10 year running averages

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.68
Salt added by rainfall (kg/m2/year)	0.02
Average annual effluent salt added & leached at steady state (kg/m2/year)	1.36
Average leaching fraction based on 10 year running averages (fraction)	0.89
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.35
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.86
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

DIAGNOSTICS

Run Messages

Messages generated when the scenario was run:

Full run chosen

DECENTRALISED WATER CONSULTING

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0408 023 265

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KENNETT RIVER TOURISM INFRASTRUCTURE IMPROVEMENTS - CITY DEAL PROJECT

Kennett River Public Toilets - On-site Wastewater Treatment System

Probability	Description	Likelihood*	Frequency*	Probability	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Severe
					Consequence				
Almost Certain	Risk will occur within the period	99%	1 per year	A	Medium	High	High	Extreme	Extreme
Likely	Risk likely to occur within the period	98% - 50%	1 in 1 to 4 years	B	Low	Medium	High	High	Extreme
Possible	Risk may occur within the period	49% - 20%	1 in 5 to 19 years	C	Low	Medium	Medium	High	High
Unlikely	Risk not likely to occur within the period	19% - 5%	1 in 20 to 49 years	D	Low	Low	Medium	Medium	High
Rare	Risk will only occur in exceptional circumstances	4% - 2%	1 in 50 years or greater	E	Low	Low	Low	Low	Medium

Extreme Risk (ER)	20 to 25
High Risk (HR)	10 to 16
Medium Risk (MR)	5 to 9
Low Risk (LR)	1 to 4

Category	Risk Description / Hazard	Likelihood	Consequences	Consequence	Existing Risk (Score)	Existing Risk Category	Control Measure	Residual Likelihood	Residual Consequence	Residual Risk	Residual Risk Class	Comment
Human Health, Environment, Operability, Damage	Damage and/or ingress of on-site wastewater treatment infrastructure due to large flooding events.	2	Wastewater treatment system experiences stormwater ingress, damage and/ or poor performance. This could lead to pollutants (TN, TP and faecal coliforms) reaching receiving environments (Kennett River or the Stormwater Wetlands / Ponds).	5	10	High Risk	Ensure all access lids are adequately sealed to prevent stormwater ingress (Design Specification Section 8), construct a raised level pad on which to install the Wisconsin Mound which enable the base of the mound distribution bed to be at or above the 5% AEP Design flood event (Design Specification Section 9).	1	3	3	Low Risk	
Human Health, Environment, Operability	The on-site wastewater treatment system performs poorly due to operational issues including pump failure, inappropriate float switch levels etc.	3	Effluent entering (or leaving the Wisconsin Mound) is of poor water quality and has not been treated to the standard specified within the detailed design. This could lead to pollutants reaching receiving environments at unacceptable concentrations / loads.	5	15	High Risk	A multi-barrier approach has been designed which includes: - A secondary treatment system with disinfection and treatment via Wisconsin Mound and raised level pad (high level of water quality treatment - refer to Sections 8 and 9 of the Design Specification); - Installation of duty/standby pumps; - Implementation of remote monitoring to notify Council and the system manager of high tank levels (Section 3 of Wastewater Management Report); - Provision for Eduction via flow balance tanks (with 100 kL of storage) if required; - High level alarm in the irrigation chamber of the secondary treatment system; - Completion of a cumulative impact assessment and groundwater modelling (including viral die-off) tested under a range of scenarios (Section 5 of the Wastewater Management Report). Additionally, the groundwater modelling showed that the TN and TP concentrations reaching Kennett River (and the Stromwater Wetlands / ponds) is less than the 'Rivers and Streams - Indicators and Objectives' concentrations as outlined in the EPA Environment Reference Standard ('*GG2021S245*')	2	1	2	Low Risk	
Human Health, Operability, Damage	Members of the public gain access to the treatment system.	5	Members of the public come in contact with untreated or partially treated wastewater and become ill. There is also potential for the treatment system to become damaged by members of the public or for operational processes to be changed. This could result in increased discharge of pollutants to sensitive environmental	5	25	Extreme Risk	The following measures have been implemented: - All access lids are to be locked; - All electrical and control equipment is to be installed in a small lockable shed; - The above ground flow balance tanks are to be installed without permanent access ladders; - Bollards are to be installed around the treatment system compound (preventing vehicular access). Refer to Section 8 of the Design Specification for further information.	1	4	4	Low Risk	
Human Health, Environment, Operability, Design	The proposed on-site wastewater treatment system is undersized.	5	Poor treatment system performance or overflow of treatment tanks, resulting in reduced water treatment and impact upon human health and sensitive receiving environments.	5	25	Extreme Risk	Council have provided DWC with site occupancy data which captures the peak flows experienced on the site. An additional 30% contingency / safety factor was then applied to these numbers to ensure adequate treatment system capacity was designed. Refer to Section 4 of the Wastewater Management Report for further information.	1	3	3	Low Risk	
Human Health, Environment, Operability, Design	The high variability in wastewater flows generated by the public facility leads to poor treatment performance.	5	Poor treatment system performance or overflow of treatment tanks, resulting in reduced water treatment and impact upon human health and sensitive receiving environments.	5	25	Extreme Risk	Installation of Flow Balance Tanks which time dose primary treated effluent to the secondary treatment system at a maximum rate of 3 kL/day.	1	3	3	Low Risk	
Human Health, Environment, Operability, Design	The chosen contractor selects a proprietary treatment secondary treatment system which does not meet the Design Criteria outlined in the detailed design.	5	The secondary treatment system performs poorly and partially treated wastewater is discharged to the Wisconsin Mound and eventually Kennett River and the Stormwater	5	25	Extreme Risk	Council are to undertake a thorough tender review process with review from DWC (treatment system designer) to determine the suitability of all tender submissions. Additionally, Commissioning and Proof of Performance Testing is required and includes component testing and collection of influent and effluent samples to confirm design criteria is being met. Where	1	5	5	Medium Risk	
Human Health, Environment, Construction	The contractor installs any treatment system component (including tanks, pad or Wisconsin Mound) incorrectly and not in accordance with the design specification.	3	The treatment system does not operate as designed and partially treated wastewater discharges into the environment.	5	15	High Risk	Commissioning and Proof of Performance Testing is required and includes component testing and collection of influent and effluent samples to confirm design criteria is being met. Where this does not occur, it is the responsibility of the contractor to ensure the system operates as designed (refer to Section 10 of the Design Specification).	1	5	5	Medium Risk	
					0	Low Risk				0	Low Risk	
					0	Low Risk				0	Low Risk	

Kennett River Tourism Infrastructure Improvements - City Deals Project

Proposed Public Toilet - Daily Use Estimate - Based on Rev J (Final) Concept Plan Carpark Designs

Vehicle type	Passengers per vehicle	No. of parks (capacity)	No. of visitors per 0.5HR - peak period (0.5P parking)	No. of visitors per 1hr - peak period (1P parking)	No. of visitors per 2hr - peak period (2P parking)	No. of visitors per 4hr period (10am-2pm) - peak period	Lead up to Peak Period (before 10am). No. of visitors	Following Peak Period - after 2pm. No. of visitors	Total visitors	% of visitors using toilets	Number of passenders using toilets	Local use & brief stops	Beachgoer Use	Total toilet visits per day
Car 2P parking limit	3.5	26	NA	NA	91	182	45.5	45.5						
Car 1/2P	3.5	7	24.5	NA	NA	196	12.25	12.25						
22 seat Bus 1P	22	6	NA	132	NA	528	0	176						
RV 2P	3	2	NA	NA	6	12	3	3						
Motorbikes	1	6		6		24	3	3						
		Totals		138		942	63.75	239.75	1245.5	70.00%	871.85	10	50	932
										assumed				

increase above to 3.5 ave (rough estimate) to account for 11 seater buses also using normal carparks

assume buses arrive all way up to 6pm so add in 2 buses per hour from 2pm-6pm

Example of a constructed mound