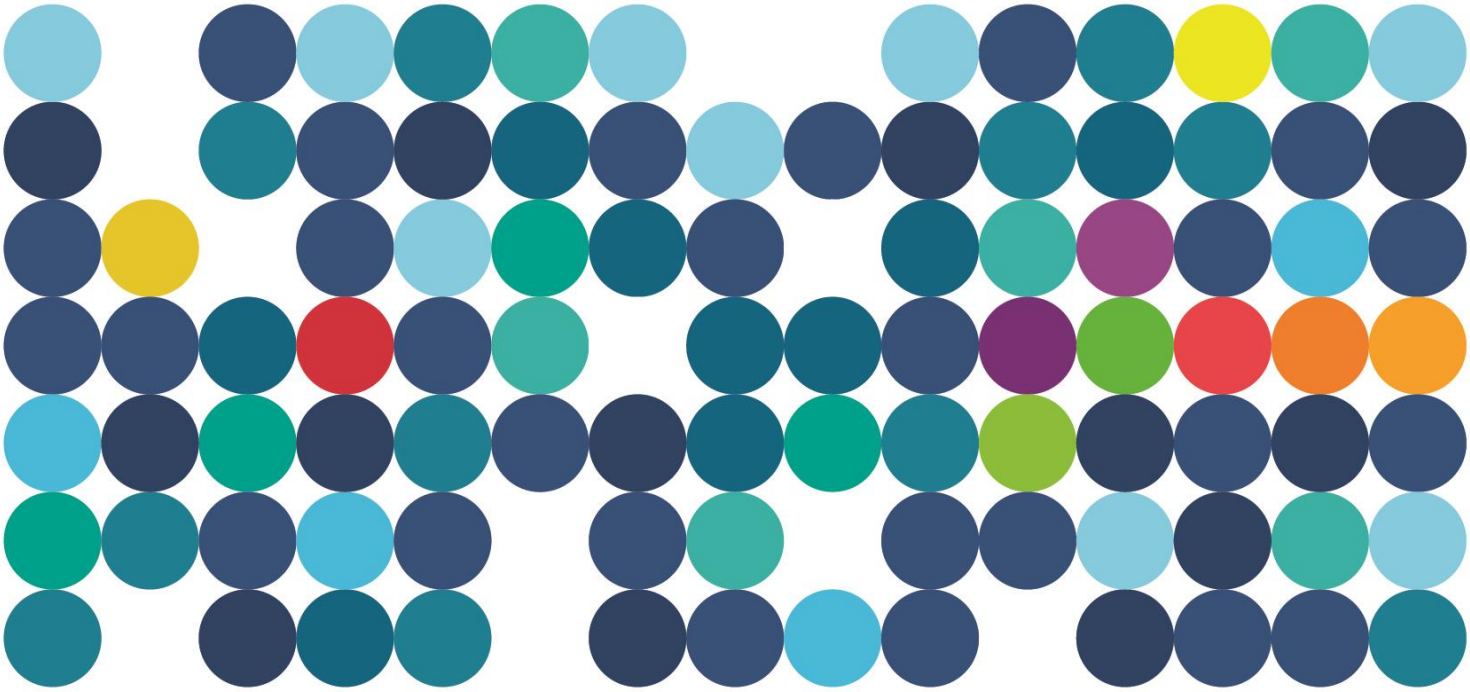
Ministerial Statement 572

Ocean Outlet for Treated Wastewater,

Bunbury Wastewater Treatment Plant

Compliance Assessment Report

July 2020 to June 2021



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Fresh Water Thinking

WATER CORPORATION

Contents

1 Introduction

Wastewater disposal at the Bunbury Wastewater Treatment Plant (WWTP) is subject to conditions contained in Statement 572, of 14 September 2001, issued by the Minister for the Environment under the Environmental Protection Act 1986 (EP Act). Condition 5-1 of Statement 572 requires the Water Corporation to submit periodic compliance reports to the Department of Environmental Protection (now the Department of Water and Environmental Regulation (DWER)). This Compliance Assessment Report (CAR) covers the period 1 July 2020 to 30 June 2021 and is prepared and submitted to DWER to in accordance with this condition.

2 Current Status

The WWTP treats wastewater to a secondary standard and consists of four Sequence Batch Reactors (SBRs). Treated wastewater is discharged into two holding lagoons and then discharged into the ocean via a 1.7 km long pipeline. Waste activated sludge is mechanically dewatered on site and solids are disposed of to landfill. Dewatered filtrate is returned to the treatment process.

Bunbury WWTP has a licenced design capacity of 15,000m^3/day. During the 2020-21 reporting period the Bunbury WWTP received an annual average daily inflow of 11,494m^3, representing a 4% increase from the 2019-20 reporting period. Up to 5,000 tonnes per year of liquid waste is also accepted at the site in tankers from controlled waste contractors (mainly sewage from pump-outs of the reticulated sewerage system, as other types of waste may disturb the balance of the treatment process).

Major infrastructure works (13 ML/d Optimisation Project) commenced in March 2017 at the Bunbury WWTP and was completed in September 2017. Additionally, a major upgrade of mechanical dewatering process was completed during the 2018-19 reporting year.

A conceptual design of the next possible upgrade is currently being reviewed by the Water Corporation.

3 New Wastewater Resource Recovery Scheme

The State Government announced, on 2 September 2020, plans to invest $11.9 million into a wastewater recycling scheme for Bunbury (see Attachment 8). Bunbury Water Resource Recovery Scheme will include the construction of a new wastewater recycling facility (adjacent to Bunbury WWTP) and associated infrastructure to supply non-potable water for use on major infrastructure projects and irrigation of public open spaces.

4 Compliance

4.1 Non-conformances/Non-compliances:

Table 1 provides a summary of compliance against monitored parameters in comparison to the key characteristics for the proposal, as shown in Schedule 1 of Ministerial Statement 572.

Table 1 - Summary of compliance with Schedule 1 treated water quality limits

Schedule 1 Limit	Compliance 2020-21	Details
SS <20mg/L (mean)	Y	Mean: 3.3 mg/L
BOD <20mg/L (mean)	Y	Mean: 2.5 mg/L
TN ≤15mg/L (mean)	Y	Mean: 8.0 mg/L
Discharge TN to ocean ≤ 60 T/year	Y	33.47 T/year.

Notes: Compliance has been assessed as per Attachment 2 to Ministerial Statement 572 (dated April 2014), which removes assessment against the water quality limits; Total Phosphorous and Faecal coliform bacteria counts, as these are managed under Part V (Licence) of the EP Act.

The operation of the ocean outlet for treated wastewater at Bunbury WWTP has been compliant according to the requirements of M572 during the reporting period, with evidence for the current status provided in Section 7 – Audit Table – "Status" and "Further information" columns.

A 'Statement of Compliance' is also provided at Attachment 1.

4.2 Bunbury Ocean Outlet Monitoring Program

There was one exceedance against Environmental Quality Guideline (EQG) 'Periphyton biomass' and Environmental Quality Standard (EQS1) seagrass health during the reporting period. Periphyton biomass and seagrass heath are indicators used by the Water Corporation to determine if the Environmental Quality Objective 'Maintenance of Ecosystem Integrity' has been met.

The exceedance of the Periphyton biomass EQG triggered a more detailed assessment to better determine marine impacts. In this instance, this required further assessment against the Environmental Quality Standard (seagrass health EQS1 and EQS2). The monitoring results have recorded an exceedance at site SG2 and SG4 against Environmental EQS1 for seagrass health, although the data suggests that high variability (i.e. large standard error) and small sample size could be a contributing to the exceedance in the EQS.

However, the EQS2 was met during 2021 as the median shoot density at all sites was greater than the 5th percentile of the pooled reference site dat. Because the criteria for EQS2 was met, the EQS was met overall. See Attachment 5 for 2020-21 BOOM Annual Report

It is also worth noting that the nitrogen stable isotope analysis (δ15N) of the periphyton samples suggest that the treated wastewater plume is not responsible for elevated periphyton biomass (chlorophyll-a) concentrations at the compliance sites.

A review of the seagrass monitoring sampling frequency will be undertaken during the next update of the Bunbury Ocean Outfall Marine Impact Monitoring and Management Plan.

4.3 Internal/External Audits:

Preparation of this CAR constitutes an internal audit by the proponent against the conditions and commitments of MS572. The audit table provided in section 7 summarises the findings.

Monthly inspections for licence compliance are also undertaken by staff independent to the day to day processing at Bunbury WWTP.

4.4 Complaints Register:

Water Corporation maintains a comprehensive complaints, reporting and management system. There were no complaints received regarding Bunbury WWTP during the 2020-21 reporting year.

5 Environmental Monitoring and Research

Bunbury WWTP has generally performed within the expected design parameters for the 2020-21 reporting period. Full details of environmental monitoring are included in the licence Annual Environmental Report for Bunbury WWTP (see Attachment 4).

There were no exceedances against key characteristics for the proposal which are shown in Schedule 1 of Ministerial Statement 572. Figures 1 to 4 below show compliance against specific conditions as listed in Table 1 – Key Proposal Characteristics (1302) of MS 572 for the 2020-21 reporting period.

Ministerial Statement MS572 specifies the Bunbury WWTP be operated to achieve a TN load of 60 tonnes or less per annum released through the discharge weir to the ocean outfall. The ocean TN loading limit did not exceed the MS572 limit, with 33.47 tonnes being reported in 2020-21.

Figure 1 – Biochemical Oxygen Demand schedule 1 limit

(Note: Samples with results below level of detection (LOD) are represented as ½ LOD (eg where LOD is 5mg/L, it is taken as being 2.5mg/L)

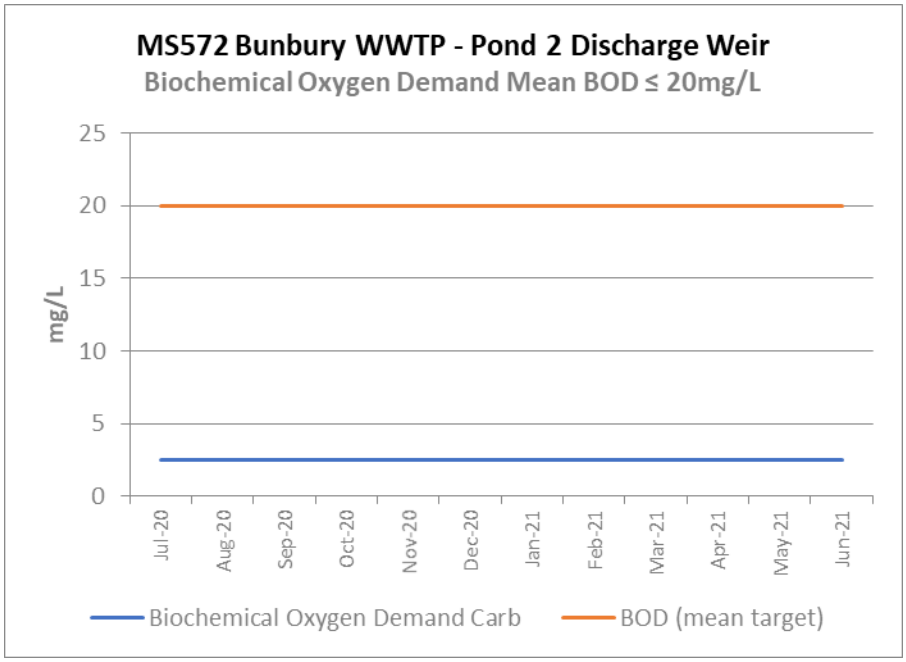

Figure 2 – Suspended Solids schedule 1 limit

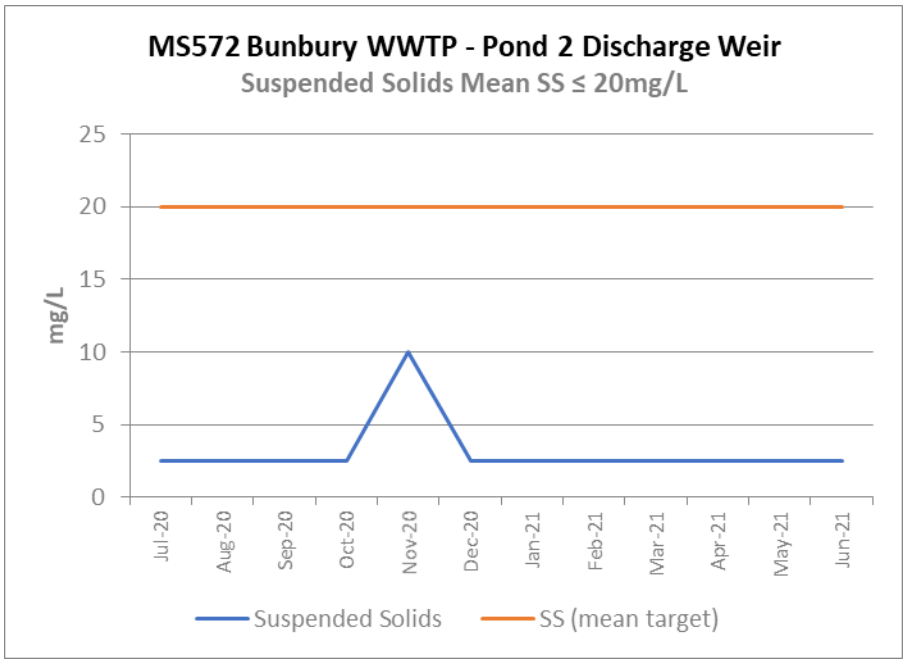

Figure 3 – Nitrogen schedule 1 limit

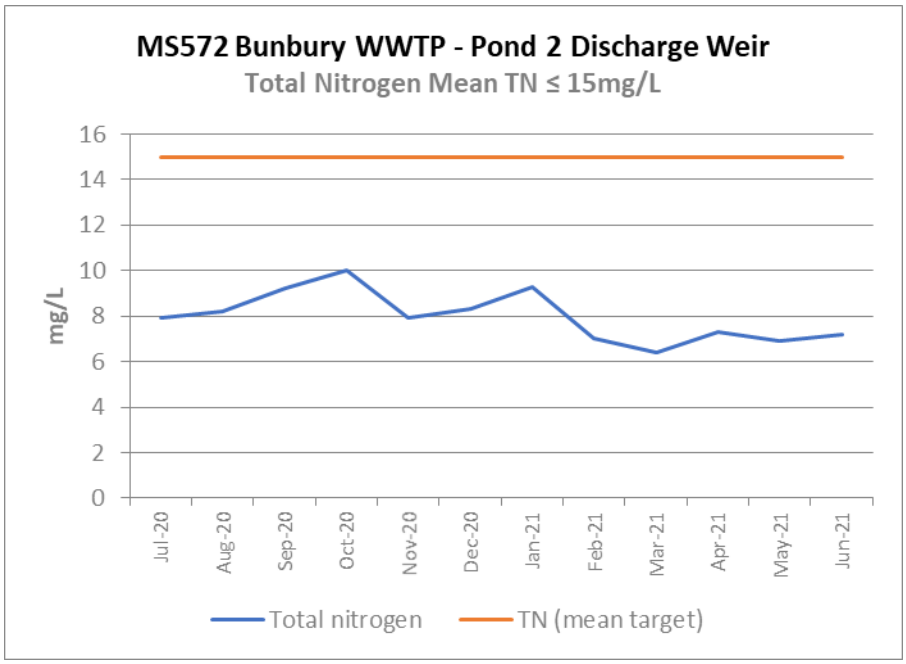

Figure 4 – Nitrogen load at ocean outfall schedule 1 limit

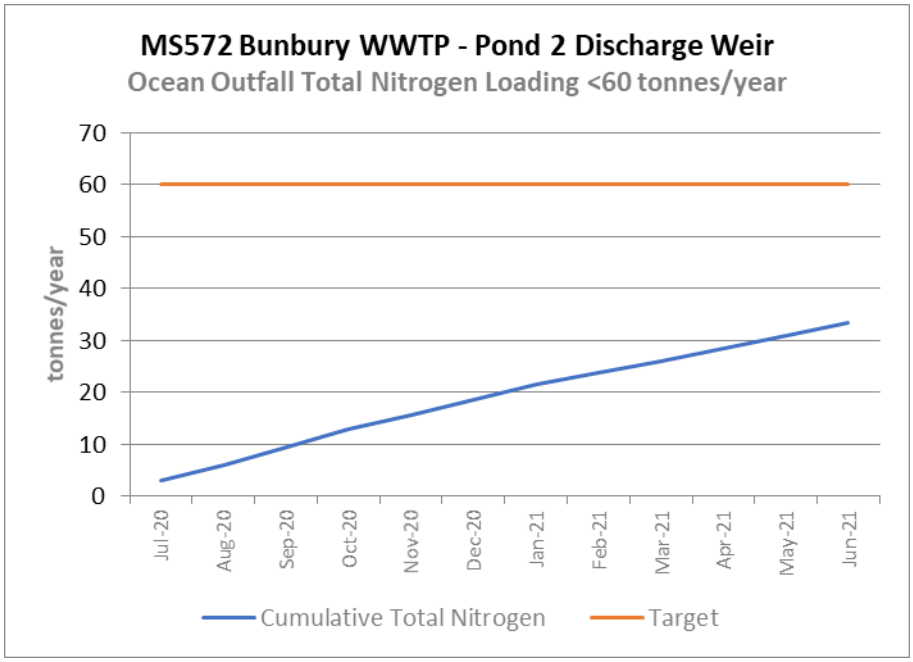

Table 2 – Monthly Monitoring Results for treated wastewater.

	Biochemical Oxygen Demand Carb (BOD)	Suspended Solids (SS)	Total nitrogen
	mg/L	mg/L	mg/L
Jul-20	2.5	2.5	7.9
Aug-20	2.5	2.5	8.2
Sep-20	2.5	2.5	9.2
Oct-20	2.5	2.5	10.0
Nov-20	2.5	10	7.9
Dec-20	2.5	2.5	8.3
Jan-21	2.5	5.0	9.3
Feb-21	2.5	2.5	7.0
Mar-21	2.5	2.5	6.4
Apr-21	2.5	2.5	7.3
May-21	2.5	2.5	6.9
Jun-21	2.5	2.5	7.2
Mean	**2.5**	**3.3**	**8.0**

Notes:

- The data presented in this table consists of the regulatory monthly sample required under licence L5972/1992/14.
- (Note: Samples with results below level of detection (LOD) are represented as ½ LOD (e.g. for BOD and SS, where LOD is 5mg/L, <5mg/L is taken as being 2.5mg/L)

Table 3 – Nitrogen load cumulative discharge ocean outfall

	Monthly Flow	Total Nitrogen	Cumulative Total Nitrogen	Target
	ML	T/month	Tonnes	t/yr
Jul-19	386.58	3.054	3.05	60
Aug-19	378.07	3.100	6.15	60
Sep-19	355.23	3.268	9.42	60
Oct-19	355.91	3.559	12.98	60
Nov-19	342.46	2.705	15.69	60
Dec-19	341.67	2.836	18.52	60
Jan-20	334.37	3.110	21.63	60
Feb-20	308.33	2.158	23.79	60
Mar-20	340.52	2.179	25.97	60
Apr-20	334.01	2.438	28.41	60
May-20	361.42	2.494	30.90	60
Jun-20	356.68	2.568	33.47	60
TOTAL		**33.47**		
Average		3.35		

6 Stakeholder Consultation

As required, Water Corporation engages with stakeholders in a timely and meaningful way and consults with them on matters of mutual interest. Associated comment relating to reuse consultation has been provided in the Audit Table – Table 4.

7 Audit Table

The following audit table is based on the Ministerial Statement 572 Audit Table received from the then OEPA. The “status” and “further information” fields of the audit table have been updated and describes the current stage of implementation for each action. The relevant codes are listed as: OEPA audit table with updated status for each Ministerial condition, i.e.

- Compliant (C)
- Non-Compliant (NC)
- Completed (CLD)
- Not Required at this Stage (NR)
- Not Audited (NA)
- In Process (IP)

Audit Table

Table 4 – Audit Table

Note:

- Phases that apply in this table = **Pre-Construction, Construction, Operation, Decommissioning, Overall (several phases)**
- This audit table is a summary and timetable of conditions and commitments applying to this project. Refer to the Minister's Statement for full detail/precise wording of individual elements.
- Code prefixes: M = Minister's condition; P = Proponent's commitment; A = Audit specification; N = Procedure.
- Any elements with status = "Audited by proponent only" are legally binding but are not required to be addressed specifically in compliance reports, if complied with.
- Acronyms list:- Minister for the Environment - Min for Env; Chief Executive Officer - CEO; Department of Environment - DoE; Evaluation Division - Part IV; Pollution Prevention Division - Part V; Waste Management Division - WMD; Department of Conservation and Land Management - CALM; Department of Minerals and Energy - DME; Environmental Protection Authority - EPA; Health Department of WA - HDWA; Water and Rivers Commission - WRC; Bush Fires Board - BFB.

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
572:M1.1	Implementation	Implement the proposal as documented in Schedule 1 of Statement 572, subject to these conditions and procedures.	The manner of detailed implementation of the proposal shall conform in substance with that set out in any designs specifications, plans or other technical material submitted by the proponent to the EPA initially with the proposal and subsequently, as part of further consideration under Section 46 of the EP Act 1986	As required by M5.1	EPA		Overall	Throughout the life of the project	C	The project has been constructed with design specifications as outlined in Schedule 1 of the Ministerial Statement. Assessment against wastewater quality criteria limits are provided in Section 4 (Table 1).
572:M1.2	Change to proposal	Refer any change to the proposal, as documented in Schedule 1, to the EPA, if the Min for Env & Her determines it is substantial		Document describing changes to the proposal and possible impacts of proposed changes	Min for Env & Her	EPA	Overall	Prior to any substantial changes to the proposal being made	C	N/A
572:M1.3	Change to proposal	Changes to the proposal, as documented in Schedule 1, may be effected where the Min for Env & Her, on advice from the EPA, determines that those changes are not substantial	The criteria are that the proposed change: 1) has no additional, significant environmental impacts; 2) is not a significant and environmentally adverse change to a key proposal characteristic as shown in Schedule 1; 3) has addressed any justifiable environmental concerns of	Document describing changes to the proposal and possible impacts of proposed changes	Min for Env & Her	EPA	Overall	Prior to any substantial changes to the proposal being made	C	There have been no changes during the current reporting period to any aspect of the proposal as documented in Schedule 1. Previous changes: Refer to Attachment 2 to Ministerial Statement 572 [signed 22 April 2014] which details the following change to

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
			relevant stakeholders; 4) is manageable under the existing conditions of this statement and 5) status of compliance reporting is satisfactory.							the proposal under S45C of the *Environmental Protection Act 1986:* Removal of the Total Phosphorous (TP) limit of 10 mg/L and the faecal coliform limit of <10,000 cfu/ 100mL.
572:M2.1	Proponent Commitments	Implement the consolidated environmental management commitments documented in Schedule 2 of Statement 572		As appropriate	EPA		Overall		C	Refer to rows below which provide details of compliance for each of the environmental management commitments.
572:M2.2	Proponent Commitments	Implement subsequent environmental management commitments which the proponent makes as part of the fulfilment of conditions and procedures in Statement 572		Compliance reports to verify that subsequently approved management plans have been properly implemented	EPA		Overall		C	A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously submitted by the Water Corporation. This condition was listed as not requiring auditing according to the OEPA letter dated 11 October 2010 because there were no subsequent commitments (Appendix E of 2008/09 – 2013/14 Performance Review Report (PRR 08/09-13/14) previously provided to DWER). nexus 49590279 This report and the licence Annual Environment Report provide evidence of activities implemented to meet conditions of MS572.
572:M3.1	Nominated Proponent	The proponent nominated by the Minister for the Environment & Heritage, under S38(6) or (7) of the EP Act is responsible for the implementation of the project until the Minister has revoked this			Min for Env & Her	DEP	Overall		C	The proponent has not changed for implementation of the proposal approved under MS 572.

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
		nomination and nominated another person in respect of the proposal under S38(7) of the EP Act								
572:M3.2	Change in Proponent	Any request for a change in proponent shall be accompanied by a copy of the Minister's statement endorsed with an undertaking by the proposed replacement proponent to carry out the proposal in accordance with the conditions and procedures set out in Statement 572		Statement endorsed by the proposed replacement proponent	Min for Env & Her	DEP	Overall	Before transfer of ownership of the proposal	C	The proponent has not changed for implementation of the proposal approved under MS 572.
572:M3.3	Proponent	Notify the DEP of any change of proponent contact name and address			EPA		Overall	Within 30 days of any change of address	C	The proponent has not changed for implementation of the proposal approved under MS 572.
572:M4.1	Commencement	Provide evidence to the Minister for the Environment within five years of the date of Statement 572 that the proposal has been substantially commenced		As required by M4.1	Min for Env & Her	DEP	Overall	By 14 Sept 2006	CLD	The proposal has substantially commenced, as evidenced by this CAR and previous PCRs. Ministerial Statement 572 was issued to the Water Corporation on 14 September 2001. The Bunbury WWTP was commissioned in July 2002, indicating that the proposal had been substantially commenced within five years of the date when the Statement was issued. The Office of the Environmental Protection Authority (OEPA) determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix E of PRR 08/09-13/14).
572:M4.2	Commencement	If the proposal has not been substantially commenced within five years of the date of this statement, the approval to	The Minister will determine any question as to whether the proposal has been substantially commenced		EPA		Overall		NR	This item is no longer relevant as the proposal has substantially commenced.

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
		implement the proposal as granted in Statement 572 shall lapse and be void								
572:M4.3	Commencement	Make an application to the Minister for the Environment and Heritage for any extension of approval for the substantial commencement of the proposal beyond five years from the date of Statement 572		Letter regarding extension required, stating that the proposal is to be implemented as approved.	EPA		Overall	At least six months prior to the expiration date of the five year period (14 March 2006)	NR	This item is no longer relevant as the proposal has substantially commenced.
572:M4.4	Approval Period	The Minister may grant an extension of approval not exceeding five years	If the proponent demonstrates to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority that the environmental parameters of the proposal have not changed significantly	Letter regarding extension required, stating that the proposal is to be implemented as approved	Min for Env & Her	EPA	Overall		NR	This item is no longer relevant as the proposal has substantially commenced.
572:M5.1	Compliance Auditing	Submit periodic Compliance Reports	In accordance with the audit programme prepared in consultation between the proponent and the DEP	Compliance report providing evidence of compliance for each audit element in the audit table.	EPA		Overall	Prior to commencement of construction and annually thereafter until further notice	C	This report
572:M5.2	Compliance Auditing	The CEO of the DEP, unless otherwise specified, will assess compliance with the conditions, procedures and commitments of Statement 572 and will issue formal, written advice when satisfied that each audit element has been complied with.		Written request for clearance of conditions procedures and commitments where the Compliance Report Provides evidence of having met the requirements.	CEO	DEP	Overall		NR	This condition as such cannot be implemented by Water Corporation but provides the pathway for Water Corporation to obtain clearance for commitments and conditions where evidence is available to show completed.
572:M5.3	Compliance Auditing	The Min for Env & Her will determine any dispute over			Min for Env &	DEP	Overall		NR	No advice of non-compliance has been received from DWER.

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
		compliance with any condition, procedure or commitment of Statement 572			Her					
572:M6.1	Marine Management	The proponent shall manage the discharge of effluent from the ocean outlet	This is to achieve simultaneously: 1) the ecosystem health objective (Environmental Quality Objective 1), as defined in the Environmental Protection Authority document Perth's Coastal Waters, Environment Values and Objectives in the zones delineated in figure 2 of schedule 1; 2) the fishing and aquaculture objective (Environmental Quality Objective 2) in the zones delineated in figure 2 of schedule 1; and 3) the recreational and aesthetic objectives (Environmental Quality Objectives 3 and 4 respectively0 in the zones delineated in figure 2 of schedule 1. NOTE: The above Environmental Quality Objective zone are subject to review in both extent and the guideline values and standard criteria applying to them, and may be varied from time to time on advice of the EPA		EPA		Overall		C	The Environmental Quality Objectives were all met during the 2020-21 reporting period. Two exceedances of environmental quality criteria used to assess the EQO – Maintenance of Ecosystem Integrity have been noted. These exceedances included; a) Environmental Quality Guideline (EQG) 'Periphyton biomass' and, b) Seagrass health EQS1. Monitoring results have recorded an exceedance against Environmental EQS1 for seagrass health. The data suggests that high variability (i.e. large standard error) and small sample size could be a contributing to the exceedance in the EQS. c) The EQS2 for seagrass health was met during the reporting period. d) Because the criteria for EQS2 was met, the EQS was met overall A review of the seagrass monitoring sampling frequency will be undertaken during the next update of the Bunbury Ocean Outfall Marine Impact Monitoring and Management Plan.

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
										Refer to BOOM 2020-21 annual report (Attachment 5) for full details.
572:M6.2	Marine Management	In meeting condition 6.1, the proponent shall address the following which are not included in commitment no 19 (operations Environmental Management Program): 1) the identification of ecosystem health indicators appropriate to the discharge site; and 2) site specific guideline values and standard criteria for the indicators, if generic criteria are not appropriate, to the requirements of the EPA on advice from the DEP		Appropriate documentation	EPA	DEP	Overall		C	Refer to BOOM 2020-21 annual report at Attachment 5 for evidence of compliance.
572:M7.1	Decommissioning Plans	Prepare a Preliminary decommissioning plan	The preliminary Decommissioning Plan shall address: 1) rationale for the sitting and design of plant and infrastructure and conceptual plans for its/ their removal or, if appropriate, retention; 2) conceptual rehabilitation plans for all disturbed areas and a process to agree on the end land use(s); and 3) management of noxious materials to avoid the creation of contaminated areas.	Preliminary Decommissioning Plan	EPA	DEP	Pre-construction		CLD	Updated audit table shows this commitment as cleared.

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
572:M7.2	Decommissioning Plans	Prepare a Final Decommissioning Plan	The Final Decommissioning Plan shall address: 1) removal or, if appropriate, retention of plant and infrastructure; 2) rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s); and 3) identification of contaminated areas, including provision of evidence of notification to relevant statutory authorities.	Final decommissioning Plan	EPA	DEP	Post-construction	At least six months prior to the anticipated date of decommissioning, or at a time agreed with the DEP	NR	
572:M7.3	Decommissioning Plans	Implement the Final Decommissioning Plan required by condition 7.2 until such a time as the Min for Env & Her determines that decommissioning is complete			Min for Env & Her		Post-construction		NR	
572:M7.4	Decommissioning Plans	Make the Final Decommissioning Plan publicly available			EPA		Post-construction		NR	
572:M8.1	Work Practices	Prepare a written prescription for contractor work practices covering pipeline installation and support vessel operation			EPA	DEP	Pre-construction		CLD	Updated audit table shows this commitment as cleared.
572:M8.2	Work Practices	Ensure that all pipeline works and support vessel operations comply with the prescription referred to in condition 8.1			EPA		Overall		CLD	A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR and information previously submitted by the Water Corporation. Following the audit this condition was completed according to the OEPA letter dated 11 October 2010 (Appendix E of PRR 08/09-13/14).

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
572:M9.1	Performance Review	The proponent shall submit a Performance Review Report to the DEP	The report should be relevant to the following: 1) environmental objectives reported on in Environmental Protection Authority Bulletin 1021; 2) proponent's consolidated environmental management commitments documented in schedule 2 of this statement and those arising from the fulfilment of conditions and procedures in this statement; 3) environmental performance targets; 4) environment management programs and plans; and/or 5) environmental performance indicators NOTE: The EPA may recommend changes and actions to the Min for the Env and Her following consideration of the Performance Review Report.	Performance Review Report	EPA	DEP	Construction	Each six years following the commencement of construction	C	Refer to Attachment 3, Bunbury Wastewater Treatment Plant, Six Year Performance Review 2014-2020. Submitted to DWER on 22 April 2021.
572:P1.1	Wastewater management	Continue to investigate options for viable wastewater re-use at Bunbury			EPA	City of Bunbury, Shire of Capel and community interest groups	Overall	On-going	C	The State Government announced on 2 September 2020 plans to invest $11.9 million into a wastewater recycling scheme for Bunbury. The Bunbury Water Resource Recovery Scheme will include the construction of a new wastewater recycling facility (adjacent to Bunbury WWTP) and associated infrastructure to supply non-potable water for use on major infrastructure projects and irrigation of public open spaces.

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
										Refer to Section 3.
572:P1.2	Wastewater management	Provide a triennial report to community and DEP	This needs to detail options investigated during the previous three years and plans for the next three years		EPA	City of Bunbury, Shire of Capel and community interest groups	Overall	Every 3 years	C	A triennial report on reuse proceedings for the period up to July 2021 has been submitted as part of this CAR (refer to Attachment 6).
572:P1.3	Wastewater Management	Review requirement after each triennial report			EPA	City of Bunbury, Shire of Capel and community interest groups	Overall	Every 3 years	C	Refer to comments in this column under P1.2.
572:P2	Construction Environment Management Program (EMP)	Prepare EMP for construction phase	EMP should include management plans for: 1) Dune rehabilitation and revegetation; 2) Beach rehabilitation; 3) Marine construction; 4) Underwater blasting (if required); 5) Protection of terrestrial vegetation; 6) Public safety; 7) Aboriginal Heritage; and 8) Construction traffic		EPA	CALM, City of Bunbury, Shire of Capel (Local Authorities), and DPI (Marine Division)	Pre-construction		CLD	Updated audit table shows this commitment as cleared.
572:P3	Construction EMP: Dune management plan	Prepare Dune Management Plan	The plan should address: 1) Minimisation of construction impacts on dune erosion; and 2) Stabilisation and revegetation of the foredune area and areas impacted by construction		EPA	Local Authorities and DPI (Maritime Division)	Pre-construction		CLD	Updated audit table shows this commitment as cleared.
572:P4	Construction EMP: Dune management plan	Implement Dune Management Plan			EPA	Local Authorities and DPI (Maritime	Post-construction	Complete within 12 months following the	CLD	The implementation of the DMP was to be completed within 12 months following the completion of construction. A desktop audit

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
						Division)		completion of construction		was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously submitted by the Water Corporation. Following the audit this commitment was completed according to the letter from OEPA dated 11 October 2010 (Appendix E of PRR 08/09-13/14).
572:P5	Construction EMP:Beach Rehabilitation Plan	Prepare a Beach Rehabilitation Plan which addresses the rehabilitation of the beach after construction			EPA	Local Authorities and DPI (Maritime Division)	Pre-construction		CLD	Updated audit table shows this commitment as cleared.
572:P6	Construction EMP:Beach Rehabilitation Plan	Implement Beach Rehabilitation Plan			EPA	Local Authorities and DPI (Maritime Division)	Post-construction	Within 1 month following completion of construction	CLD	The implementation of the BRP was to be completed within one month following the completion of construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously submitted by the Water Corporation. Following the audit this commitment was completed according to the letter from OEPA dated 11 October 2010 (Appendix E of PRR 08/09-13/14).
572:P7	Construction EMP:Terrestrial flora management plan	Prepare Terrestrial Flora management plan (including Declared Rare and Priority Flora)	The plan should address the issues: 1) That changes in local groundwater levels do not result in the loss of nearby Tuarts and other significant flora; 2) That construction results in minimal and reversible		EPA	CALM	Pre-construction		CLD	The TFMP was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix E of PRR 08/09-13/14). Updated audit table shows this commitment as cleared.

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
			impact on dune vegetation; and 3) That weeds are not introduced or spread							
572:P8	Construction EMP:Terrestrial flora management plan	Implement Terrestrial Flora Management Plan (including Declared Rare and Priority Flora)			EPA	CALM	Post-construction	Complete within 12 months of completion of construction	CLD	The implementation of the TFMP was to be completed within 12 months following the completion of construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously submitted by the Water Corporation. Following the audit this commitment was completed according to the letter from OEPA dated 11 October 2010 (Appendix E of PRR 08/09-13/14).
572:P9	Construction EMP: Marine construction management plan	Prepare a Marine Construction Management Plan	The plan should outline procedures to minimise impacts of marine construction on:1) Marine flora and fauna; and 2) Marine water quality		EPA	CALM	Pre-construction		CLD	The MCMP was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix E of PRR 08/09-13/14).
572:P10	Construction EMP: Marine construction management plan	Implement Marine Construction Management Plan			EPA	CALM	Construction		CLD	The MCMP was to be implemented during construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously submitted by the Water Corporation. Following the audit this commitment was completed according to the letter from OEPA dated 11 October 2010 (Appendix E of PRR 08/09-13/14).
572:P11	Construction EMP: Underwater blasting management	Prepare an Underwater Blasting Management Plan - if blasting is used	The plan will specifically address issues associated with the protection of marine mammals		EPA	CALM	Pre-construction		CLD	The UBMP was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this commitment was completed during a desktop audit dated 11

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
	plan									October 2010 Appendix E of (PRR 08/09-13/14).
572:P12	Construction EMP: Underground blasting management plan	Implement Underwater blasting management plan			EPA	CALM	Construction		CLD	The UBMP was to be implemented during construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously submitted by the Water Corporation. Following the audit this commitment was listed as completed according to the letter from OEPA dated 11 October 2010 (Appendix E of PRR 08/09-13/14).
572:P13	Construction EMP: Public safety plan	Prepare Public Safety Plan	This should address the issues of: 1) Restriction of public access to the construction site; 2) Marine equipment complying with Department of Transport regulations; and 3) Public notification of any restrictions		EPA	Local Authorities	Pre-construction		CLD	Updated audit table shows this commitment as cleared
572:P14	Construction EMP: Public safety plan	Implement Public Safety Plan			EPA	Local Authorities	Construction		CLD	The PSP was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this commitment was completed during a desktop audit dated 11 October 2010 (Appendix E of PRR 08/09-13/14).
572:P15	Construction EMP: Aboriginal Heritage	Prepare an Aboriginal Heritage Plan	The plan should address the issues of: 1) Consultation with local Aboriginal groups; and 2) Obtaining advice from the Department of Indigenous Affairs on work practices		EPA	Local Aboriginal groups and DIA	Pre-construction		CLD	Prior to construction, the Water Corporation was required to prepare an AHP. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
										submitted by the Water Corporation. The audit referred to a letter dated 30 January 2002 which indicates that this commitment had been complied with, therefore this commitment was considered complete (OEPA letter dated 11 October 2010 Appendix E of PRR 08/09-13/14).
572:P16	Construction EMP; Aboriginal Heritage	Implement Aboriginal Heritage Plan			EPA	Local Aboriginal groups and DIA	Pre-construction		CLD	This item is complete and requires acknowledgement as such by DWER.
572:P17	Construction EMP: Construction traffic plan	Prepare a construction traffic plan to minimise impacts of construction traffic on local residents			EPA	Local Authorities	Pre-construction		CLD	The CTP was required to be prepared prior to construction commencing. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously submitted by the Water Corporation. The audit referred to a letter dated 30 January 2002 which indicates that this commitment had been complied with, therefore this commitment was considered complete (OEPA letter dated 11 October 2010, Appendix E of PRR 08/09-13/14).
572:P18	Construction EMP: Construction Traffic Plan	Implement Construction Traffic Plan			EPA	Local Authorities	Construction		CLD	The CTP was to be implemented during construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously submitted by the Water Corporation. The audit referred to the previous six yearly performance review (Oceanica 2009a) which indicates that this

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
										commitment had been complied with and the fact that the WWTP was now in operation and was only required during construction. Therefore, this commitment was considered complete (OEPA letter dated 11 October 2010, Appendix E of PRR 08/09-13/14).
572:P19	Operations Environmental Management Program	Prepare EMP for the operations phase	This should include plans for: 1) Marine biota, sediment and water quality; 2) Recreational water quality; and 3) Wastewater treatment management		EPA	CALM, Local Authorities and DPI (Maritime Division)	Pre-construction	Prior to commissioning	CLD	The Operations EMP (provided to DWER in previous compliance reports – (Water Corporation internal https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/49503192) includes a Marine Impacts Monitoring and Management Plan (MIMMP, DALSE 2002b; refer Section 4.2). The MIMMP was revised two more times: an interim plan (Water Corporation 2001b); and a final revised MIMMP (Water Corporation 2012a). The interim and revised versions of the MIMMP were approved by the OEPA (Appendix G of PRR 08/09-13/14).
572:P20	Operations EMP: Marine biota, sediment and water quality management plan	Prepare Marine Biota, Sediment and Water Quality Management Plan	The plan should address the following issues: 1) Derive site specific trigger levels for waters in the vicinity of the outlet for indicators other than toxicants, where appropriate (ANZECC, 2000); 2) Design appropriate study to differentiate between natural and anthropogenic sources of nitrogen currently existing and due to future discharge from the outfall; 3) Design monitoring programs for		EPA	CALM	Pre-construction	Prior to commissioning of the outlet	CLD	The MBSWMP was prepared as part of the Operations EMP required under P19 (see above). The MBSWMP was cleared by the DEC audit branch on 26 July 2002 and the OEPA determined that this commitment was listed as completed during a desktop audit dated 11 October 2010 (Appendix E of PRR 08/09-13/14).

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
			the sediments in the vicinity of the outlet; 4) Design of water quality monitoring programs which have the ability to measure long term changes in water quality, including changes in productivity, biodiversity and ecosystem processes. Include reference site for comparison; 5) Contingency planning to improve water quality or reduce loads of contaminants and nutrients discharged if monitoring shows that agreed criteria are not met; 6) Reporting procedures to DEP; 7) Monitoring of contaminant levels in treated wastewater at Bunbury WWTP; and 8) Quality assurance procedures for monitoring programmes.								
572:P21	Operations EMP:Marine biota, sediment and water quality management plan	Implement Marine Biota, Sediment and Water Quality Management Plan for five years after completion of construction, after which time it will be reviewed in consultation with DEP			EPA	CALM	Post-construction	For 5 years after completion of construction, after which time the program will be reviewed	C	BOOM Sediment Sampling completed in May 2019 and provided in the 2019-20 PCR. (See Attachment 7). The EMP (2012) (Attachment 2) contains a review history for the EMP, done in consultation with the Regulator.
572:P22	Operations EMP:Recreational water quality management plan	Prepare a Recreational Water Quality Management Plan	The plan should address the following issues: 1) Design a bacterial monitoring program which will establish whether primary contact criteria are met within 100m of the diffuser and whether		EPA	Department of Health and Local Authorities	Pre-construction	Prior to commissioning of the outlet	CLD	Updated audit table shows this commitment as cleared.

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
			shellfish harvesting criteria within 500m of the diffuser; and 2) Contingency planning to improve water quality if monitoring shows that agreed criteria are not met							
572:P23	Operations EMP:Recreational water quality management plan	Implement Water Quality Management Plan			EPA	DEP, Department of Health and Local Authorities	Post-construction	For five years after completion of construction after which time it will be reviewed in consultation with the DEP	CLD	Refer to BOOM 2020/21 annual report for evidence of compliance (Attachment 5). The EMP (2012) (Attachment 2) contains a review history for the EMP, done in consultation with the Regulator.
572:P24	Recreation (land based)	Maintain legitimate recreational uses of the beach and dune areas	*No plan required		EPA	Relevant Local Authorities	Overall		Only proponent to audit	The beach and foredune remain open to public access. Water Corporation has received no reports that the recreational value of the beach or dune areas have diminished since the construction of the Bunbury Wastewater Treatment Plant.
572:P25	Operations EMP:Wastewater treatment management plan	Prepare a Wastewater Treatment Management Plan	The plan should address the following issues: 1) Operate WWTP such that national guidelines for toxicant concentrations in marine waters are met; 2) Bring forward upgrade of wastewater treatment system if monitoring shows unacceptable environmental impacts; 3) Operate WWTP such that agreed EQO's and EQC are met to 95% confidence; 4) Discontinue the current practice of discharging treated wastewater to unlined lagoons, except where flows are required		EPA		Pre-construction	Prior to the commissioning of the outlet	CLD	Updated audit table shows this commitment as cleared

Audit Table

Number	Issue	Action	How	Report	Satisfy	Advice	Phase	When	WC Status	Further information
			to reduce stress on nearby trees; 5) Ensure maximum annual average nitrogen load to the ocean from the outlet is less than 60tpa; and 6) Contingency plans for non-standard operation of the WWTP							
572:P26	Operations EMP :Wastewater treatment management plan	Implement Wastewater Treatment Management Plan			EPA		Pre-construction	For five years after completion of construction, after which time it will be reviewed in consultation with DEP	CLD	Refer to BOOM 2020/21 annual report for evidence of compliance (Attachment 5). The EMP (2012) (Attachment 2) contains a review history for the EMP, done in consultation with the Regulator.
572:P27	Community Consultation	Provide information during construction of outlet and monitoring of operations to community groups and Consider community objectives			EPA	City of Bunbury, Shire of Capel and interest groups	Overall		C	Refer section 5

ATTACHMENT 1

Statement of Compliance 2020-21

(https://nexus.watercorporation.com.au/otcs/cs.exe/link/120978498)

Statement of Compliance

1. Proposal and Proponent Details

Proposal Title	*Ocean Outlet for Treated Wastewater, Bunbury Wastewater Treatment Plant*
Statement Number	*572*
Proponent Name	*Water Corporation*
Proponent's Australian Company Number *(where relevant)*	28 003 434 917

2. Statement of Compliance Details

Reporting Period	*1/07/20* to *30/06/21*

Implementation phase(s) during reporting period (please tick ✓ relevant phase(s))							
Pre-construction		Construction		Operation	✓	Decommissioning	

Audit Table for Statement addressed in this Statement of Compliance is provided at Attachment:	within Compliance Assessment Report
An audit table for the Statement addressed in this Statement of Compliance must be provided as Attachment 2 to this Statement of Compliance. The audit table must be prepared and maintained in accordance with the Department of Water and Environmental Regulation (DWER) *Post Assessment Guideline for Preparing an Audit Table*, as amended from time to time. The 'Status Column' of the audit table must accurately describe the compliance status of each implementation condition and/or procedure for the reporting period of this Statement of Compliance. The terms that may be used by the proponent in the 'Status Column' of the audit table are limited to the Compliance Status Terms listed and defined in Table 1 of Attachment 1.	

Were all implementation conditions and/or procedures of the Statement complied with within the reporting period? (please tick ✓ the appropriate box)			
No (please proceed to Section 3)		Yes (please proceed to Section 4)	✓

Each page (including Attachment 2) must be initialed by the person who signs Section 4 of this Statement of Compliance.
INITIALS: DS.

3. Details of Non-compliance(s) and/or Potential Non-compliance(s)

The information required Section 3 must be provided for each non-compliance or potential non-compliance identified during the reporting period covered by this Statement of Compliance.

Non-compliance/potential non-compliance 3-1

Which implementation condition or procedure was non-compliant or potentially non-compliant?
Was the implementation condition or procedure non-compliant or potentially non-compliant?
On what date(s) did the non-compliance or potential non-compliance occur (if applicable)?
Was this non-compliance or potential non-compliance reported to the Chief Executive Officer, DWER?
☐ Yes ☐ Reported to DWER verbally Date _____ ☐ Reported to DWER in writing Date _____ ☐ No
What are the details of the non-compliance or potential non-compliance and where relevant, the extent of and impacts associated with the non-compliance or potential non-compliance?
What is the precise location where the non-compliance or potential non-compliance occurred (if applicable)? (please provide this information as a map or GIS co-ordinates)
What was the cause(s) of the non-compliance or potential non-compliance?
What remedial and/or corrective action(s), if any, were taken or are proposed to be taken in response to the non-compliance or potential non-compliance?
What measures, if any, were in place to prevent the non-compliance or potential non-compliance before it occurred? What, if any, amendments have been made to those measures to prevent re-occurrence?
Please provide information/documentation collected and recorded in relation to this implementation condition or procedure: • in the reporting period addressed in this Statement of Compliance; and • as outlined in the approved Compliance Assessment Plan for the Statement addressed in this Statement of Compliance. (the above information may be provided as an attachment to this Statement of Compliance)

For additional non-compliance or potential non-compliance, please duplicate this page as required.

Each page (including Attachment 2) must be initialed by the person who signs Section 4 of this Statement of Compliance.
INITIALS: _____

4. Proponent Declaration

I, Digby Short, Manager - Environment

declare that I am authorised on behalf of Water Corporation

(being the person responsible for the proposal) to submit this form and that the information contained in this form is true and not misleading.

Signature:..... Date: 19/11/2021

Please note that:

- it is an offence under section 112 of the *Environmental Protection Act 1986* for a person to give or cause to be given information that to his knowledge is false or misleading in a material particular; and
- the Chief Executive Officer of the DWER has powers under section 47(2) of the *Environmental Protection Act 1986* to require reports and information about implementation of the proposal to which the statement relates and compliance with the implementation conditions.

5. Submission of Statement of Compliance

One hard copy and one electronic copy (preferably PDF on CD or thumb drive) of the Statement of Compliance are required to be submitted to the Chief Executive Officer, DWER, marked to the attention of Manager, Compliance (Ministerial Statements).

Please note, the DWER has adopted a procedure of providing written acknowledgment of receipt of all Statements of Compliance submitted by the proponent, however, the DWER does not approve Statements of Compliance.

6. Contact Information

Queries regarding Statements of Compliance, or other issues of compliance relevant to a Statement may be directed to Compliance (Ministerial Statements), DWER:

Manager, Compliance (Ministerial Statements)

Department of Water and Environmental Regulation

Postal Address:	Locked Bag 10 Joondalup DC WA 6919
Phone:	(08) 6364 7000
Email:	compliance@dwer.wa.gov.au

7. Post Assessment Guidelines and Forms

Post assessment documents can be found at www.epa.wa.gov.au

ATTACHMENT 1

Table 1 Compliance Status Terms

Compliance Status Terms	Abbrev	Definition	Notes
Compliant	C	Implementation of the proposal has been carried out in accordance with the requirements of the audit element.	This term applies to audit elements with: • ongoing requirements that have been met during the reporting period; and • requirements with a finite period of application that have been met during the reporting period, but whose status has not yet been classified as 'completed'.
Completed	CLD	A requirement with a finite period of application has been satisfactorily completed.	This term may only be used where: • audit elements have a finite period of application (e.g. construction activities, development of a document); • the action has been satisfactorily completed; and • the DWER has provided written acceptance of 'completed' status for the audit element.
Not required at this stage	NR	The requirements of the audit element were not triggered during the reporting period.	This should be consistent with the 'Phase' column of the audit table.
Potentially Non-compliant	PNC	Possible or likely failure to meet the requirements of the audit element.	This term may apply where during the reporting period the proponent has identified a potential non-compliance and has not yet finalized its investigations to determine whether non-compliance has occurred.
Non-compliant	NC	Implementation of the proposal has not been carried out in accordance with the requirements of the audit element.	This term applies where the requirements of the audit element are not "complete" have not been met during the reporting period.
In Process	IP	Where an audit element requires a management or monitoring plan be submitted to the DWER or another government agency for approval, that submission has been made and no further information or changes have been requested by the DWER or the other government agency and assessment by the DWER or other government agency for approval is still pending.	**The term 'In Process' may not be used for any purpose other than that stated in the Definition Column.** The term 'In Process' may not be used to describe the compliance status of an implementation condition and/or procedure that requires implementation throughout the life of the project (e.g. implementation of a management plan).

ATTACHMENT 2

Bunbury Ocean Outlet Operations EMP – Marine Impacts Monitoring and Management Plan June 2012

https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/49491479

WATER CORPORATION

Bunbury Ocean Outlet Operations EMP

Marine Impacts Monitoring and Management Plan

June 2012

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Bunbury Wastewater Treatment Plant

Marine Impacts Monitoring and Management Plan (2012)

Prepared by

Water Corporation

June 2012

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Document Revision History

Doc No & Rev No.	Date	Description of Revision Made	Author	Reviewer	Approved	Initial*
4259280 v1	14 September 2002	Original Document	DAL Science & Engineering		DAL Science & Engineering	
4774732 v1	29 May 2011	Interim Version - Water Quality Monitoring Reduced to Annually – No technical amendments	M. Hatch	G. Watson	G. Watson	
5542160 v1	15 September 2011	Technical Changes – Inclusion of new figures	M. Hatch			
5542160 v1a	29 September	EQO Amendments	M. Hatch			
5542160 v1b	6 October 2011	Technical	M. Hatch			
5542160 v2	7 October 2011	Final Draft	M. Hatch	G. Groth	G. Groth	
5542160 v3	12 October 2011	SWR Final Review/Approval	M. Hatch		M. Rempel	
5542160 v3A	1 June 2012	Revision to 5.4.4 and 9.3.3	B. Scott	G. Groth		

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FOREWARD

The original Marine Impacts Monitoring and Management Plan (MIMMP) for the Bunbury Wastewater Treatment Plant was written in 2002. This 2012 revised version reflects the project's current status, current standards in environmental management and the Water Corporation's commitment to protecting the marine environment within which the Bunbury Ocean Outlet is located.

Responsible environmental management depends on knowledge of the potential effects of ocean wastewater disposal together with an understanding of the receiving environment, including the extent of natural variation. To ensure that the effects (if any) of ocean disposal are detected early, the Water Corporation has committed to an extensive summer program of environmental monitoring, the details of which are included in this MIMMP.

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CONTENTS

TABLES

FIGURES

1. INTRODUCTION

This Marine Impacts Monitoring and Management Plan for the Bunbury Ocean Outfall forms a part of the Bunbury Operations Environmental Management Plan (EMP) and addresses the following items raised in Schedule 2 (Proponent's Environmental Management Commitments) of EPA Bulletin 1021 (EPA, 2001a):

- Derive site specific trigger levels for waters in the vicinity of the outfall for indicators other than toxicants, where appropriate (ANZECC & ARMCANZ, 2000);
- Design appropriate study to differentiate between natural and anthropogenic sources of nitrogen currently existing and due to future discharge from outfall;
- Design monitoring programs for the sediments in the vicinity of the outfall;
- Design of water quality monitoring programs which have the ability to measure long-term changes in water quality, including changes in productivity, biodiversity and ecosystem processes. Include reference site for comparison;
- Contingency planning to improve water quality or reduce loads of contaminants and nutrients discharged if monitoring shows that agreed criteria are not met;
- Reporting procedures to DEP;
- Monitoring of contaminant levels in treated wastewater at Bunbury WWTP;
- Quality assurance procedures for monitoring programs;
- Design a bacterial monitoring program which will establish whether primary contact criteria are met within 100 m of the diffuser and whether shellfish harvesting criteria are met within 500 m of the diffuser; and
- Contingency planning to improve water quality if monitoring shows that agreed criteria are not met.

The Water Corporation's stated objectives are to:

- Maintain the biodiversity of the seafloor within the relevant geographical area;
- Ensure that impacts upon locally significant marine flora and fauna communities are avoided;
- Maintain or improve marine water and sediment quality consistent with agreed EQOs and EQC; and
- Achieve criteria at defined zones to 95% confidence.

This plan has been developed using the framework set out in the ANZECC & ARMCANZ (2000) water quality guidelines (the Guidelines), the requirements set out in EPA Bulletin 1021 (EPA, 2001a), Environmental Quality Criteria Reference Document for Cockburn Sound (EPA, 2005) and the concepts set out for the Environmental Protection Policy (EPP) (Cockburn Sound) (EPA, 2001b).

2. EXISTING MARINE ENVIRONMENT

2.1 OVERVIEW

The outfall diffuser is located about 1.7 km offshore of the Bunbury WWTP at the northern end of Geographe Bay (Figure 2.2). The primary concerns are the discharge of nutrients, pathogens and toxicants to the environment.

The nutrient related water quality data collected for the Public Environmental Review (PER; Water Corporation, 2000) process suggested that the water body shows levels of production similar to other Western Australian near-shore coastal areas and embayments. Productivity in the marine ecosystem is limited by the availability of nitrogen and as such, the load of nitrogen from the WWTP is likely to result in increased primary productivity in the vicinity of the diffuser (Water Corporation, 2000).

The key sources of anthropogenic nitrogen which may impact on the local ecosystem other than those from the outfall are due to:

- Flows from the Leschenault Estuary, 8 km north;
- Local shoreline flows from groundwater contaminated by previous operation of the infiltration lagoons; and
- Flows from drains and creeks, the closest being approximately 2 km away.

The key natural factors affecting the local water quality are the effects of the Leeuwin Current, the sheltering effect of Cape Naturalist and the broad extent and coverage of mixed seagrass and algal reef habitat in the region. The extensive marine flora can have a significant effect through the continuous process of nutrient recycling: as seagrass and algae dies or is ripped from the seabed in storms this material is then broken down by microbial action with the much of the nutrients returned to the system.

2.2 MONITORING PRIOR TO COMMISSIONING

2.2.1 Parameters

The following parameters were measured for the PER and baseline survey work (e.g. DAL Science & Engineering (DALSE), 2002):

Water quality parameters

Physical:

- Currents;
- Wind speed; and
- Salinity and temperature profiles.

Chemical:

- Total phosphorus;
- Free reactive phosphorus;
- Total Nitrogen;

- Total Kjeldahl Nitrogen;
- Ammonium;
- Nitrate+Nitrite;
- Chlorophyll a;
- Thermotolerant coliforms; and
- Faecal Streptococci.

Biological:

- Phytoplankton species, biomass (as chlorophyll a) and productivity;
- Periphyton growth, measured as chlorophyll, carbonate and organic content; and
- Sentinel mussels analysed for heavy metals, organochlorine pesticides and extractable organohalogens (EOX) contamination.

Sediment quality parameters

- Heavy metals;
- Organochlorine pesticides;
- Extractable organohalogens (EOX);
- Loss on ignition (LOI);
- Calcium carbonate; and
- Particle size distribution.

2.2.2 Methodology and site locations

Background information concerning the water quality sampling and analysis methodology and the site locations is provided in D.A. Lord & Associates (DAL) (1999a). The information detailing the methodology and sites for the periphyton monitoring is given in SKM (2000a), and the sediment quality and mussel bio-monitoring sampling methodology and sites in SKM (2000b).

2.2.3 Sampling schedule

Samples were collected on 9 March 1999, 5 October 1999, 11 February 2000, 10 October 2000, 13 March 2001 and 1 February 2002. Therefore, there were four surveys in which late summer conditions were sampled and two surveys where spring conditions were sampled.

2.2.4 Summary of existing nutrient related water quality

Reports have been prepared describing the water quality on each sampling survey (DAL 1999a, DAL 1999b, DAL 2000, DAL 2001a, DAL 2001b, DALSE 2002). Sample sites were grouped into shoreline (collected in surf zone), offshore surface and offshore depth. Chlorophyll a data were derived both through acetone extraction and fluorometrically (with extractions used to calibrate the fluorometric data). The acetone extraction technique is considered to be a more reliable method than the fluorometric technique and as such only data derived from acetone extraction are used in the derivation of draft site specific criteria in this EMP (refer Section 4.2). The acetone extracted surface chlorophyll a values for summer and spring generated through the routine surveys and other work for the PER (Waite and Alexander, 2000) are summarized in Table 2.1 below.

The ANZECC & ARMCANZ (2000) approach to the derivation of site specific reference data is to provide reference data applicable to each month of the year, recognizing the extreme seasonal variability in some water quality parameters. Figure 2.1 demonstrates that Bunbury is no exception. For this exercise, due to a lack of data, the data have been grouped into summer and spring. However, given the variability observed, monthly values may be derived as more reference data become available.

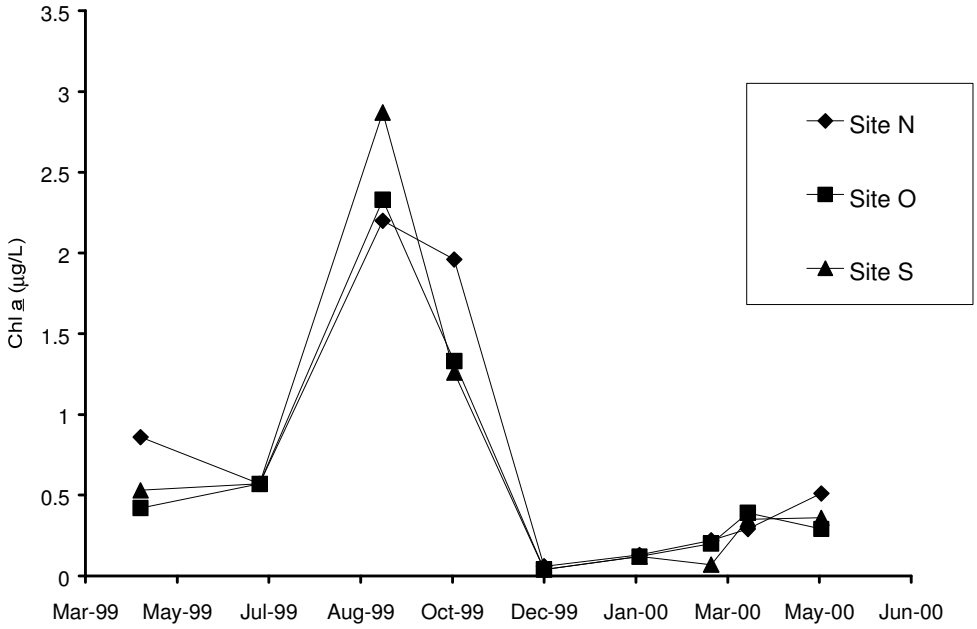

Figure 2.1 Seasonal variation in depth-averaged chlorophyll concentrations offshore from Bunbury WWTP (Waite and Alexander, 2000)

Table 2.1 Summary of offshore surface chlorophyll a data (all concentrations in µg/l)

	SPRING	SUMMER
Number of values	15	23
Median	0.93	0.25
20%ile	0.25	0.19
80%ile	1.77	0.39
Max.	3.16	1.82
Min.	0.05	0.11

Periphyton collectors were deployed at six locations for spring summer and autumn in 1999 and 2000 (SKM, 2000a). The chlorophyll analysis was undertaken using the acetone extraction technique by the same laboratory as did the water column chlorophyll. The periphyton chlorophyll a data are summarized in Table 2.2.

Table 2.2 Summary of 1999/2000 periphyton chlorophyll a data

COLLECTOR DEPTH	STATISTIC	SPRING CHL. a (mg/m^2)	SUMMER CHL. a (mg/m^2)	AUTUMN CHL. a (mg/m^2)
2 m	median	0.2	2.3	6.8
2 m	80%ile	0.6	2.9	14.3
2 m	95%ile	0.7	3.0	22.6
8 m	median	0.5	15.2	9.8
8 m	80%ile	0.8	17.6	12.9
8 m	95%ile	0.9	18.7	15.9

It can be seen for both the water quality and the periphyton data there are significant differences between the seasons and also with depth. The periphyton chlorophyll levels are lowest in spring while the water column chlorophyll levels are lowest in summer. The reason for this is unclear as the periphyton collectors would have been experiencing the same nutrient concentration as the phytoplankton. The only plausible explanation is that periphyton growth may have been affected by either the water temperature or the colonisation rates of the bare plates. The dramatic difference with depth may also be a result of reduced colonisation of the plates near the surface. The results tend to bear out the difficulties in characterizing productivity levels in marine ecosystems and point out the need for more monitoring data to refine criteria.

It is recommended that, in the case of the periphyton criteria, the criteria for the edge of the E4/E2 boundary are developed on the basis of the data from the reference site for that particular monitoring period, i.e. criteria are not fixed numbers but rather, fixed percentiles of the reference site results. This way, any regional or inter-annual effects are captured.

This approach is likely to be useful for water quality measurements as the temporally integrating effect of periphyton collection is not present and spatial variability is considerable. Therefore, water quality criteria should be built up from an ever expanding database, with the aim of developing increasingly refined criteria for the months of interest.

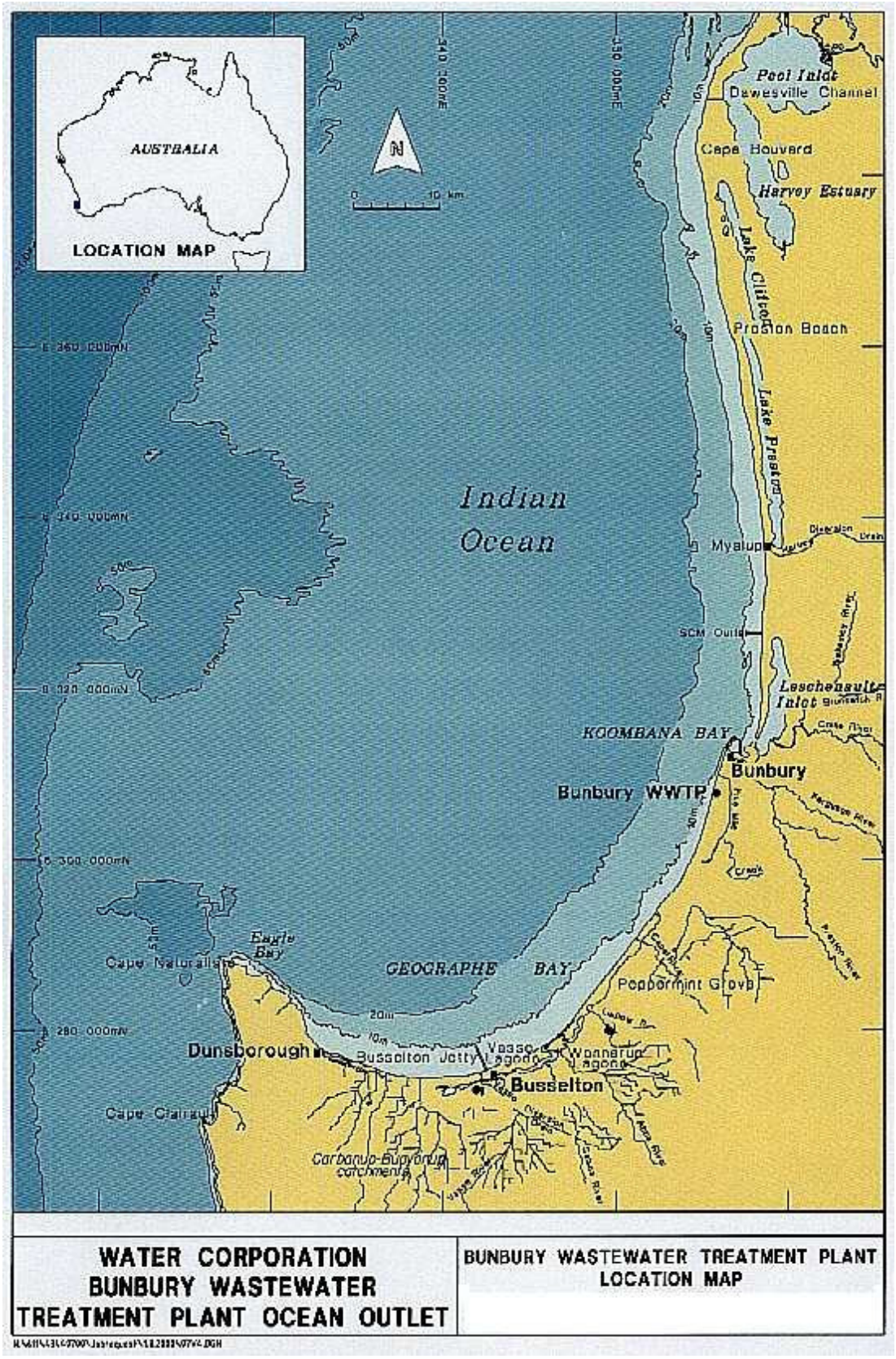

Figure 2.2 Bunbury WWTP location map

3. ENVIRONMENTAL VALUES AND QUALITY OBJECTIVES

3.1 FRAMEWORK

Management of the Bunbury ocean outlet will be undertaken according to the framework developed by the National Water Quality Management Strategy (NWQMS): the Environmental Quality Management Framework (EQMF). The Government of Western Australian has endorsed the state-wide implementation of the EQMF on a priority basis (Government of Western Australia 2004). The EQMF is based upon:

Establishing local **Environmental Values (EVs)**;

Establishing and spatially defining **Environmental Quality Objectives (EQOs)** that need to be maintained to meet the associated Environmental Values;

Monitoring and managing to ensure the EQOs are achieved and/or maintained in the long-term in the areas they have been designated; and

Establishing **Environmental Quality Criteria (EQC)**, which are quantitative bench marks or 'trigger values' against which monitoring results can be compared.

The Environmental Values (EVs) for the region have been defined by the EPA (EPA, 2001a). The EVs defined in EPA (2000) which apply to the waters are: Ecosystem Health (an ecological value); Fishing and Aquaculture (a social value); and, Recreation and Aesthetics (a social value). The fourth EV, Industrial Water Supply (a social value) does not apply as there is no industry which draws water from the region of the outfall. Various Environmental Quality Objectives (EQOs) have been established for the protection of these values, with the EQO for ecosystem health split into objectives corresponding to relative levels of ecosystem protection. These are shown in **Error! Reference source not found.**.

Table 3.1 Environmental Values, Environmental Quality Objectives and associated areas applied to the Bunbury ocean outlet

Environmental Value	Environmental Quality Objective	Requirement and associated area
Ecosystem Health	EQO1 Maintenance of ecosystem integrity	Within 100 m of the diffuser: a low level of ecosystem integrity will apply (E4)
		At distances greater than 100 m from the diffuser: a high level of ecosystem integrity will apply (E2)
Fishing and Aquaculture	EQO2 (i) Maintenance of aquatic life for human consumption	No shellfish harvesting within 500 m of the diffuser (S2)
	EQO2 (ii) Maintenance of aquaculture	
Recreation and Aesthetics	EQO3 Maintenance of primary contact recreation values	Within 100 m of the diffuser: a primary contact recreation exclusion area will apply (S3)
	EQO4 Maintenance of secondary contact and recreation values	Not to be affected by the presence of outlet
	EQO5 Maintenance of aesthetic values	Not to be affected by the presence of outlet
Industrial water supply	EQO6 Maintenance of industrial water supply	The waters are of suitable quality for industrial water supply except in areas designated S6

3.2 EQO ZONES IN THE VICINITY OF THE OUTFALL

During the approval process for the outfall, the Water Corporation and the EPA have agreed to apply the quality objective designations to zones around the outfall diffuser as shown in Figure 3.1 on the basis that the zones and the associated criteria may be varied subject to further review (EPA, 2001a).

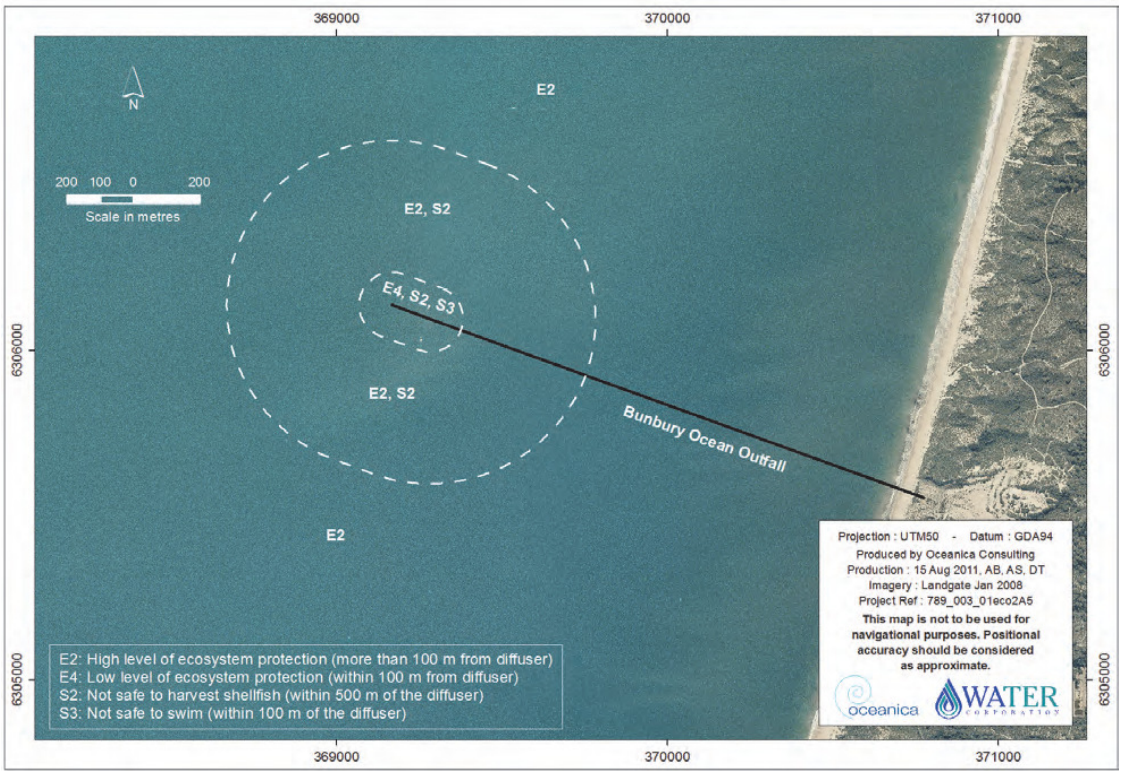

Figure 3.1 Bunbury ocean outfall: Schematic diagram showing levels of protection (EPA, 2001a)

The Water Corporation and ANZECC & ARMCANZ position is that the criteria which results in the need for a zone of exclusion in the vicinity of the Bunbury ocean outfall relates solely to the harvesting of shellfish, not the harvesting of seafood. This is stated in the PER (Water Corporation, 2000) and confirmed explicitly in Table 4.4.4 of the Guidelines (ANZECC & ARMCANZ, 2000). There is no evidence to suggest that the levels of bacteria in the vicinity of Water Corporation's outfalls will lead to public health concerns in regard to harvesting of seafood other than shellfish.

4. ENVIRONMENTAL QUALITY CRITERIA

Environmental quality criteria (EQC) play an important role in the management framework by providing the quantitative benchmarks for measuring success in achieving the EQO. For each of the EQO a set of environmental quality criteria have been established to provide the benchmark against which environmental quality and the performance of environmental management can be measured. Two main types of EQC have been developed to remain consistent with ANZECC/ARMCANZ (2000).

Environmental Quality Guidelines (EQG): are threshold numerical values or narrative statements that, if met, indicate there is a high degree of certainty that the associated environmental quality objective has been achieved. If the guideline is not met, there is uncertainty as to whether the associated environmental quality objective has been achieved and a more detailed assessment against the EQS is triggered.

Environmental Quality Standards (EQS): are threshold values or narrative statements that indicate a level beyond which there is a significant risk that the associated environmental quality objective has been not been achieved. The response would normally focus on identifying the cause (or source) of the exceedance and then reducing loads of the contaminant of concern (i.e. source control) and may also require in situ remedial work to be undertaken. EQS are generally equivalent to the water quality objectives described in ANZECC/ARMCANZ (2000).

4.1 MANAGEMENT RESPONSE PROTOCOL

EQG have been developed according the approach defined in EPA (2005) such that exceedance of an EQG is a 'trigger' for further investigation against the corresponding EQS. EQG are generally relatively simple and easy to measure indicators of environmental quality. If exceeded, it is considered that there is an increased risk that the associated environmental quality objectives may not be met and this signals the need for more comprehensive assessment against the EQS.

EQS have been developed according to the risk based approach also defined in EPA (2005). EQS incorporate multiple lines of evidence and integrate more refined measures of the surrogate indicators with more direct measures of the EQO. If an EQS is exceeded, it is considered that there is a significant risk that the associated EQO has not been achieved, investigation of the cause is needed and an adaptive management response is triggered if the exceedance continues. The management response protocol following EPA (2005) is outlined in Figure 4.1. Contingency plans to be implemented in the event that agreed criteria are not met are further outlined in Section 10.

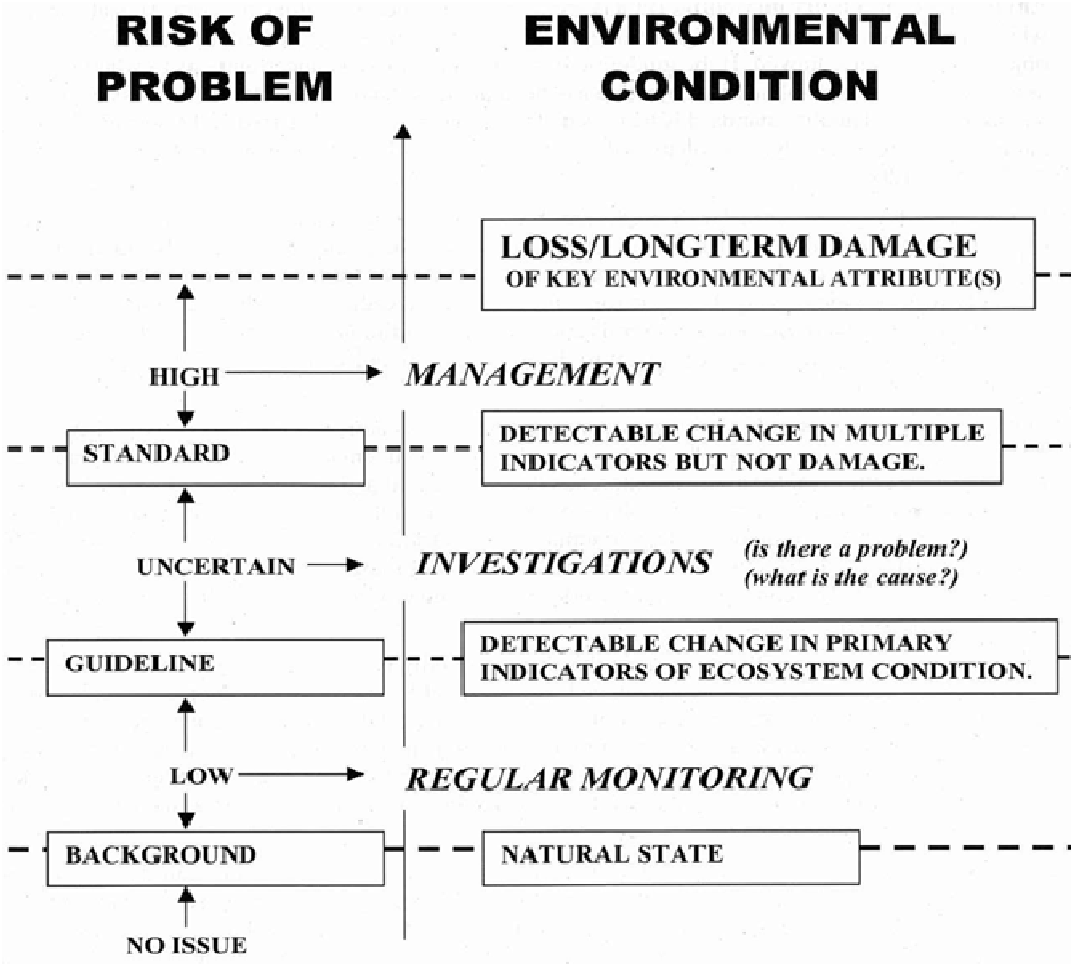

Figure 4.1 Management response protocol from EPA (2005): Conceptual diagram showing the relationship between the two types of EQC on the left hand side with the associated environmental condition on the right hand side

4.2 SITE SPECIFIC EQC

4.2.1 Methodology

The EQC in Table 4.2, 4.3 and 4.4 are largely based on the original MIMMP requirements as well as guidelines most recently accepted as part of the Alkimos Wastewater Treatment Plant and those likely to be accepted as part of the Sepia Depression Ocean Outlet Management and Monitoring Plans (Oceanica 2011a, b).

Regular monitoring has been undertaken in the region of the outfall in the period leading up to its commissioning and throughout its operation. This monitoring has provided valuable 'background' data for the purposes of characterising the ambient water quality and developing ecological criteria for compliance purposes. It was found that samples collected 500 m or more offshore were not impacted by the nutrient contaminated groundwater from the WWTP lagoons entering the ocean at the surf zone (such impacts were apparent in the shoreline samples).

4.2.2 EQO1: Maintenance of Ecosystem Integrity

The EQC for the maintenance of ecosystem integrity are based on the existing EQC set in the original MIMMP along with criteria set out in the Environmental Quality Reference Document for Cockburn Sound (EPA 2005) (Table 4.2). The physical-chemical stressor, dissolved oxygen (DO) indicates whether conditions surrounding the outlet are within the natural variation expected within the region. Measures of dissolved oxygen are particularly important at the bottom of the water column, where anoxic conditions may adversely affect benthic fauna.

One of the main cause-effect pathways relevant to treated wastewater outlets results from the addition of nutrients. Indicators relevant to the EQG for nutrients are in-water measures of chlorophyll *a*, phytoplankton biomass, periphyton biomass (also measured as chlorophyll a) and water clarity (measured as light attenuation). When present in high enough concentrations, phytoplankton may act to shade benthic communities, including seagrass. A plant receiving enough light at the leaf epidermis is one of the primary determinants of seagrass survival (EPA 2005). Therefore, the EQS or second line of defence following an exceedance of a nutrient EQG is related to seagrass health (measured as shoot density).

Table 4.2 EQG and EQS for the high ecological protection area surrounding the Bunbury Ocean Outlet and pertaining to the EQO for the maintenance of ecological integrity

Parameter		EQG for high ecological protection	EQS for high ecological protection
Nutrients - indicators of nutrient enrichment and algal growth[2]	Surface chlorophyll *a*	Ambient value of the defined area during the summer period is not to exceed the 80th percentile of reference site data[1]	i) The ambient values for seagrass meadow shoot density measured during January and in two consecutive years is greater than the 20th percentile of shoot density measured at an appropriate reference site; AND ii) The ambient values for seagrass meadow shoot density in any one year is greater than the 5th percentile of meadow shoot density measured at an appropriate reference site
	Periphyton chlorophyll *a*	Ambient value of the defined area during the summer period is not to exceed the 80th percentile of reference site data at the 8 m depth from the current reporting period	
	LAC	Ambient value of the defined area during the summer period is not to exceed the 80th percentile of reference site data[1]	
	Phytoplankton biomass	Ambient value for phytoplankton biomass measured as chlorophyll *a* does not exceed 3 times the median of chlorophyll *a* concentrations of reference sites[1], on any occasion during non river-flow period	Ambient value for phytoplankton biomass measured as chlorophyll *a* not to exceed 3 times the median of chlorophyll *a* concentration of reference sites[1], on more than one occasion during non river-flow period and in two consecutive years
Physical-chemical stressor:	Dissolved oxygen % saturation	Ambient value for dissolved oxygen in bottom waters (0–0.5 m above the sediment surface)[7] is greater than 90% saturation at any site for a defined period of not more than six weeks	i) Ambient value for dissolved oxygen in bottom waters (0–0.5 m above the sediment surface) [7] is greater than 60% saturation at any site for a defined period of not more than six weeks AND ii) No significant change beyond natural variation in any ecological or biological indicators that are affected by poorly oxygenated water unless that change can be demonstrably linked to a factor other than oxygen concentration. AND ii) No recorded deaths of marine organisms related to deoxygenation.

Notes:
1. The numerical reference site values will be updated each year to incorporate the latest reference site data, and will replace the respective criteria from the previous year; as described in Section 3.1.2 of EPA (2005) Guidelines.
2. Summer = December to March inclusive.
3. Ambient value = median value of individual sample data for a defined area
4. Defined area = area to be characterised for environmental quality against the EQO for maintenance of environmental integrity i.e. HEPA.
5. Non-river flow period = period December-March inclusive, when river and estuarine flows are weak.
6. DO saturation measured during daylight hours.

4.2.3 EQO2: Maintenance of aquatic life for human consumption

The original MIMMP did not stipulate EQC for the maintenance of aquatic life for human consumption (DALSE 2002a); however thermotolerant coliforms were subsequently included in the Bunbury Ocean Outlet Monitoring (BOOM) program, and therefore have been retained. The EQC for the maintenance of shellfish harvesting are in-line with the ANZECC/ARMCANZ (2000) Guidelines, unless otherwise indicated (Table 4.3).

In addition to the microbiological component, the BOOM program also includes a requirement to monitor potentially toxic phytoplankton species in the vicinity of the Bunbury Ocean Outlet. Nutrient enrichment as a result of treated wastewater discharge could result in changes to the naturally occurring planktonic algae community. While most algal blooms are considered harmless, some may contain species that produce toxins and/or have a potentially harmful effect on the surrounding marine environment. Species such as *Heterosigma akashiwo* and *Cryptosporidium parvum* are two such algae that cause large and recurrent fish mortalities. In terms of the trophic consequences of algal biotoxins (i.e. flow-on effects up the food chain), there are around 2000 species of dinoflagellates in the world, many of which produce potent neurotoxins that are capable of inducing poisonings in humans (DoF 2005).

Table 4.3 EQG and EQS in relation to the seafood harvesting exclusion area surrounding the Bunbury outlet and pertaining to the EQO for maintenance of aquatic life for human consumption

Parameter	EQG for high ecological protection	EQS for high ecological protection
Microbiological contaminants: Thermo-tolerant faecal coliforms	Median thermo-tolerant coliform concentrations not to exceed 14 CFU/100mL, with no more than 10% of the samples exceeding 21 CFU/100mL, measured using the membrane filtration method; outside of the proposed safety area	Median thermo-tolerant coliform concentrations not to exceed 70 CFU/100mL, with no more than 10% of the samples exceeding 85 CFU/100mL, measured using the membrane filtration method; outside of the proposed safety area
Algal biotoxins	Concentrations of potentially toxic algae not to exceed the WASQAP[1] trigger concentrations in any samples	Toxin concentrations in seafood not to exceed environmental quality standards in any sample ;as per Table 4 of EPA (2005)[2]

Notes:
1. Western Australian Shellfish Assurance Program (DoF 2007). Note that the EQG is only exceeded if the exceedance of a WASQAP trigger value can be attributed to the Bunbury Ocean Outlet.
2. Note that monitoring of this EQS requires sentinel mussel deployment at the appropriate compliance sites for seafood safe for human consumption.

Despite the inclusion of EQC for maintenance of aquatic life for human consumption, it is noted that guidelines refer only to filter-feeding shellfish (i.e. bivalve molluscs) and the Department of Health recommends only eating commercially harvested shellfish and not shellfish collected from the wild and that without a full sanitary survey, the management of thermo-tolerant coliforms and phytoplankton outside of the designated aquaculture areas is insufficient to protect those who wish to eat wild shellfish.

4.2.4 EQO 3 & 4: Maintenance of primary and secondary contact recreation

While the original MIMMP did not stipulate EQC for the maintenance of primary and secondary recreation (DALSE 2002), measures of enterococci were included in the BOOM program. The revised MIMMP now includes EQC for primary contact, in line with the criteria recently accepted for the Alkimos ocean outlet. The EQC for the maintenance of primary and secondary contact recreation are in-line with the Guidelines for Managing Risks in Recreational Water (2008), unless indicated otherwise.

Disease-causing microorganisms (pathogens) associated with bathing areas include salmonellae, shigellae, enteropathogenic *Escherichia coli*, cysts of *Entamoeba histolytica*, parasite ova, enteroviruses and infectious hepatitis (Hart 1974, McNeill 1985; cited in ANZECC/ARMCANZ 2000). The most common types of diseases associated with water-borne pathogens are eye, ear, nose and throat infections, skin diseases and gastrointestinal disorders (ANZECC/ARMCANZ 2000).

Detecting faecal pathogens within routine water samples is difficult and often 'indicator' micro-organisms are used to assess the health risks associated with pathogens in recreational waters (Elliot & Colwell 1985; cited in ANZECC/ARMCANZ 2000). To meet the EQG the risk of faecal pathogens is measured against the 95th percentile of pooled faecal streptococci (*Enterococci* spp.) counts sampled over the bathing season at recreational compliance sites, which is not to exceed 40 MPN/100mL (NHMRC 2008).

Table 4.4 EQG and EQS in relation to the primary and secondary contact recreation exclusion area surrounding the Bunbury outlet and pertaining to the EQO for maintenance of recreational waters

Parameter	EQG for high ecological protection	EQS for high ecological protection
Faecal pathogens: *Enterococci* spp.	The 95th percentile of the pooled enterococci organism data from recreational compliance sites compared against the upper NHMRC category A value is not to exceed 40 MPN/100mL	The 95th percentile of the pooled enterococci organism data from shoreline sites compared against the upper NHMRC category A value is not to exceed 40 MPN/100mL[3]
Algal biotoxins	Median total phytoplankton cell count (either from one sampling occasion or from a single site over an agreed period of time) should not exceed 10 cells/mL *Karenia brevis* and/or have *Lyngbya majuscula* and/or *Pfiesteria* present in high numbers outside the LEPA OR[2]	There should be no confirmed incidences (by the Department of Health) of skin or eye irritation caused by toxic algae, or of algal poisoning in recreational users
	There should be no reports of skin or eye irritation or potential algal poisoning in swimmers considered by a medical practitioner as potentially resulting from toxic algae when less than 10 cells/mL *Karenia brevis* and/or have *Lyngbya majuscula* and/or *Pfiesteria* is present in the water column.[2]	

Notes:
1. The numerical Environmental Quality Guideline for algae biotoxins was largely developed for inland waters and is to be used as an indicative guideline only, until sufficient marine data have been gathered for its revision (EPA 2005).
2. Guidelines for Managing Risks in Recreational Water (NHMRC 2008). These have been used in preference to EPA (2005) as they reflect more up to date guidelines.

4.2.5 Revision of criteria

As the EMP monitoring program progresses, additional reference data will be generated allowing the EQG and EQS to be refined. If there is found to significant inter-annual variation between sets of reference data, EQC may need to be derived on a year by year or even survey by survey basis. The program will be reviewed in consultation with the OEPA if this variation in reference data occurs.

The monitoring program and all criteria will be reviewed periodically. Any change to the requirements of this plan resulting from such reviews will be determined on advice of the OEPA.

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5. WATER QUALITY MONITORING PROGRAM

5.1 BACKGROUND

The Water Quality Monitoring Program (WQMP) will be undertaken on the basis of the understanding of local water quality developed through monitoring undertaken since 1999 and the findings of the PLOOM program.

5.2 SITES

The annual summer WQMP consists of 48 offshore sites with eight sampling grids, appropriate for the prevailing flow conditions at the outlet on the day of the summer water quality survey, and at nine shoreline sites.

The eight sampling grids are designed to capture varying ocean current scenarios that reflect a specific drogue displacement bearing. Table 5.1 outlines the sites required to be sampled for each of the eight grid scenarios. The relevant grid scenario for each summer sampling occasion is determined by inputting the bearing of the drogue displacement into Table 5.2. The locations of all sampling sites are outlined in Figure 5.1.

There will be five types of water quality monitoring sites within the sampling grids in the vicinity of the outfall: *Monitoring compliance sites, Diffuser sites, Drogue tracking sites, Shoreline sites* and *Reference sites* as shown in Figure 5.1 and Figure 5.2.

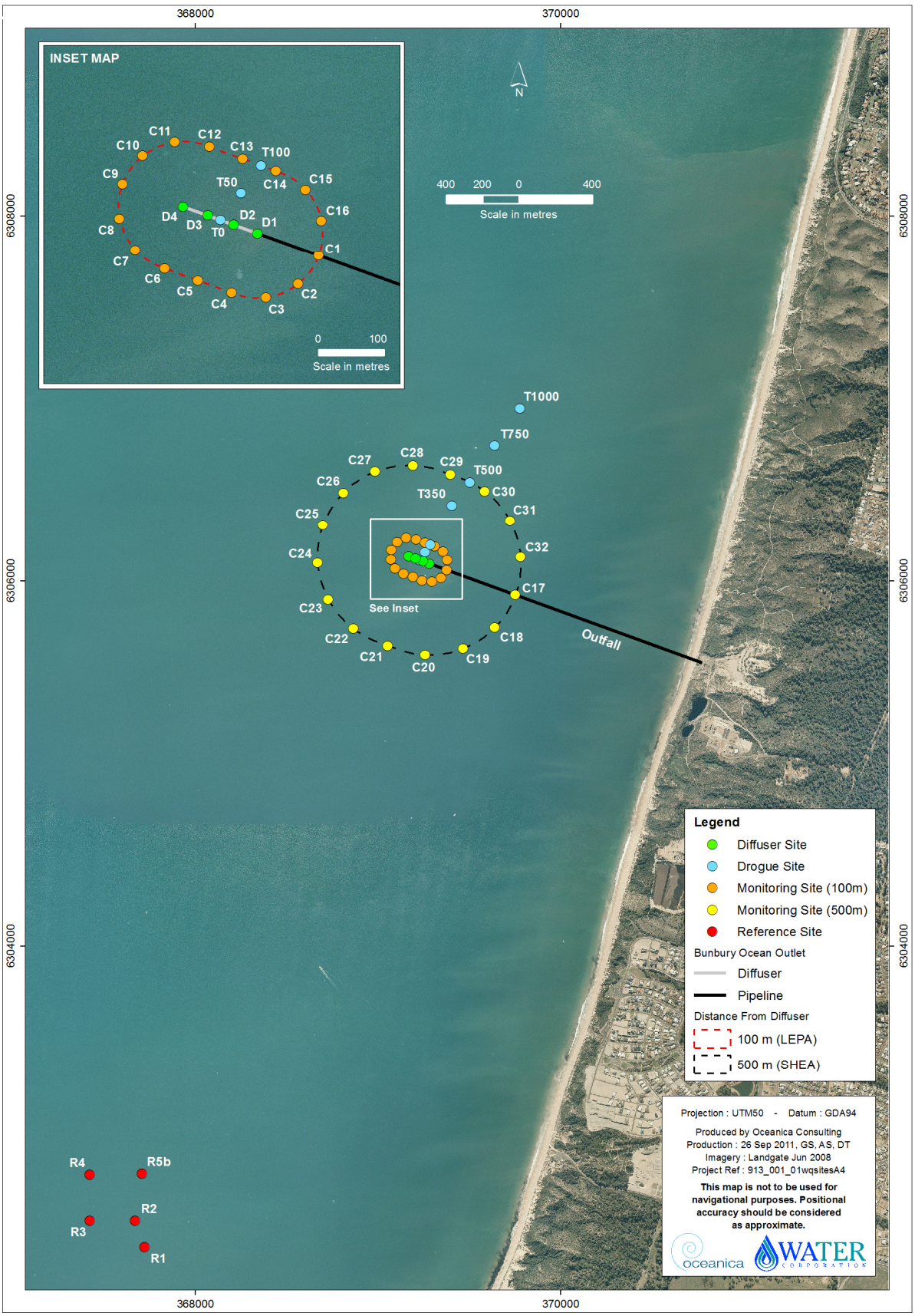

Figure 5.1 Schematic showing compliance (monitoring), diffuser, drogue and reference sites for water quality monitoring program and EQC boundaries at 100 m and 500 m distance from the diffuser

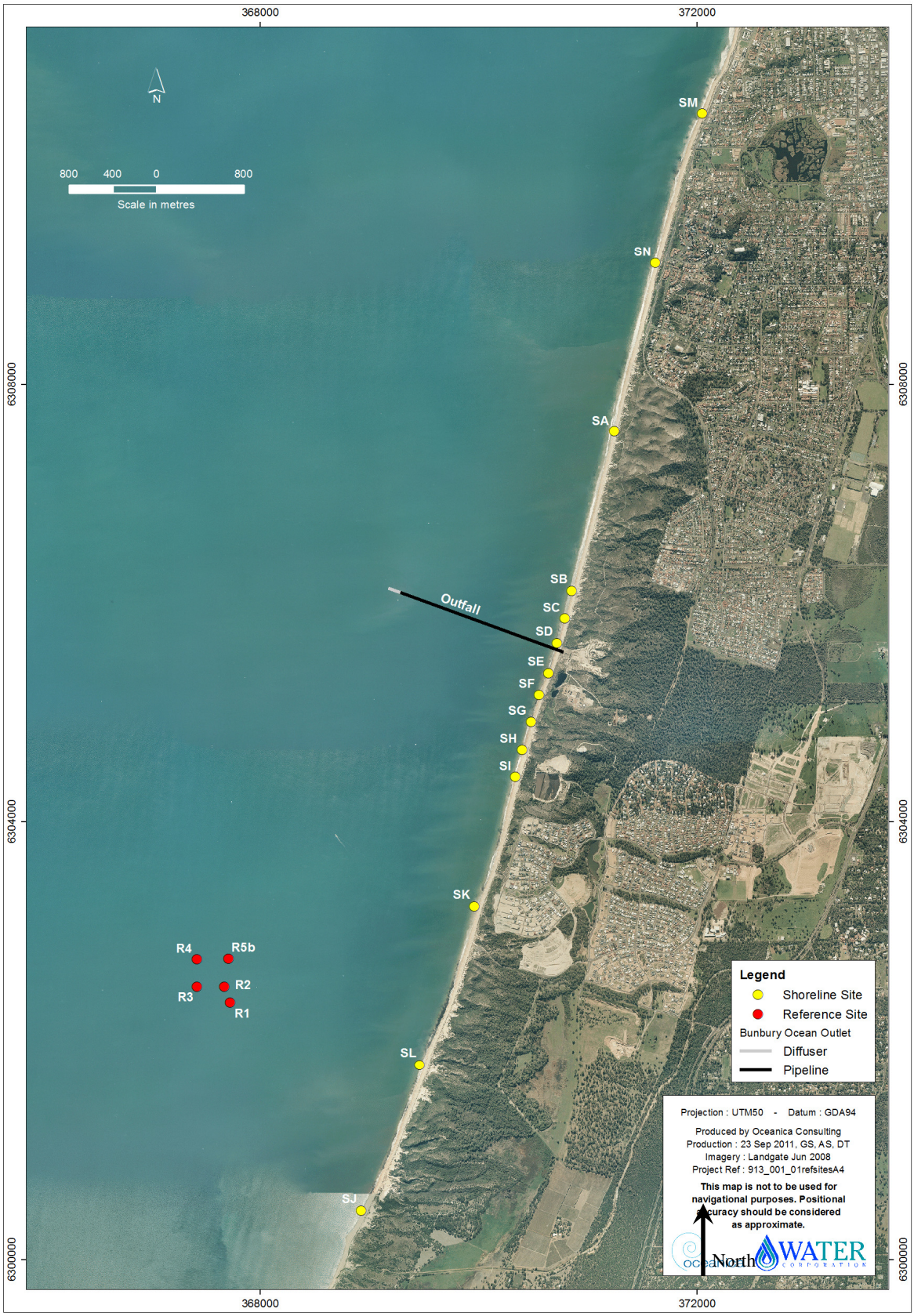

Figure 5.2 Approximate shoreline sampling and reference site monitoring site locations

Table 5.1 Sampling Program Grid Selection Protocol

Site Name	Grid1	Grid2	Grid3	Grid4	grid5	Grid6	Grid7	Grid8
C1		x	x	x				
C2			x	x				
C3			x	x	x			
C4				x	x			
C5				x	x	X		
C6					x	X		
C7					x	X	x	
C8						X	x	
C9						X	x	x
C10							x	x
C16		x	x					
C17		x	x	x				
C18			x	x				
C19			x	x	x			
C20				x	x			
C21				x	x	X		
C22					x	X		
C23					x	X	x	
C24						X	x	
C25						X	x	x
C26							x	x
C32		x	x					
C11	x						x	x
C12	x							x
C13	x	x						x
C14	x	x						
C15	x	x	x					
C27	x						x	x
C28	x							x
C29	x	x						x
C30	x	x						
C31	x	x	x					
D1	x	x	x	x	x	X	x	x
D2	x	x	x	x	x	X	x	x
D3	x	x	x	x	x	X	x	x
D4	x	x	x	x	x	X	x	x

Table 5.2 Drogue Bearing Grid Selection

Grid	Bearing 1 (°)	Bearing 2 (°)
Grid 1	357.5	42.5
Grid 2	42.5	87.5
Grid 3	87.5	132.5
Grid 4	132.5	177.5
Grid 5	177.5	222.5
Grid 6	222.5	267.5
Grid 7	267.5	312.5
Grid 8	312.5	357.5

5.2.1 Coordinates of fixed sites

The coordinates provided in Table 5.1 have been derived on the basis of the final location of the end of the diffuser (369275E, 6306099N) (or Site D4).

While it is important that the reference and compliance sites are sampled as close to given coordinate locations as possible (±10 m), the locations for the initial sites are indicative only. These sites should be sampled in the visible boils approximately 20-40 m apart (depending on the number of diffuser ports open). The plume boils are likely to be difficult to see and, if they are not visible on the day, then the locations in Table 5.3 should be used.

Table 5.3 Locations of monitoring sites (GDA94)

SITE	EASTING	NORTHING
C1	369376	6306062
C2	369345	6306018
C3	369296	6305997
C4	369242	6306004
C5	369191	6306023
C6	369140	6306041
C7	369095	6306070
C8	369070	6306118
C9	369075	6306172
C10	369106	6306215
C11	369155	6306236
C12	369209	6306229
C13	369260	6306211
C14	369311	6306192
C15	369356	6306163
C16	369381	6306115
C17	369752	6305925
C18	369640	6305747
C19	369466	6305631
C20	369258	6305597
C21	369054	6305647
C22	368865	6305740
C23	368729	6305899
C24	368670	6306101
C25	368699	6306309
C26	368811	6306486
C27	368985	6306602
C28	369193	6306637
C29	369397	6306586
C30	369586	6306493
C31	369722	6306334
C32	369781	6306132
D1	369179	6306133
D2	369206	6306124
D3	369248	6306108
D4	369275	6306099
SMS-A	371347	6307546
SMS-B	370948	6306096
SMS-C	370897	6305846
SMS-D	370847	6305596
SMS-E	370748	6305346
SMS-F	370647	6305147
SMS-G	370597	6304897
SMS-H	370498	6304646
SMS-I	370447	6304396
SMS-J	370047	6303196
SMS-K	369548	6301747
SMS-L	368925	6300450
SMS-M	372198	6310446
SMS-N	371697	6309096
WQR1	367725	6302350
WQR2	367673	6302496
WQR3	367425	6302498
WQR4	367422	6302745
WQR5b	367710	6302752
SG1 + PP1	368882	6305702
SG2 + PP2	369075	6306055
SG3 + PP3	369156	6306266
SG4 + PP4	369367	6306614
SG5	TBA	TBA

5.2.2 Plume tracking sites

The seven plume tracking sites follow the direction of the water movement above the diffuser, which is established through the monitoring of the drogue position. The first site (T0) is immediately above the centre of diffuser between dilution sites D2 and D3. the second site (T1) is 50 m immediately 'downstream' of the centre of the diffuser, the third site (T3) is 100 m downstream, the fourth site (T4) is 300 m downstream, the fifth site (T5) is 500 m downstream, the sixth site (T6) is 750 m downstream and the seventh site (T7) is 1000 m downstream.

The spacing and number of plume tracking sites will be reviewed after the first year of surveys.

5.3 PARAMETERS

The following water quality parameters will be monitored. The parameter selection has been determined by the requirements to meet Commitments and Conditions and also by the experience gained through Alkimos, PLOOM and previous Bunbury monitoring.

5.3.1 Compliance sites

Compliance Sites C1-C16

The following will be measured 1 m below the surface and approximately 2 m above the seabed at each site:

- Chlorophyll a (µg/l)
- Enterococci bacteria (counts/100ml)
- Light attenuation coefficient (m^{-1})

The following will be measured at 1 m intervals from surface to seabed at each site:

- Salinity
- Dissolved Oxygen

Compliance Sites C17-C32

The following will be measured 1 m below the surface and approximately 2 m above the seabed at each site:

- Thermotolerant faecal coliforms (counts/100ml)
- Phytoplankton species (cell counts/litre)

5.3.2 Diffuser sites

The following will be measured at 1 m intervals from surface to seabed at each site:

- Salinity
- Temperature,
- Dissolved oxygen

5.3.3 Plume tracking sites

The following will be measured 1 m below the surface and approximately 2 m above the seabed at each site:

- Enterococci bacteria (counts/100ml)
- Thermotolerant faecal coliform (counts/100ml)
- Light attenuation coefficient (m^{-1})
- Chlorophyll a (µg/l)
- Ammonia (NH_3^+) (µg/l)
- Nitrate+Nitrite (NO_x) (µg/l)
- Ortho-Phosphorus (µg/l)

The following will be measured at 1 m intervals from surface to seabed at each site:

- Salinity
- Temperature
- Dissolved oxygen

5.3.4 Shoreline monitoring sites

The following will be measured in waters taken just below the surface at each site:

- Enterococci bacteria (counts/100ml)
- Thermotolerant faecal coliform (counts/100ml)
- Chlorophyll a (µg/l)
- Ammonia (NH_3^+) (µg/l)
- Nitrate+Nitrite (NO_x) (µg/l)
- Ortho-Phosphorus (µg/l)

5.3.5 Reference sites

The following will be measured 1 m below the surface and approximately 2 m above the seabed at each site:

- Enterococci bacteria (counts/100ml)
- Thermotolerant faecal coliform (counts/100ml
- Light attenuation coefficient (m^{-1})
- Chlorophyll a (µg/l)
- Ammonia (NH_3^+) (µg/l)
- Nitrate+Nitrite (NO_x) (µg/l)
- Ortho-Phosphorus (µg/l)
- Phytoplankton species (cell counts/litre)

The following will be measured at 1 m intervals from surface to seabed at each site:

- Salinity

- Temperature
- Dissolved oxygen

5.4 METHODOLOGY

5.4.1 Field procedure: offshore sampling

It is intended that the following sequence be followed in sampling the sites. This sequence can be revised on site if the field supervisor sees the need (e.g. weather or operational factors) and assumes that the boat is leaving from Bunbury Harbour:

1. Sample reference sites.
2. Look for diffuser boil.
3. Drop drogue above diffuser and record time and GPS location.
4. Sample the four initial dilution samples. It is important that if boils (where the fresher water of the plume first reaches the sea surface) are visible that the four sites are selected on the basis of sampling within the boils rather than at the exact location in Table 5.3 (refer Section 5.2.1).
5. Check progress of the drogue, pick up if more than 100 m away and record time, GPS location and calculate the direction of drogue displacement as a bearing.
6. Select relevant sampling grid in Table 5.3 that corresponds with drogue displacement (bearing) and sample the sites as outlined in Table 5.2.
7. Pick up drogue if not picked up earlier and record time and GPS location.
8. Sample the seven plume tracking sites.
7. Return to Bunbury Harbour.

The methodology for the collection of the offshore water quality samples described in DALSE (2002) should be followed.

5.4.2 Field procedure: shoreline sampling

The shoreline monitoring program will occur while the offshore sampling is underway. This work is usually undertaken by Water Corporation staff. The sites will be accessed by four-wheel drive from the beach, at each site the sample will be collected by filling the container just below the water surface in waist deep water. Samples will be placed on ice in the dark immediately after collection.

5.4.3 Sampling and laboratory procedures

Water quality analysis and sampling procedures are to remain consistent with those established in previous surveys (DALSE, 2002).

5.4.4 Timing

For Perth's ocean outfalls, the EPA and Health Department's primary concerns are reflected in the licence conditions for the outfalls, whereby the outfalls must meet stipulated criteria during summer monitoring events. Although there was no commitment or condition regarding the timing or frequency of monitoring in the Bunbury environmental assessment documentation, it is understood that the more times water quality is sampled over the summer period, the greater the opportunity to understand any

potential long-term changes in productivity, biodiversity and ecosystem processes caused by the discharge.

The summer water quality monitoring will be undertaken three times - in January, February and March, with the intent being to spread the sampling evenly through this period (weather dependent).

5.5 REPORTING OF RESULTS

The results of each survey will be forwarded directly to the Water Corporation. The results of each year will be written up with data compared to draft criteria and discussion regarding findings, criteria and the monitoring program. After review by the Water Corporation, the report for the year will be submitted to the OEPA as part of the requirement for annual Performance and Compliance reporting.

Where possible, the reporting will include a 'report card' style presentation of the water quality results suitable for public dissemination through the community consultation program.

5.6 REVIEW

All aspects of the revised water quality monitoring program will be reviewed periodically. Any change to the requirements of this plan resulting from such reviews will be determined on advice of the OEPA.

6. PERIPHYTON MONITORING PROGRAM

6.1 BACKGROUND

Periphyton collectors provide a temporally integrated measure of marine growth on an artificial substrate. They have been used extensively in the PLOOM programs (e.g. DAL, 2002) and the EPA has prepared draft periphyton chlorophyll a criteria for Cockburn Sound (EPA, 2001b).

Periphyton collectors were deployed offshore of the Bunbury WWTP as part of the PER process (SKM 2000a; Water Corporation 2000). The results of periphyton monitoring to date are summarised in Table 2.2.

6.2 SITES

The original monitoring program allowed for four periphyton sites 500 m north, east, south and north away from the proposed outfall location and two control sites.

For the EMP monitoring it is proposed to have sites 100 m north and south and 500 m north and south of the diffuser as shown in Figure 6.1. The sites are north and south of the diffuser as the oceanographic monitoring program has demonstrated that currents in this region are predominantly parallel to the shore and therefore the maximum impact of the plume should be observed at these locations (Water Corporation, 2000). The coordinates of sites PP1, PP2, PP3 and PP4 are outlined in Table 5.3.

In addition, periphyton collectors will also be installed at the Water Quality monitoring reference sites (WQR1 and WQR2); to be called PPR1 and PPR1 (refer Table 5.3 for coordinates).

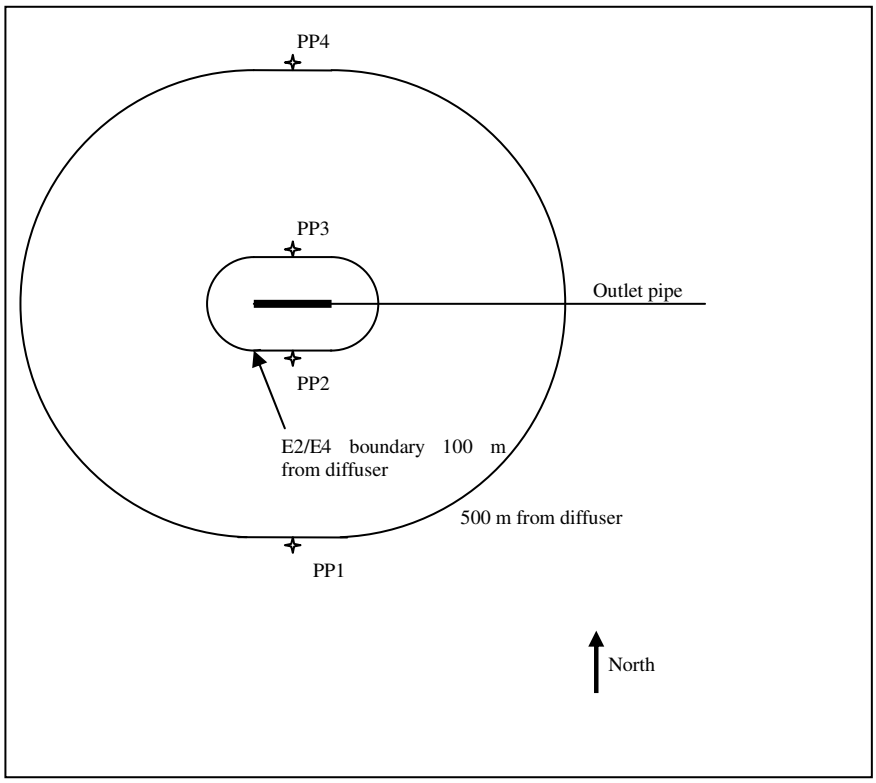

Figure 6.1 Periphyton collector locations

6.3 METHODOLOGY

6.3.1 Deployment

Permanent moorings will be placed at the six periphyton monitoring stations using similar methodology as employed for the moorings for the PLOOM3 program.

Periphyton collectors (150 mm by 150 mm) will be deployed at 2 m and 8 m below the water surface at each site.

6.3.2 Timing

The collectors will be deployed once per year, in:

- The last two weeks of January (Summer)

On each occasion the collectors will be left in the water for 30 days before retrieval.

6.3.3 Field and Laboratory procedures

The field and laboratory procedures established in previous Bunbury surveys (SKM, 200a) will be implemented.

The following parameters will be determined:

- Chlorophyll a, b and c at each depth at each location; and
- The nitrogen isotope ratio $^{15}N:^{14}N$ ($\delta^{15}N$) within the collected periphyton at each location.

6.4 REPORTING OF RESULTS

The results will be reported annually, with comparison against criteria generated from the reference site data and discussion regarding findings, criteria and the monitoring program. After review by the Water Corporation, the report for the year will be submitted to the DEP as part of the requirement for annual Performance and Compliance reporting.

Where possible, the reporting will include a 'report card' style presentation of the results suitable for public dissemination through the community consultation program.

6.5 REVIEW

All aspects of the periphyton monitoring program will be reviewed after the two years of monitoring. The results of the nitrogen isotope signature monitoring will be reviewed and submitted to the OPEA for assessment at the end of the two year period. Following this, advice will be sought from the OPEA regarding any further monitoring requirements.

7. SEAGRASS HEALTH MONITORING PROGRAM

7.1 BACKGROUND

As part of the recent EPP process for Cockburn Sound (EPA, 2001), the use of seagrass health indicators (leaf and shoot density) has been proposed as a monitoring tool to determine whether EQS have been exceeded. The DEP has requested that the Water Corporation consider seagrass health monitoring at the Ocean Reef Outfall. It is considered prudent to include this relatively simple monitoring in the Bunbury program as seagrass meadows are relatively abundant in the region (Cambridge and Kendrick, 2000).

7.2 SITES

The seagrass compliance monitoring sites (SG1-SG5) will be located in meadows adjacent to the periphyton mooring sites described in Section 6. The 5 seagrass reference sites (SGR1-SGR5) will be located in meadows adjacent to the water quality reference sites (R1-R4 and R5b) as outlined in Figure 5.1 (refer Table 5.3 for coordinates).

7.3 METHODOLOGY

7.3.1 Setup

At each periphyton mooring site a diver will descend to the seafloor and establish the closest location containing healthy seagrass meadow, preferably of *Posidonia angustifolia* however *Amphibolis* species will suffice if no *P. angustifolia* is to be found locally. Cambridge and Kendrick (2000) found that *P. angustifolia* was the most widespread of the seagrasses recorded.

Within each seagrass meadow, replicate sites will be selected and marked. Repetitive non-destructive monitoring of the shoot density of the dominant seagrass species will be undertaken using a 0.25 m^2 PVC quadrant to measure *in situ* shoot density at each replicate. The methodology for site set up and monitoring will follow that established by Tunbridge (2002) which is similar to that employed by Lavery (2001).

In addition to repetitive non-destructive monitoring of shoot density, further quantitative measures will to be undertaken at Water Corporations discretion, including:

- Videography & photography of all quadrants at all sites
- Qualitative measurement of the percent cover of the seagrass canopy with each quadrant at all sites.
- Adjacent bare sand areas examined for remains of seagrass rhizome
- Visual observation of composition of filamentous and coralline epiphytes
- Visual observation of presence or absence of detritus and dead rhizome

These quantitative assessments closely follow the methodology established by Lavery and Gartner (2008).

7.3.2 Timing

As divers are required to enter the water in deploying the periphyton collectors, the seagrass shoot density surveys will be undertaken when the collectors are deployed in:

- The last two weeks of January (Summer)

7.3.3 Field and Laboratory procedures

The field procedures established by Tunbridge (2002) will be used.

7.4 REPORTING OF RESULTS

The results will be reported annually, with comparisons against draft criteria and discussion regarding findings, criteria and the monitoring program. After review by the Water Corporation, the report for the year will be submitted to the OEPA as part of the requirement for annual Performance and Compliance reporting.

Where possible, the reporting will include a 'report card' style presentation of the results suitable for public dissemination through the community consultation program.

7.5 REVIEW

All aspects of the revised seagrass monitoring program will be reviewed periodically. Any change to the requirements of this plan resulting from such reviews will be determined on advice of the OEPA.

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8. SEDIMENT QUALITY MONITORING PROGRAM

8.1 BACKGROUND

As part of the Bunbury EIA process sediment and mussel tissue monitoring was undertaken to establish a baseline for contaminants in the area (SKM 2000b). This work found the sediments and water column to be clean.

The treated wastewater plume will be buoyant and rise rapidly to the surface. There will be little contact of any components of the plume with the sediments before considerable dilution has occurred. Furthermore, sediments around the proposed outfall location are generally coarse-grained calcareous sands with a low capacity to bind contaminants. Therefore, the potential for accumulation of contaminants in sediments is considered to be extremely low. This is evident in the fact that PLOOM program monitoring of sediments adjacent to the Sepia Depression outfall, which has discharged loads of chromium (350–860 kg/annum), copper (2,900–7,110 kg/annum), lead (125–300 kg/annum), nickel (225–550 kg/annum) and zinc (1,575–3,860 kg/annum) since 1985, has not found any of accumulation of these metals in sediments adjacent to the outfall

8.2 SITES

Sediment monitoring will be undertaken at the sites (S1-S8) shown in Figure 8.1 and at the two reference sites (SR1 and SR2) established for the water quality monitoring program (refer Figure 5.2 and Table 8.1).

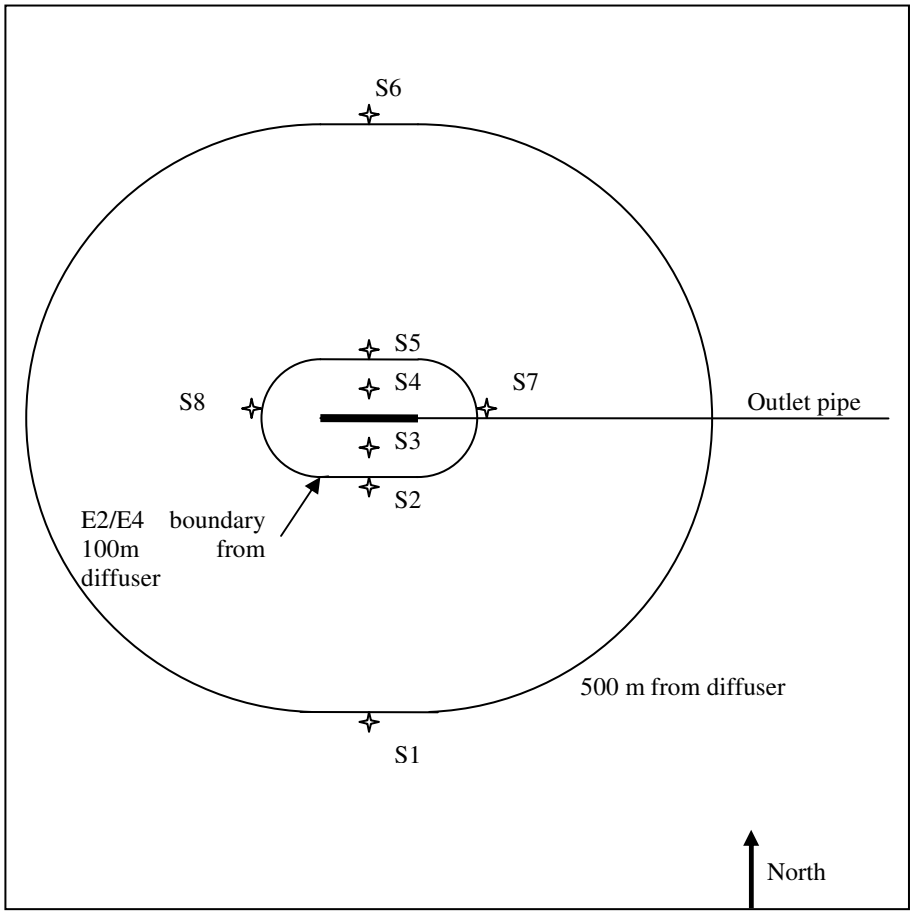

Figure 8.1 Sediment quality survey sites

Table 8.1 Sediment site locations (GDA94)

SITE	EASTING	NORTHING
S1	369226	6305616
S2	369226	6306016
S3	369226	6306066
S4	369226	6306166
S5	369226	6306216
S6	369226	6306616
S7	369226	6306096
S8	369383	6306137
SR1	367725	6302350
SR1	367673	6302496

8.3 PARAMETERS

Sediments will be monitored for:

- Heavy metals (As, Ag, Cd, Cu, Cr, Hg, Ni, Pb and Zn);
- Organochlorine pesticides;
- Extractable organohalogens (EOX);
- Total organic carbon; and
- Loss on ignition at 550^{o}C.

8.4 METHODOLOGY

8.4.1 Field and laboratory methods

The sample collection, transport and analysis will be undertaken as described in SKM (2000b).

8.4.2 Timing

The first sediment survey will be undertaken in January/February 2003, approximately 6 months after commencement of operations. A follow-up survey will be undertaken one year later in January/February 2004 with subsequent surveys at five-yearly intervals.

8.5 REPORTING OF RESULTS

The results will be reported annually, with comparisons against ANZECC & ARMCANZ (2000) criteria and discussion regarding findings, criteria and the monitoring program. After review by the Water Corporation, the report for the sediment quality report will be submitted to the DEP as part of the requirement for annual Performance and Compliance reporting (refer Operations EMP). It is anticipated that sediment quality reports will be submitted to the DEP by the end of June of the year of the survey.

Where possible, the reporting will include a 'report card' style presentation of the results suitable for public dissemination through the community consultation program (refer Operations EMP).

8.6 REVIEW

All aspects of the sediment quality monitoring program will be reviewed periodically. Any change to the requirements of this plan resulting from such reviews will be determined on advice of the OEPA.

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9. TREATED WASTEWATER CHARACTERISATION

9.1 BACKGROUND

Effective characterisation of the treated wastewater forms a vital part of the monitoring program and is also a Condition of Approval.

Treated wastewater characterisation, when coupled with the results of initial dilution surveys and initial dilution modelling, will provide the primary indication as to the likely concentrations of contaminants in the water column offshore.

9.2 PARAMETERS

Treated wastewater will be analysed for the following parameters:

- Ammonia as nitrogen;
- Biochemical Oxygen Demand (5 day);
- Nitrate as nitrogen;
- Nitrite as nitrogen;
- Total Suspended Solids;
- Total phosphorus;
- Salinity;
- Arsenic;
- Cadmium;
- Chromium;
- Copper;
- Lead;
- Mercury;
- Molybdenum;
- Nickel;
- Selenium;
- Silver;
- Zinc; and
- Pesticides and Herbicides: base neutral pesticides; chlorinated acidic herbicides; and organochlorine and organophosphate pesticides (including chlorpyrifos, dieldrin, atrazine, aldrin, chlordane, DDT, heptachlor, lindane, HCB, simazine, 2,4-dichlorophenoxyacetic acid).

In addition, the average daily flow to the WWTP will be noted for the sampling period.

9.3 METHODOLOGY

9.3.1 Sampling and transport

The wastewater samples will be taken from the weir at the north of Lagoon 1 leading to the ocean outfall. By collecting from this point, the effects of changing flows due to the IDEA decant cycle and the diurnal wastewater

inflow cycle on wastewater quality will be largely integrated as pre-discharge lagoon system has a retention time of the order of days.

The water samples will be stored in laboratory supplied containers and stored in the dark on ice for transport to the laboratory within 24 hours of sampling.

9.3.2 Analyses

The analyses will be undertaken by a NATA accredited laboratory.

9.3.3 Timing

Sampling will be undertaken four times a year - in October (spring), January (summer), April (autumn) and July (winter). The January sampling will be done concurrently with the water quality monitoring offshore, for application to initial dilution modeling.

9.4 REPORTING OF RESULTS

The results will be reported annually, with comparisons against relevant ANZECC & ARMCANZ (2000) or DEP criteria for the edge of the E2/E4 boundary or mixing zone following initial dilution of the constituents. The initial dilution factor used in calculations will be the lowest of that estimated using a CORMIX (or similar internationally recognised mixing model) simulation of the conditions at the time of sampling and that calculated from the water quality surveys. After review by the Water Corporation, the report for the treated wastewater characterisation will be submitted to the OEPA as part of the requirement for annual Performance and Compliance reporting. The treated wastewater characterisation program will be reviewed in consultation with the OEPA after the first annual report is submitted.

Where possible, the reporting will include a 'report card' style presentation of the results suitable for public dissemination through the community consultation program.

9.5 REVIEW

All aspects of the treated wastewater characterisation monitoring program will be reviewed periodically. Any change to the requirements of this plan resulting from such reviews will be determined on advice of the OEPA.

10. CONTINGENCY PLANNING

The following contingency plans are to be implemented in the event that agreed nutrient or contaminant criteria are not met.

10.1 EXCEEDENCE OF ENVIRONMENTAL QUALITY CRITERIA

In the event that monitoring finds that EQG are exceeded, the cause of the exceedance should be investigated, and may include the following actions:

- Investigate control site data to establish whether there has been a regional increase in the value;
- Examine site records to establish whether any surface slicks or other unusual local anomalies were observed;
- Examine weather records to establish the range of conditions prior to sampling;
- Check WWTP operations for the days leading up to the sampling to establish whether the plant was operating normally;
- Check laboratory and sampling quality assurance procedures to ensure that results are not spurious due to laboratory or sampling errors; and/or
- If required (in consultation with OEPA), undertake sampling additional to the routine program to assist in identifying whether the exceedance persists and whether it is a result of the operation of the outfall.

If it is found that contaminant criteria are likely to be exceeded from the wastewater characterisation program, then a sentinel mussel monitoring program will be implemented. This program will involve the deployment of mussels at the E2/E4 boundary and at the reference sites with subsequent analysis for the contaminants of concern. The program will be reviewed by the OEPA prior to implementation.

10.2 EXCEEDENCE OF ENVIRONMENTAL QUALITY STANDARDS

In the event that EQS are exceeded, similar investigations will be implemented to those outlined for EQG exceedance, if subsequent monitoring finds that the operation of the outfall is resulting in an ongoing exceedance of the EQS, then management measures will be implemented. These measures may take the form of some or all of the following actions:

- Detailed investigation to confirm significance and extent of impact with recommendations for future management, reviewed by the OEPA and independent technical reviewer with subsequent implementation of agreed management actions; and/or
- Review of WWTP operations with recommendations to improve water quality from the outfall with subsequent implementation of agreed management actions.

10.3 REVIEW

All aspects of the contingency plan will be reviewed periodically. Any change to the requirements of this plan resulting from such reviews will be determined on advice of the OEPA.

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11. QUALITY ASSURANCE

Quality assurance procedures have been incorporated into each of the above programs. Each program has an emphasis on strict sample handling protocols and use of NATA certified laboratories.

The requirements of this MIMMP may be reviewed from time to time. Any change to the requirements of this plan resulting from such reviews will be determined on advice of the relevant advisory agencies.

The materials and methodology stated in this plan are correct as at the publication date. The materials and/or methodology may change during implementation of the project provided that those changes do not result in an additional or significant environmental impact. Changes to the materials or methodology that may cause an additional environmental impact will be referred to the relevant advisory agencies.

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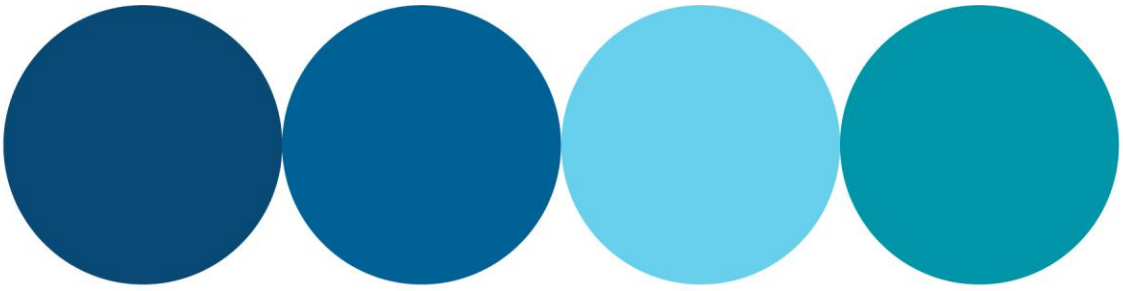
ATTACHMENT 3

MS572 Bunbury Ocean Outlet 6-Year Review (PRR) 2014/15-2019/20_RevB_20210326.pdf

(https://nexus.watercorporation.com.au/otcs/cs.exe/link/114850275)

Bunbury Wastewater Treatment Plant Six Year Performance Review

2014/15–2019/20



WATER CORPORATION

This report has been prepared for Water Corporation by BMT, March 2021, Report Number R-10239-1.

Document history

Distribution

Revision	Author	Recipients	Organisation	No. copies & format	Date
A	G Cummins	M Lourey	BMT	1 x docm	18/03/2021
B	G Cummins	R Munro	Water Corporation	1 x pdf	26/03/2021

Review

Revision	Reviewer	Intent	Date
A	M Lourey	Technical and Editorial Review	24/03/2021
B	R Munro, J Phillips, A Brown, T Carlino, B Scott	Client Review	

Quality Assurance

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BMT commercial Australia Pty Ltd has prepared this report in accordance with our Integrated Management System, in compliance with OHSAS18001, ISO14001 and ISO9001

Status

This report is 'Draft' until approved for final release, as indicated below by inclusion of signatures from: (i) the author and (ii) a Director of BMT commercial Australia Pty Ltd (BMT) or their authorised delegate. A Draft report may be issued for review with intent to generate a 'Final' version, but must not be used for any other purpose.

Approved for final release:

Author
Date:

Director (or delegate)
Date:

Contents

Introduction

Document purpose

Water Corporation is required to ensure that the discharge of treated wastewater (TWW) from the Bunbury wastewater treatment plant (WWTP) to the marine environment is environmentally sustainable and managed appropriately for the protection of ecosystem and social values. To achieve this outcome, Water Corporation undertake their operations in accordance with environmental commitments outlined in Ministerial Statement (MS) 572 and Licence L5972/1992/14.

The Bunbury Operations Environmental Management program and the Marine Impacts Monitoring and Management Plan (MIMMP; Water Corporation 2012) for the Bunbury Ocean Outlet were designed according to Schedule 2 (Proponent's Environmental Management Commitments) of MS 572. Each summer annual monitoring period was carried out in accordance with the methods and criteria in Water Corporation (2012).

The purpose of this report is to fulfil Ministerial Condition 9–1 which requires Water Corporation to submit a Performance Review Report (PRR) on the operation of the Bunbury ocean outlet and associated infrastructure every six years. This report covers the six-year period from 2014/15 to 2019/20.

Bunbury wastewater treatment plant

Ocean disposal of TWW from the Bunbury WWTP commenced in July 2002. The Bunbury WWTP primarily services the City of Bunbury. On the 15 January 2020, total daily inflow into Bunbury WWTP was 11.5 kL. Prior to disposal, the wastewater is treated using microbial processes to reduce concentrations of nitrogen via an intermittently decanting extended aeration plant. These processes produce secondary TWW and biosolids.

The ocean outlet is located ~7 km south of the Bunbury Central Business District, south-west Western Australia (Figure 1). TWW is discharged via a sub-sea diffuser 1.7 km due west of the shoreline (Water Corporation 2012). The freshwater TWW is less dense than seawater and forms a buoyant plume that rises through the water column after discharge and mixes as it ascends.

Figure 1 Location of the Bunbury wastewater treatment plant and ocean outlet

Wastewater treatment plant capacity upgrades

Major infrastructure works (13 ML/d Optimisation Project) commenced in March 2017 at the Bunbury WWTP and were completed in September 2017. Additionally, a major upgrade of the mechanical dewatering process was completed during the 2018–19 reporting year.

Environmental approval

The Environmental Protection Authority (EPA) released Bulletin 1021 in July 2001 to provide advice to the Minister for Environment and Heritage on the environmental factors relevant to the proposal to dispose of up to 6000 ML per annum (ML/yr) of TWW from the Bunbury plant to the ocean (EPA 2001). The environmental factors listed as relevant to the Bunbury WWTP were:

- wastewater and marine environment including water and sediment quality and marine flora and fauna.
- Coastal systems including dunes and foreshore, terrestrial flora and fauna,
- Aboriginal Heritage and public health and safety

The Water Corporation received approval from the Minister for the Environment and Heritage to construct and operate an ocean outlet and associated infrastructure for the Bunbury WWTP environmental approval under Part IV of the Environmental Protection Act (EP Act) on 14 September 2001. Approval is subject to a series of Ministerial Conditions and proponent commitments in Ministerial Statement 572 (MS 572).

The Water Corporation is licenced to operate the Bunbury WWTP as a prescribed premise under Part V of the EP Act as category 54 (sewage facility) and category 61 (liquid waste facility) according to current Licence L5972/1992/14.

Environmental Quality Management Framework

Environmental management of the Bunbury TWW outlet is in accordance with the Environmental Quality Management Framework (EQMF) adopted by the Government of Western Australia for Western Australia's coastal waters. The EQMF is based on:

- Identifying Environmental Values (EVs)
- Establishing and spatially defining the Environmental Quality Objectives (EQOs) that need to be maintained to ensure the associated EVs are protected
- Monitoring and management to ensure that the EQOs are achieved and/or maintained in the long-term in the areas they have been designated
- Establishing Environmental Quality Criteria (EQC) which are quantitative benchmarks or 'trigger values' against which monitoring results can be compared.

According to the EQMF, a suite of appropriate EQC is used to assess the extent to which the EVs and EQOs are met. There are two levels of EQC.

1. Environmental Quality Guidelines (EQGs) – quantitative, investigative triggers, which if met, indicate there is a high degree of certainty that the associated EQO has been achieved, and if not met then there is uncertainty as to whether the EQO has been achieved and further investigations are triggered
2. Environmental Quality Standards (EQSs) – management triggers based on multiple lines of evidence, which if exceeded, indicate a significant risk that the EQO is not being met and a management response is required.

Six Year Performance Review Outline

Ministerial Condition 9–1

Condition 9–1 of Ministerial Statement 572 (M9–1) requires the Water Corporation to submit a Performance Review Report to the Department of Environmental Protection (DEP)[1] each six years post construction of the Bunbury WWTP. The first six-yearly performance review report covered the period from 2002/03 to 2007/08, inclusive (Oceanica 2009). The second six-yearly performance review report covered the period from 2008/09 to 2013/14, inclusive. This report is the third six-yearly performance review and covers the period from 2014/15 to 2019/20, inclusive. This review documents the Water Corporation's performance against each of the conditions and commitments in Statement 572 and is submitted in fulfilment of condition M9–1.

Performance review objectives

The core objectives of Condition M9-1 are to:

1. Document the outcomes, beneficial or otherwise
2. Review the success of goals, objectives and targets
3. Evaluate the environmental performance over the six years
4. Evaluate the investigation and implementation of additional options for the reuse of treated wastewater.

In addition, M9–1 requires the review to be relevant to the following:

1. Environmental objectives in Environmental Protection Authority (EPA) Bulletin 1021
2. Proponent's consolidated environmental management commitments in schedule 2 of Ministerial Statement 572 and those arising from the fulfilment of Conditions and procedures in Ministerial Statement 572 **Error! Reference source not found.**.
3. Environmental performance targets
4. Environmental management programs and plans; and/or
5. Environmental performance indicators.

Review structure

This report addresses the requirements of M9–1 by assessing compliance against each of the audit table elements of Ministerial Statement 572 for the period 2014/15 to 2019/20. Compliance has been assessed based on the evidence provided in the Water Corporation's annual reports for 2014/15 to 2019/20, the previous six yearly performance review reports, and other evidence as appropriate, including management plans, monitoring reports and emails and letters from regulatory authorities.

Compliance terminology

This performance review uses the terms in Table 1 to indicate compliance with Ministerial Statement 572, as per the requirements of the OEPA (2012b).

Table 1 Compliance assessment terminology

Term	Definition
Compliant	Implementation of the proposal has been carried out in accordance with the requirements of the audit element.

[1] Department of Environmental Protection is now called the Department of Water and Environmental Regulation

Complete	A requirement with a finite period of application has been satisfactorily completed.
Not required at this stage	The requirements of the audit element were not triggered during the reporting period.
Potentially non-compliant	Possible or likely failure to meet the requirements of the audit element.
Non-compliant	Implementation of the proposal has not been carried out in accordance with the requirements of the audit element.
In process	Where an audit element requires a management or monitoring plan be submitted to the OEPA or another government agency for approval, that submission has been made and no further information or changes have been requested by the OEPA or other government agency and assessment by the OEPA or other government agency for approval is still pending.

Notes

1. Definitions obtained from the Environmental Protection Authority guidance document for performance and compliance reporting (OEPA 2012).
2. OEPA = Office of the Environmental Protection Authority.

Table 2 Audit elements of the 2020 performance review report

Audit code (572)	Subject	Element	Evidence	Compliance status	Document sections
Ministerial Conditions					
M1-1	Implementation	Implement the proposal as documented in schedule 1 of MS 572, subject to conditions and procedures	This document describes the status of implementation of each of the conditions and commitments contained in Ministerial Statement 572 (MS 572) for the period 2014/15 to 2019/20. The Water Corporation submits annual performance compliance reports for the Bunbury wastewater treatment plant (WWTP) to the Chief Executive Officer (CEO) of the Department of Water and Environment Regulation (DWER) describing how the proposal has been implemented in accordance with MS 572 for the specific reporting year. Water Corporation Performance compliance reports (PCRs) show every year from 2014-2020 operation of the ocean outlet was compliant with the Ministerial Statement 572 requirements (PCRs are in Appendix BB).There were 3 non-compliances in the 2008/09-2013/14 6-year PRR, all of which were deemed compliant in the 2014-2016 PCR (Appendix BB). The Water Corporation also submits annual reports for the Bunbury Ocean Outlet Monitoring (BOOM) program, which present the results of the marine environmental monitoring around the Bunbury ocean outlet in accordance with the Bunbury Ocean Outlet Operations Environmental Management Plan (Water Corporation 2012). The reports that have been submitted annually for the 2014/15–2019/20 reporting period are BMT Oceanica 2015, 2016, 2017, 2018, BMT 2019 and BMT 2020. (Appendix B)	Compliant Compliant. See M6-1.	Condition 1-1 Implementation below table and Performance Compliance Reports in Appendix BB See M6-1 in this table.
M1-2	Implementation	Changes to any aspect of the proposal as documented in schedule 1 to be referred to the Environmental Protection Authority (EPA) if the Minister deems that it is substantial.	There have been no changes to the proposal as documented in schedule 1 over the 2014/15 to 2019/20 review period.	Compliant	N/A
M1-3	Implementation	Changes to any aspect of the proposal may be effected where the Minister determines on advice from the EPA that those changes are not substantial.	The Water Corporation (R Munro, Environmental Specialist) notified auditors, via email dated 26 November 2020 that there have been no changes to the proposal requested during 2014/15 to 2019/20.	Compliant	N/A
M2-1	Proponent commitments	Implement the consolidated management commitments documented in Schedule 2 of MS 572	The Water Corporation submits annual performance compliance reports for the Bunbury WWTP to the Department of Water and Environmental Regulation (DWER) describing how the proposal has been implemented in accordance with the commitments contained in schedule 2 of MS 572 for the specific reporting year. The reports for 2014/15–2019/20 are contained in Appendix BB. This document describes the status of implementation of each of the proponent commitments contained in schedule 2 of MS 572 for the period 2014/15–2019/20 only. Assessment of compliance prior to this was covered in the two previous six yearly performance reviews (BMT Oceanica 2015, Oceanica 2009; Appendix A).	Compliant	Appendix BB

M2-2	Proponent commitments	Implement subsequent environmental management commitments which the proponent makes as part of the fulfilment of conditions and procedures in MS 572	A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 performance compliance report and information previously submitted by the Water Corporation. This condition was listed as not requiring auditing according to the OEPA letter dated 11 October 2010 because there were no subsequent commitments (Appendix C). The management plans required during construction and operations have been implemented by the Water Corporation, as described in the proponent commitments listed in this table.	Compliant	Appendix C, this table.
M3-1	Proponent	The proponent nominated by the Minister is responsible for implementation of the proposal until such time as the Minister revokes the nomination of that proponent and nominates another person in respect of the proposal	The Water Corporation remains the nominated proponent for implementation of MS 572 since it was issued in 14 September 2001.	Compliant	N/A
M3-2	Proponent	Any request to the Minister for a change in proponent to be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement to carry out the proposal in accordance with the conditions and procedures of MS 572	There have been no requests made to the Minister for a replacement proponent during 2014/15 to 2019/20.	Compliant	N/A
M3-3	Proponent	Proponent to notify the Department of Environmental Protection (DEP) of any change of proponent contact name and address within 30 days of such change.	There has been no change in the contact name and address of the proponent between 2014/15 to 2019/20.	Compliant	N/A
M4-1	Commencement	Provide evidence to the Minister that the proposal has been substantially commenced within five years of the date of this statement.	MS 572 was issued to the Water Corporation on 14 September 2001. The Bunbury WWTP was commissioned in July 2002, indicating that the proposal had been substantially commenced within five years of the date when the Statement was issued. The Office of the Environmental Protection Authority (OEPA) determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C
M4-2	Commencement	If the proposal has not substantially commenced within five years, then the approval to implement the proposal shall lapse and be void.	As noted above for M4-1, the proposal was substantially commenced within five years. The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C
M4-3	Commencement	Any application for extension of approval for the substantial commencement of the proposal beyond five years shall be made to the Minister at least 6 months prior to expiration of the five year period.	An extension of approval application from the Minister was not required by Water Corporation since the proposal was substantially commenced within five years (refer M4-1). The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C
M4-4	Commencement	If the proponent demonstrates to the Minister that the environmental parameters of the proposal have not changed significantly then the Minister may grant an extension not exceeding five years for the substantial commencement of the proposal.	An extension of approval application from the Minister was not required by Water Corporation since the proposal was substantially commenced within five years (refer M4-1). The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C

M5-1	Compliance Audit	Submit periodic compliance reports in accordance with an audit program prepared in consultation between the proponent and DEP.	The Water Corporation submits annual Performance Compliance Reports (PCRs) to the DER, which constitute internal audits and document compliance with the conditions and commitments contained in MS 572. Six PCRs relevant to the period 2014/15 to 2019/20 are provided in Appendix BB. An internal audit was completed on 13 June 2018 and there were no significant findings made during this audit (Appendix BB). In addition, monthly audits of licence compliance are also undertaken by staff independent to the day to day processing at Bunbury WWTP.	Compliant	Appendix BB
M5-2	Compliance Audit	The CEO of the DEP has responsibility for assessing compliance with the conditions, procedures and commitments contained in Ministerial Statement 572 and for issuing formal, written advice that the requirements have been met.	This condition applies to the CEO of the DEP. Evidence of the DEP and OEPA assessing the Water Corporation's compliance with Ministerial Statement 572 are provided in Appendix C.	Compliant	Appendix C
M5-3	Compliance Audit	The Minister will determine any dispute concerning compliance with any condition, procedure or commitment.	Water Corporation (R Munro, Environmental Specialist) notified auditors, via email dated 26 November 2020, that there had been no disputes concerning compliance during the 2014/15 to 2019/20 period.	Compliant	N/A
M6-1	Marine management	Manage the discharge of effluent from the ocean outlet to achieve simultaneously: 1. Ecosystem health (Environmental Quality Objective (EQO) 1 as defined in the EPA's Perth Coastal Waters, Environmental Values and Objectives) in the zones delineated in figure 2 of schedule 1 2. The fishing and aquaculture objective (EQO 2) in the zones delineated in figure 2 of schedule 1 3. The recreational and aesthetic objectives (EQO 3 and 4, respectively) in the zones delineated in figure 2 of schedule 1.	An assessment of Water Corporation's compliance with Environmental Quality Guidelines (EQGs) and Environmental Quality Standards (EQSs) during 2014/15 to 2019/2020 for the BOOM annual monitoring results have been described in detail in this report and summarised below. The monitoring results indicate that the environmental quality objectives (EQOs 1, 2, 3 and 4) have met the criteria defined in the EPA's Perth Coastal Waters, Environmental Values and Objectives and detailed in the Operations EMP Marine Impacts Monitoring and Management Plan (Water Corporation 2012). **EQO1**: Between 2014/15 to 2019/20 there were three instances in which the EQG for periphyton was not met. There were two instances (17/18 and 19/20) when one of the EQS criteria for seagrass health (EQS1) was exceeded but there were no exceedances of EQS2 during the review period and the EQO was achieved. **EQOs2-4**: There were no exceedances of EQC for EQO2–4 during the 2014/15 to 2019/20 period and the EQOs were achieved. The above discussed in detail in PCR 2019-20 (Appendix B)	Compliant	Condition M6-1: Marine management below table and Appendix C
M6-2	Marine management	Address the following to the requirements of the EPA on advice from the DEP when meeting condition 6-1, which are included in commitment no. 19 (MIMMP): • The identification of ecosystem health indicators appropriate to the discharge site	The Operations EMP: Marine Impacts and Monitoring and Management Plan (Water Corporation 2012) identifies site specific EQC and the process for revision of the EQC. The indicators, guidelines, and standards from the MIMMP are summarised below this table.	Compliant	M6-2 Section Appendix C

		• Site specific guideline values and standard criteria for the indicators if generic criteria are not appropriate.			
M7-1	Decommissioning Plans	Prepare a Preliminary DP which provides the framework to ensure that the site is left in a suitable condition, with no liability to the State, to the requirements of the EPA on advice of the DEP. The Preliminary DP shall address: 1. Rationale for the siting and design of plant and infrastructure and conceptual plans for its/their removal or retention 2. Conceptual rehabilitation plans for all disturbed areas and a process to agree on the end land use(s) 3. Management of noxious materials to avoid the creation of contaminated areas.	This condition for preparation of the Preliminary DP was submitted on 8 March 2002 and cleared in the audit table by the Department of Environment and Conservation (DEC) on 1 July 2002. The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C
M7-2	Decommissioning Plans	Prepare a Final DP at least six months prior to the anticipated date of decommissioning, or at a time agreed with the DEP, designed to ensure that the site is left in a suitable condition, with no liability to the State, to the requirements of the EPA on advice of the DEP. The Final DP shall address: 1. Removal or retention of plant and infrastructure 2. Rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s) 3. Identification of contaminated areas, including provision of evidence of notification to relevant statutory authorities.	The Final DP is not yet required as the plant is still in operation and decommissioning is yet to occur.	Not required at this stage	N/A
M7-3	Decommissioning Plans	Implement the Final DP until such time as the Minister determines that decommissioning is complete.	The Final DP is not yet required as the plant is still in operation and decommissioning is yet to occur.	Not required at this stage	N/A
M7-4	Decommissioning Plans	Make the Final DP publicly available, to the requirements of the EPA.	The Final DP is not yet required as the plant is still in operation and decommissioning is yet to occur.	Not required at this stage	N/A
M8-1	Work Practices	Prepare a written prescription for contractor work practices covering pipeline installation and support vessel operation prior to the commencement of construction, to ensure that work practices are carried out in accordance with best practice in environmental management, to the requirements of the EPA on advice of the DEP.	This condition for a written prescription for contractor work practices was cleared by the DEC on 30 January 2002. The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C

M8-2	Work Practices	Ensure that all pipeline works and support vessel operations comply with the prescription in M8-1.	A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR and information previously submitted by the Water Corporation. Following the audit this condition was completed according to the OEPA letter dated 11 October 2010 (Appendix C).	Complete	Appendix C
M9-1	Performance Review	Submit a Performance Review Report to the DEP each six years following the commencement of construction to the DEP to: • document the outcomes, beneficial or otherwise • review the success of goals, objectives and targets • evaluate the environmental performance over six years • evaluate the investigation and implementation of additional options for the reuse of treated wastewater; relevant to the following: 1. environmental objectives reported on in EPA Bulletin 1021 2. proponent's consolidated management commitments in schedule 2 of Ministerial Statement 572 and those arising from the fulfilment of conditions and procedures in Ministerial Statement 572 3. environmental performance targets 4. environmental management programs and plans 5. environmental performance indicators to the requirements of the EPA on advice of the DEP.	The first six-yearly performance review from 2003/04 to 2007/08 (Oceanica 2009) was submitted to the DEC on 30 April 2009. The second six-yearly performance report from 2008/09 to 2013/14 was submitted by the Water Corporation to the DER on 23 September 2015. This report covers the six-year compliance review period from 2014/15 to 2019/20 and once finalised will be submitted by the Water Corporation to DWER.	Compliant	This document and the previous six yearly performance review reports (Appendix AA).
Proponent Commitments					
P1.1	Wastewater management	Continue to investigate options for viable wastewater reuse at Bunbury	The State Government announced on 2 September 2020 plans to invest $11.9 million into a wastewater recycling scheme for Bunbury. The Bunbury Water Resource Recovery Scheme will include the construction of a new wastewater recycling facility (adjacent to Bunbury WWTP) and associated infrastructure to supply non-potable water for use on major infrastructure projects and irrigation of public open spaces.	Compliant	Appendix BB
P1.2	Wastewater management	Provide a triennial report to community and DEP detailing opinions investigated during the previous three years and plans for the next three years.	A triennial report was submitted in the 2017/18 PCR for the period 2015/16 to 2017/18 (Appendix BB). The next triennial report will be submitted in the 2020/2021 PCR for the period 2018/19 to 2020/2021.	Compliant	Appendix BB

P1.3	Wastewater management	Review requirement after each triennial report.	See P1.2 – submitted in PCRs.	Compliant	Appendix BB
P2	Construction and Environmental Management Program (CEMP)	Prepare CEMP for the construction phase of the project which includes management plans for: • Dune rehabilitation and revegetation • Beach rehabilitation • Marine construction • Underwater blasting (if required) • Protection of terrestrial vegetation • Public safety • Aboriginal heritage • Construction traffic.	The CEMP for the construction phase was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C)	Complete	Appendix C
P3	Construction EMP: Dune management plan (DMP)	Prepare DMP which addresses: • Minimalisation of construction impacts on dune erosion • Stabilisation and revegetation of the foredune area and areas impacted by construction.	The DMP was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C
P4	Construction EMP: Dune management plan	Implement DMP	The implementation of the DMP was to be completed within 12 months following the completion of construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously submitted by the Water Corporation. Following the audit this commitment was completed according to the letter from OEPA dated 11 October 2010 (Appendix C).	Complete	Appendix C
P5	Construction EMP: Beach Rehabilitation Plan (BRP)	Prepare a BRP which addresses the rehabilitation of the beach after construction.	The BRP was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C
P6	Construction EMP: Beach Rehabilitation Plan	Implement BRP	The implementation of the BRP was to be completed within 12 months following the completion of construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR (Water Corporation 2009) and information previously submitted by the Water Corporation. Following the audit this commitment was completed according to the letter from OEPA dated 11 October 2010 (Appendix C).	Complete	Appendix C
P7	Construction EMP: Terrestrial Flora Management Plan (TFMP)	Prepare a TFMP which addresses the issues: • That changes in local groundwater levels do not result in the loss of nearby Tuarts and other significant flora • That construction results in minimal and reversible impact on dune vegetation • That weeds are not introduced or spread	The TFMP was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C
P8	Construction EMP: Terrestrial Flora	Implement TFMP	The implementation of the TFMP was to be completed within 12 months following the completion of construction. A desktop	Complete	Appendix C

	Management Plan (TFMP)		audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR and information previously submitted by the Water Corporation. Following the audit this commitment was completed according to the letter from OEPA dated 11 October 2010 (Appendix C		
P9	Construction EMP: Marine Construction Management Plan (MCMP)	Prepare a MCMP which outlines procedures to minimise impacts of marine construction on: • Marine flora and fauna • Marine water quality.	The MCMP was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this condition was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C
P10	Construction EMP: Marine Construction Management Plan (MCMP)	Implement MCMP	The MCMP was to be implemented during construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR and information previously submitted by the Water Corporation. Following the audit this commitment was completed according to the letter from OEPA dated 11 October 2010 (Appendix C).	Complete	Appendix C
P11	Construction EMP: Underwater Blasting Management Plan (UBMP)	Prepare a UBMP (if blasting is used) to minimise the effect of underwater blasting on marine fauna and eliminate possible effects on protected marine fauna. The plan will specifically address issues associated with the protection of marine mammals.	The UBMP was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this commitment was completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C
P12	Construction EMP: UBMP	Implement UBMP if required.	The UBMP was to be implemented during construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR and information previously submitted by the Water Corporation. Following the audit this commitment was listed as completed according to the letter from OEPA dated 11 October 2010 (Appendix C).	Complete	Appendix C
P13	Construction EMP: Public Safety Plan (PSP)	Prepare PSP which addresses the issues of: • Restriction of public access to the construction site • Marine equipment complying with DoT regulations • Public notification of any restrictions	The PSP was cleared by the DEC audit branch on 30 January 2002. The OEPA determined that this commitment was completed during a desktop audit dates 11 October 2010 (Appendix C).	Complete	Appendix C
P14	Construction EMP: Public Safety Plan	Implement PSP	The PSP was to be implemented during construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR and information previously submitted by the Water Corporation. Following the audit this commitment was listed as completed according to the letter from OEPA dated 11 October 2010 (Appendix C).	Complete	Appendix C
P15	Construction EMP: Aboriginal Heritage Plan (AHP)	Prepare an AHP which addresses the issues of: • Consultation with local Aboriginal groups • Obtaining advice from the DIA on work practices	Prior to construction, the Water Corporation was required to prepare an AHP. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR and information previously submitted by the Water Corporation. The audit referred to a letter dated 30 January 2002 which indicates that this commitment had been complied with, therefore this commitment was considered complete (OEPA letter dated 11 October 2010, Appendix C).	Complete	Appendix C

P16	Construction EMP: Aboriginal Heritage Plan	Implement AHP	The AHP was to be implemented prior to construction to ensure no sites of Aboriginal Heritage or culture are inadvertently destroyed. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR and information previously submitted by the Water Corporation. The audit referred to a letter dated 8 January 2001 which indicates that this commitment to be audited by another agency and is therefore outside the scope of this audit (OEPA letter dated 11 October 2010, Appendix C).	Not audited	Appendix C
P17	Construction EMP: Construction Traffic Plan (CTP)	Prepare a CTP to minimise impacts of construction traffic on local residents.	The CTP was required to be prepared prior to construction commencing. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR and information previously submitted by the Water Corporation. The audit referred to a letter dated 30 January 2002 which indicates that this commitment had been complied with, therefore this commitment was considered complete (OEPA letter dated 11 October 2010, Appendix C).	Complete	Appendix C
P18	Construction EMP: Construction Traffic Plan	Implement CTP.	The CTP was to be implemented during construction. A desktop audit was conducted by the OEPA in August 2010, based on the 2008/09 PCR and information previously submitted by the Water Corporation. The audit referred to the previous six yearly performance review (Oceanica 2009) which indicates that this commitment had been complied with and the fact that the WWTP was now in operation and was only required during construction. Therefore, this commitment was considered complete (OEPA letter dated 11 October 2010, Appendix C).	Complete	Appendix C
P19	Operations Environmental Management Program	Prepare EMP for the operations phase of the project which includes plans for: • Marine biota, sediment and water quality • Recreational water quality • Wastewater treatment management.	The operations EMP was required to be prepared prior to commissioning. The operations EMP (DALSE 2002a) incorporated the three management plans and was cleared by the DEC audit branch on 26 July 2002 (Appendix C). The Operations EMP includes a Marine Impacts Monitoring and Management Plan (MIMMP; DALSE 2002b). The MIMMP was revised two more times: an interim plan and a final revised MIMMP (Water Corporation 2012). The interim and revised versions of the MIMMP were approved by the OEPA.	Complete	Appendix C
P20	Operations EMP: Marine Biota, Sediment and Water Quality Management Plan (MBSWMP)	Prepare a MBSWMP which addresses the following issues: • Derive site specific trigger levels for waters in the vicinity of the outlet for indicators other than toxicants, where appropriate (ANZECC 2000)[1] • Design appropriate study to differentiate between natural and anthropogenic sources of nitrogen currently existing and due to future discharge from the outfall • Design monitoring programs for the sediments in the vicinity of the outlet	The MBSWMP was prepared as part of the Operations EMP required under P19 (see above). The MBSWMP was cleared by the DEC audit branch on 26 July 2002 and the OEPA determined that this commitment was listed as completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C

		• Design of water quality monitoring programs which have the ability to measure long-term changes in water quality, including changes in productivity, biodiversity and ecosystem processes. Include reference site for comparison • Contingency planning to improve water quality or reduce loads of contaminants and nutrients discharged if monitoring shows that agreed criteria are not met • Reporting procedures to DEP • Monitoring of contaminant levels in treated wastewater at Bunbury WWTP • Quality assurance procedures for monitoring programs.			
P21	Operations EMP: Marine Biota, Sediment and Water Quality Management Plan	Implement MBSWMP for five years after completion of construction, after which time it will be reviewed in consultation with DEP.	The OEPA undertook a targeted desktop audit of commitments P21, P23 and P26 in 2013, and found that the Water Corporation was in full compliance with these commitments. The results of the audit were provided to the Water Corporation on 30 May 2013 (Appendix C).	Complete	Appendix C
P22	Operations EMP: Recreational Water Quality Management Plan (RWQMP)	Prepare a RWQMP which addresses the following issues: • Design a bacterial monitoring program which will establish whether primary contact criteria are met within 100 m of the diffuser and whether the shellfish harvesting criteria within 500 m of the diffuser • Contingency planning to improve water quality if monitoring shows that agreed criteria are not met.	The RWQMP was prepared as part of the Operations EMP required under P19 (see above). The RWQMP was cleared by the DEC audit branch on 26 July 2002 and the OEPA determined that this commitment was listed as completed during a desktop audit dated 11 October 2010 (Appendix C).	Complete	Appendix C
P23	Operations EMP: Recreational Water Quality Management Plan	Implement RWQMP for five years after completion of construction, after which time it will be reviewed in consultation with the DEP.	The OEPA undertook a targeted desktop audit of commitments P21, P23 and P26 in 2013, and found that the Water Corporation was in full compliance with these commitments. The results of the audit were provided to the Water Corporation on 30 May 2013 (Appendix C).	Complete	Appendix C
P24	Recreational (land based)	Maintain legitimate recreational uses of the beach and dune areas (no plan required).	This commitment was only to be audited by the proponent according to the DEC audit branch on 7 November 2001. In their annual PCRs between 2014/15 and 2019/20 (Appendix B), the Water Corporation state that they have not received any reports that the recreational value of the beach or dune areas had diminished since the construction of the Bunbury WWTP. The beach and foredune remain open to public access.	Compliant	Appendix BB
P25	Operations EMP: Wastewater Treatment	Prepare a WTMP for the plant which addresses the following environmental issues:	The WTMP was prepared as part of the Operations EMP required under P19 (see above). The WTMP was cleared by the DEC audit branch on 26 July 2002 and the OEPA	Complete	Appendix C

	Management Plan (WTMP)	• Operate WWTP such that national guidelines for toxicant concentrations in marine waters are met • Bring forward upgrade of wastewater treatment system if monitoring shows unacceptable environmental impacts • Operate WWTP such that agreed EQOs and EQC are met to 95% confidence • Discontinue the current practice of discharging treated wastewater to unlined lagoons, except where flows are required to reduce stress on nearby trees • Ensure maximum annual average nitrogen load to the ocean from the outlet if less than 60 tpa • Contingency plans for non-standard operation of the WWTP.	determined that this commitment was listed as completed during a desktop audit dated 11 October 2010 (Appendix C).		
P26	Operations EMP: Wastewater Treatment Management Plan	Implement WTMP for five years after completion of construction, after which time it will be reviewed in consultation with DEP.	The OEPA undertook a targeted desktop audit of commitments P21, P23 and P26 in 2013, and found that the Water Corporation was in full compliance with these commitments. The results of the audit were provided to the Water Corporation on 30 May 2013 (Appendix C).	Complete	Appendix C
P27	Community consultation	Provide information during construction of outlet and monitoring of operations to community groups. Consider community objectives.	Following a period of significant consultation for Bunbury WWTP in 2009/10 and since the commissioning of the upgraded WWTP in November 2009 the Water Corporation has continued to maintain relationships with key stakeholders and community groups. Each of the PCR from 2014/15 to 2019/20 demonstrate Water Corporation engages with stakeholders and community interest groups in a timely and meaningful way and consults with them on matters of mutual interest.	Compliant	Appendix BB

Compliance with Ministerial Conditions

Condition 1–1: Implementation

572:M–1 requires the Water Corporation to implement the proposal as documented in Schedule 1 of MS 572, subject to these conditions and procedures. For the reporting period 2014/15 to 2019/20, there was total compliance with the parameters in Schedule 1 of MS 572 (Table 3; Appendix B).

Table 3 Compliance with Schedule 1 key characteristics table between 2014/15 to 2019/20

Parameter	Original limit	Revised limit	Year and compliance status					
			2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019–2020
Suspended solids (mg/L)	<20	No change	Compliant 4.1	Compliant 4.5	Compliant 6.9	Compliant 10.4	Compliant 5.4	Compliant 5.4
Biological oxygen demand (mg/L)	<20	No change	Compliant 2.9	Compliant <5	Compliant 3.5	Compliant 5.4	Compliant 5.0	Compliant 5.0
Total nitrogen (mg/L)	15	No change	Compliant 5.9	Compliant 7.0	Compliant 11.4	Compliant 10.6	Compliant 12.7	Compliant 8.7
Discharge of total nitrogen to ocean (T/yr)	<60	No change	Compliant 18.9	Compliant 21.9	Compliant 42.8	Compliant 45.4	Compliant 52.5	Compliant 35.1

Notes:

1. Original approval limit (mean concentration or value) defined in Ministerial Statement 572 issued on 14 September 2001.
2. As per Attachment 2 to Ministerial Statement 572 approved on 22 April 2014, total phosphorus and faecal coliform bacteria counts are now managed under Part V Licence under the EP Act and therefore not included in Schedule 1.

Condition 6-1: Marine management

Condition 6-1 of MS 572 requires the Water Corporation to manage the discharge of effluent from the ocean outlet to achieve simultaneously the environmental values of ecosystem health, fishing and aquaculture and recreation and aesthetics and their associated EQOs (Table 4, Figure 2). Compliance against the EQOs has been assessed each year and reported in the Bunbury Ocean Outlet Monitoring (BOOM) annual reports:

- 2014/2015 BOOM Annual Report (BMT Oceanica 2015)
- 2015/2016 BOOM Annual Report (BMT Oceanica 2016)
- 2016/2017 BOOM Annual Report (BMT Oceanica 2017)
- 2017/2018 BOOM Annual Report (BMT 2018)
- 2018/2019 BOOM Annual Report (BMT 2019)
- 2019/2020 BOOM Annual Report (BMT 2020)

Table 4 Marine management requirements at Bunbury TWW ocean outlet

Environmental Value (EV)	Environmental Quality Objective (EQO)	Requirement and associated area
Ecosystem health	EQO1 Maintenance of Ecosystem Integrity	Within 100 m of the diffuser a low level of ecosystem integrity will apply (E4)
		At distance greater than 100 m from the diffuser a high level of ecosystem integrity will apply (E2)
Fishing and aquaculture	EQO2(i) Maintenance of aquatic life for human consumption	No shellfish harvesting within 500 m of the diffuser (S2)
	EQO2(ii) Maintenance of aquaculture	
Recreation and aesthetics	EQO3 Maintenance of primary contact recreation values	Within 100 m of the diffuser a primary contact recreation exclusion area will apply (S3)
	EQO4 Maintenance of secondary contact and recreation values	Not to be affected by the presence of the outlet
	EQO5 Maintenance of aesthetic values	Not to be affected by the presence of the outlet

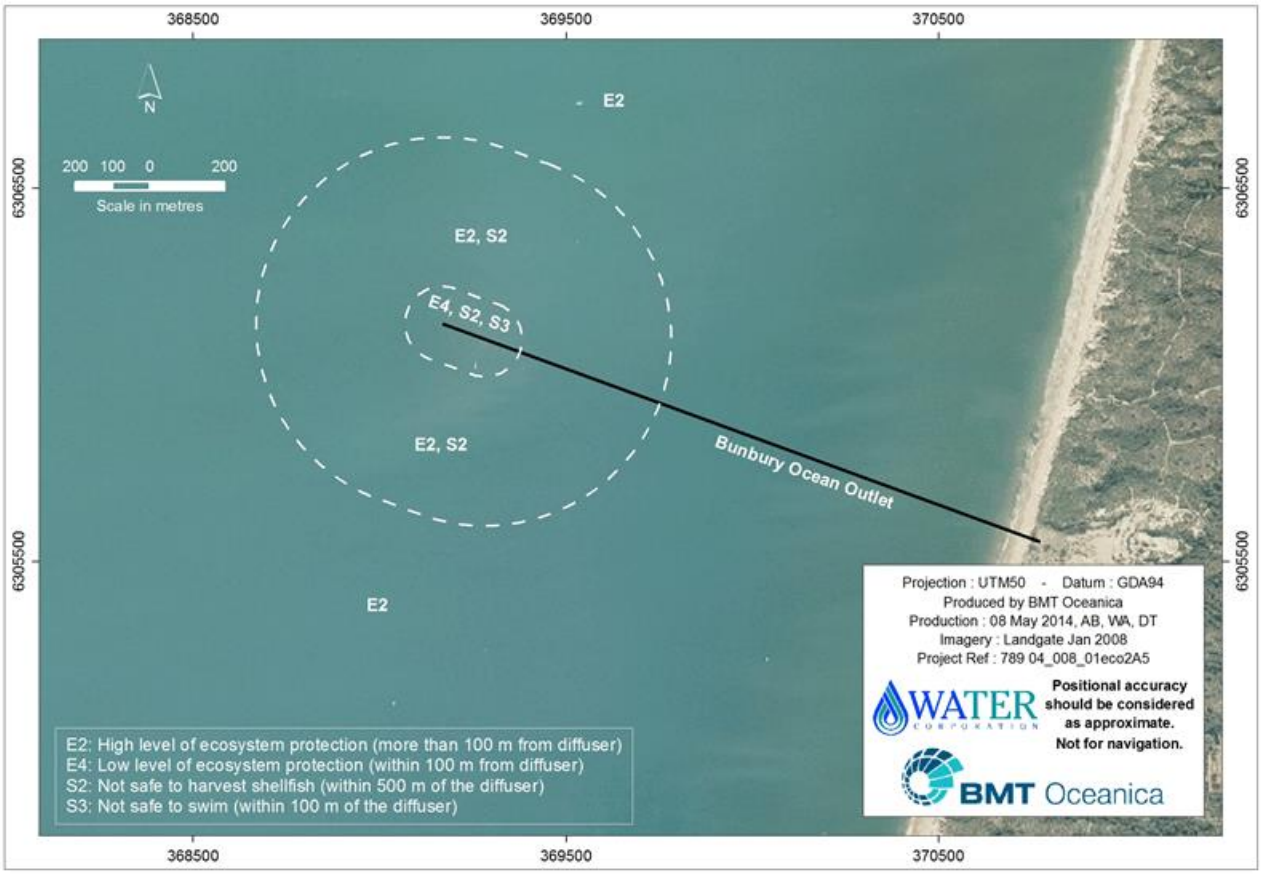


Figure 2 Ecosystem protection areas as defined in Ministerial Statement 572

Condition 6-2: Marine management

MS 572 requires the Water Corporation to address the following which are not included in commitment No.19 (MIMMP):

1. the identification of ecosystem health indicators appropriate to the discharge sites
2. site specific guideline values and standard criteria for the indicators, if generic criteria are not appropriate to the requirements of the EPA on advice from the DEP.

Since 2002, three sets of EQC have been developed:

1. original EQC used prior to October 2006 developed as part of the original OEMP (DALSE 2002b)
2. EQCs used between 2006 and 2011 (developed following a review of long-term data)
3. Current EQGs, which were developed by Water Corporation as part of the revised MIMMP (Water Corporation 2012).

Revisions to Environmental Quality Criteria and BOOM program

There have been no revisions to the EQC over the six-year reporting period (2014/15 to 2019/20). The MIMMP (Water Corporation 2012) approved by the OEPA on 29 June 2012 outlines all EQC in the BOOM program followed annually over the reporting period (2014/15 to 2019/20).

Compliance with Environmental Quality Criteria

All EQC are summarised in the following tables for each EQO over the reporting period 2014/15 to 2019/20:

- Maintenance of Ecosystem Integrity (EQO1) EQG & EQS (Table 5)
- Maintenance of Aquatic Life for Human Consumption (EQO2) EQG & EQS (Table 6)
- Maintenance of Primary and Secondary Contact Recreation (EQOs 3 & 4) EQG & EQS (Table 7)

There has been no requirement to develop EQC for EQO5 Maintenance of Aesthetic Values. Commitment P24 (Land Based Recreation) required the Proponent to maintain recreational uses of the marine and terrestrial beach/dune areas. Water Corporation records indicate no significant change in the aesthetic qualities of the marine or terrestrial habitats and no complaints regarding the quality of recreation, meeting EQO5.

Evidence of the Water Corporation's environmental performance against EQOs 1–4 is provided in Table 8, Table 9 and Table 10 respectively. These compliance assessments have been summarised from the information provided in the BOOM annual reports from 2014/15 to 2019/20.

Table 5 Environmental Quality Guidelines (EQGs) and Environmental Quality Standards (EQSs) for EQO1 Maintenance of Ecosystem Integrity

Parameter	Methods	EQG	EQS
Toxicants in treated wastewater (TWW)	i) Comprehensive TWW characterisation ii) Initial dilution	i) Concentrations of contaminants not to exceed the ANZECC & ARMCANZ (2000) guideline for 99% species protection following initial dilution (or 80% species protection before dilution, for any toxicant with the potential to bioaccumulate) ii) Where there are mixtures of toxicants, the total toxicity of the mixture (TTM) at a single site or for a defined area should not exceed 1	NA
Nutrients – indicators of increased nutrients and algal growth potential	Surface chlorophyll-a	Ambient value in the defined area during the summer period is not to exceed the 80th percentile of reference site data[1]	i) The ambient values for seagrass meadow shoot density measured during January and in two consecutive years is greater than the 20th percentile of shoot density measured at an appropriate reference site; AND ii) The ambient values for seagrass meadow shoot density in any one year is greater than the 5th percentile of meadow shoot density measured at an appropriate reference site
	Periphyton chlorophyll-a	Ambient value of the defined area during the summer period is not to exceed the 80th percentile of reference site data at the 8 m depth from the current reporting period	
	Light attenuation coefficient	Ambient value of the defined area during the summer period is not to exceed the 80th percentile of reference site data[1]	
	Phytoplankton biomass	Ambient value for phytoplankton biomass measured as chlorophyll-a does not exceed 3 times the median of chlorophyll-a concentrations of reference sites[1] on any occasion during the non river-flow period	Ambient value for phytoplankton biomass measured as chlorophyll-a not to exceed 3 times the median of chlorophyll-a concentration of reference sites[1], on more than one occasion during the non river-flow period and in two consecutive years
Physico-chemical stressors	Dissolved oxygen % saturation	Ambient value for dissolved oxygen in bottom waters (0-0.5 m above the sediment surface) is greater than 90% saturation at any site for a defined period of not more than six weeks	i) Ambient value for dissolved oxygen in bottom waters (0-0.5 m above sediment surface) is greater than 60% saturation at any site for a defined period of not more than six weeks; AND ii) No significant change beyond natural variation in any ecological or biological indicators that are affected by poorly oxygenated water unless that change can be demonstrably linked to a factor other than oxygen concentration AND iii) No recorded deaths of marine organisms related to deoxygenation.

Notes:

1. The numerical reference site values are updated each year to incorporate the latest reference site data.
2. Ambient value = median value of individual sample data for a defined area
3. Defined area = area to be characterised for environmental quality against the EQO for maintenance of environmental integrity
4. Non-river flow period = December to March inclusive, when river and estuarine flows are weak.
5. DO saturation measured during daylight hours.

Table 6 Environmental Quality Guidelines (EQGs) and Environmental Quality Standards (EQSs) relevant to the EQO2 for Maintenance of Aquatic Life for Human Consumption

Parameter	EQG	EQS
Microbiological contaminants; thermotolerant faecal coliforms	Median thermotolerant coliform concentrations not to exceed 14 CFU/100 mL, with no more than 10% of the samples exceeding 21 CFU/100 mL measured using the membrane filtration method; outside of the proposed safety area	Median thermotolerant coliform concentrations not to exceed 70 CFU/100 mL, with no more than 10% of the samples exceeding 85 CFU/100 mL, measured using the membrane filtration method; outside of the proposed safety area
Algal biotoxins ; potentially toxic phytoplankton species	Concentrations of potentially toxic algae not to exceed the WASQAP[1] trigger concentrations in any samples	Toxin concentrations in seafood not to exceed environmental quality standards in any sample as per Table 4 of EPA 2005[2]

Notes:

1. Western Australian Shellfish Assurance Program (DoF 2007). Note that the EQG is only exceeded if the exceedance of a WASQAP trigger value can be attributed to the Bunbury Ocean Outlet.
2. Note that monitoring of this EQS requires sentinel mussel deployment at the appropriate compliance sites for seafood safe for human consumption.

Table 7 Environmental Quality Guidelines (EQGs) and Environmental Quality Standards (EQSs) relevant to the EQO for Maintenance of Primary and Secondary Contact Recreation

Parameter	EQG	EQS
Faecal pathogens: *Enterococci* spp.	The 95th percentile of the pooled enterococci organism data from recreational compliance sites compared against the upper NHMRC category A value is not to exceed 40 MPN/100 mL	The 95th percentile of the pooled enterococci organism data from shoreline sites compared against the upper NHMRC category A value is not to exceed 40 MPN/100 mL
Algal biotoxins	Median total phytoplankton cell count (either from one sampling occasion or from a single site over an agreed period of time) should not exceed 10 cells/mL *Karenia brevis* and/or have *Lyngbya majuscula* and/or *Pfiesteria* present in high numbers outside the LEPA or	There should be no confirmed incidences (by the Department of Health) of skin or eye irritation caused by toxic algae, or of algal poisoning in recreational users
	There should be no reports of skin or eye irritation or potential algal poisoning in swimmers considered by a medical practitioner as potentially resulting from toxic algae when less than 10 cells/mL *Karenia brevis* and/or have *Lyngbya majuscula* and/or *Pfiesteria* is present in the water column.	

Between 2014/15 and 2019/20 there were three instances in which the EQG for periphyton biomass (measured as chlorophyll-a) was exceeded triggering assessment against the seagrass health EQS (Table 8). On two of those occasions (2017/18 and 2019/20) the seagrass health EQS1 was exceeded but EQS2 was met on all occasions and therefore the EQO was met (Table 8).

Table 8 Summary of the Water Corporation's environmental performance against the Environmental Quality Criteria for EQO1

EQO1	Indicator	Monitoring period					
		2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
Environmental Quality Guideline (EQG)	Toxicants in TWW after initial dilution						
	Total toxicity of the mixture (TTM) <1						
	Surface water chlorophyll-a						
	Periphyton chlorophyll-a						
	Light attenuation coefficient						
	Dissolved oxygen >90%						
	Phytoplankton biomass						
	Toxicants in sediments	NA	NA	NA	NA		NA
Summary	ALL EQG	All nutrient enrichment EQG were met therefore the EQO was met without needing to examine the EQS	All nutrient enrichment EQG were met therefore the EQO was met without needing to examine the EQS	All nutrient enrichment EQG were met therefore the EQO was met without needing to examine the EQS	Periphyton EQG exceeded, leading to seagrass health assessment against EQS	Periphyton EQG exceeded, leading to seagrass health assessment against EQS	Periphyton EQG exceeded, leading to seagrass health assessment against EQS
Environmental Quality Standards (EQS)	Seagrass health EQS1	NA (EQG met)	NA (EQG met)	NA (EQG met)	Exceeded at site SG4		Exceeded at site SG2
	Seagrass health EQS2	NA (EQG met)	NA (EQG met)	NA (EQG met)			

Notes:

1. TWW = treated wastewater, TTM = total toxicity of the mixture, EQG = environmental quality guideline, EQS = environmental quality standard, EQO = environmental quality objective
2. EQG met; EQG not met investigate against EQS; EQS not met (management response required).

Between 2014/15 and 2019/20, all environmental quality criteria for maintenance of aquatic life for human consumption (EQO2) were met (Table 9).

Table 9 Summary of Water Corporation's environmental performance against the Environmental Quality Criteria for EQO2

EQO	Indicator	Monitoring period					
		2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
EQG	Thermotolerant coliforms	■	■	■	■	■	■
	Presence potentially toxic phytoplankton	■	■	■	■	■	■

Note:

1. ■ Green symbols represent EQG met.

Between 2014/15 and 2019/20, all environmental quality criteria for the maintenance of primary (EQO3) and secondary (EQO4) contact recreation were met (Table 10).

Table 10 Summary of Water Corporation's environmental performance against the Environmental Quality Criteria for EQO3 & EQO4

EQO	Indicator	Monitoring period					
		2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
EQG	*Enterococci* species	■	■	■	■	■	■
	Toxic algal species of concern	■	■	■	■	■	■

Note:

1. ■ Green symbols represent EQG met.

Compliance with Proponent Commitments

There were no changes to the Proponent Commitments over the 2014/15 to 2019/20 reporting period. All proponent commitments were either complete or compliant in the 2014/15 to 2019/20 reporting period with the exception of P16 which was not audited (Table 2).

Conclusion

The preparation of this performance review report for the Bunbury ocean outlet entailed a systematic review of each condition and commitment of MS 572, according to evidence provided by Water Corporation to determine the appropriate status of each condition/commitment. The audit evidence reviewed during this performance review was based on a sample of information provided by the Water Corporation relevant to the time period for which this report has been prepared (i.e. 2014/15 to 2019/20).

Of the 24 Ministerial Conditions, seven were complete, 14 were compliant and three were not required (Table 2). Of the 29 Proponent Commitments, 23 were complete, 5 were compliant and one was not audited (Table 2). Based on the evidence provided by the Water Corporation, it has been determined that the Bunbury WWTP is in compliance with the conditions and commitments of MS 572.

References

ANZECC, ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1: The Guidelines. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT, October 2000

BMT Oceanica (2015) Bunbury Wastewater Treatment Plant – Six Year Performance Review. Prepared for Water Corporation by BMT Oceanica Pty Ltd, Report No 789_04_009/2_Rev0, Perth, Western Australia, July 2015

DALSE (2002a) Bunbury Ocean Outfall Environmental Management Programme for Operations. Prepared for Water Corporation of Western Australia by DAL Science & Engineering Pty Ltd, Report No. 02/189/2, Perth, Western Australia, August 2002

DALSE (2002b) Bunbury Ocean Outfall Operations EMP Marine Impacts Monitoring and Management Plan. Prepared for Water Corporation of Western Australia by DAL Science & Engineering Pty Ltd, Report No. 02/189/3, Perth, Western Australia, August 2002

DoF (2007) Western Australian Shellfish Quality Assurance Program (WASQAP) Operations Manual. Department of Fisheries

EPA (2001) Ocean outlet for treated wastewater, Bunbury wastewater treatment plant. Prepared for the Water Corporation of Western Australia by Environmental Protection Authority, Report No. 1021, Perth, Western Australia, July 2001

EPA (2005) Environmental Quality Criteria Reference Document for Cockburn Sound (2003–2004) – A supporting document to the State Environmental (Cockburn Sound) Policy 2005. Environmental Protection Authority, Report No. 20, Perth, Western Australia, January 2005

Oceanica (2009) Bunbury Wastewater Treatment Plant – Six Year Performance Review. Prepared for Water Corporation by Oceanica Consulting Pty Ltd, Report No 749_001/1, Perth, Western Australia, April 2009

OEPA (2012) Post Assessment Guideline for Preparing an Audit Table. Office of the Environmental Protection Authority, Report No PAG 1, Perth, Western Australia, August 2012

Appendix A	Bunbury Wastewater Treatment Plant Six Year Performance Review 2015 (A1) and 2009 (A2)
Appendix B	Water Corporation's Annual Performance Compliance Reports 2014-2020 (B1 – B5)
Appendix C	Audit Compliance Table Status Documentation

(Appendices submitted electronically, along with this report)

ATTACHMENT 4

Bunbury WWTP Annual Licence Monitoring Report 2020-2021

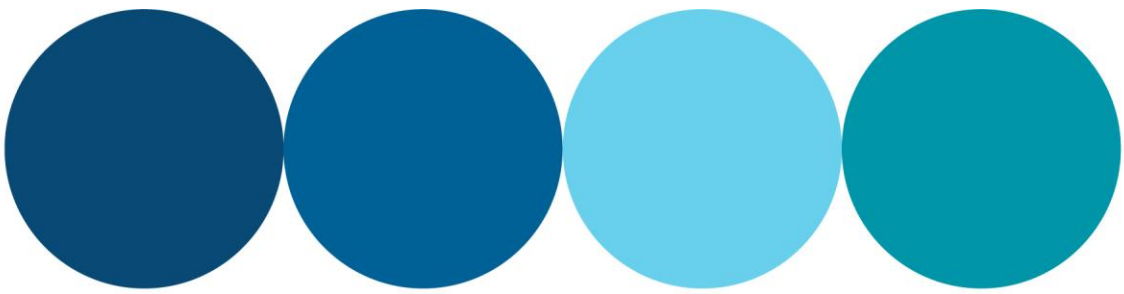
(https://nexus.watercorporation.com.au/otcs/cs.exe/link/120534605)

Annual Environmental Report

Bunbury Wastewater Treatment Plant

Part V Licence L5972/1992/14

1 July 2020 to 30 June 2021



WATER CORPORATION

Document Management

This report has been prepared by Water Corporation for the Department of Water and Environmental Regulation to meet annual reporting requirements under its emission licence as issued under Part V of the *Environmental Protection Act 1986*.

Rev No.	Version description	Prepared by	Reviewed by	Date
1	First Draft	R.Munro	Operations Service Team Leader	03/08/2021
2	Technical Review (Optional)		D. Puzey	11/08/2021
3	Environmental Section Review		B. Scott	04/08/2021
4	Asset Investment Planner Review - Final		A. Brown	16/08/2021

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Contents

1 Summary

Annual Environmental Reports (AERs) are required under most Water Corporation emission licences issued under Part V of the *Environmental Protection Act 1986*. This AER relates to the operation of Water Corporation's Bunbury Wastewater Treatment Plant (WWTP) and addresses the requirements of Condition 4.2.1 of Licence L5972/1992/14 for the period 1 July 2020 to 30 June 2021.

There were no compliance issues reported at Bunbury WWTP for the 2020-2021 reporting period.

2 Site Background and Environmental Context

Environmental Context Descriptor	Details
Disposal Method / Discharges to the Environment	Treated Wastewater (TWW) is discharged into the ocean 1.7km offshore.
Soil Type	Uniform calcareous sands showing variable depths of surface darkening
Depth to Groundwater	The groundwater is generally within 2.0-10.0m of the surface.
Distance to Nearest Sensitive Receptor(s) (km)	Two (2) Threatened Ecological Communities (TECs) and five (5) Priority Ecological Communities (PECs) listed under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) are mapped within 2 km of the site. No national environmentally sensitive areas were identified within 2 km of the site boundary.
Surrounding Land Use(s)	The plant is surrounded by Crown land. Residential area is located approximately 700 m south-east of the plant.

3 Monitoring

3.1 Sampling Methodology

All water samples were collected, handled and preserved in accordance with the relevant parts of Australian Standard AS/NZS 5667:1 where practicable.

Holding time guidance for pH (6 hours) and was not routinely achieved at Bunbury WWTP. Water Corporation internal studies (provided to DWER in correspondence dated 4 June 2019) demonstrate that holding times of up to 48 hours do not have a significant impact on the accuracy of pH analysis where samples are preserved and transported in accordance with Water Corporation Standards (S100 and S210). Section 1.1 of AS/NZS 5667:1:1998 affords the use of alternative sampling procedures where it is demonstrated that procedures are at least as reliable as the prescribed standard. DWER has acknowledged that Water Corporation's standards is an acceptable alternative. Analysis is therefore in accordance with AS/NZS 5667:1:1998. Should a significant statistical variation in data be observed, the impact of holding times will be investigated as a possible cause.

All water samples sent externally were analysed by either SGS Australia Laboratory, Analytical Reference Laboratories or PathWest. All laboratories are NATA accredited commercial laboratories.

All water samples analysed internally by the Water Corporation were in accordance with the Water Corporation's Manual of Analytical Procedures as approved by the Director. These procedures are based on the current "Standard Methods for Examination of Water and Wastewater – APHA-AWWA-WEF".

Results for *E. coli* analysis have been reported as Colony Forming Units (CFU/100mL), however have been obtained using the substrate technology method 'Colilert' (Most Probable Number (MPN/100mL)) (as detailed in AS/NZS 4276.21:2007). Results obtained by the MPN method provide comparable and reproducible results against the 'membrane filtration' method (CFU) (AS/NZS 4276.07:2007) and both methods are NATA accredited.

3.2 Discharge Rate Calculations

3.2.1 Equation One – Daily Discharge Rate over Sampling Period

The following equation is used to estimate daily discharge rates for each waste type over the sampling period, unless otherwise specified by the licence.

$$R_{sp} = \frac{Q_{sp} \times C}{1000 \times D_{sp}}$$

Where:

$\boldsymbol{R_{sp}} = Estimated\ Daily\ Discharge\ Rate\ over\ the\ Sampling\ Period\ in\ kg/day$

$\boldsymbol{Q_{sp}} = Total\ Flow\ over\ the\ Sampling\ Period\ in\ m^3$

$\boldsymbol{C} = Concentration\ of\ waste\ type\ during\ the\ Sampling\ Period\ in\ mg/L$

$\boldsymbol{D_{sp}} = Total\ number\ of\ days\ in\ Sampling\ Period$

3.2.2 Equation Two – Average Daily Discharge Rate over Annual Period

For each waste type, an average daily discharge rate for the entire annual period is estimated by calculating the mean average of all daily discharge rates calculated under equation one, unless otherwise specified by the licence.

$$R_{annual} = \frac{R_{sp^1} + R_{sp^2} + R_{sp^3} + \cdots + R_{sp^n}}{n}$$

Where:

$\boldsymbol{R_{annual}} = Average\ Daily\ Discharge\ Rate\ over\ the\ Annual\ Period\ in\ kg/day$

$\boldsymbol{R_{sp}} = Estimated\ Discharge\ Rate\ for\ each\ Sample\ Period\ (Equaltion\ One)\ in\ kg/day$

$\boldsymbol{n} = Total\ number\ of\ sampling\ periods\ in\ the\ Annual\ Fee\ Period$

3.3 Monitoring of Inputs and Outputs

Tables 1, 2 & 3 provide monthly, cumulative and average daily flow data in cubic meters (m^3) for the following processes at the WWTP:

- Table 1: Magflow meter measuring raw wastewater inflow into the treatment plant. Inflow into WWTP are permitted to be used as a surrogate for outflow to the discharge weir as per licence condition 3.2,1.
- Table 2: Magflow meter measuring treated wastewater directed for reuse within the treatment plant for process water; and.
- Table 3: Treated wastewater delivered to the treatment plant by tanker. Data obtained from DWER Controlled Waste Tracking System website

The Bunbury WWTP has been operated within the approved premises production or design capacity of 15,000m^3/day throughout the 2020-2021 reporting period, with an annual average daily inflow of 11,494m^3. This represents a 4% increase from the 2019-2020 reporting period. The plant also received 4,125.31 tonnes of tankered waste (K130) during the reporting period.

Table 1: Summary of Inputs and Outputs

	Bunbury 2 WWTP Total Inflow		
	Monthly Flow	Cumulative Flow	Average Daily Flow
	m3		m3
Jul 2020	386584	386584	12470
Aug 2020	378065	764649	12196
Sep 2020	355227	1119876	11841
Oct 2020	355915	1475791	11481
Nov 2020	342465	1818255	11415
Dec 2020	341672	2159927	11022
Jan 2021	334373	2494301	10786
Feb 2021	308325	2802626	11012
Mar 2021	340516	3143142	10984
Apr 2021	334014	3477156	11134
May 2021	361416	3838572	11659
Jun 2021	356684	4195256	11889
Average			**11494**

Table 1: Summary of Treated Wastewater Directed for Onsite Reuse

	Bunbury 2 WWTP On-site Reuse		
	Monthly Flow	Cumulative	Flow Daily
	m3	m3	m3
July-20	10583	10583	341
Aug-20	11137	21719	359
Sep-20	5248	26967	175
Oct-20	6361	33328	205
Nov-20	9598	42926	320
Dec-20	9369	52294	302
Jan-21	9726	62020	314
Feb-21	8956	70976	320
Mar-21	11095	82071	358
Apr-21	9702	91774	323
May-21	11920	103693	385
Jun-21	10993	114686	366
Average			**314**

Note: Flow data estimated from March 2021 to June 20221 due to faulty flow reuse meter.

Table 3: Summary of treated wastewater delivered to premise by tanker (Controlled Waste Summary)

	Treated Wastewater Received via Tanker	
	Monthly Flow	Cumulative Flow
	m3	m3
July-20	317	317
Aug-20	247	564
Sep-20	277	841
Oct-20	488	1329
Nov-20	418	1747
Dec-20	435.5	2182.5
Jan-21	523.6	2706.1
Feb-21	575	3281.1
Mar-21	768.5	4049.6
Apr-21	640	4689.6
May-21	400	5089.6
Jun-21	640	5729.6

Note: All tankered inflow was category K130

3.4 Wastewater Monitoring Data

3.4.1 Exceptions & Exceedances

There were no exceptions or exceedances against licence criteria during the 2020-2021 reporting period.

3.4.2 Trends

Table 4 Summary of Trends

There were no notable adverse trends (i.e. deviations from typical ranges) observed across the monitored parameters during 2020-2021 reporting period. Trend graphs included in Appendix 2

3.4.3 Contaminant Loads

Table 5 Contaminant Load Discharge from the Discharge Weir to Ocean Outfall (Nutrients)

	Ammonium as nitrogen Loading	Biochemical Oxygen Demand Carb Loading	Nitrite plus nitrate as N Loading	Suspended Solids Loading	Total Dissolved Solids by evap Loading	Total Nitrogen Loading	Total Phosphorus Loading
	kg/day	kg/day	kg/day	kg/day	kg/day	kg/day	kg/day
July 2020	19.92	31.12	58.51	31.12	6,970.91	98.34	49.79
August 2020	21.94	30.48	57.29	30.48	6,704.58	99.96	57.29
September 2020	23.66	29.57	60.33	29.57	6,742.68	108.83	50.87
October 2020	36.73	28.69	50.5	28.69	6,656.76	114.77	49.35
November 2020	21.68	28.53	45.65	114.11	6,846.82	90.15	36.52
December 2020	22.02	27.53	48.45	27.53	5,836.38	91.4	49.55
January 2021	12.94	26.96	60.4	53.93	6,471.47	100.31	53.93
February 2021	14.31	27.52	48.44	27.52	5,284.3	77.06	40.73
March 2021	9.66	27.44	43.9	27.44	6,146.63	70.25	35.12
April 2021	34.59	27.9	29.01	27.9	5,691.34	81.46	31.25
May 2021	24.55	29.22	33.9	29.22	6,312.39	80.66	45.59
June 2021	23.77	29.72	34.47	29.72	6,656.58	85.58	42.79
Average:	**22.15**	**28.72**	**47.57**	**38.1**	**6,360.07**	**91.56**	**45.23**

Table 6: **Contaminant Load Discharge Weir to Ocean Outfall (Metals)**

	Arsenic Loading kg/day	Cadmium Loading kg/day	Chromium Loading kg/day	Copper Loading kg/day	Lead Loading kg/day	Mercury Loading kg/day	Molybdenum Loading kg/day	Nickel Loading kg/day	Selenium Loading kg/day	Silver Loading kg/day	Zinc Loading kg/day
July 2020	0.06	0.12	0.12	0.04	0.12	0	0.12	0.12	0.12	0.12	0.5
August 2020	0.06	0.12	0.12	0.01	0.12	0	0.12	0.12	0.12	0.12	0.49
September 2020	0.06	0.12	0.12	0.01	0.12	0	0.12	0.12	0.12	0.12	0.47
October 2020	0.06	0.11	0.11	0.01	0.11	0	0.11	0.11	0.11	0.11	0.46
November 2020	0.06	0.11	0.11	0.05	0.11	0	0.11	0.11	0.11	0.11	0.46
December 2020	0.06	0.11	0.11	0.04	0.11	0	0.11	0.11	0.11	0.11	0.44
January 2021	0.05	0.11	0.11	0.04	0.11	0	0.11	0.11	0.11	0.11	0.43
February 2021	0.06	0.11	0.11	0.04	0.11	0	0.11	0.11	0.11	0.11	0.44
March 2021	0.05	0.11	0.11	0.04	0.11	0	0.11	0.11	0.11	0.11	0.44
April 2021	0.06	0.11	0.11	0.04	0.11	0	0.11	0.11	0.11	0.11	0.45
May 2021	0.06	0.12	0.12	0.01	0.12	0	0.12	0.12	0.12	0.12	0.7
June 2021	0.06	0.12	0.12	0.01	0.12	0	0.12	0.12	0.12	0.12	0.71
Average:	**0.06**	**0.11**	**0.11**	**0.03**	**0.11**	**0**	**0.11**	**0.11**	**0.11**	**0.11**	**0.5**

Table 7: Contaminant Load Discharge Weir to Ocean Outfall (Pesticides and Herbicides)

	Aldrin Loading	Atrazine Loading	Chlordane Loading	Chlorpyrifos Loading	DDT (total isomers)	Dieldrin Loading	Hexachlorobenzene Loading	Lindane Loading	Simazine Loading
	kg/day	kg/day	kg/day	kg/day	kg/day	kg/day	kg/day	kg/day	kg/day
July 2020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
August 2020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
September 2020	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002
October 2020	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002
November 2020	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002
December 2020	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002
January 2021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
February 2021	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002
March 2021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
April 2021	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002
May 2021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
June 2021	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002
Average:	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**

Table 8: Total Nitrogen Loading for Discharge Weir of the Ocean Outfall

	Monthly Flow	Total Nitrogen	Cumulative Total Nitrogen	MS 572 Limit
	ML	T/month	Tonnes	t/yr
Jul-20	386.58	3.05	3.05	60
Aug-20	378.07	3.10	6.15	60
Sep-20	355.23	3.27	9.42	60
Oct-20	355.91	3.56	12.98	60
Nov-20	342.46	2.71	15.69	60
Dec-20	341.67	2.84	18.52	60
Jan-21	334.37	3.11	21.63	60
Feb-21	308.33	2.16	23.79	60
Mar-21	340.52	2.18	25.97	60
Apr-21	334.01	2.44	28.41	60
May-21	361.42	2.49	30.90	60
Jun-21	417.99	3.01	33.91	60
TOTAL			33.91	60

Explanation of Monitoring Data

Monitoring of process operational data final effluent (SP Final Effluent ex SBR)

Bunbury WWTP has generally performed within the expected design parameters for the 2020-2021 reporting period. The final effluent monitoring data is consistent with previous reporting periods with no discernible trends.

Table 8: Typical Discharge Concentrations for Activated Sludge Plants

Activated Sludge Plant Results	Guideline (mg/L)	Bunbury WWTP 2020-21 Average Ex SBR (mg/L)
Biochemical Oxygen Demand	20	<5
Suspended Solids	30	4.17
Total Nitrogen	15	8.03
Total Phosphorus	10*	3.31

*With no phosphorus control measures

Assessment of emissions for impacts on surface water quality,

Following treatment via the four (4) Sequence Batch Reactors (SBRs), TWW is discharged to lined lagoons prior to discharge into ocean via a 1.7km pipeline. The disposal of TWW to the ocean is considered one of the key environmental considerations for Bunbury WWTP and is managed by treating wastewater to the defined water quality outlined in Attachment 2 of Ministerial Statement 572 dated 22 April 2014 and through compliance monitoring undertaken in accordance with Licence L5972/1992/14. Additionally, the operating licence also sets a Total Phosphorus emissions limit of 10mg/L.

The following comments can be made regarding the impact on surface water quality (ocean):

- Condition 2.1.2 of Licence L5972/1992/14 specifies an emissions limit to surface water of 10mg/L of TP. The TP concentration of the Discharge Weir samples did not exceed the specified limit during the 2020-2021 reporting period with a maximum concentration of 5.08mg/L reported during January 2021. The average TP concentration was 3.31mg/L.
- The increased hydraulic loading caused by the Eaton SPS diversion to Bunbury WWTP (January 2017) has resulted in a general increase in TP concentrations in the final effluent, however, the results continue to be significantly below the licence limit of 10mg/L.
- Ministerial Statement MS572 specifies the Bunbury WWTP be operated to achieve a TN load of 60 tonnes or less per annum released through the discharge weir to the ocean outfall. The ocean TN loading limit did not exceed the MS572 limit with 33.91 tonnes being reported in 2020-2021.

Assessment of emissions for impacts on land and groundwater

Onsite infiltration ponds were the main disposal method for TWW prior to the approval of the ocean outfall in 2001. Discharge to the infiltration ponds exists on the licence solely for emergency situations such as a major infrastructure failure. The ponds have not been used since 2002 and, as such, the environmental risk to land and to groundwater is deemed negligible.

4 Complaints and Incidents

4.1 Complaints

There were no complaints received during the 2020-2021 reporting period.

4.2 Incidents

There were no incidents reported during the 2020-2021 reporting period.

5 Audits and Inspections

Date of Inspection	Details of Issue	Corrective Actions undertaken
Management System Certification Audit 14/10/2020]	No significant findings	NA

6 Recent Changes and Planning Activities

6.1 Recent Changes

During the 2020-2021 reporting period there were no changes to site boundaries, surface drainage channels and on-site or off-site impacts or pollution.

6.2 Planning Activities

The Corporation is undertaking long term wastewater treatment upgrades to cater for growth. Part of this includes the upgrade of dewatered sludge (cake) storage prior to transportation. The project to upgrade the cake storage hopper at Bunbury WWTP is currently on track for completion August 2022.

In parallel with this work, the Corporation is working closely with Aqwest to develop a treatment plant to recycle the effluent for industrial and irrigation use. If implemented, this plant may re-use up to half (5.6ML/d) of the treated wastewater currently produced by the plant.

7 Sludge/Solid Waste Management

During the 2020-2021 reporting period, a total of a total of 3726.7 tonnes of sludge was dewatered utilising centrifuge technology and sent to VMS composting.

Appendix 1 – Monitoring Data (Tables)

SP Bunbury 2 WWTP Final Effluent Ex SBR

	Ammonium as nitrogen	Biochemical Oxygen Demand Carb	Nitrite plus nitrate as N	pH measured in laboratory	Suspended Solids	Total dissolved solids by evaporation	Total nitrogen	Total phosphorus
	mg/L	mg/L	mg/L	NOUNIT	mg/L	mg/L	mg/L	mg/L
July 2020	1.2	<5	4.6	8.02	<5	570	7.5	3.8
August 2020	1.2	<5	4.7	7.81	10	550	8.2	3.7
September 2020	1.1	<5	5.4	7.79	10	560	9.2	3.9
October 2020	2.1	<5	5.4	7.88	5	590	10	3.8
November 2020	1.3	<5	4.7	8.03	5	610	8.2	2.5
December 2020	1.4	<5	5.8	7.86	<5	520	9.2	4.1
January 2021	1.3	<5	6.0	7.95	<5	610	8.8	3.2
February 2021	0.88	<5	4.3	7.84	<5	490	6.6	2.9
March 2021	0.74	<5	4.5	7.94	<5	550	6.7	3.6
April 2021	1.8	<5	4.5	7.70	<5	500	8.3	1.4
May 2021	1.3	<5	3.9	7.98	<5	530	7.1	3.5
June 2021	1.1	10	3.5	8.08	<5	540	6.6	3.3

SP Bunbury 2 WWTP Pond 2 Discharge Weir

(Discharge Weir to Ocean Outfall)

	Ammonium as nitrogen	Biochemical Oxygen Demand Carb	Escherichia coli	Nitrite plus nitrate as N	pH measured in laboratory	Suspended Solids	Total dissolved solids by evaporation	Total nitrogen	Total phosphorus
	mg/L	mg/L	/100 mL	mg/L	NOUNIT	mg/L	mg/L	mg/L	mg/L
July 2020	1.6	<5	>24000	4.7	7.83	<5	560	7.9	4.0
August 2020	1.8	<5	17000	4.7	7.76	<5	550	8.2	4.7
September 2020	2.0	<5	24000	5.1	7.66	<5	570	9.2	4.3
October 2020	3.2	<5	1800	4.4	7.66	<5	580	10	4.3
November 2020	1.9	<5	13000	4.0	7.92	10	600	7.9	3.2
December 2020	2.0	<5	6500	4.4	7.63	<5	530	8.3	4.5
January 2021	1.2	<5	24000	5.6	7.61	5	600	9.3	5.0
February 2021	1.3	<5	20000	4.4	7.59	<5	480	7.0	3.7
March 2021	0.88	<5	>24000	4.0	7.68	<5	560	6.4	3.2
April 2021	3.1	<5	>24000	2.6	7.64	<5	510	7.3	2.8
May 2021	2.1	<5	>24000	2.9	7.69	<5	540	6.9	3.9
June 2021	2.0	<5	20000	2.9	7.88	<5	560	7.2	3.6

SP Bunbury 2 WWTP Pond 2 Discharge Weir

(Metals)

	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Zinc
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
August 2020	<0.01	<0.02	<0.02	<0.002	<0.02	<0.0005	<0.02	<0.02	<0.02	<0.02	0.04
November 2020	<0.01	<0.02	<0.02	0.004	<0.02	<0.0005	<0.02	<0.02	<0.02	<0.02	0.04
February 2021	<0.01	<0.02	<0.02	0.004	<0.02	<0.0005	<0.02	<0.02	<0.02	<0.02	0.04
May 2021	<0.01	<0.02	<0.02	<0.002	<0.02	<0.0005	<0.02	<0.02	<0.02	<0.02	0.06

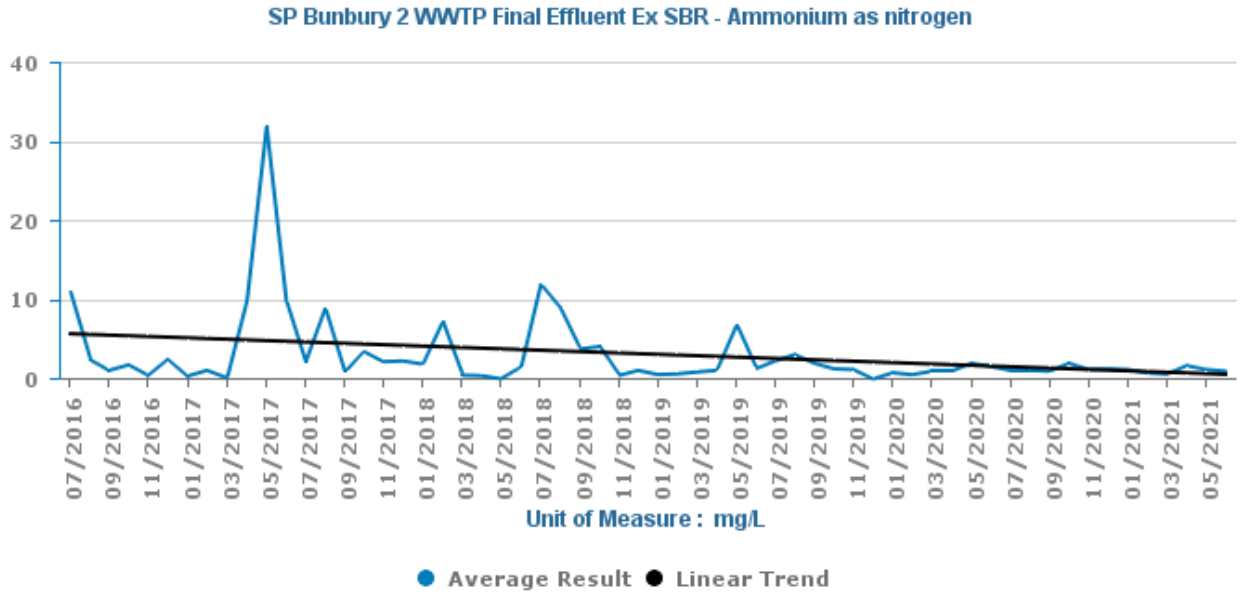
SP Bunbury 2 WWTP Pond 2 Discharge Weir

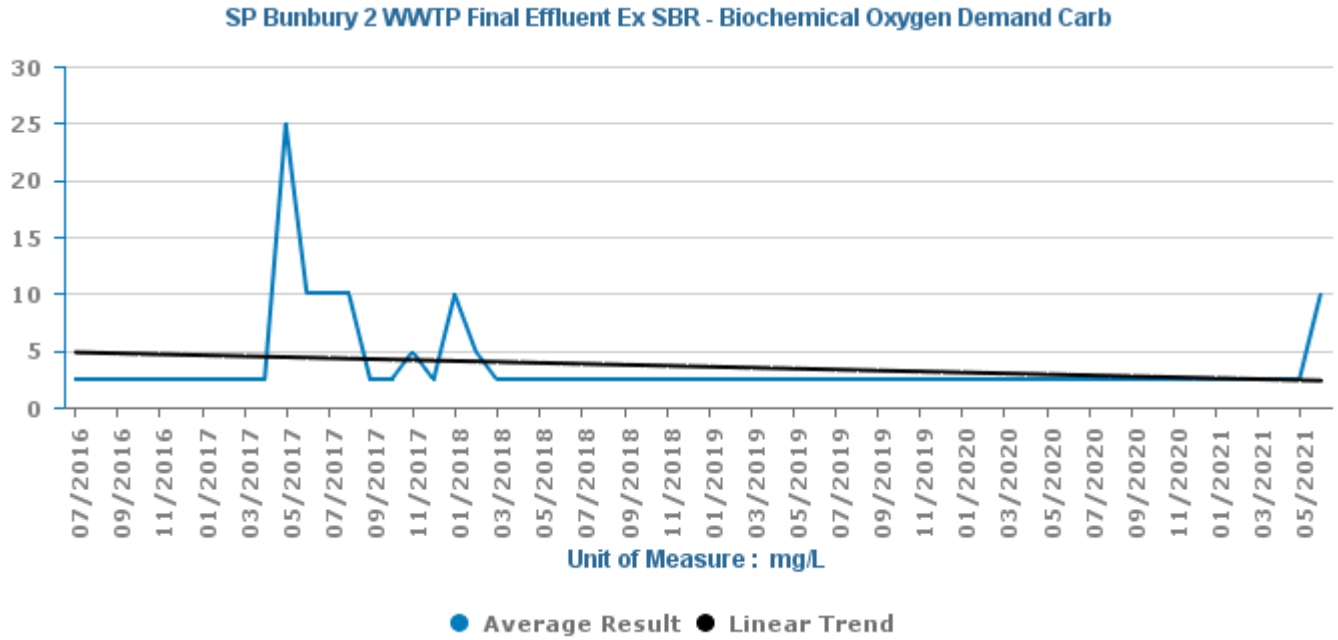
(Pesticides and Herbicides)

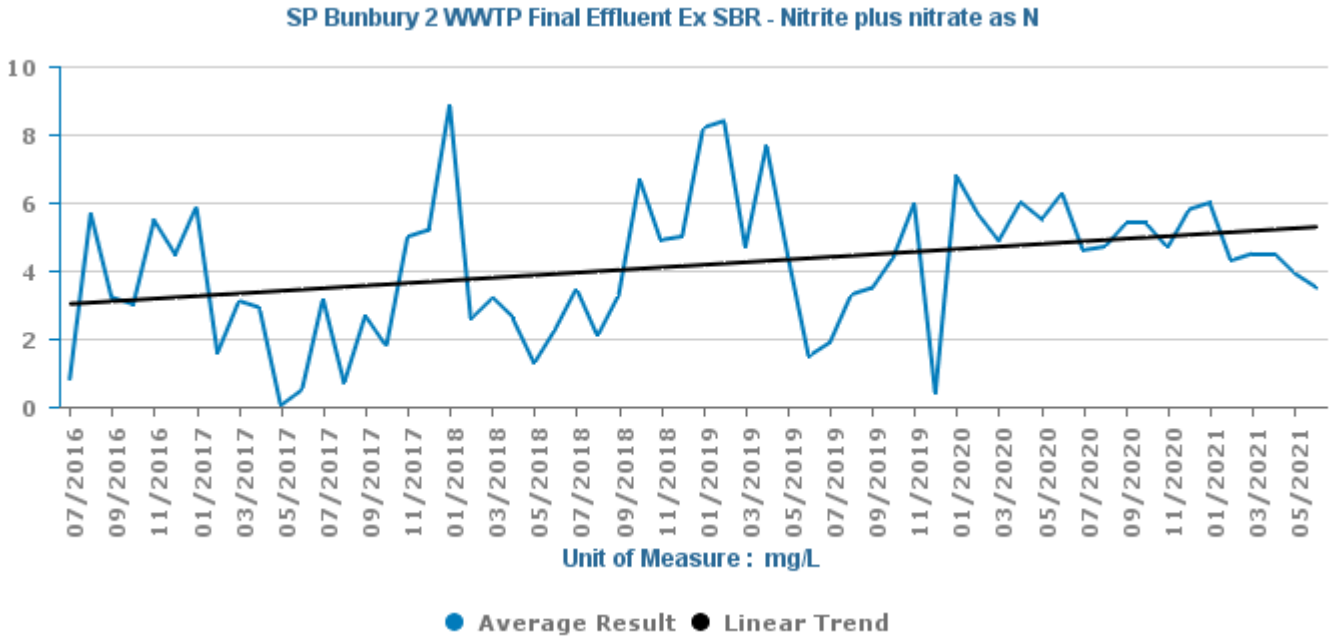
	2,4-dichlorophenoxyacetic acid	4-chloro-2-methylphenoxy acetic acid	Aldrin	Atrazine	Chlordane	Chlorpyrifos	DDT (total isomers)	Dieldrin	Heptachlor & heptachl	Hexachlorobenzene	Lindane	Simazine
	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
August 2020	<0.8	<0.8	<0.003	<0.4	<0.006	<0.007	<0.005	<0.004	<0.005	<0.004	<0.004	<0.4
November 2020	<0.8	<0.8	<0.003	<0.4	<0.006	<0.007	<0.005	<0.004	<0.005	<0.004	<0.004	<0.4
February 2021	<0.8	<0.8	<0.003	<0.4	<0.006	<0.007	<0.005	<0.004	<0.005	<0.004	<0.004	<0.4
May 2021	<0.8	<0.8	<0.003	<0.4	<0.006	<0.007	<0.005	<0.004	<0.005	<0.004	<0.004	<0.4

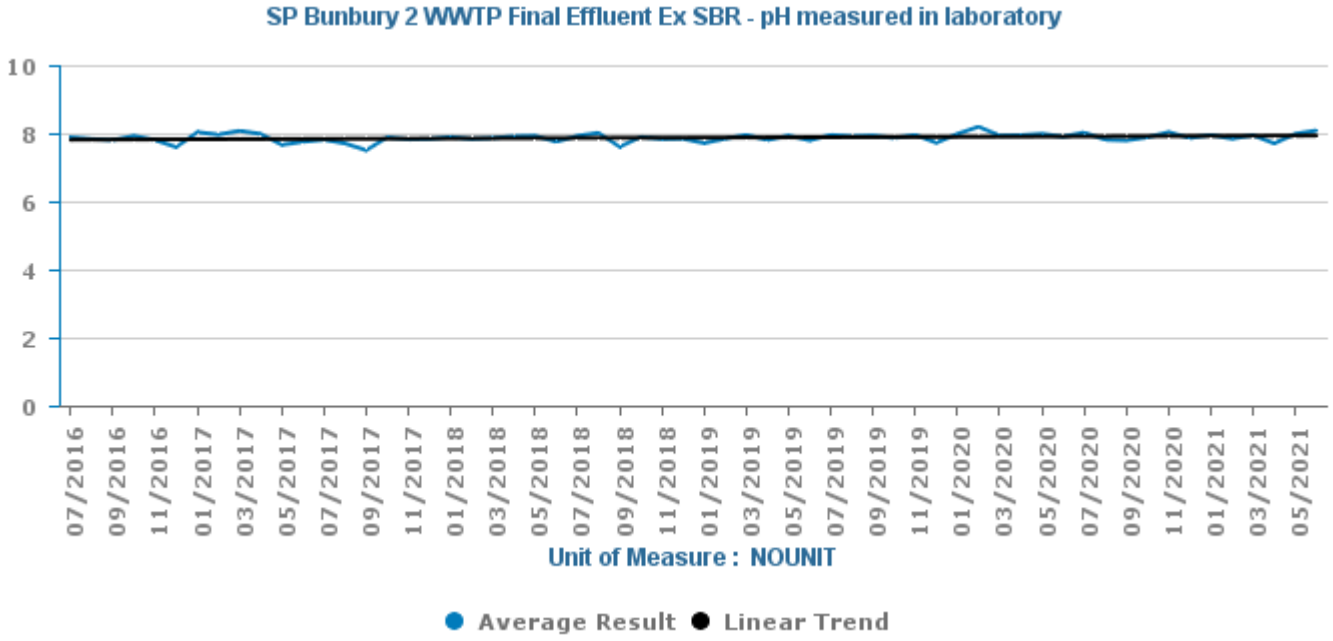
Appendix 2 – Trend Graphs

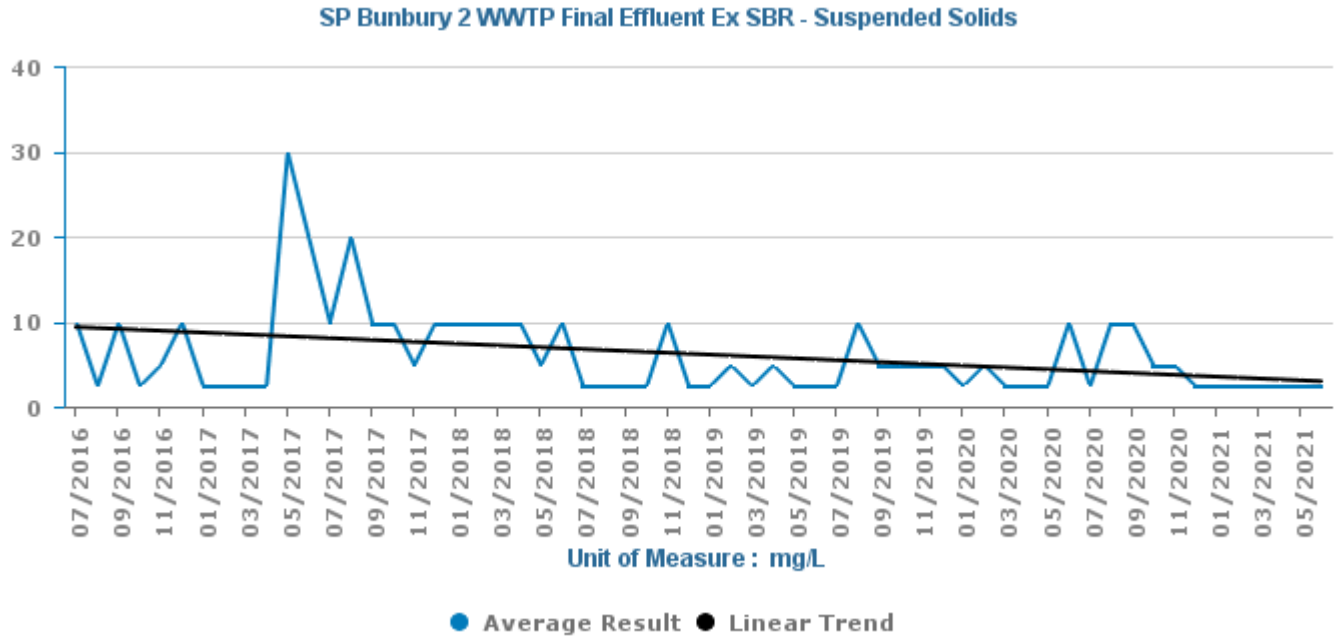
SP Bunbury 2 WWTP Final Effluent Ex SBR

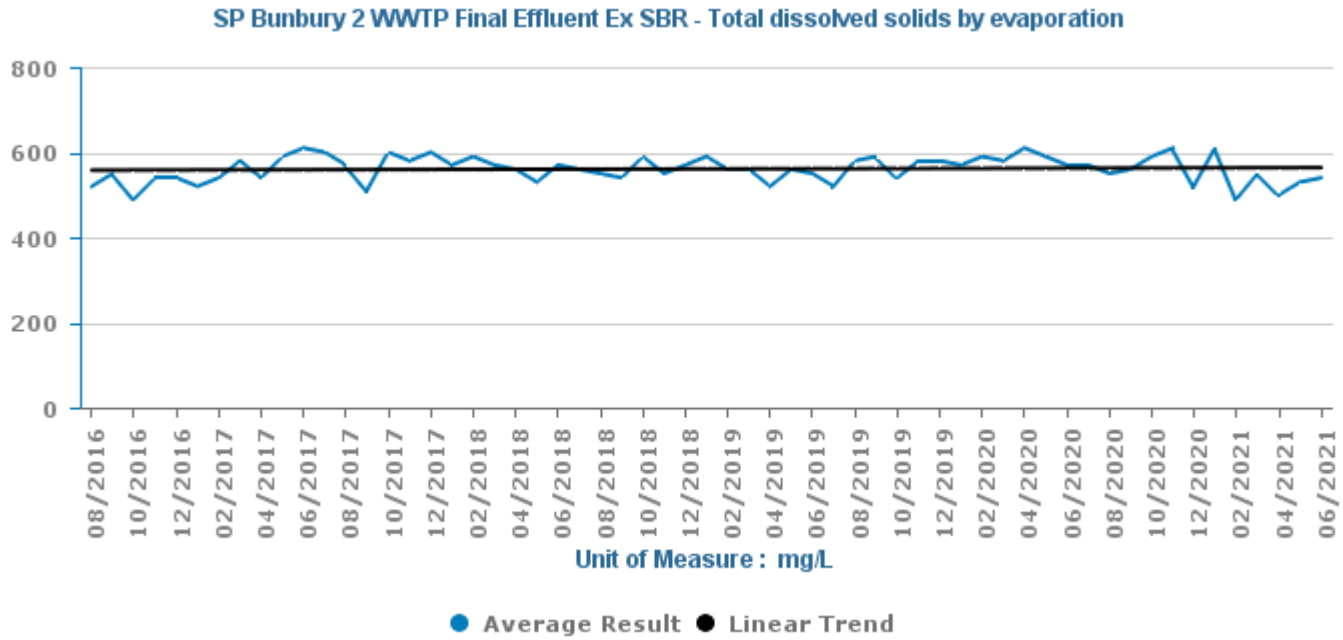


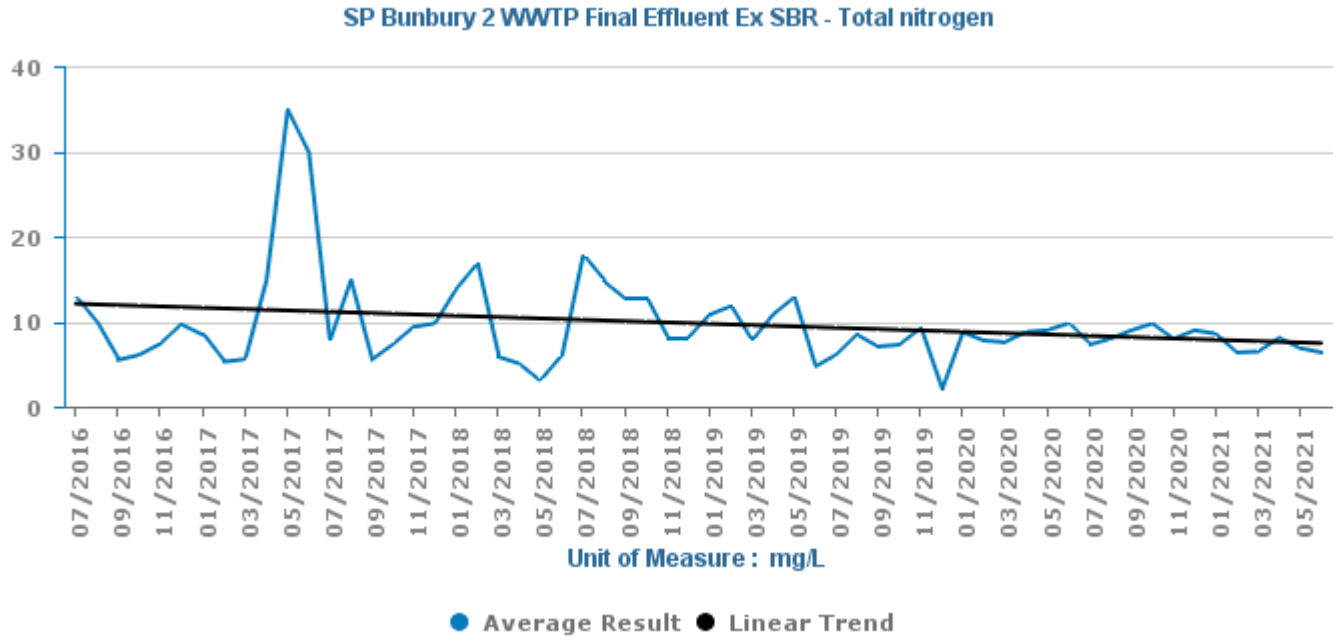


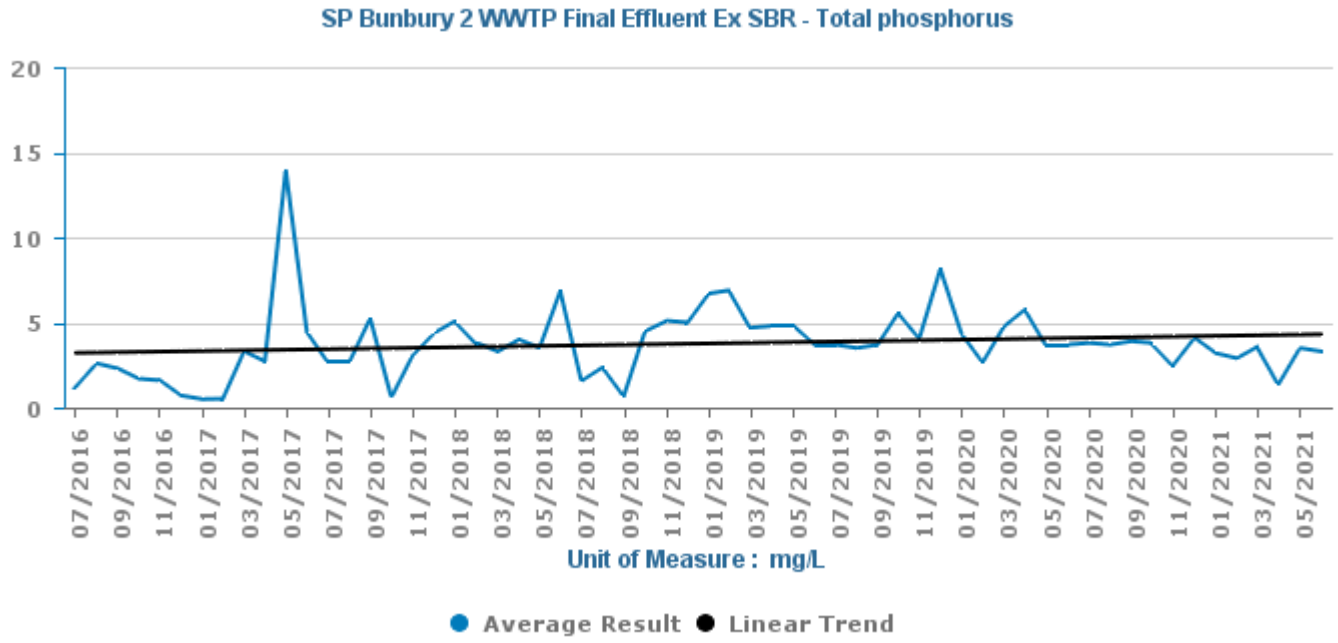

SP Bunbury 2 WWTP Final Effluent Ex SBR - Nitrite plus nitrate as N
10
8
6
4
2
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Final Effluent Ex SBR - pH measured in laboratory
10
8
6
4
2
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : NOUNIT
Average Result
Linear Trend

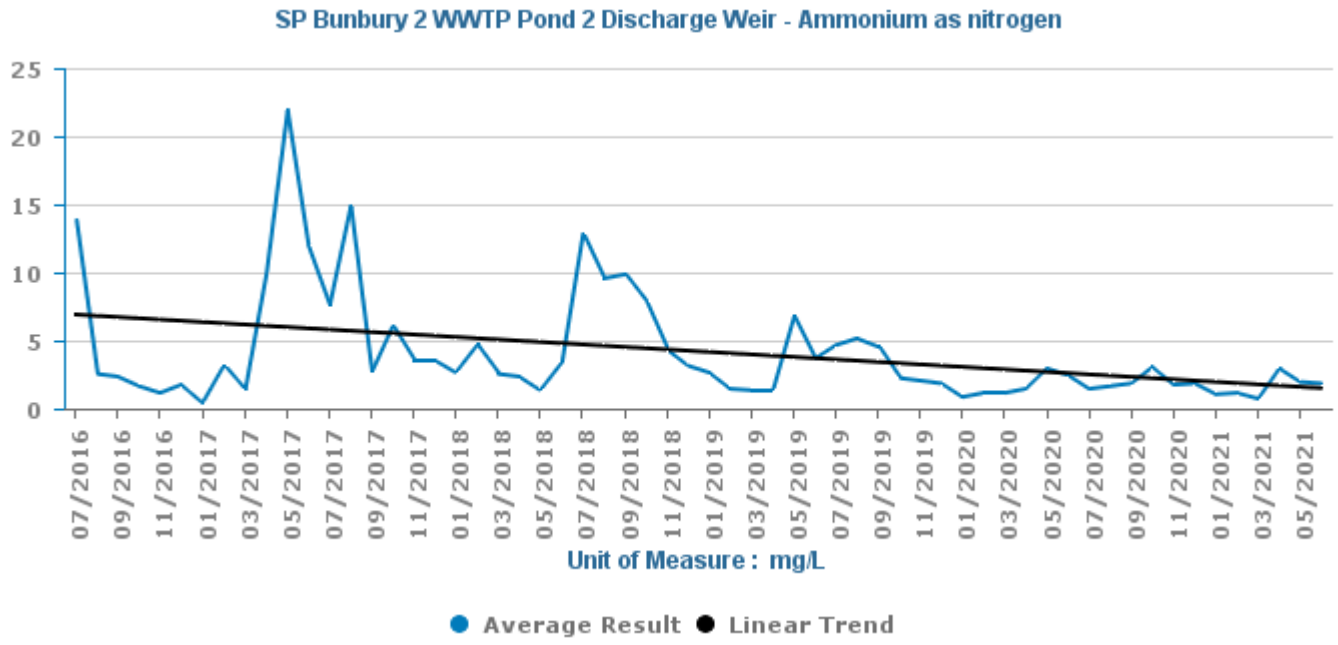

SP Bunbury 2 WWTP Final Effluent Ex SBR - Suspended Solids
40
30
20
10
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend

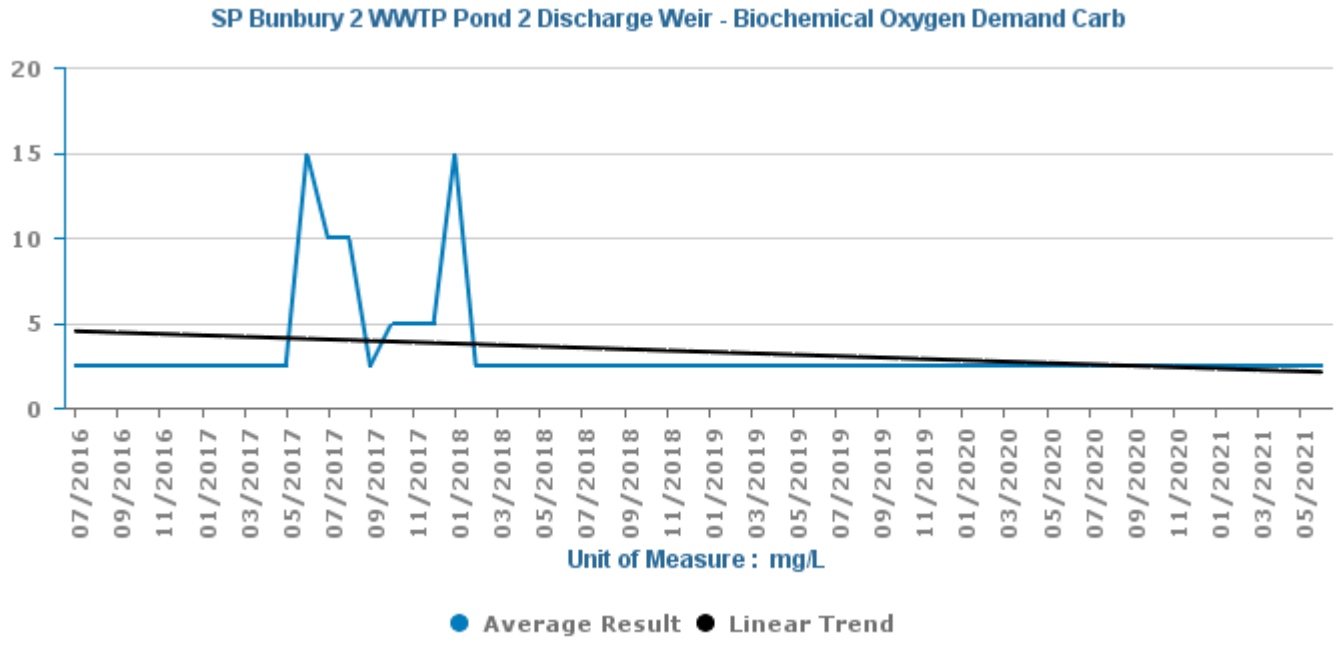

SP Bunbury 2 WWTP Final Effluent Ex SBR - Total dissolved solids by evaporation
800
600
400
200
0
08/2016
10/2016
12/2016
02/2017
04/2017
06/2017
08/2017
10/2017
12/2017
02/2018
04/2018
06/2018
08/2018
10/2018
12/2018
02/2019
04/2019
06/2019
08/2019
10/2019
12/2019
02/2020
04/2020
06/2020
08/2020
10/2020
12/2020
02/2021
04/2021
06/2021
Unit of Measure : mg/L
Average Result
Linear Trend

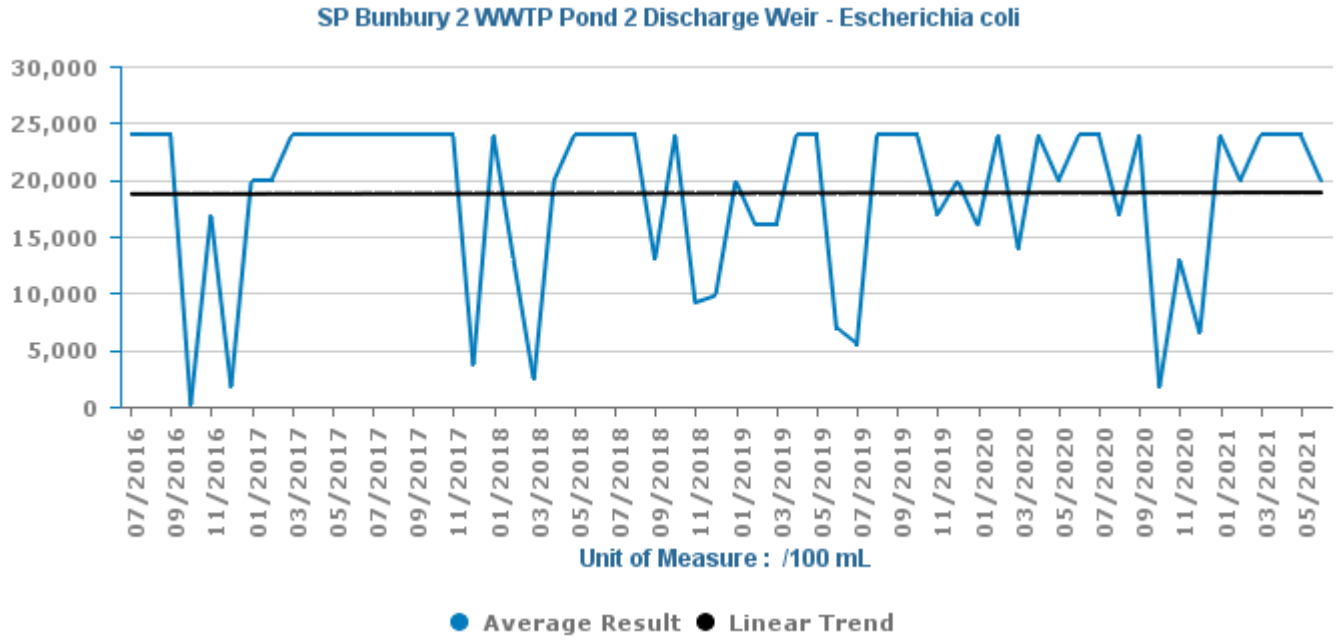

SP Bunbury 2 WWTP Final Effluent Ex SBR - Total nitrogen
40
30
20
10
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend

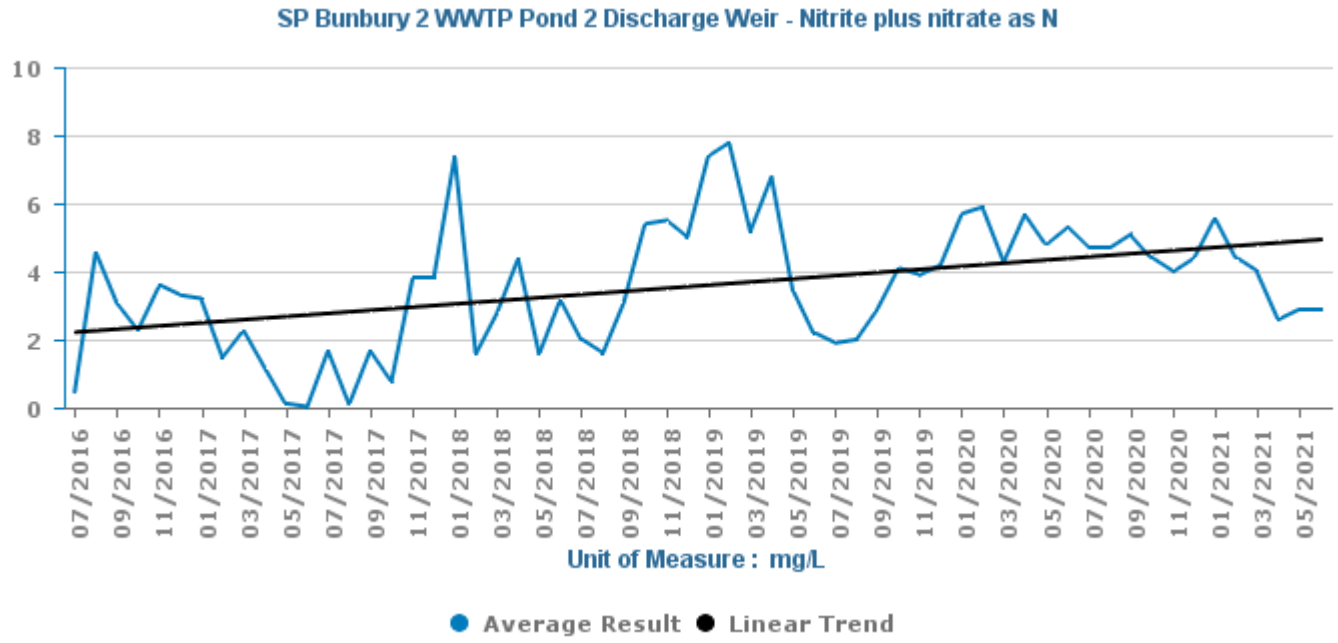

SP Bunbury 2 WWTP Final Effluent Ex SBR - Total phosphorus
20
15
10
5
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend

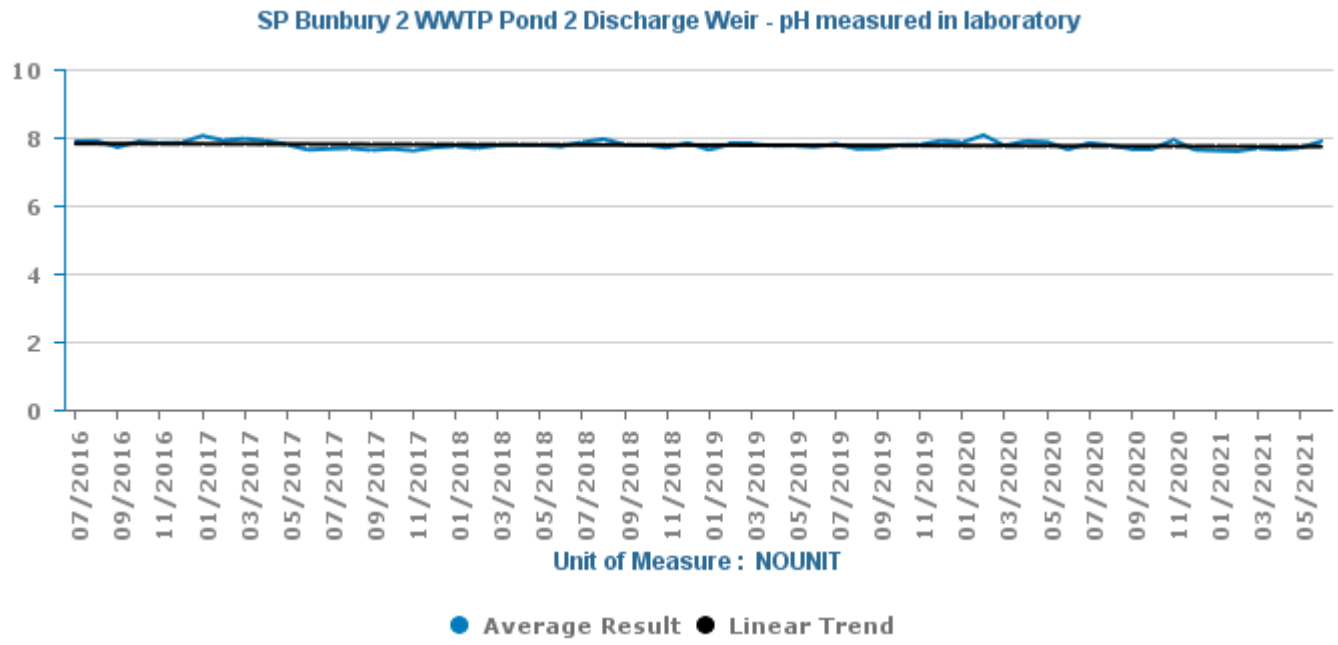
SP Bunbury 2 WWTP Pond 2 Discharge Weir

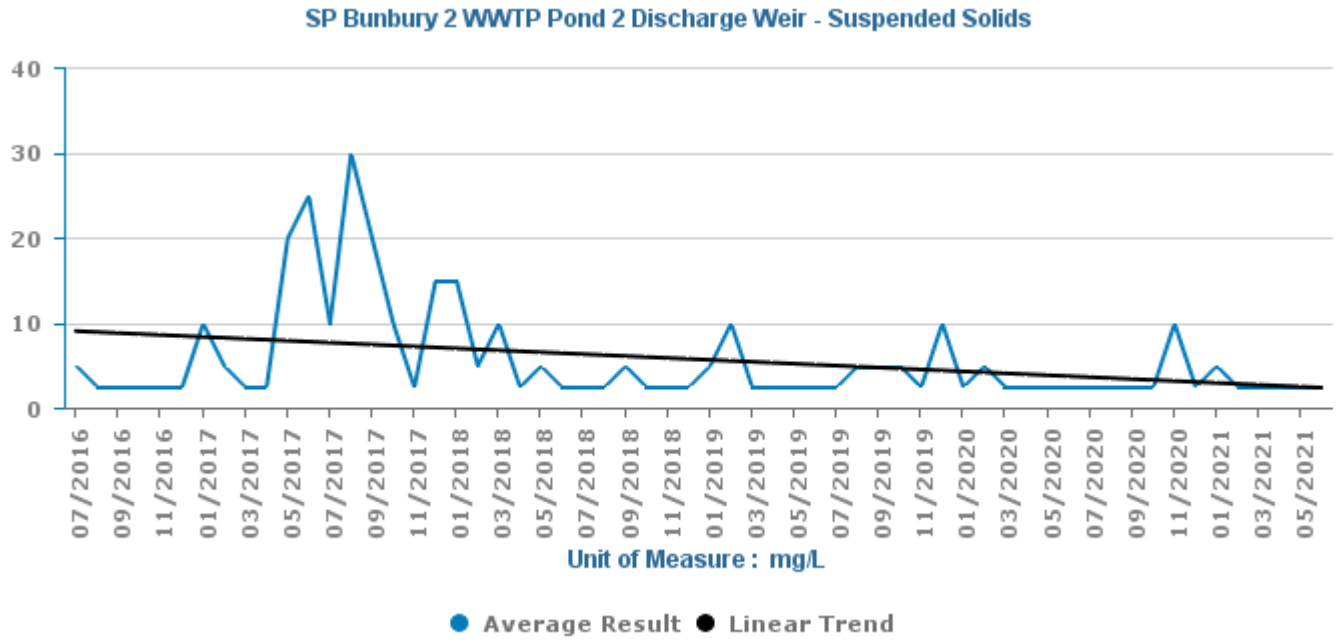


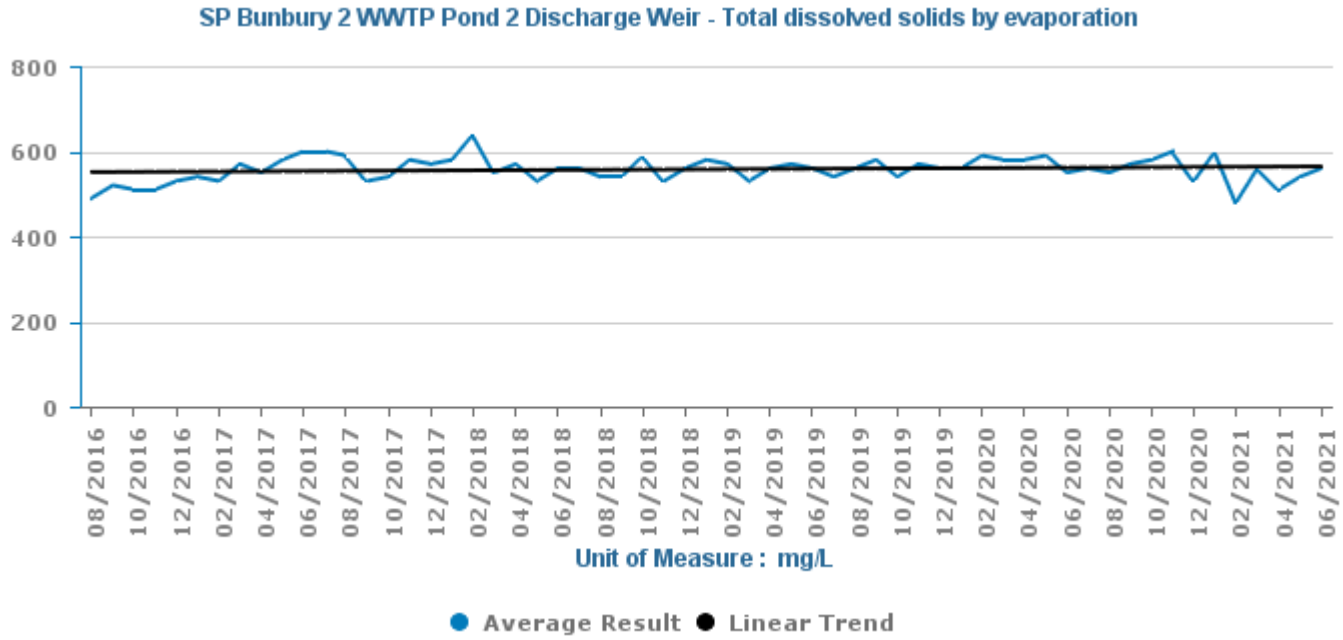


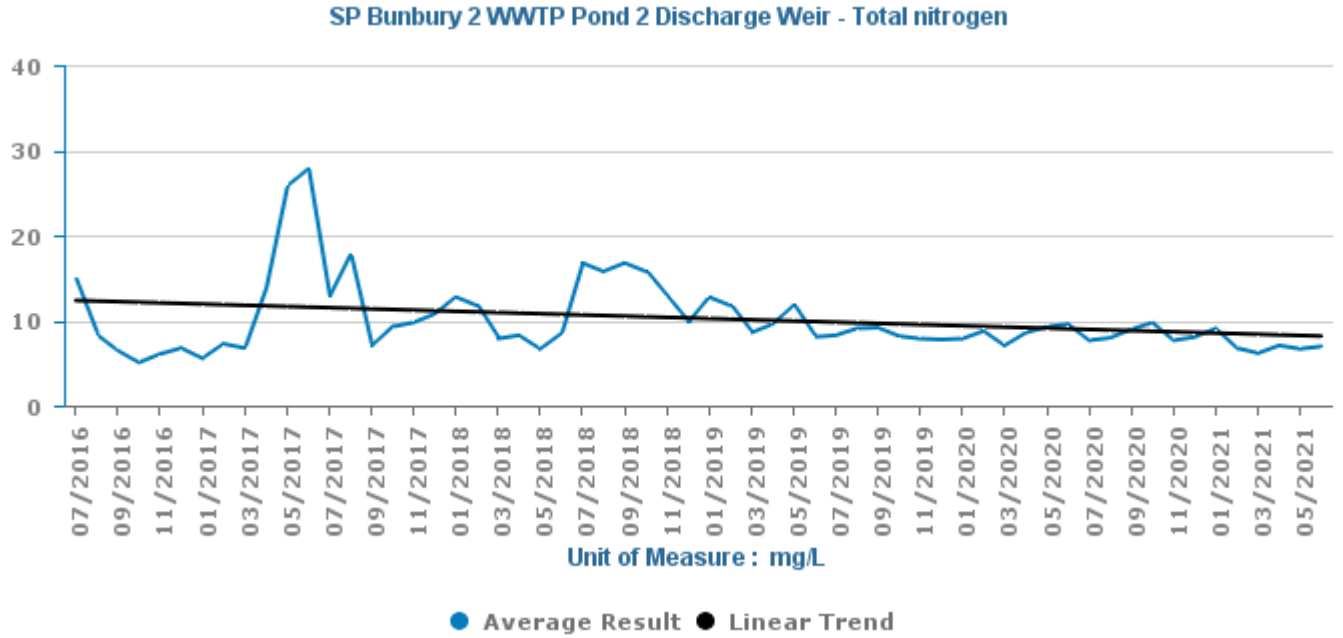

SP Bunbury 2 WWTP Pond 2 Discharge Weir - Escherichia coli
30,000
25,000
20,000
15,000
10,000
5,000
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : /100 mL
Average Result
Linear Trend

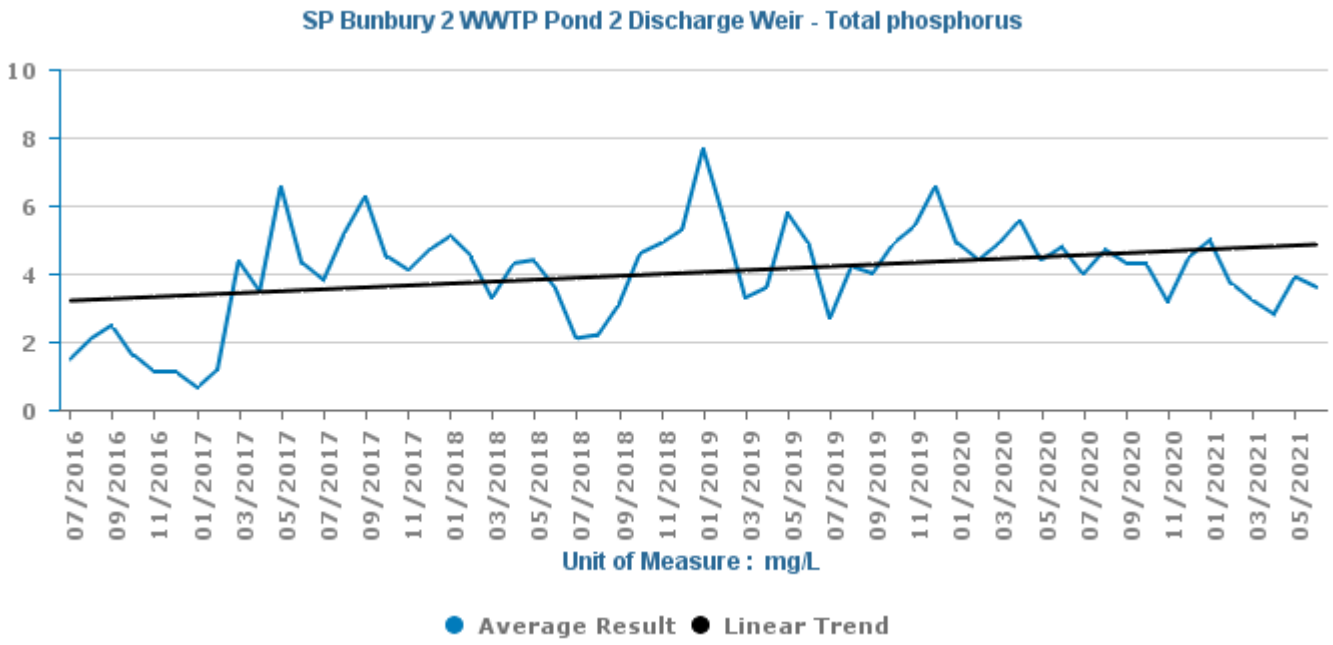

SP Bunbury 2 WWTP Pond 2 Discharge Weir - Nitrite plus nitrate as N
10
8
6
4
2
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - pH measured in laboratory
10
8
6
4
2
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : NOUNIT
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Suspended Solids
40
30
20
10
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend

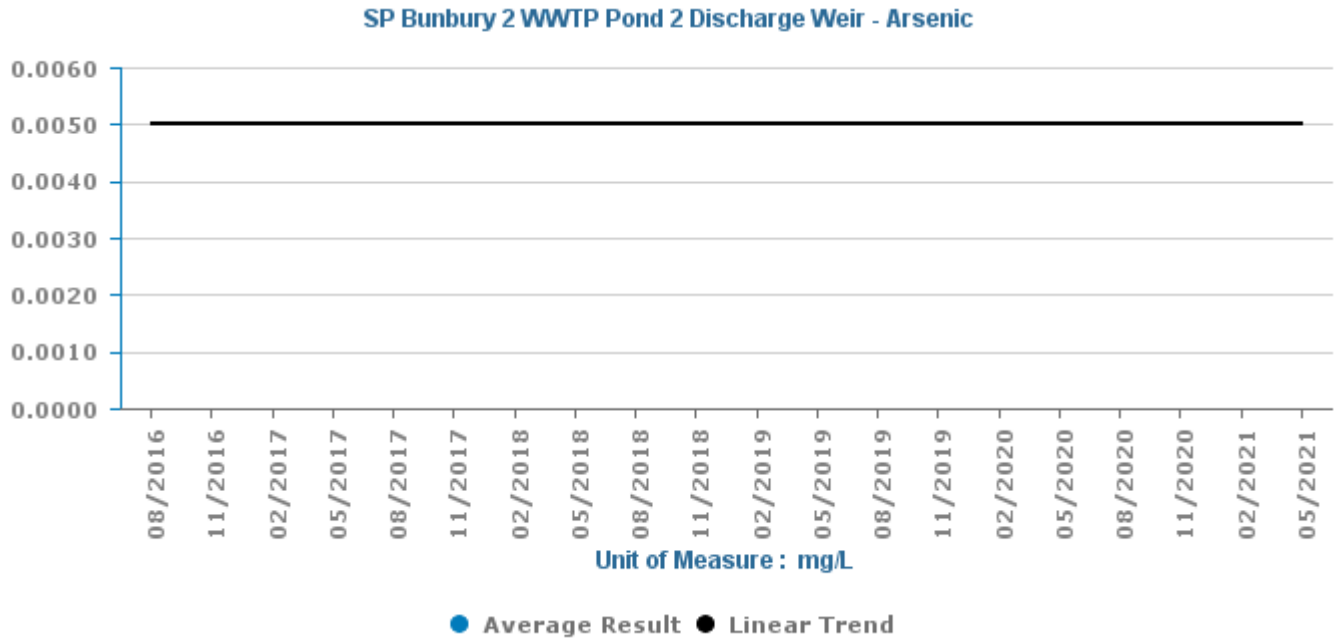

SP Bunbury 2 WWTP Pond 2 Discharge Weir - Total dissolved solids by evaporation
800
600
400
200
0
08/2016
10/2016
12/2016
02/2017
04/2017
06/2017
08/2017
10/2017
12/2017
02/2018
04/2018
06/2018
08/2018
10/2018
12/2018
02/2019
04/2019
06/2019
08/2019
10/2019
12/2019
02/2020
04/2020
06/2020
08/2020
10/2020
12/2020
02/2021
04/2021
06/2021
Unit of Measure : mg/L
Average Result
Linear Trend

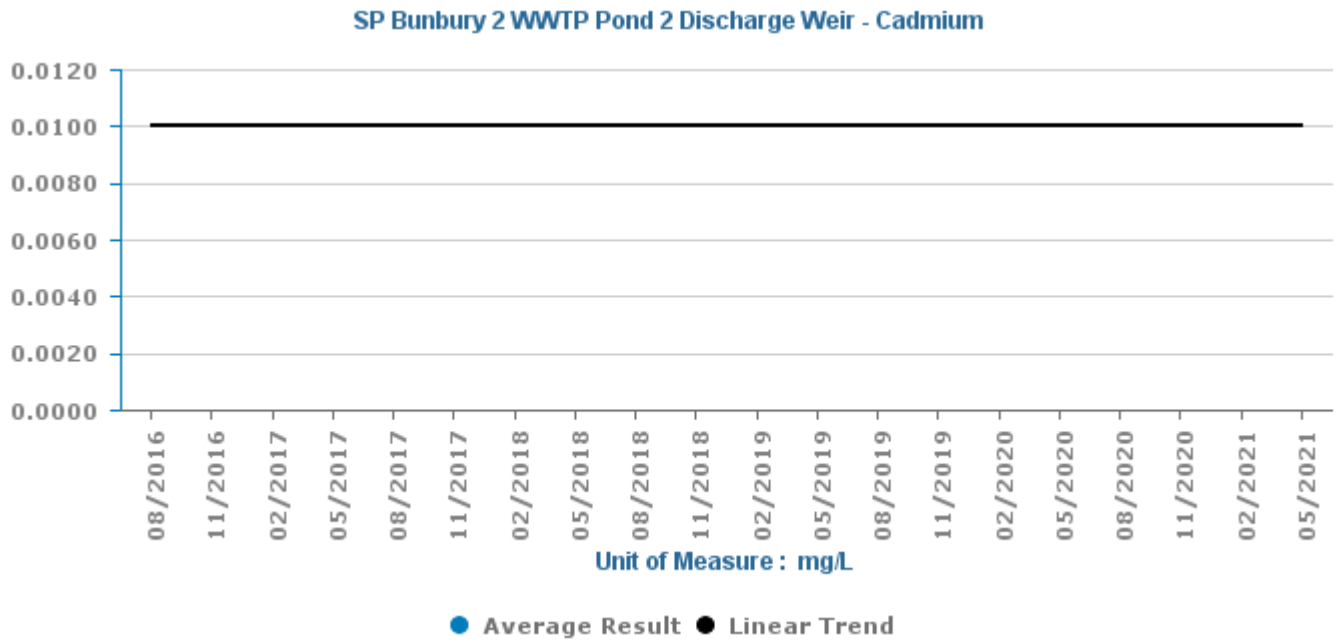

SP Bunbury 2 WWTP Pond 2 Discharge Weir - Total nitrogen
40
30
20
10
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend

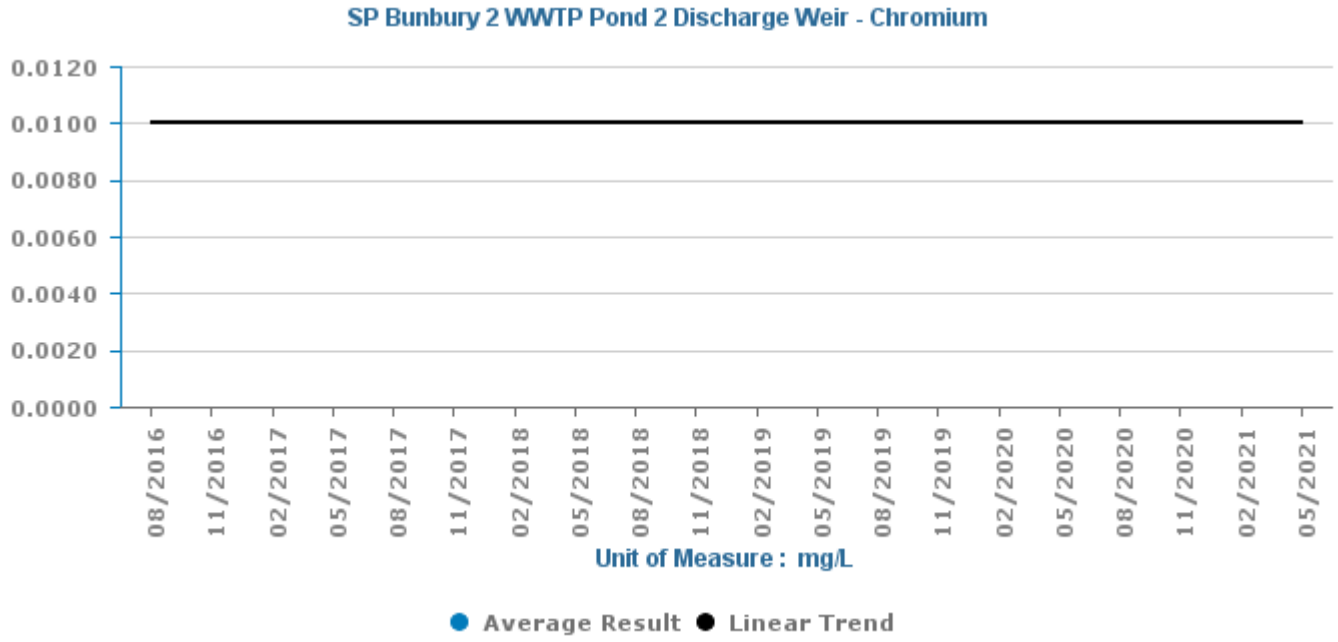

SP Bunbury 2 WWTP Pond 2 Discharge Weir - Total phosphorus
10
8
6
4
2
0
07/2016
09/2016
11/2016
01/2017
03/2017
05/2017
07/2017
09/2017
11/2017
01/2018
03/2018
05/2018
07/2018
09/2018
11/2018
01/2019
03/2019
05/2019
07/2019
09/2019
11/2019
01/2020
03/2020
05/2020
07/2020
09/2020
11/2020
01/2021
03/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend

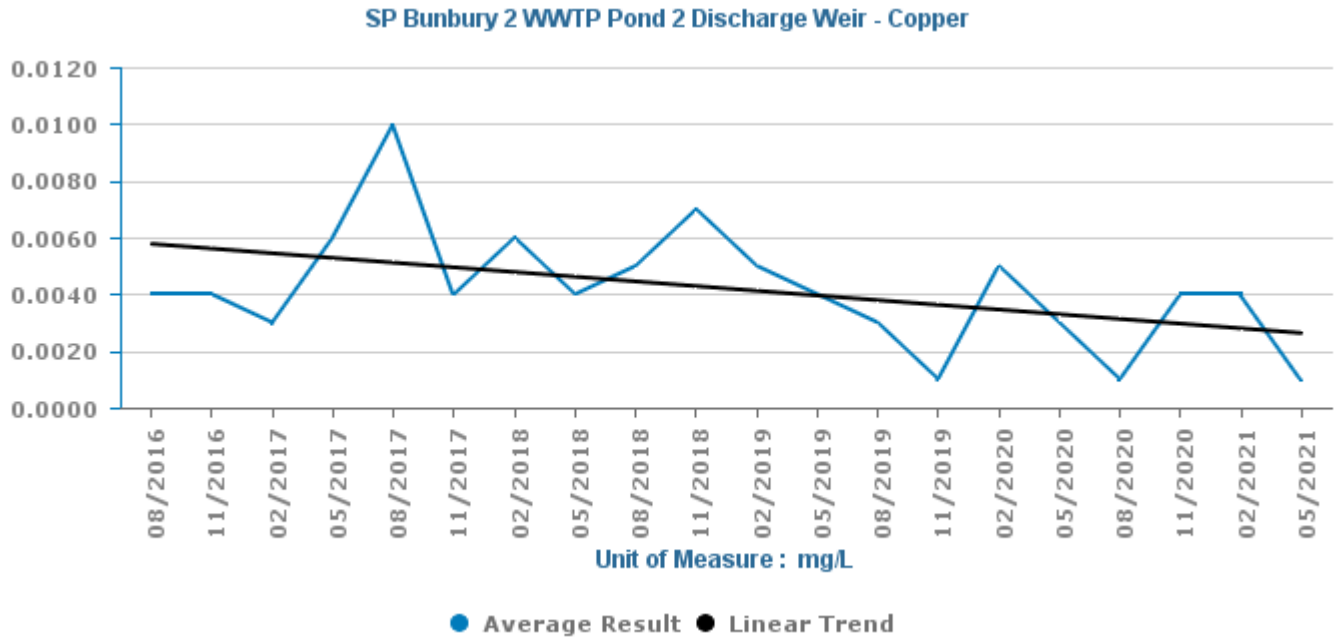
SP Bunbury 2 WWTP Pond 2 Discharge Weir

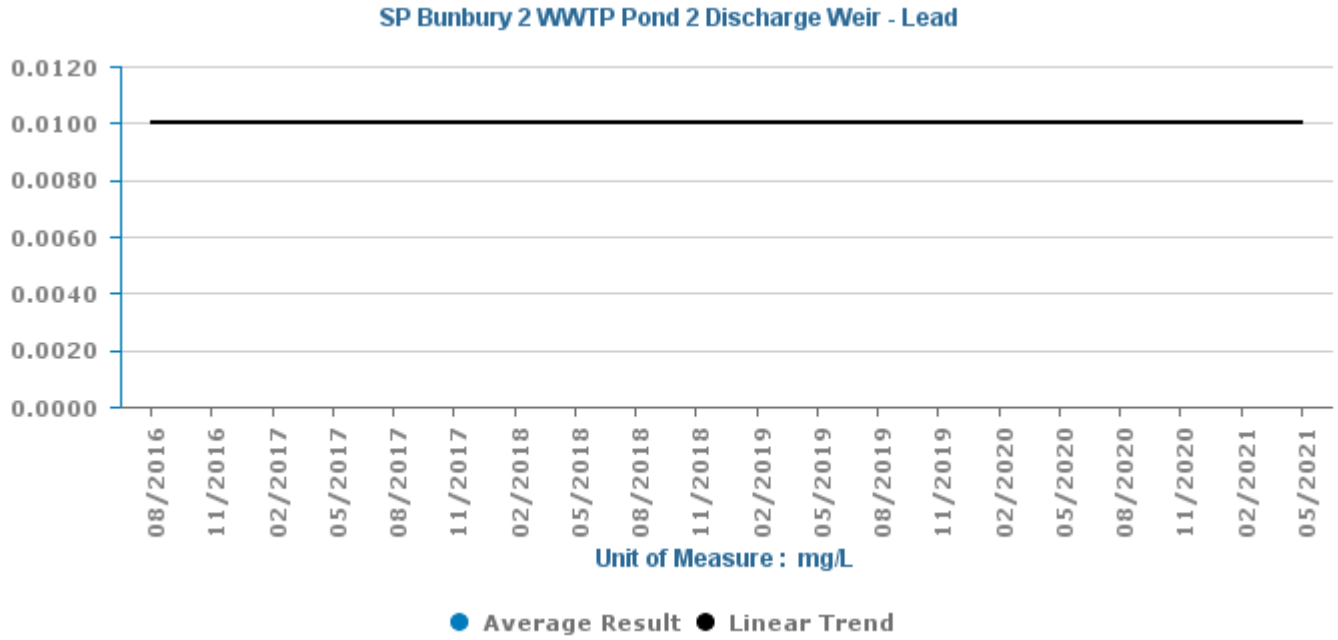
(Discharge Weir to Ocean Outfall - Metals)

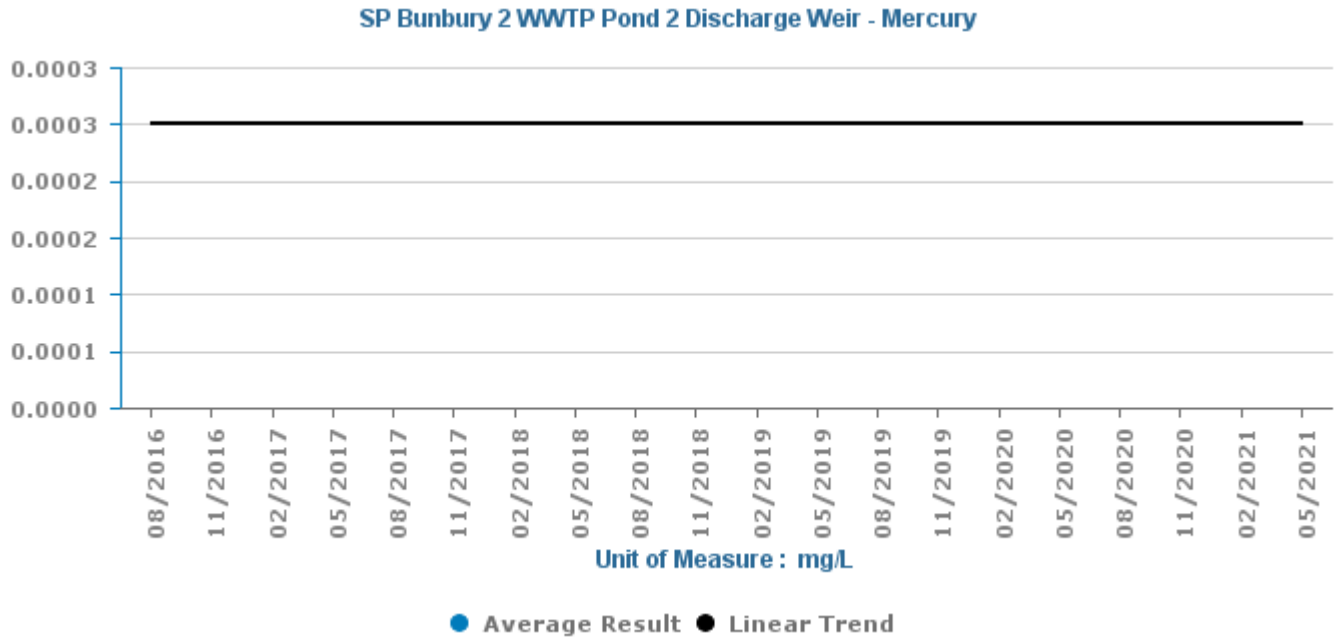





SP Bunbury 2 WWTP Pond 2 Discharge Weir - Chromium
0.0120
0.0100
0.0080
0.0060
0.0040
0.0020
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
11/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Copper
0.0120
0.0100
0.0080
0.0060
0.0040
0.0020
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
11/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Lead
0.0120
0.0100
0.0080
0.0060
0.0040
0.0020
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
11/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Mercury
0.0003
0.0003
0.0002
0.0002
0.0001
0.0001
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
11/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
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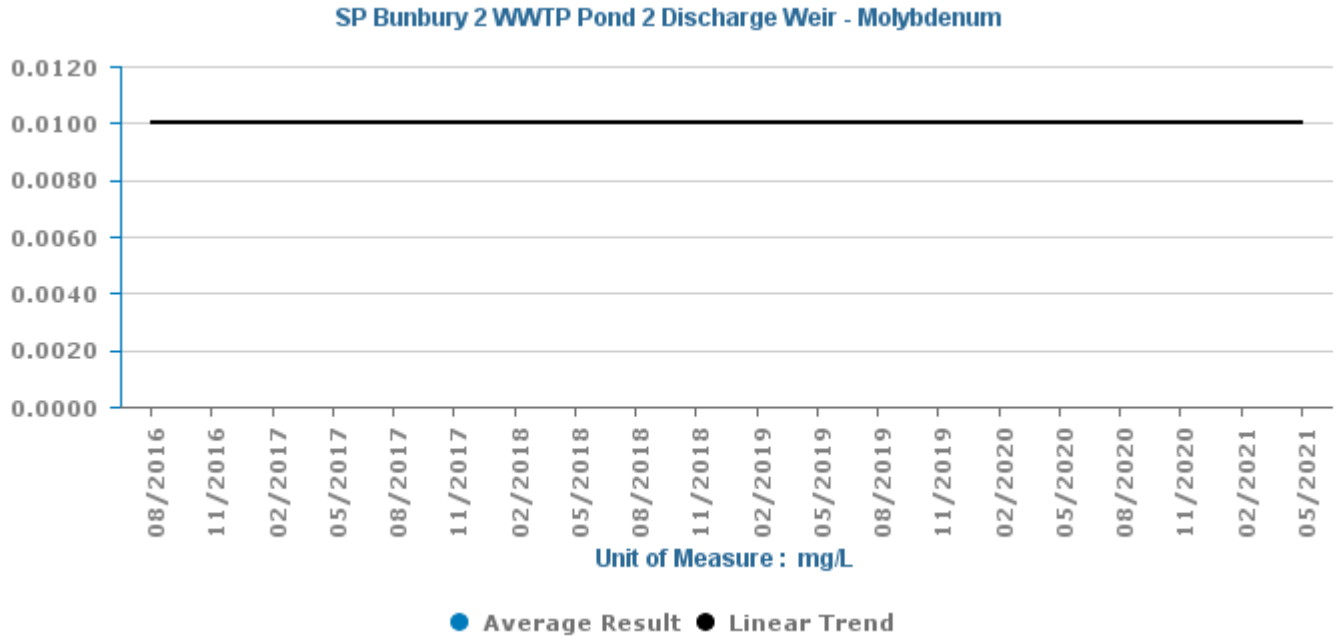
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Molybdenum
0.0120
0.0100
0.0080
0.0060
0.0040
0.0020
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
11/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
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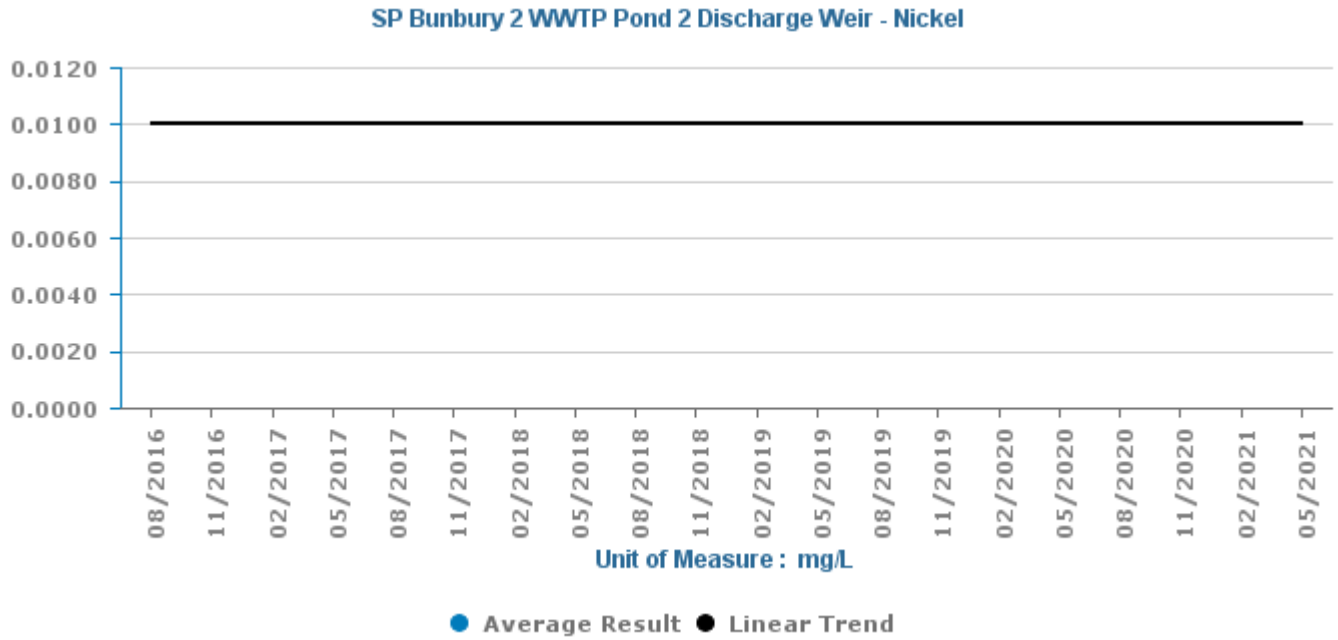
02/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Nickel
0.0120
0.0100
0.0080
0.0060
0.0040
0.0020
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
11/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
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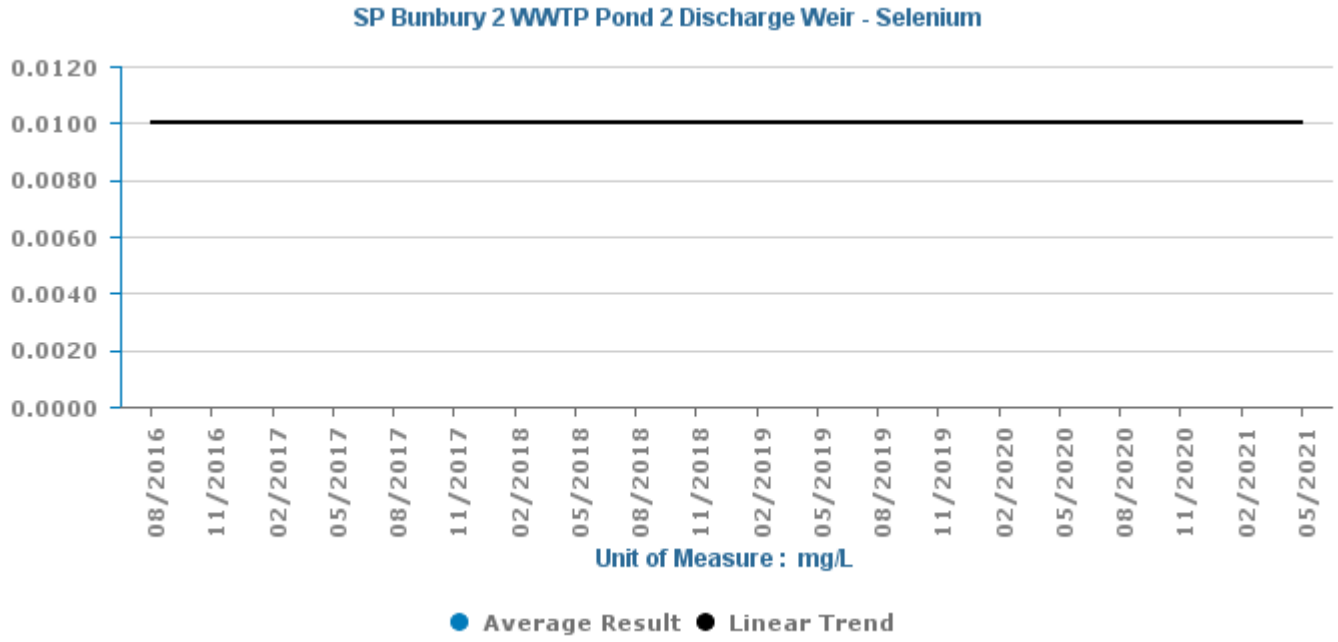
08/2020
11/2020
02/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend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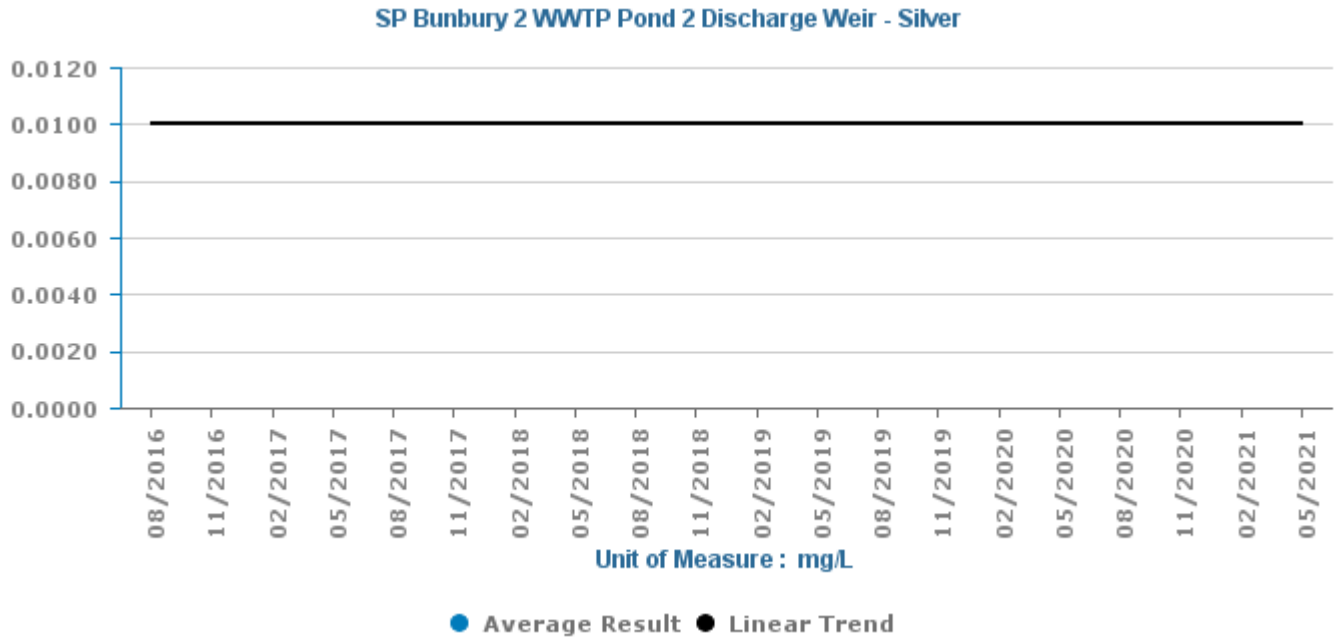
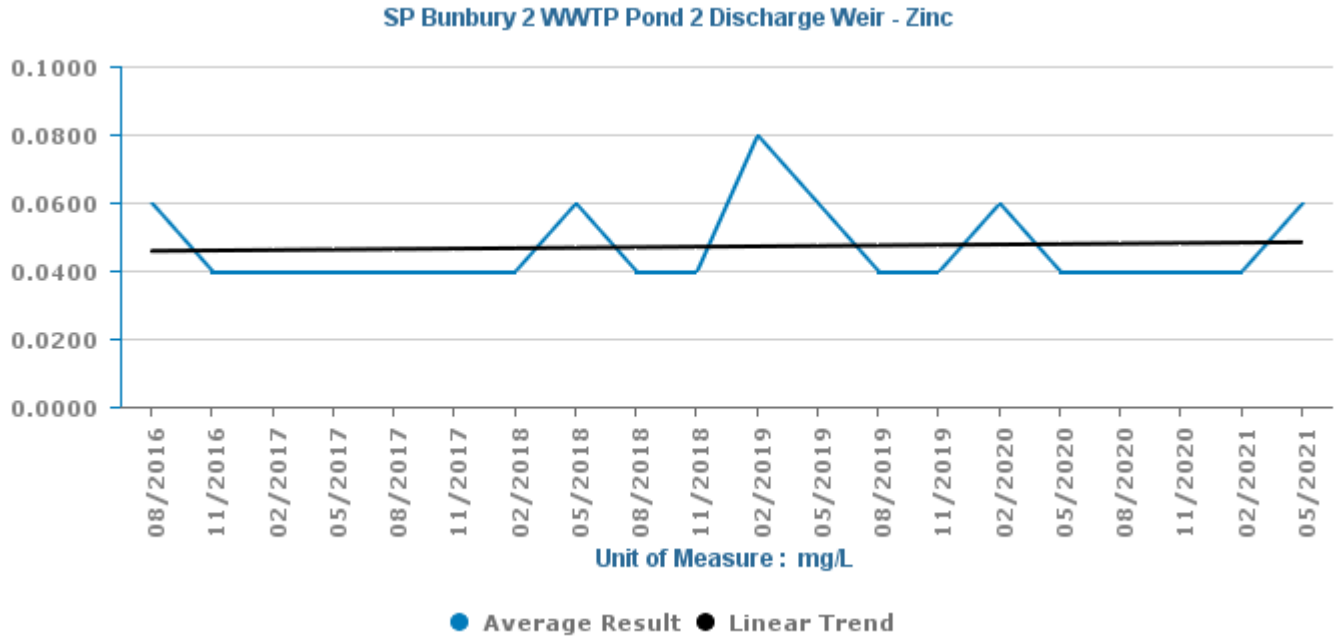
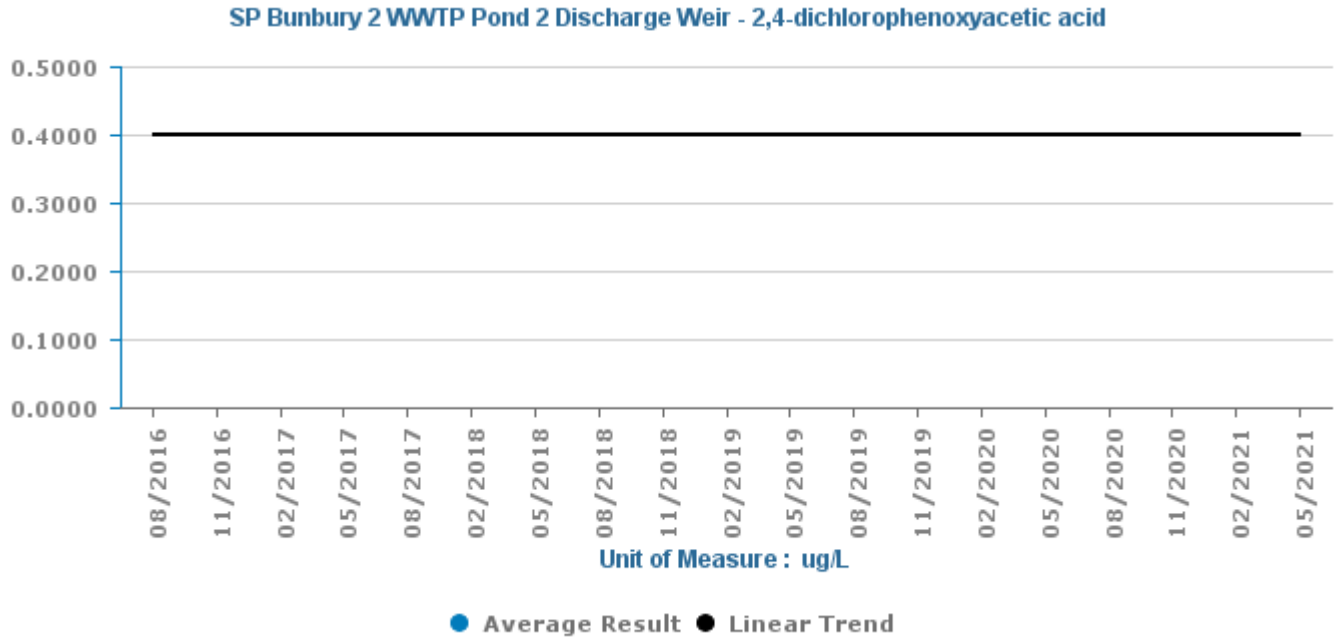
0.0120
0.0100
0.0080
0.0060
0.0040
0.0020
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
11/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend

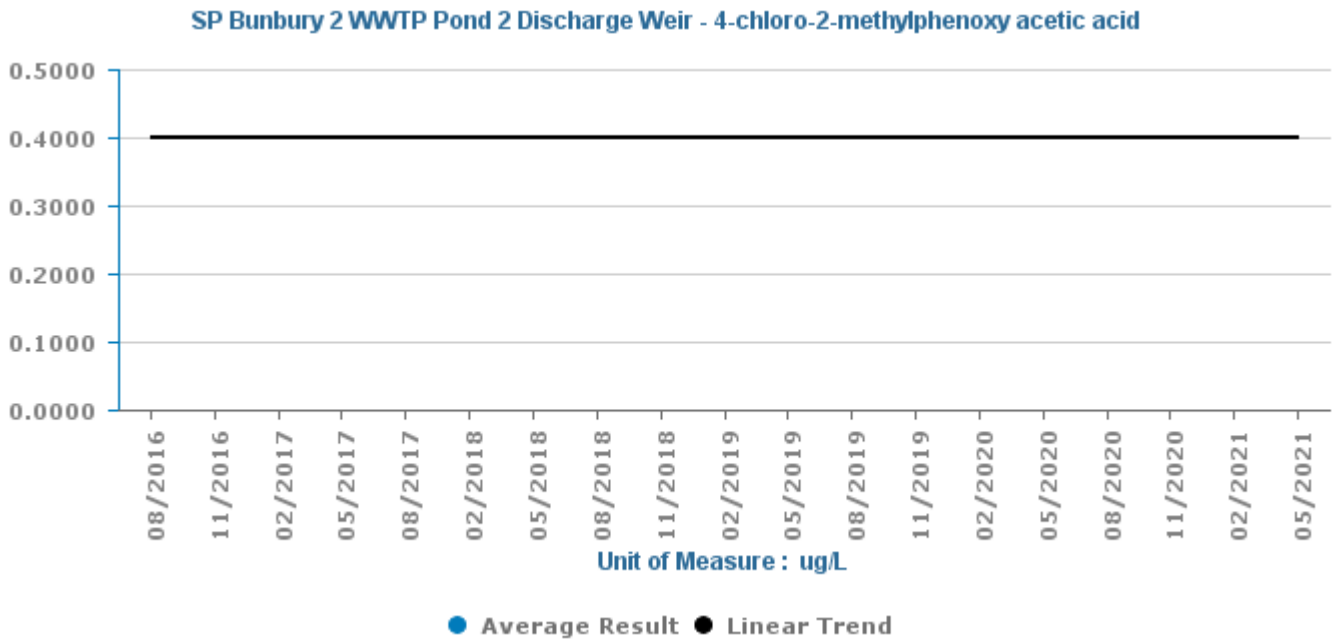

SP Bunbury 2 WWTP Pond 2 Discharge Weir - Silver
0.0120
0.0100
0.0080
0.0060
0.0040
0.0020
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
11/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : mg/L
Average Result
Linear Trend



SP Bunbury 2 WWTP Pond 2 Discharge Weir

(Discharge Weir to Ocean Outfall – Pesticides and Herbicides)




SP Bunbury 2 WWTP Pond 2 Discharge Weir - 4-chloro-2-methylphenoxy acetic acid
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
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05/2020
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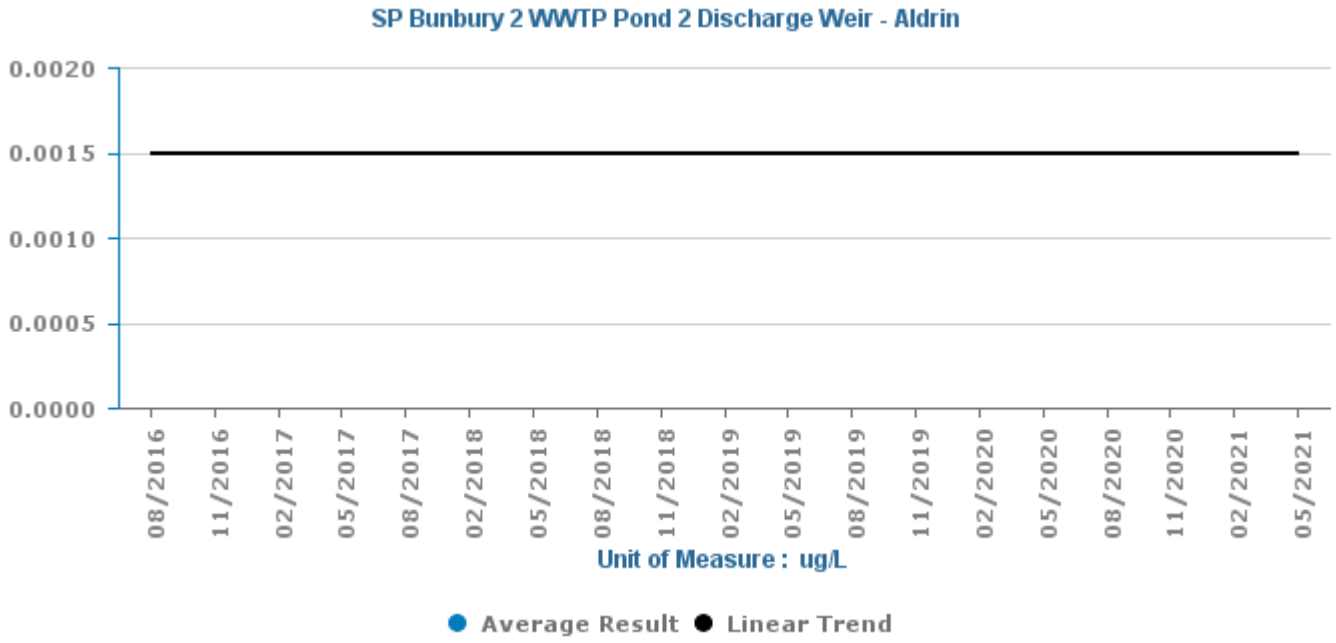
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Aldrin
0.0020
0.0015
0.0010
0.0005
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
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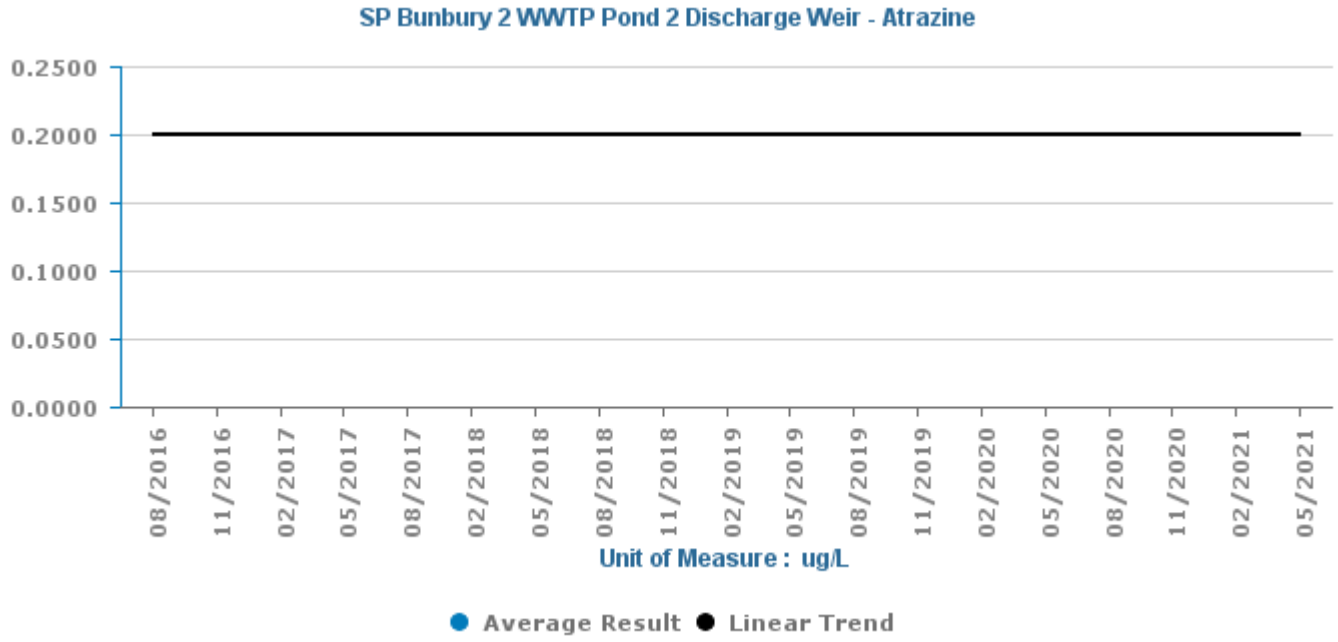
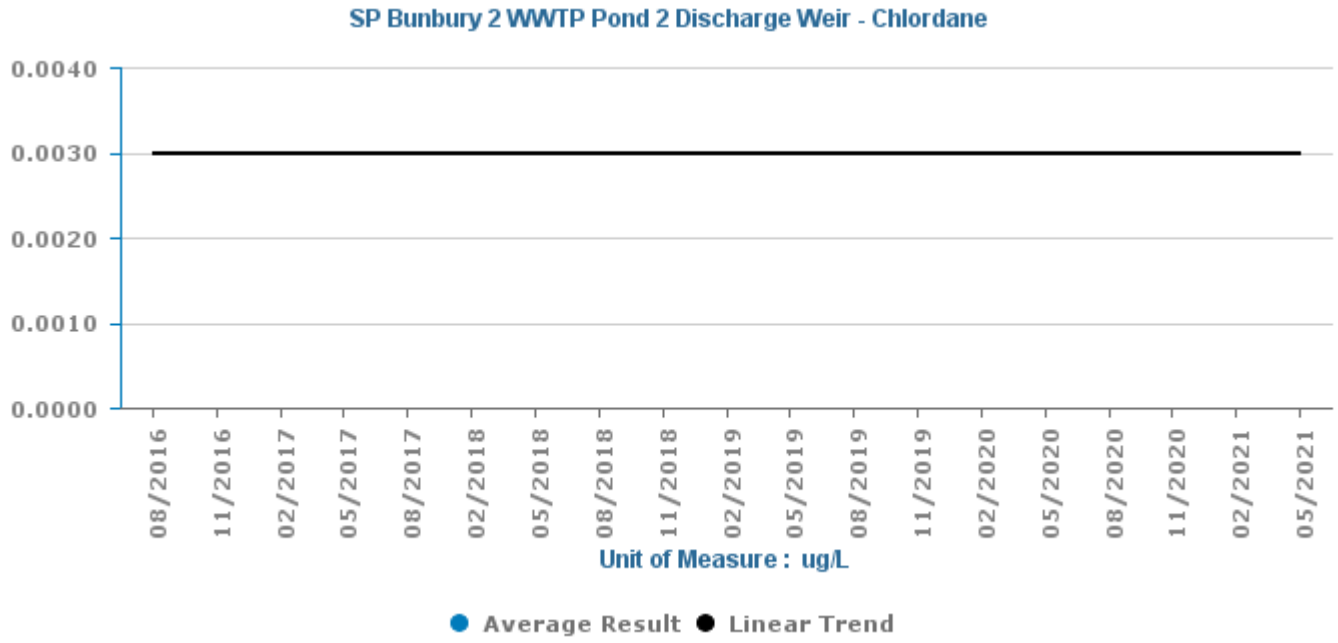
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Atrazine
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Chlordane
0.0040
0.0030
0.0020
0.0010
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
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08/2020
11/2020
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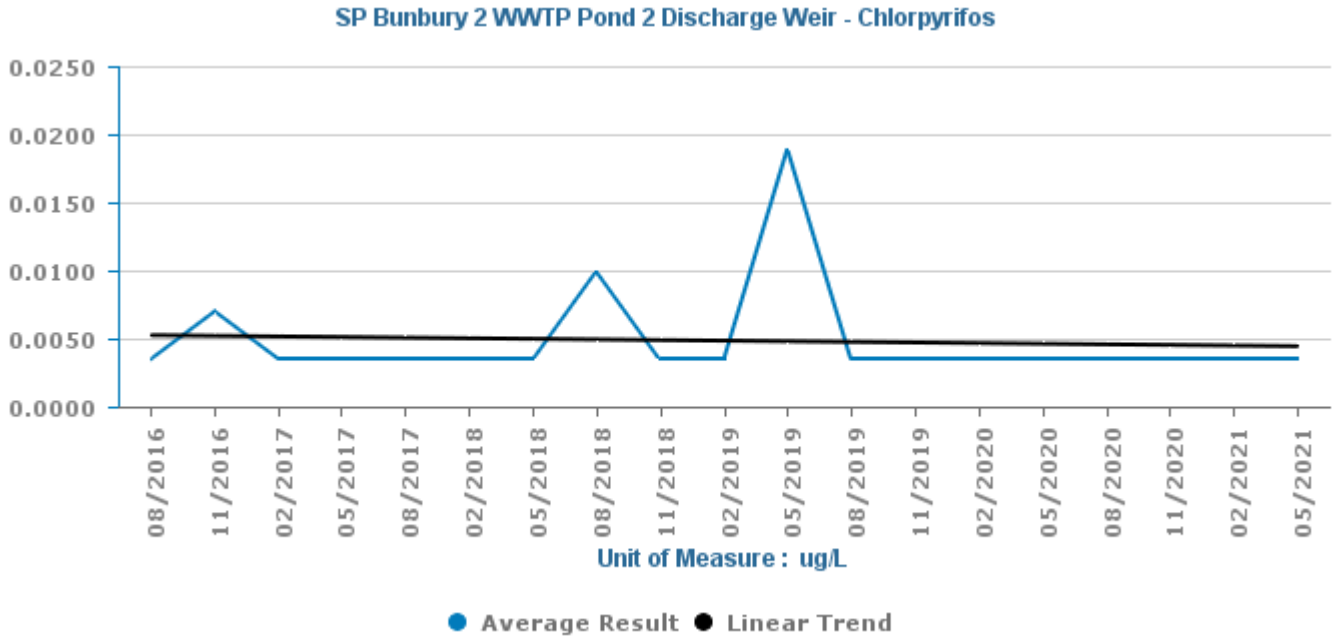
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Chlorpyrifos
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0.0200
0.0150
0.0100
0.0050
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
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05/2020
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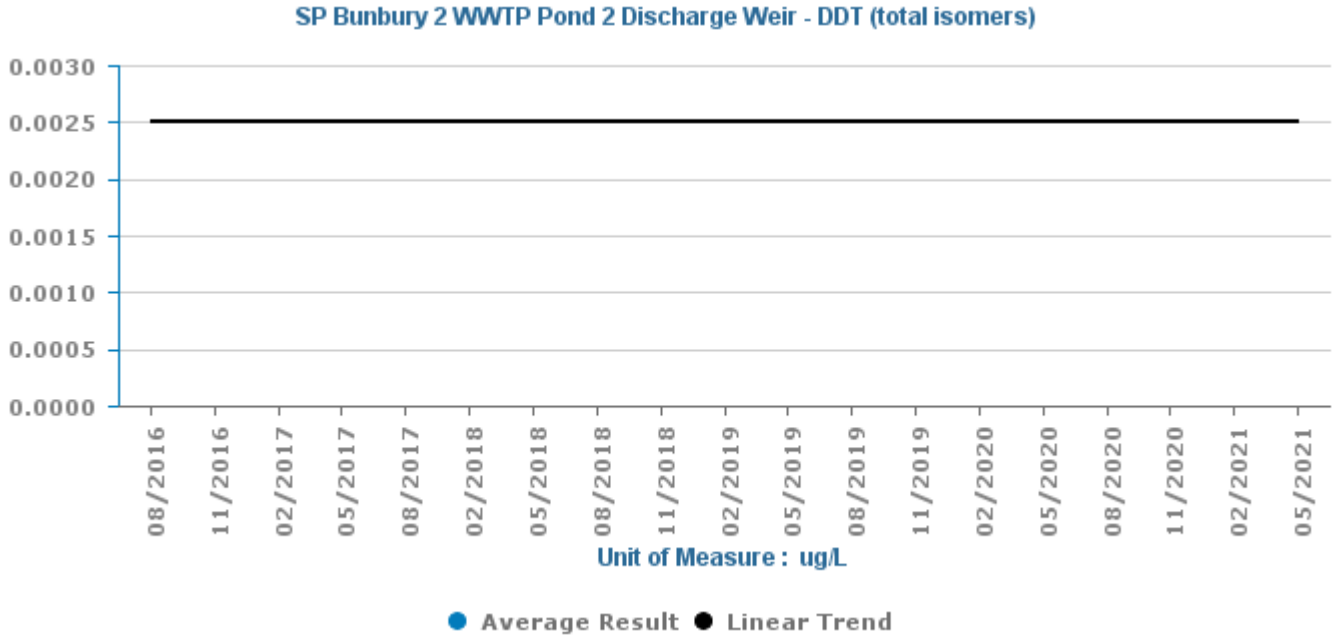
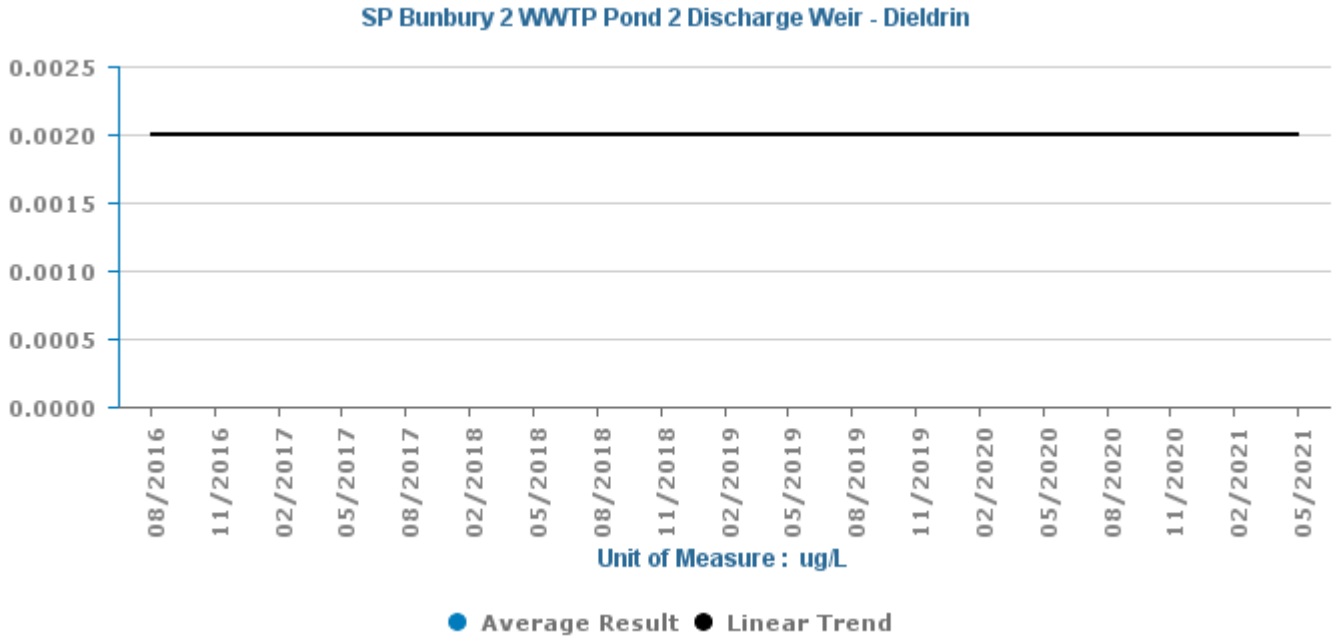
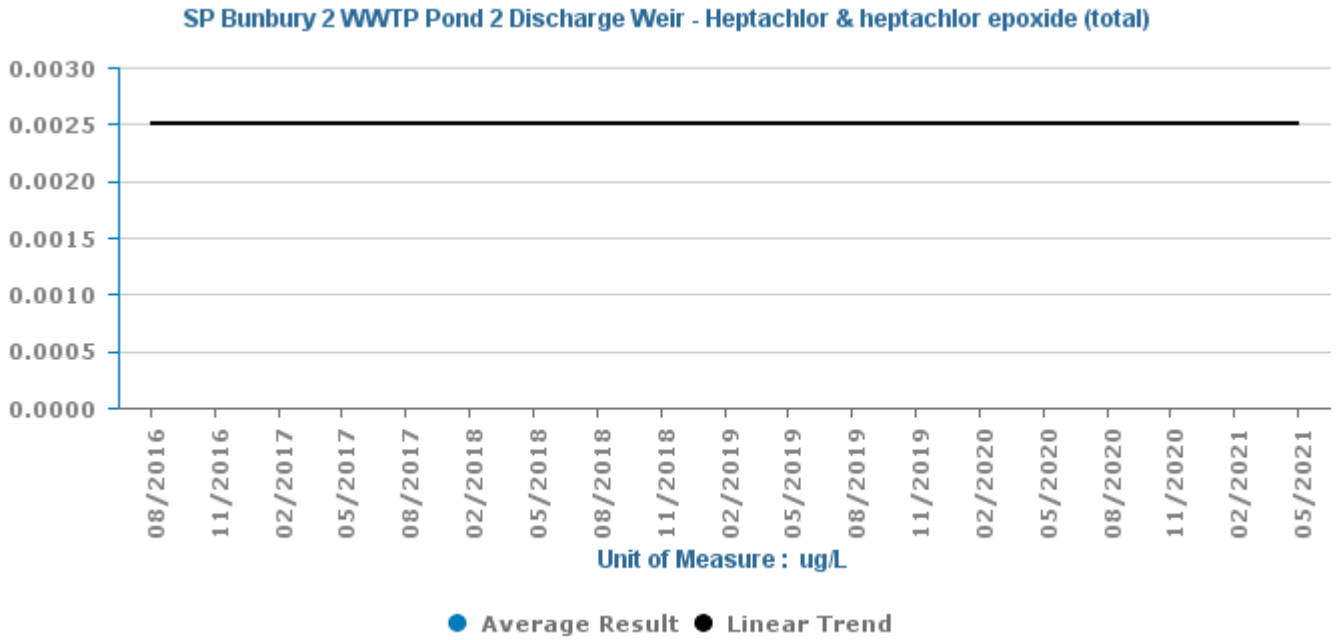
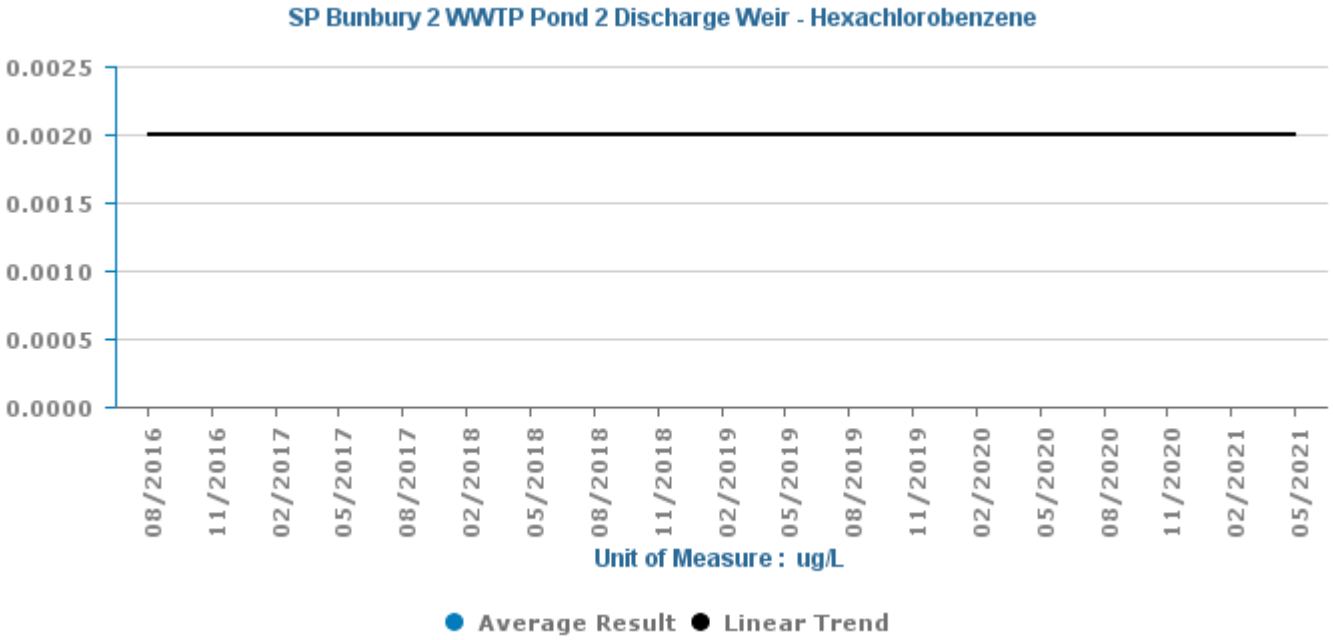
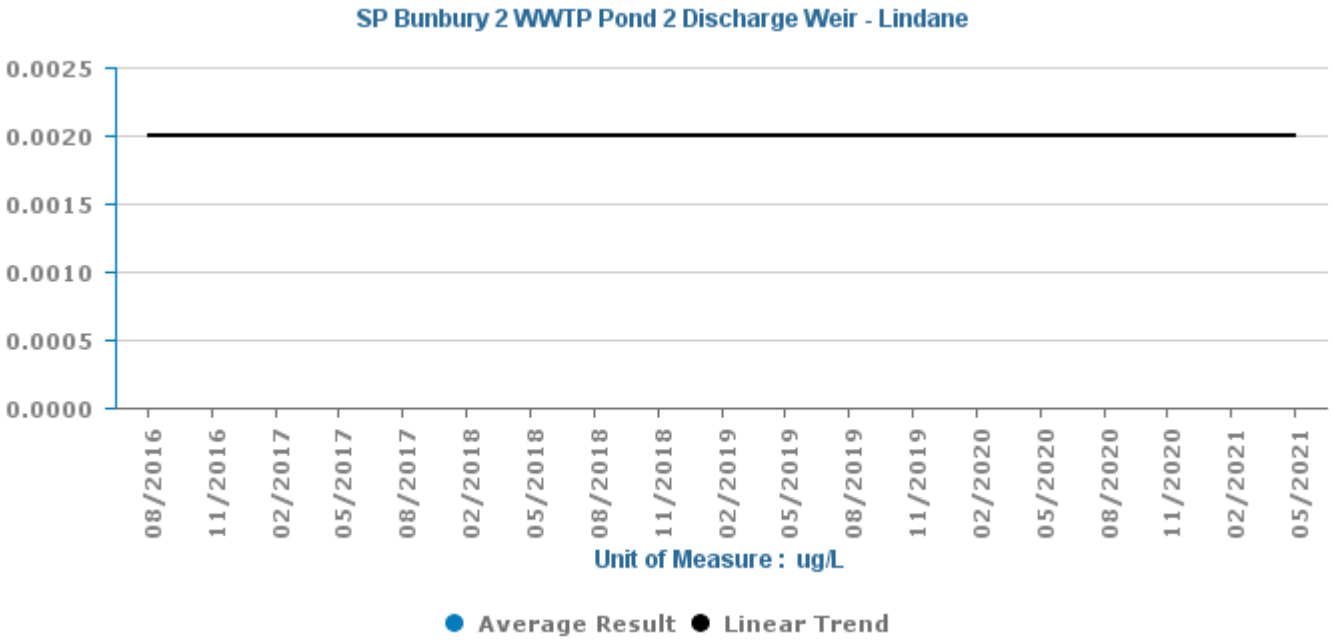
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend

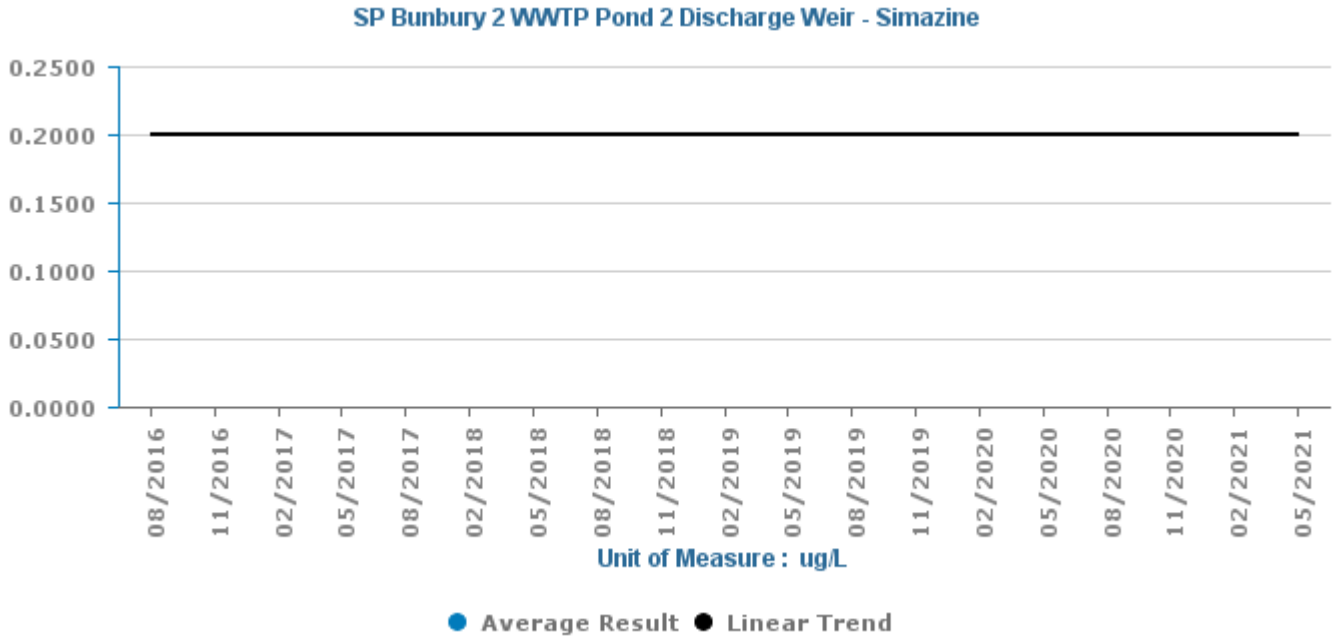

SP Bunbury 2 WWTP Pond 2 Discharge Weir - DDT (total isomers)
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Dieldrin
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Heptachlor & heptachlor epoxide (total)
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Hexachlorobenzene
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Lindane
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend


SP Bunbury 2 WWTP Pond 2 Discharge Weir - Simazine
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
08/2016
11/2016
02/2017
05/2017
08/2017
02/2018
05/2018
08/2018
11/2018
02/2019
05/2019
08/2019
11/2019
02/2020
05/2020
08/2020
11/2020
02/2021
05/2021
Unit of Measure : ug/L
Average Result
Linear Trend

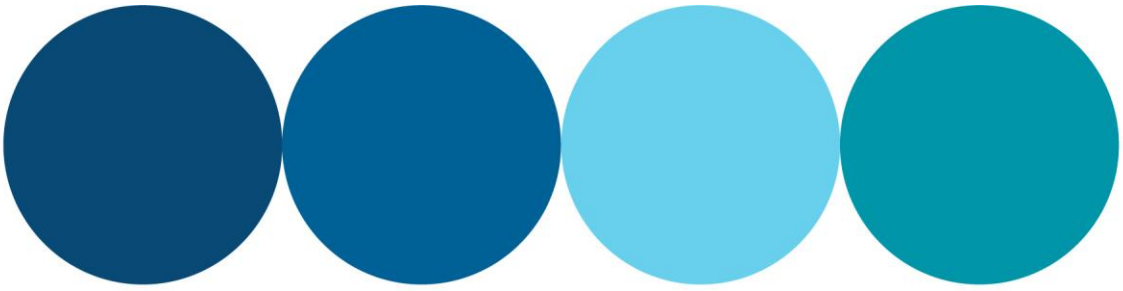
ATTACHMENT 5

Bunbury Ocean Outlet Monitoring Annual Report 2020 – 2021

(https://nexus.watercorporation.com.au/otcs/cs.exe/link/123223004)

Bunbury Wastewater Treatment Plant Ocean Outlet Monitoring Program

Annual Report 2020/2021



WATER CORPORATION

This report has been prepared for Water Corporation by BMT, September 2021 Report Number R-1136_07-1

Document history

Distribution

Revision	Author	Recipients	Organisation	No. copies & format	Date
A	A Sherwood	M Lourey	BMT	1 x docm	16/09/2021
B	A Sherwood	R Munro	Water Corporation	1 x pdf	12/10/2021
0	A Sherwood	R Munro	Water Corporation	1 x pdf	29/10/2021

Review

Revision	Reviewer	Intent	Date
A	M Lourey	Technical Review	16/09/21
B	R Munro	Interim Client Review	12/10/2021

Quality Assurance

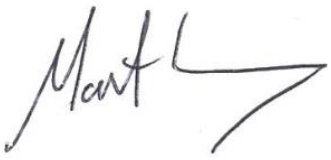
WWW.JAS-ANZ.ORG/REGISTER

BMT Commercial Australia Pty Ltd has prepared this report in accordance with our Integrated Management System, in compliance with ISO14001 and ISO9001.

Status

This report is 'Draft' until approved for final release, as indicated below by inclusion of signatures from: (i) the author and (ii) a Director of BMT Commercial Australia Pty Ltd (BMT) or their authorised delegate. A Draft report may be issued for review with intent to generate a 'Final' version, but must not be used for any other purpose.

Approved for final release:



Author
Date: 26/10/2021

Director (or delegate)
Date: 26/10/2021

Contents

Acronyms

ANZECC/ARMCANZ	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
CFU	Colony forming unit
DoH	Western Australian Department of Health
EPA	Environmental Protection Authority
EQC	Environmental Quality Criteria
EQG	Environmental Quality Guideline
EQMF	Environmental Quality Management Framework
EQO	Environmental Quality Objective
EQS	Environmental Quality Standard
EV	Environmental Value
HEPA	High ecological protection area
MPN	Most probable number
NATA	National Association of Testing Authorities
SHEZ	Shellfish harvesting exclusion zone
TTC	Thermotolerant coliforms
TWW	Treated wastewater
WASQAP	Western Australian Shellfish Quality Assurance Program
WWTP	Wastewater treatment plant

Executive Summary

This report documents the results of the 2020–2021 marine environmental monitoring around the Bunbury ocean outlet. The monitoring has been carried out in accordance with the requirements of the Marine Impacts Monitoring and Management Plan (MIMMP; Water Corporation 2012). The monitoring program aims to determine the physical and chemical properties of the treated wastewater plume and establish its effect on the receiving marine environment. Results are reported in the context of the Environmental Quality Management Framework (EQMF) in accordance with the MIMMP (Water Corporation 2012). The results are summarised in Report Card format (Table ES 1). The report card contains colour-coded results, with the individual colours representing the extent to which the Environmental Quality Criteria (EQC) were met (Table ES 2 – Table ES 4).

Table ES 1 Summary report card legend

Management response	Colour
Monitor: EQG met (continue monitoring)	
Investigate: EQG not met (investigate against the EQS)	
Action: EQS not met (management response required)	

Note:

1. The required response following an exceedance of either the Environmental Quality Guideline (EQG) or Environmental Quality Standard (EQS) is shown in parentheses.

Table ES 2 Summary report card for the Environmental Quality Objective 'Maintenance of Ecosystem Integrity'

Environmental quality indicator		EQC	Comments	Compliance
Toxicants in treated wastewater (TWW)	Bioaccumulating toxicants	EQG	Concentrations of cadmium and mercury in the undiluted TWW stream were below the analytical limit of reporting and ANZECC/ARMCANZ (2000) 80% species protection guideline	
	Non-bioaccumulating toxicants and initial dilution	EQG	Total ammonia, copper and zinc concentrations exceeded ANZECC/ARMCANZ (2000) guidelines in TWW prior to initial dilution. Initial dilution of 1:36 expected at the LEPA boundary was sufficient to reduce contaminant concentrations to below their associated ANZECC/ARMCANZ (2000) 99% species protection guidelines.	
Nutrient enrichment indicators of	Chlorophyll-a	EQG	Median concentration of chlorophyll-a at compliance sites was equal to (and did not exceed)	

increased nutrients and algal growth potential			the 80th percentile of reference site data	
	Phytoplankton biomass (measured as chlorophyll-a)	EQG	Chlorophyll-a biomass did not exceed 3 times the median of chlorophyll-a concentration of reference site data, on any occasion during summer monitoring	
	Light attenuation coefficient (LAC)	EQG	Median light attenuation measured over the summer period at compliance sites did not exceed the 80th percentile of historical reference site data.	
	Periphyton chlorophyll-a	EQG	Median concentration of periphyton biomass (measured as chlorophyll-a) at compliance sites exceeded the 80th percentile of reference site data. This triggered assessment against the seagrass health EQS.	
	Seagrass health	EQS1	Median shoot density fell below the 20th percentile of reference sites, at sites SG2 and SG4, in two consecutive years (2020 and 2021).	
		EQS2	Median shoot density, at all sites in 2021, was greater than the 5th percentile of the pooled reference site data	
Physio-chemical stressor	Dissolved oxygen % saturation	EQG	Dissolved oxygen saturation in bottom waters remained above 90% saturation at all times.	

Notes:

1. Green (■) symbols indicate the Environmental Quality Criteria (EQC) were met; amber (■) and red (■) symbols represent an exceedance of the Environmental Quality Guideline or Environmental Quality Standard (EQS), respectively.
2. TWW = treated wastewater, EQC = Environmental Quality Criteria, EQG = Environmental Quality Guidelines, EQS = Environmental Quality Standard, LEPA = Low Ecological Protection Area (100 m from diffuser).

Table ES 3 Summary report card for the Environmental Quality Objective 'Maintenance of Seafood for Human Consumption'

Environmental quality indicator		EQC	Comments	Compliance
Microbial contaminants	Thermotolerant coliforms (TTC)	EQG	Median TTC concentrations (<10 CFU/100 mL) did not exceed 14 CFU/100 mL and less than 10% of samples exceeded 21 CFU/100 mL	■
Algal biotoxins	Toxic phytoplankton species	EQG	No toxic phytoplankton species were recorded in numbers greater than WASQAP trigger values (DoF 2007)	■

Notes:

1. Green (■) symbols indicate the Environmental Quality Criteria (EQC) were met; amber (■) and red (■) symbols represent an exceedance of the Environmental Quality Guideline or Environmental Quality Standard (EQS), respectively.
2. WASQAP = Western Australia Shellfish Quality Assurance Program (DoF 2007)

Table ES 4 Summary report card for the Environmental Quality Objective 'Maintenance of Primary and Secondary Contact Recreation'

Environmental Quality Indicator		EQC	Comments	Compliance
Faecal pathogens	Enterococci spp.	EQG	All sites had *Enterococci* spp. concentrations between <10 and 10 MPN/100 mL. Therefore, the 95th percentile of pooled *Enterococci* spp. concentrations was <40 MPN/100 mL	■
Algal biotoxins	Phytoplankton (cell concentration)	EQG	The toxic algal species of concern (*Karenia brevis, Lyngbya majuscula* and *Pfiesteria* spp.) were not recorded	■

Note:

1. Green (■) symbols indicate the Environmental Quality Criteria (EQC) were met; amber (■) and red (■) symbols represent an exceedance of the Environmental Quality Guideline or Environmental Quality Standard (EQS), respectively.

1 Introduction

1.1 Document purpose

Water Corporation is required to ensure that the discharge of treated wastewater (TWW) from the Bunbury wastewater treatment plant (WWTP) to the marine environment is environmentally sustainable and managed appropriately for the protection of ecosystem and social values. To meet this outcome, Water Corporation undertake their operations in accordance with environmental commitments and Licence Conditions that are outlined in Ministerial Statement (MS) 572.

The Bunbury Operations Environmental Management program and the Marine Impacts Monitoring and Management Plan (MIMMP; Water Corporation 2012) for the Bunbury Ocean Outlet were designed according to Schedule 2 (Proponent's Environmental Management Commitments) of MS 572. The monitoring for the 2019-2020 reporting period was carried out in accordance with the methods and criteria in Water Corporation (2012).

This report describes the results and outcomes of the 2020-2021 Bunbury Ocean Outlet Monitoring (BOOM) program field surveys. The program aims to determine the chemical and physical properties of the TWW plume and to determine the effects of TWW discharge on the receiving marine environment.

1.2 Wastewater treatment plant infrastructure

Ocean disposal of TWW from the Bunbury WWTP commenced in July 2002. The Bunbury WWTP primarily services the City of Bunbury. On the 19 January 2021, total inflow into Bunbury WWTP was 10.786 kL. Prior to disposal, the wastewater is treated using microbial processes to reduce concentrations of nitrogen via an intermittently decanting extended aeration plant. These processes produce secondary TWW and biosolids.

The ocean outlet is located ~7 km south of the Bunbury Central Business District, south-west Western Australia (Figure 1). TWW is discharged via a sub-sea diffuser 1.7 km due west of the shoreline (Water Corporation 2012). The freshwater TWW is less dense than seawater and forms a buoyant plume that rises through the water column and mixes as it ascends.

Figure 1 Location of the Bunbury wastewater treatment plant and ocean outlet

1.3 Conditions of operation

The Bunbury WWTP operates in accordance with Conditions outlined in MS 572. Conditions 6.1 and 6.2 of MS 572 include a requirement to ensure the ecological and social health objectives are met in their respective management areas.

1.4 Environmental Quality Management Framework

Monitoring was completed according to Western Australia's Environmental Quality Management Framework (EQMF; EPA 2016). The EQMF is based on:

- identifying Environmental Values (EVs) (Figure 2)
- establishing and spatially defining Environmental Quality Objectives (EQOs) that need to be maintained to ensure the associated EVs are protected (Figure 2)
- monitoring and managing to ensure the EQOs are achieved and/or maintained in the long-term in the areas they have been designated
- establishing Environmental Quality Criteria (EQC) which are quantitative benchmarks or 'trigger values' against which monitoring results can be compared.

There are two levels of EQC:

1. Environmental Quality Guidelines (EQGs) are quantitative, investigative triggers which, if met, indicate there is a high degree of certainty the associated EQO has been achieved. If the guideline is not met a more detailed assessment against the EQS is triggered.
2. Environmental Quality Standards (EQSs) are management triggers which, if exceeded, signify the EQO is at risk of not being met and that a management response may be required.

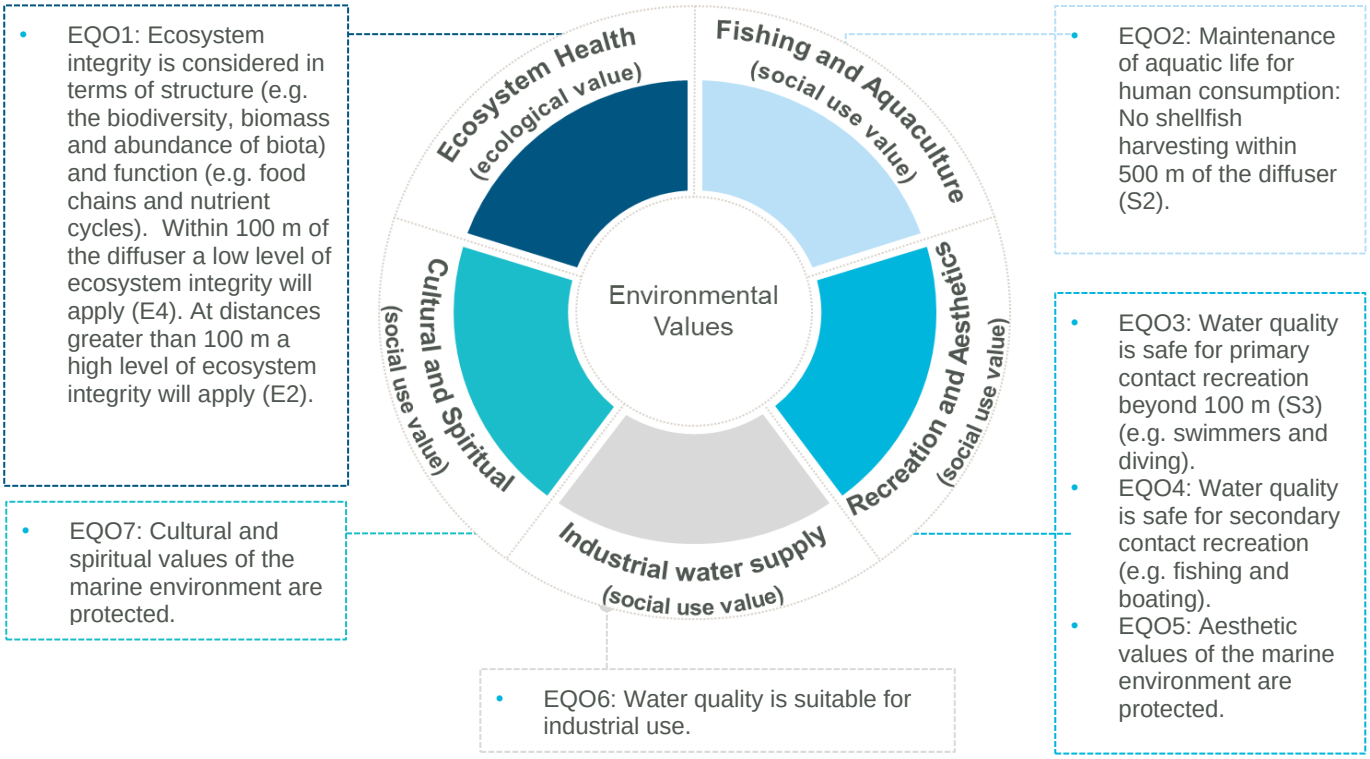


Figure 2 Establishing Values and Environmental Quality Objectives (EQO) for the marine waters of Western Australia

1.5 BOOM program framework

MS 572 requires that the EVs Ecosystem Health and Recreation and Aesthetics are maintained and the associated EQOs (EQO1, EQO3, EQO4 and EQO5; Figure 2) are met within 100 m of the Bunbury TWW ocean outlet (Figure 3). MS 572 requires that the EV Fishing and Aquaculture is maintained and the associated EQOs (EQO2; Figure 2) are met within 500 m of the Bunbury TWW ocean outlet (Figure 3).

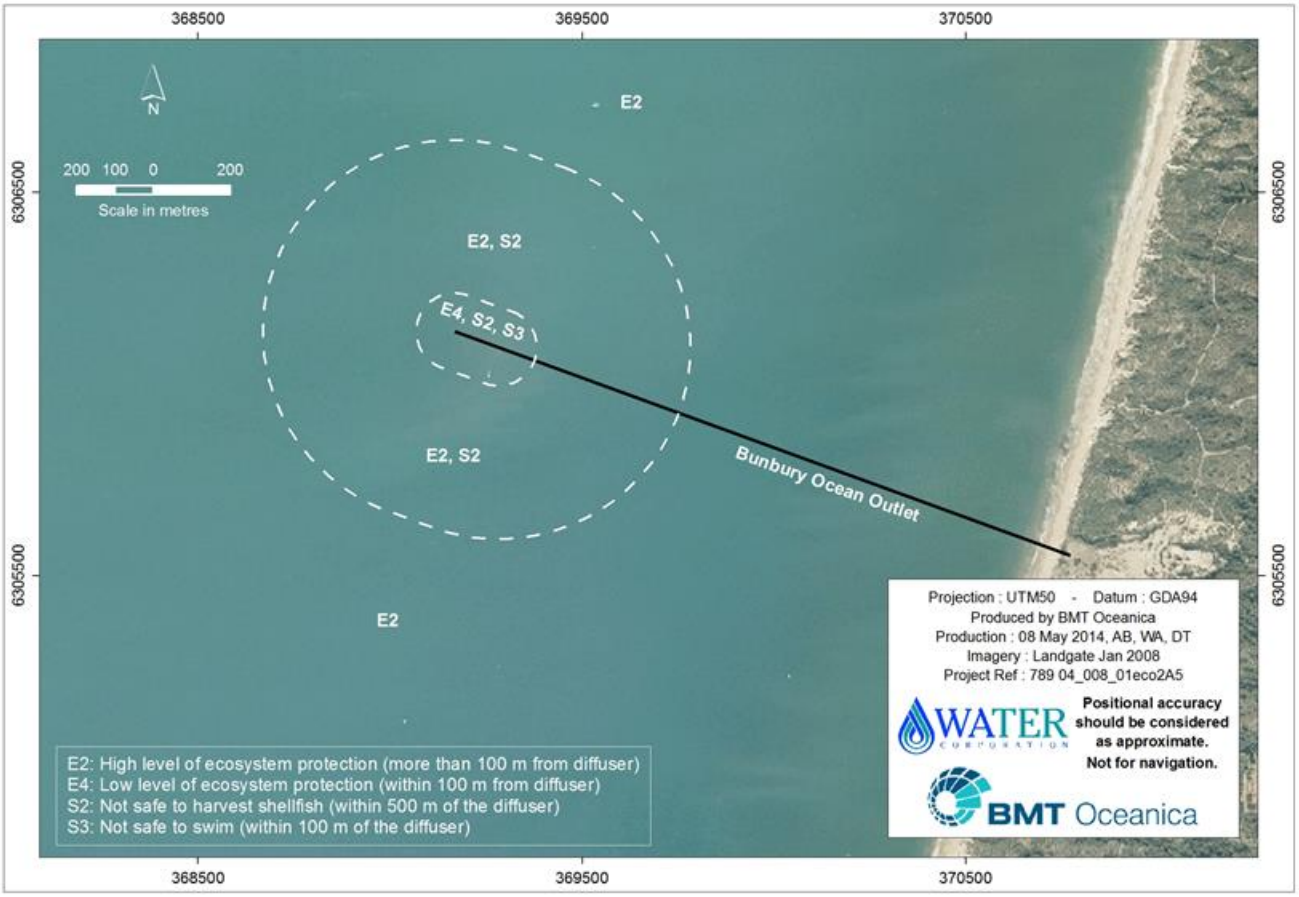


Figure 3 Environmental management areas as defined in Schedule 1 of Ministerial Statement 572

1.5.1 'Maintenance of ecosystem integrity' EQO

The intent of this EQO is to maintain a healthy and diverse ecosystem. The EQO applies a designated level of ecological protection: low, moderate, high or maximum (Figure 4). A low level of ecological protection applies in the low ecological protection area (LEPA) occupying the area within a 100 m radius of the diffuser at the Bunbury outfall. Waters outside the LEPA are designated as a high ecological protection area (HEPA) and maintained to a high level of ecological protection.

The extent to which the EQO for the Maintenance of Ecosystem Integrity was met during the 2020–2021 reporting period is assessed against the EQC for waste stream characterisation (i.e. toxicants in TWW) and the EQC for receiving waters (i.e. water quality and seagrass health).

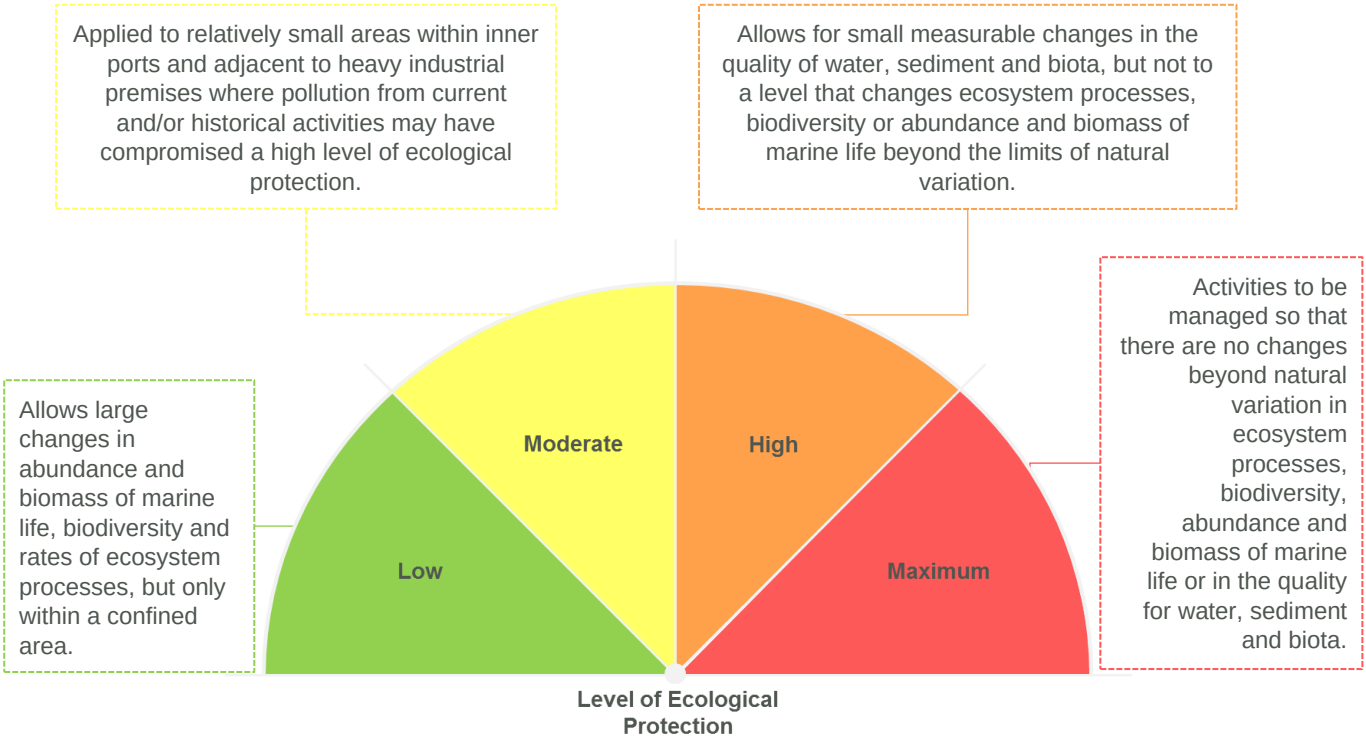


Figure 4 Level of Ecological Protection

1.5.2 'Maintenance of aquatic life for human consumption' EQO

The intent of this EQO is to maintain aquatic life safe for human consumption (a social value) except for a small area surrounding the ocean outlet within 500 m of the diffuser (S2; Figure 3), where shellfish may be unsafe to eat.

1.5.3 'Maintenance of primary and secondary contact recreation' EQO

Primary contact recreation will be maintained outside 100 m of the diffuser (S3; Figure 3). Secondary contact recreation is not to be affected by the presence of the Bunbury ocean outlet. As the EQO for maintenance of primary contact recreation uses a higher water quality standard than secondary contact recreation, it is assumed that if the primary contact criteria are met, then the secondary contact criteria are also met by default.

2 Waste stream monitoring

Monitoring of TWW prior to discharge consisted of:

- monthly TWW characterisation
- annual comprehensive TWW characterisation
- initial dilution monitoring.

2.1 Monthly treated wastewater characterisation

TWW from Pond 2 Discharge Weir was sampled on the second Tuesday of each month by Water Corporation and analysed for:

- total ammonium
- filtered biochemical oxygen demand (BOD)
- conductivity at 25 C
- total nitrogen (TN)
- total phosphorus (TP)
- nitrate and nitrite (NO_x)
- *Escherichia coliforms* (E. coli).

This regulatory monthly sampling is carried out in accordance with Bunbury No. 2 WWTP operating licence L5972/1922/14. The operating licence limit for total phosphorus of 10 mg/L was met during the July 2020–June 2021 reporting period (Table 1). All other discharge limits in the Schedule 1 Table of MS 572 (suspended solids, biochemical oxygen demand, total nitrogen and total nitrogen load), are reported separately.

Table 1 Regulatory monthly parameter results from Pond 2 Discharge Weir

Month	Total ammonium	Filtered BOD	TN	TP	pH	NOx	E. coli
Unit	mg/L	mg/L	mg/L	mg/L		mg/L	cells/100mL
LoR	NA	<5	NA	NA	NA	NA	NA
Jul 20	1.6	<5	7.9	4.0	7.83	4.7	>24 000
Aug 20	1.8	<5	8.2	4.7	7.76	4.7	17 000
Sept 20	2.0	<5	9.2	4.3	7.66	5.1	24 000
Oct 20	3.2	<5	10.0	4.3	7.66	4.4	1800
Nov 20	1.9	<5	7.9	3.2	7.92	4.0	13 000
Dec 20	2.0	<5	8.3	4.5	7.63	4.4	6 500
Jan 21	1.2	<5	9.3	5.0	7.61	5.6	24 000
Feb 21	1.3	<5	7.0	3.7	7.59	4.4	20 000
Mar 21	0.88	<5	6.4	3.2	7.68	4.0	>24 000
Apr 21	3.1	<5	7.3	2.8	7.64	2.6	>24 000
May 21	2.1	<5	6.9	3.9	7.69	2.9	>24 000
Jun 21	2.0	<5	7.2	3.6	7.88	2.9	20 000
Mean	**1.9**	**<5**	**8.0**	**3.9**	**7.71**	**4.14**	**18 525**

Note:

1. LoR = Limit of reporting, BOD = biological oxygen demand, TN = total nitrogen, TP = total phosphorus, NOx = nitrate+nitrite, E. coli = Escherichia coli, NA = not applicable.

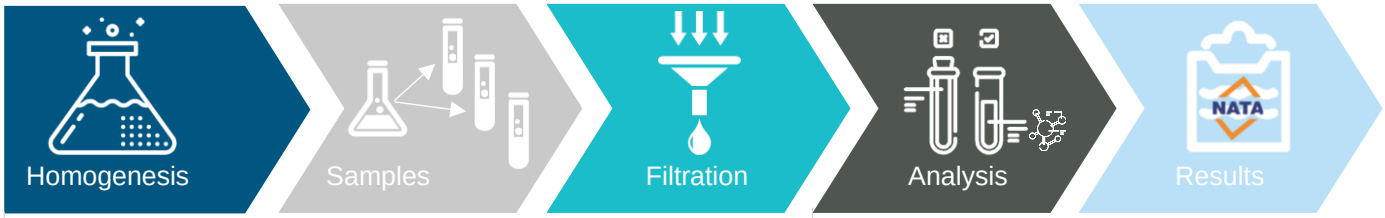
2.2 Comprehensive treated wastewater characterisation

TWW (final effluent) from the Bunbury WWTP was analysed for a suite of potential contaminants of concern:

- ammonium as nitrogen
- NO_x as nitrogen
- TP
- TSS
- BOD (5–day)
- salinity
- metals (Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn)
- pesticides
- herbicides.

A 24-hour flow weighted composite sample was obtained from the Bunbury WWTP on 19 January 2021.

Samples for bioavailable metals were filtered through a 0.45 µm filter prior to analyses.



The bulk sample was homogenised (agitated), split into individual sample containers and sent to a National Association of Testing Authorities (NATA)-accredited laboratory for analysis.

Samples were handled according to the NATA accredited laboratory requirement. Analyses were completed using NATA-accredited methods.

2.2.1 Initial dilution monitoring

The MIMMP requires the initial dilution of TWW to be estimated using two different methods (i) using an internationally recognised mixing model (in the case VPLUMES) simulation of the conditions at the time of sampling and (ii) using the concentrations of nutrients within TWW compared to the in-water estimates at the times of sampling (Water Corporation 2012). The most conservative (lowest) estimate of the two is used in further calculations and comparisons (Water Corporation 2012).

2.2.2 Initial dilution using model simulation

Initial dilution modelling (using plume dispersion model VPLUMES) was used to predict the near field dilution of the wastewater plume around the Bunbury TWW ocean outlet. Initial dilution is the dilution between the point of discharge and the point of maximum rise or fall of the plume (in this case when the buoyant plume reaches the surface).

On 19 January 2021 (concurrent to the first summer water quality survey), ambient data (i.e. temperature and flow) were collected for input into the plume dispersion model. To determine the current velocity and direction at the time of sampling, a surface drogue was released above the outlet diffuser and the location of the drogue recorded at intervals over time using an on-board Global Positioning System. Surface current velocities were used to synthesise a vertical velocity profile based on the gradient determined by current meters deployed at 2 m and 7.5 m above the seabed ~900 m offshore from the diffuser at the Bunbury TWW ocean outlet (WNI 2000).

Modelling using VPLUMES indicated an average initial dilution of 1:384 and a centreline dilution of 1:219 on 19 January 2021 (Figure 5). The full model output is included in Appendix A.

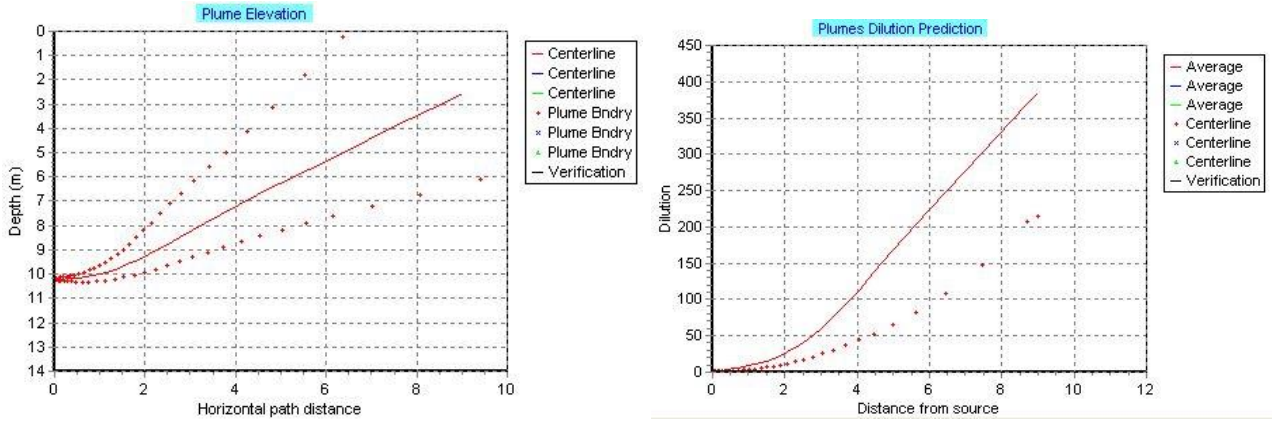


Figure 5 Initial dilution modelling output showing predicted plume elevation trajectory (left) and predicted average and centreline dilutions (right)

2.2.3 Initial dilution using the nutrient concentrations within TWW

The lowest dilution expected to occur at the Bunbury TWW outlet based on dilution of nitrate and nitrite was 1:36 (Table 2). This is the most conservative estimate of initial dilution (more conservative than the average initial dilution modelled via VPLUMES of 1:384) and it will be used in calculations below.

Table 2 Minimum initial dilution achieved for total ammonia, nitrate+nitrite and total phosphorus

Parameter	Undiluted TWW concentration	Surface maximum[1]	Surface background[2]	Minimum initial dilution achieved[3]
Total ammonia	9900	63	1.5	161
Nitrate+nitrite	1600	46	1	36
Total phosphorus	8000	8	1	1143

Notes:

1. Highest surface concentration recorded at the nutrient dilution sites.
2. Average surface concentration of five reference sites (WQR1–WQR5); where this value was <LoR, the LoR was used to calculate the average surface concentration.
3. Minimum initial dilution = treated wastewater (TWW) concentration/(Surface Maximum – Surface Background).

2.2.4 Bioaccumulating toxicants

The EQG for bioaccumulating toxicants (cadmium and mercury) in the TWW is outlined in Table 3.

Table 3 Environmental Quality Guideline for bioaccumulating toxicants

EQG	Concentrations of contaminants will not exceed the ANZECC/ARMCANZ (2000) 80% species protection guideline trigger levels for bioaccumulating toxicants in wastewater stream before dilution

Source: Water Corporation (2012)

Concentrations of cadmium and mercury (i.e. bioaccumulating toxicants) in the TWW sample before dilution were both below the analytical limit of reporting (and the ANZECC/ARMCANZ (2000) 80% species protection guideline trigger levels) and the EQG for bioaccumulating toxicants was met (Table 4).

2.2.5 Non-bioaccumulating toxicants

Non-bioaccumulating toxicants concentrations were generally below the analytical limit of reporting and the ANZECC/ARMCANZ (2000) 99% species protection guidelines prior to discharge and dilution with the exception of ammonia, copper and zinc (Table 4). After initial dilution of 1:36 (a conservative

estimate of the dilution expected at the LEPA boundary; Appendix A), contaminant concentrations of ammonia, copper and zinc were below ANZECC/ARMCANZ (2000) 99% species protection guidelines (Table 4) and the EQG for non-bioaccumulating toxicants was met.

Table 4 Toxicants in the Bunbury TWW compared with relevant guideline trigger levels after initial dilution

Toxicant	Bunbury TWW concentration (µg/L)	Concentration after initial dilution (µg/L)[1]	Trigger (µg/L)[2]
Ammonia-N	**9900**	276.5	500
Nitrate+Nitrite	1600	-	ID
Total phosphorus	8000	-	n/a
Total suspended solids	13	-	<10[3]
Arsenic	20	-	
Cadmium*	0.6	-	36
Chromium*	1	-	0.14 (Cr VI)
Copper*	**3**	0.16	0.3
Lead*	10	-	2.2
Mercury*	0.1	-	1.4
Nickel*	7	-	7
Selenium	20	-	
Silver*	10	-	0.8
Zinc*	**32**	1.04	7
Molybdenum	4	-	ID
Salinity (psu)		-	n/a
BOD	5000	-	n/a
Chloropyrifos	<0.1	-	0.0005
Endrin	<0.01	-	0.004
Endosulfan sulfate	<0.01	-	0.005

Notes:

1. Initial dilution = 1:36. Contaminant dilution calculations were not performed (–) on any toxicants where concentrations were below the analytical limit of reporting or where the 99% species protection guideline value was not the trigger (i.e. cadmium, mercury and total suspended solids).
2. Assessment against ANZECC/ARMCANZ (2000) 99% species protection guidelines for non-bioaccumulating toxicants; guideline values for marine waters.
3. Guideline value for the protection of aquaculture species in saltwater production (ANZECC/ARMCANZ (2000)
4. The bioaccumulating toxicants cadmium and mercury must meet the 80% species protection guidelines at the diffuser (i.e. prior to initial dilution), and therefore a diluted concentration was not calculated.
5. ID = insufficient data to derive a reliable national trigger value.
6. Amber bold text represents an exceedance of guideline values prior to initial dilution.

3 Water quality monitoring – receiving environment

Water Corporation (2012) requires the assessment for indicators of nutrient enrichment and physico-chemical stress in receiving waters. Indicators of nutrient enrichment that were measured in receiving waters to assess marine water quality are:

- surface chlorophyll-a
- phytoplankton biomass
- light attenuation coefficient (LAC)
- periphyton
- seagrass shoot density.

Dissolved oxygen (DO) was also measured and is the primary indicator of physico-chemical stress.

Sampling procedures were followed at compliance monitoring, plume tracking, periphyton monitoring and seagrass health sites over the summer monitoring period (Figure 6; Appendix B). Nutrients, phytoplankton biomass, light attenuation and the physico-chemical stressor DO were monitored during three separate surveys on 19 January, 17 February and 24 March 2021, along a down-current gradient away from the diffuser (Appendix B). Periphyton was monitored using collector plates deployed from 18 January 2021 to 17 February 2021 (Appendix B). Seagrass shoot density was measured on 20 and 21 January 2021 (Appendix B). Compliance with the EQS was assessed based on *Posidonia angustifolia* shoot density at each location. However, *Amphibolis* shoot density was also recorded, if present, as an additional line of evidence. Additional sites in the vicinity of SG4 were surveyed to determine if the declining trend was widespread and typical of the entire area. It was determined that impacts were restricted and due to natural blow-outs at that specific site rather than impacts from the wastewater discharge. One of the additional sites sampled, SG4d, was selected from the four additional sites sampled (SG4a-d) to be established as a permanent new site that was more representative of the area for assessing long-term change. (Figure 6).

Nutrient concentrations (ammonia, ortho-phosphate, nitrate+nitrite) in receiving waters were measured with distance from the outlet (to test for nutrient gradients), for contextual purposes only (see Appendix C for results).

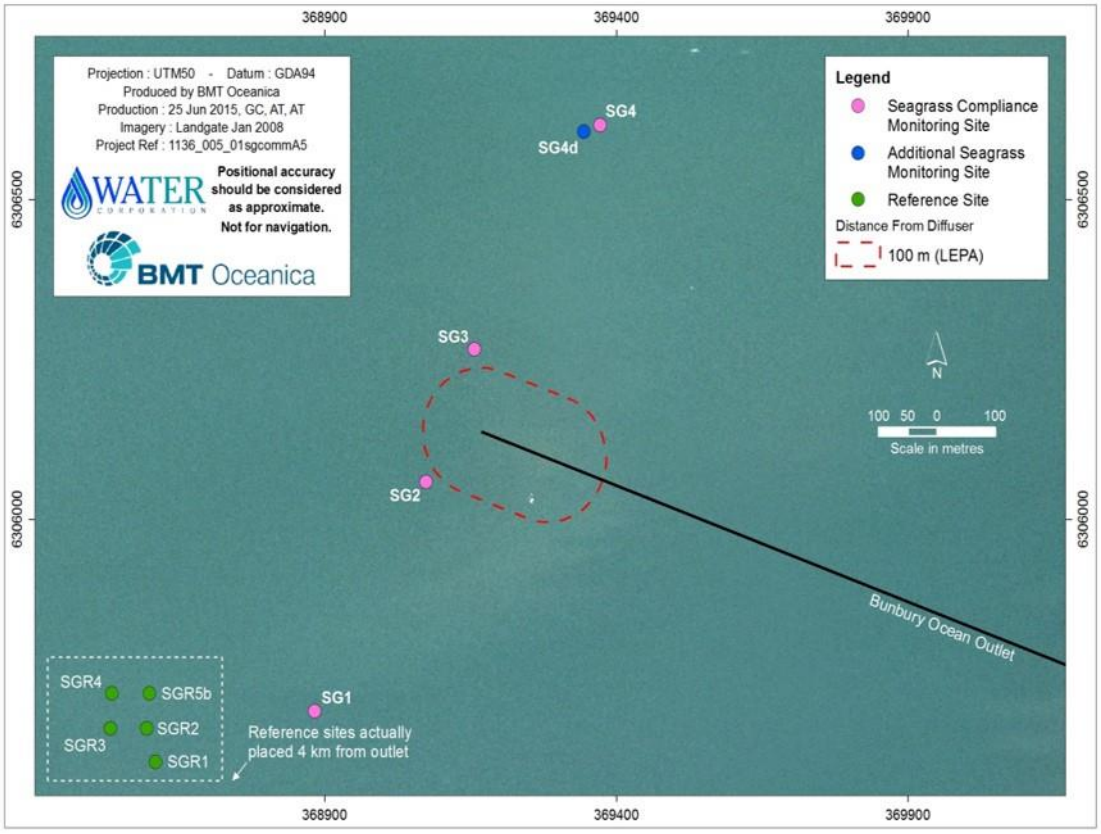


Figure 6 Seagrass health monitoring locations

3.1 Nutrient enrichment

3.1.1 Surface water chlorophyll-a

The EQG for surface water chlorophyll-a is outlined in Table 5.

Table 5 Environmental quality guideline for surface water chlorophyll-a

EQG	The median surface chlorophyll-a concentration at the boundary of the LEPA is not to exceed the 80th percentile of historical reference site data.

Chlorophyll-a in surface waters ranged from below the analytical detection limit (<0.1 µg/L) to 0.4 µg/L (Figure 7). The median chlorophyll-a concentration in surface waters at compliance monitoring sites was 0.2 µg/L. This was equal to the 80th percentile of historical reference site data (0.2 µg/L from 2003–2021: yellow dashed line in Figure 7), meeting the EQG for surface water chlorophyll-a.

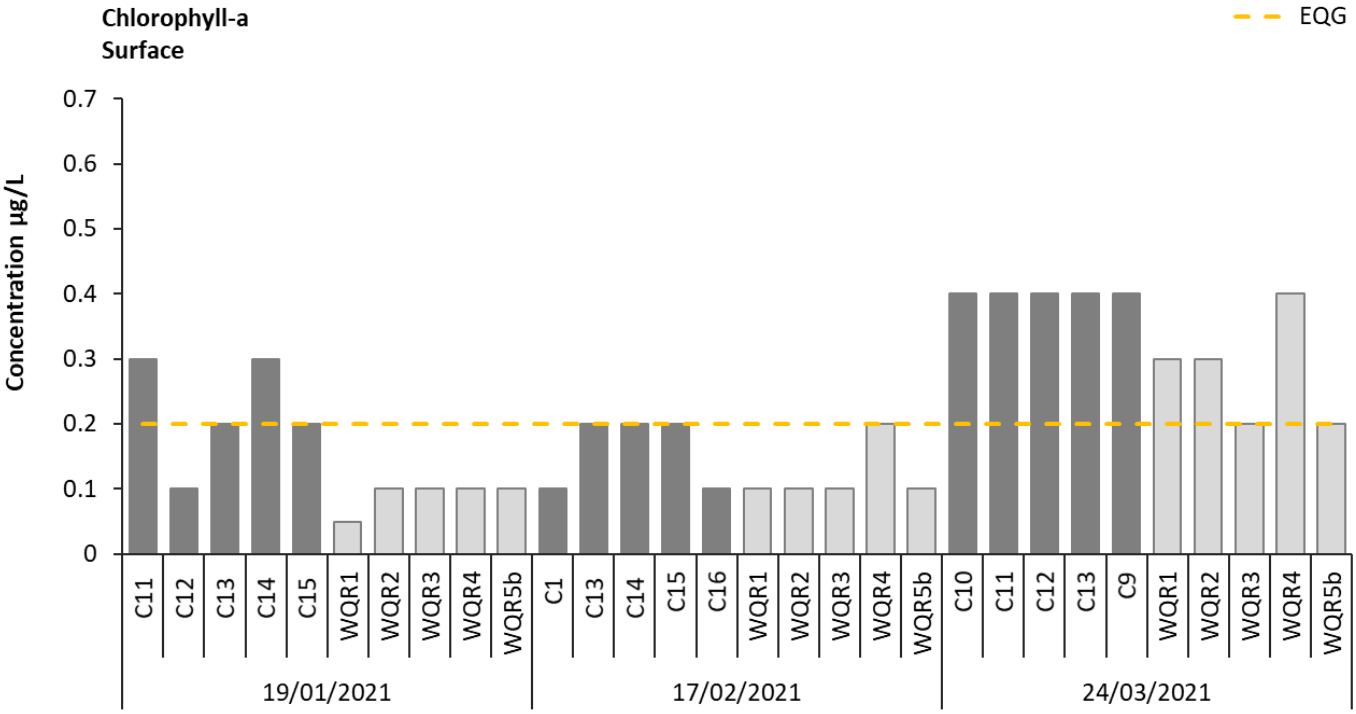


Figure 7 **Surface chlorophyll-a concentrations at compliance and reference sites in 2021 around Bunbury ocean outlet**

3.1.2 Phytoplankton biomass

The EQG for phytoplankton biomass (also measured as concentration of chlorophyll-a) is outlined in Table 6.

Table 6 **Environmental quality guideline for phytoplankton biomass**

EQG	Phytoplankton biomass (measured as chlorophyll-a concentration) does not exceed three times the median of chlorophyll-a concentrations of historical reference site data, on any occasion, during the non-river flow period

Phytoplankton biomass (measured as chlorophyll-a) in surface waters ranged from below the analytical detection limit (<0.1 µg/L) to 0.4 µg/L and did not exceed three times the median of historical reference site data (0.6 µg/L) on any occasion during the non-river flow period (Figure 8). Therefore, the EQG for phytoplankton biomass was met.

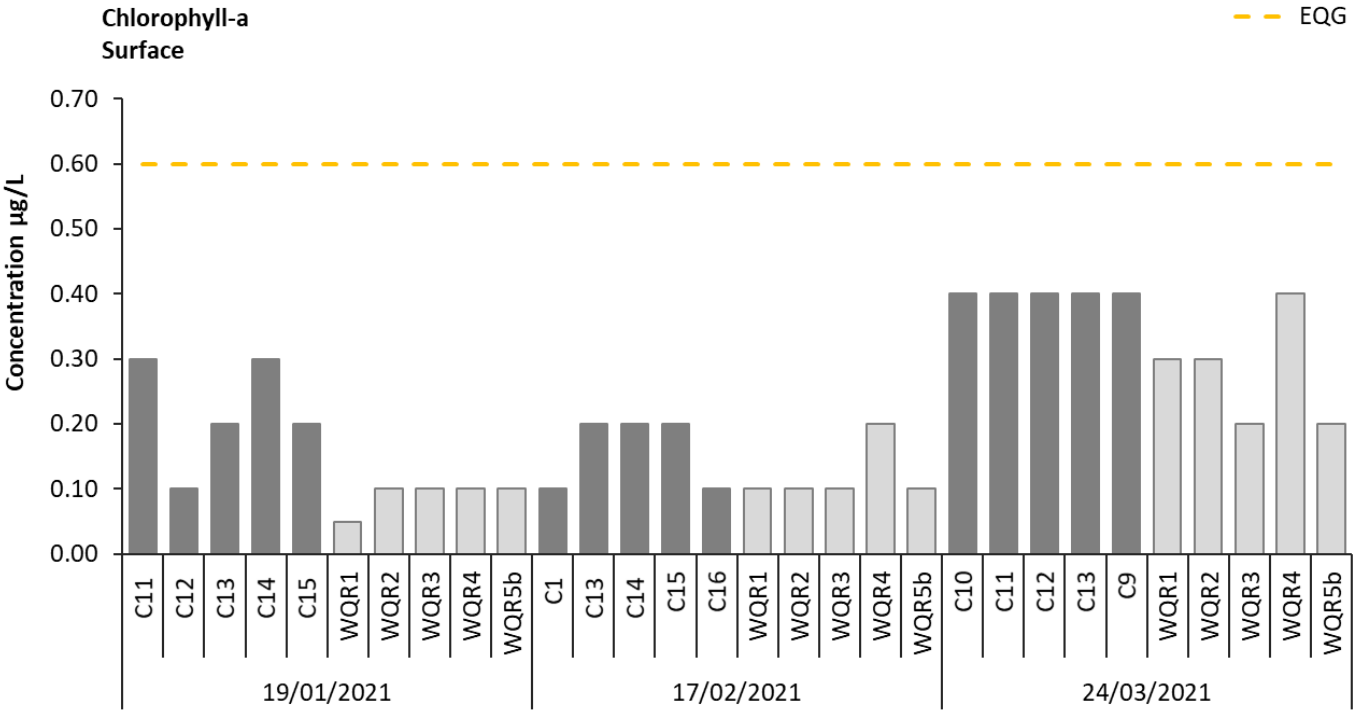


Figure 8 Phytoplankton biomass at compliance and reference sites in 2021 around Bunbury ocean outlet

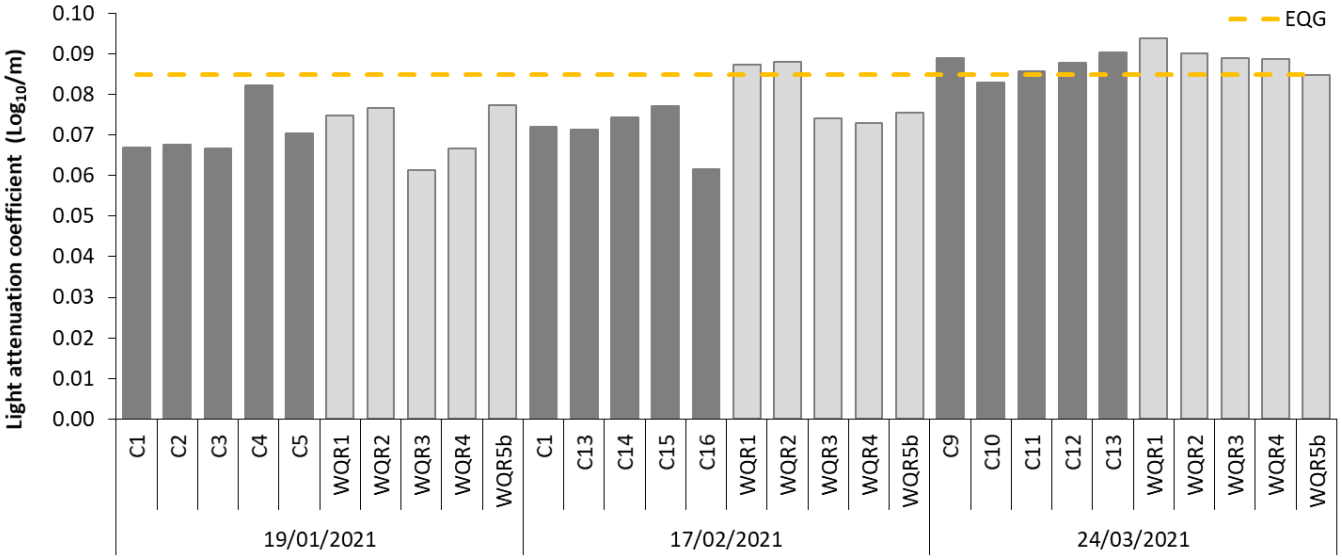
3.1.3 Light attenuation coefficient

The EQG relevant to the LAC is outlined in Table 7.

Table 7 Environmental Quality Guideline for light attenuation

EQG	The median LAC, during the summer period, is not to exceed 80th percentile of historical reference site data.

Median LAC measured over summer at compliance sites (0.0780 Log_{10}m) did not exceed the 80th percentile of historical reference site data (0.0850 Log_{10}/m), meeting the EQG for this indicator (Figure 9).



Notes:

1. Water quality monitoring occurred at compliance sites C1–C5 on 19 January, C1, C13–C16 on 17 February and C9–C13 on 24 March 2021, as a result of prevailing currents at the time of sampling.
2. Dark grey bars indicate sites relevant to the Environmental Quality Guideline (EQG) for light attenuation, median of which is 0.0780 Log_{10}m.
3. Yellow dashed line is 80th percentile of historical reference site data which is the Environmental Quality Guideline (0.0850 Log_{10}m).

Figure 9 Light attenuation coefficient measured at compliance and reference sites in 2021

3.1.4 Periphyton biomass

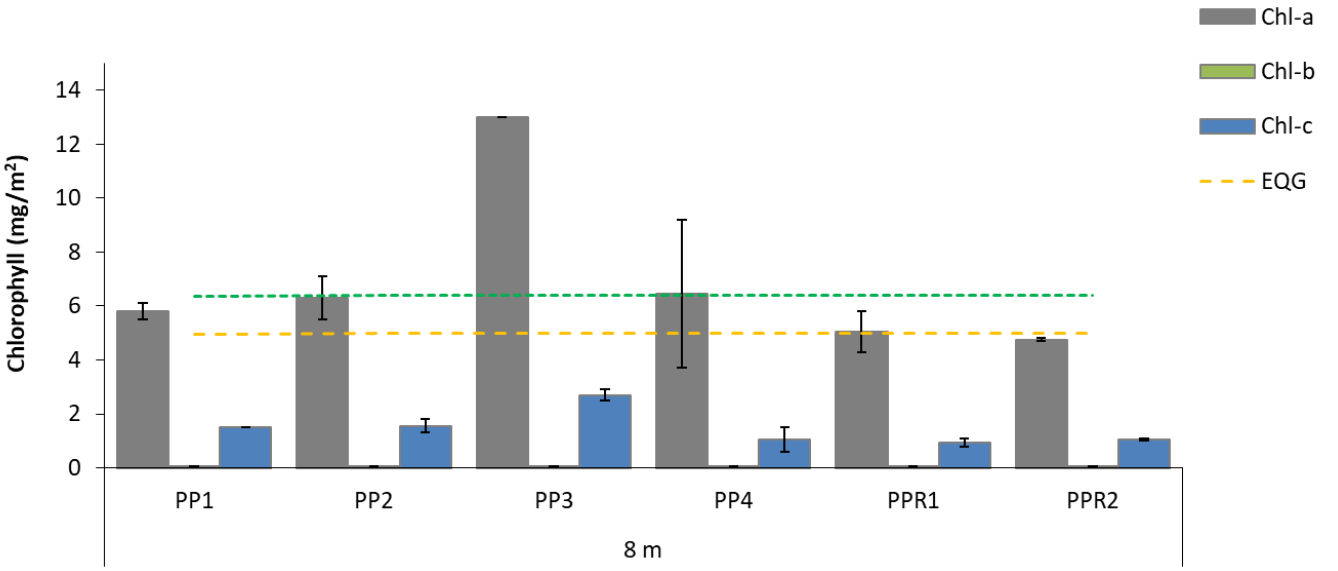
Periphyton collectors provide a time-integrated measure of attached algal growth (epiphytes). Increased periphyton biomass on artificial substrata (measured as chlorophyll-a, -b and -c) in response to nutrient enrichment has been confirmed as an indicator of enhanced productivity resulting from wastewater discharge in Perth's coastal waters (Cosgrove et al. 2004). The EQG for periphyton biomass is in Table 8.

Table 8 Environmental Quality Guideline for periphyton biomass

EQG	Median periphyton biomass (measured as chlorophyll a) from compliance sites is not to exceed the 80th percentile of reference site data from the same sampling period at 8 m depth.

The median chlorophyll-a concentration for the 8 m depth was 6.4 mg/m^2 and exceeded the 80th percentile of reference site data at the 8 m depth (5.0 mg/m^2) (Figure 10). Therefore, the EQG was not met and further assessment against the EQS (seagrass health) was triggered.

Of the three chlorophyll types (chlorophyll-a, -b and -c) measured on periphyton collector plates, chlorophyll-a was present in the highest biomass, followed by chlorophyll-c and then chlorophyll-b (Figure 10). The more dominant chlorophyll-a content is indictive of a periphyton assemblage dominated by diatoms and/or brown algae (SKM 1999).



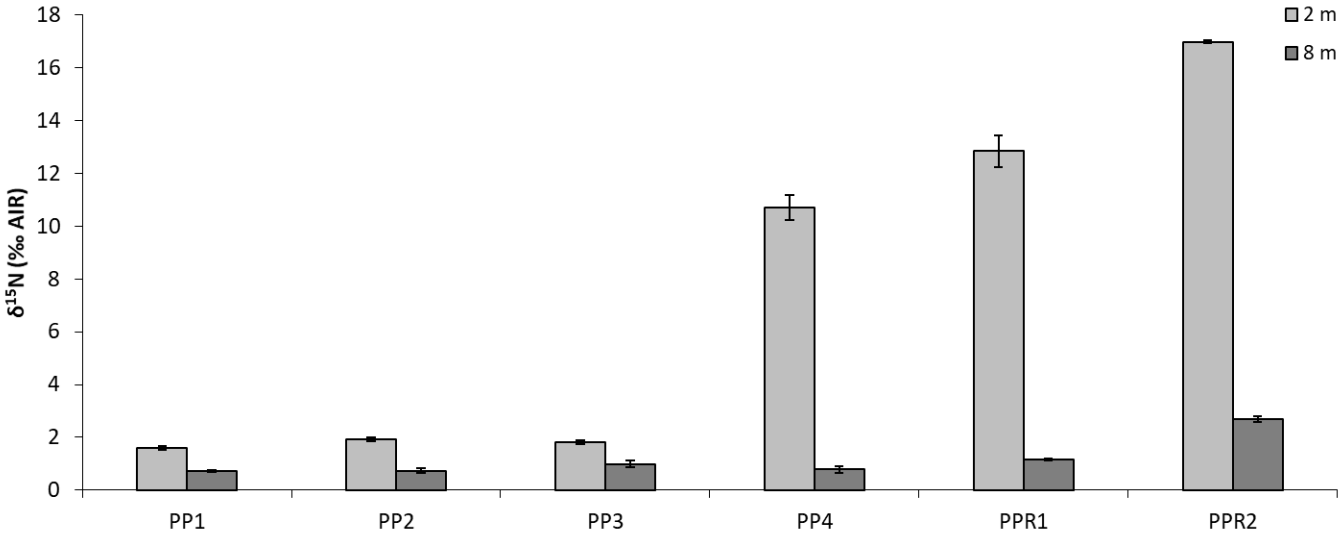
Notes:

1. Bars=mean (± standard error) chlorophyll-a, -b and -c concentration at compliance sites (PP1-PP4) and reference sites (PPR1 and PPR2).
2. Green dashed line = median of chlorophyll-a concentration across compliance sites (6.4 mg/m^2 pooled across n=8).
3. Yellow dashed line = 80th percentile of chlorophyll-a concentration at reference sites (5.0 mg/m^2 where n=4).

Figure 10 Periphyton chlorophyll-a,-b and-c content at compliance and reference sites at 8 m depth

Assimilation of dissolved nitrogen from wastewater by periphyton generally leads to a higher tissue nitrogen stable isotope composition ($\delta^{15}N$) in microalgae than that associated with the assimilation of naturally occurring nitrogen from seawater (Costanzo et al. 2001). Therefore, the nitrogen isotopic signature of periphyton can be used as an indicator that periphyton growth may have been stimulated from nutrients in wastewater (Costanzo et al. 2001, DALSE 2003). Accordingly, the periphyton samples were analysed for nitrogen isotopic composition, to determine if the periphyton growth patterns can be attributed to nutrient-rich wastewater around the Bunbury TWW ocean outlet.

Mean $\delta^{15}N$ was lower in surface samples at all compliance sites (PP1–PP4), compared to surface samples from the two reference sites (PPR1 and PPR2) (Figure 11). At each site, mean $\delta^{15}N$ of periphyton was higher in the surface samples than for the bottom samples (Figure 11). In bottom samples, mean $\delta^{15}N$ was very low compared to surface samples and similar between the compliance sites and reference sites (Figure 11). The high mean periphyton $\delta^{15}N$ at the surface but not in bottom samples (Figure 11) suggests that the influence of the buoyant TWW plume is restricted to the surface and evidently not responsible for the elevated bottom water chlorophyll-a concentrations at compliance sites (Figure 10).



Notes:

1. PP1-PP4 = periphyton compliance sites; PPR1 and PPR2 = periphyton reference sites
2. At each site and each depth there was sufficient epiphyte growth on the collector plates for 2 replicates.
3. Error bars represent ± standard error.

Figure 11 Mean $\delta^{15}N$ content in periphyton collected at compliance and reference sites

3.1.5 Seagrass health

The EQG for periphyton biomass was exceeded during the 2021 monitoring and assessment against the EQS (seagrass health) was required. The EQS for seagrass health are outlined in Table 9.

Table 9 Environmental Quality Standards for seagrass health

EQS1	Median seagrass meadow shoot density measured during January and in two consecutive years is greater than the 20th percentile of shoot density measured at an appropriate reference site.
EQS2	Median seagrass meadow shoot density in any one year is greater than the 5th percentile of meadow shoot density measured at an appropriate reference site.

Note:

1. The EPA derived these EQS for seagrass shoot density specifically relevant for assessing the health of species of *Posidonia* (EPA 2005).

EQS1 is exceeded if median shoot density at the same site over two consecutive years falls below the 20th percentile of reference sites (red dashed line; Figure 12). Median shoot density, at site SG2 and SG4, were below the 20th percentile of reference sites (red dashed line; Figure 12) in 2020 and in 2021, leading to an exceedance of EQS1. At no other site was median shoot density below the 20th percentile of reference sites in two consecutive years. In 2021 median shoot density at site SG2 (272 shoots/m^2) was only below the EQS1 (320 shoots/m^2) by 48 shoots/m^2, while the standard error was 129 shoots/m^2. This suggests that that high variability and small sample size could be contributing the exceedance of the EQS.

In 2021, the median shoot density at each individual site was greater than the 5th percentile of the reference site data (ref solid line; Figure 12; Appendix F), meeting EQS2. Because the criteria for EQS2 was met, the EQS was met overall.

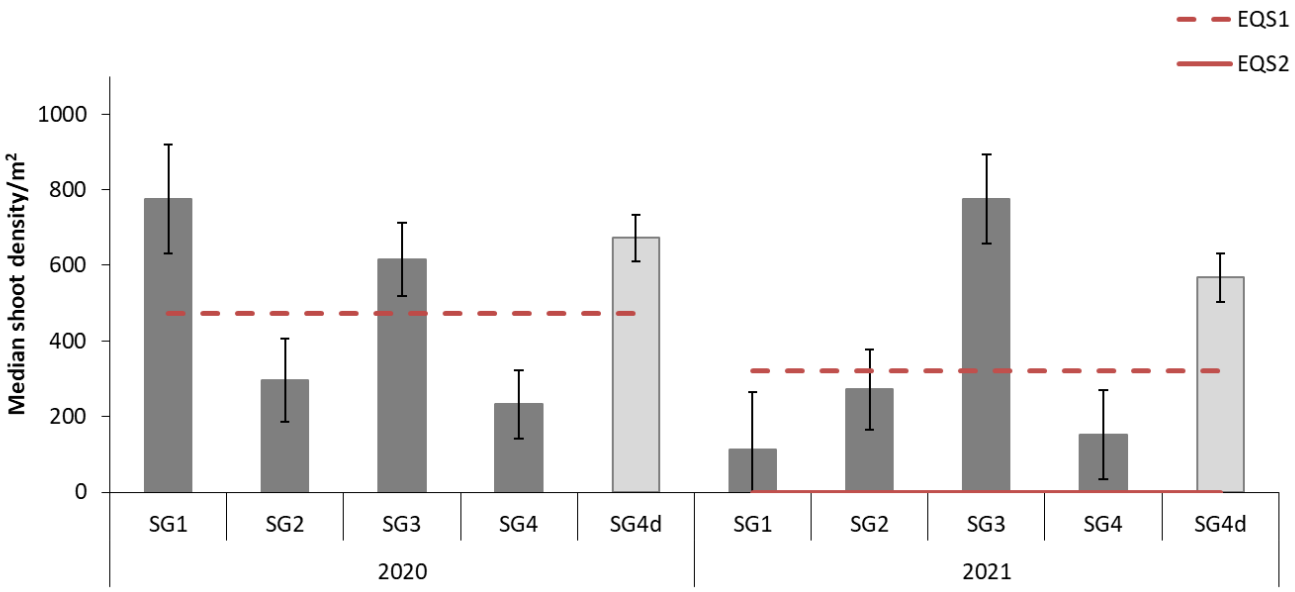


Figure 12 Median seagrass shoot density at seagrass health monitoring sites (n=10)

3.2 Physico-chemical stressor

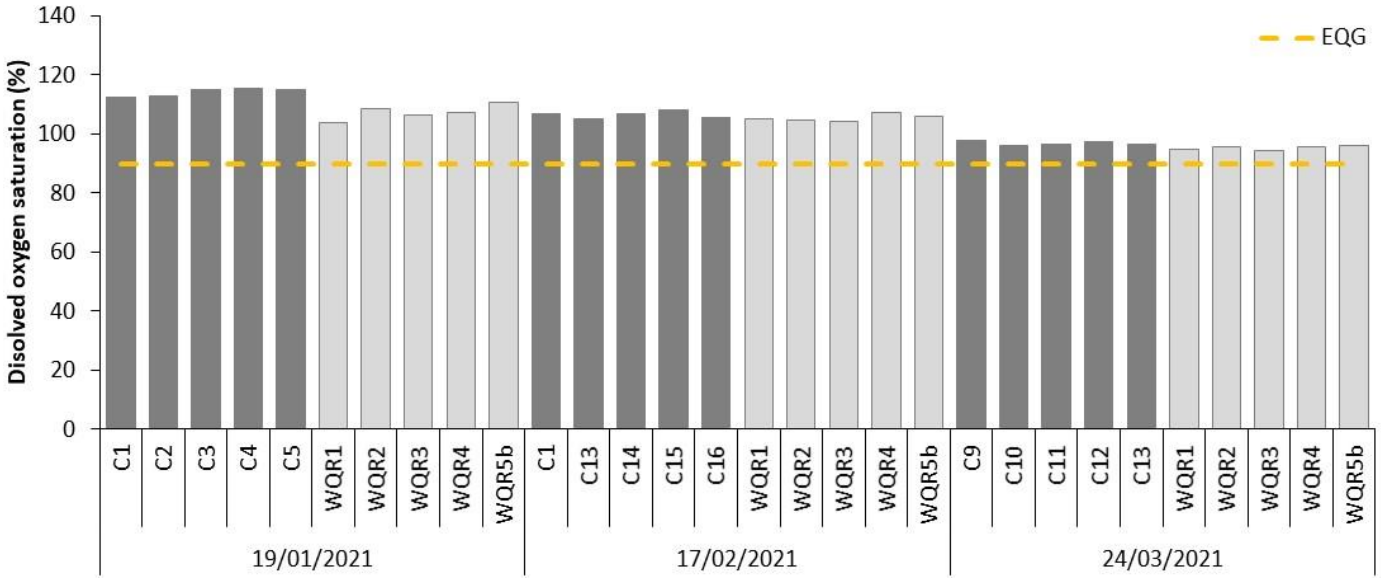
3.2.1 Dissolved oxygen

The EQG for DO is outlined in Table 10.

Table 10 Environmental Quality Guideline for dissolved oxygen

EQG	Ambient dissolved oxygen in bottom waters (0-0.5 m above the sediment surface) is greater than 90% saturation at any site for a defined period of not more than six weeks.

Percent saturation of dissolved oxygen in the bottom remained above the 90% saturation limit at compliance monitoring sites at all times, meeting the EQG (Figure 13).



Notes:

1. Water quality monitoring occurred at compliance sites C1–C5 on 19 January, C1, C13–C16 on 17 February and at C9–C13 on 24 March 2021, as a result of prevailing currents at the time of sampling.
2. Dark grey bars indicate sites relevant to the Environmental Quality Guideline for dissolved oxygen (DO).
3. Yellow dashed lines is the EQG for DO (90% saturation).
4. DO was measured from the seabed to 0.5 m above seabed.

Figure 13 Dissolved oxygen in bottom waters at compliance and reference sites

4 Seafood safe for human consumption

4.1 Sampling approach and site locations

The EQO for the EV 'Fishing and Aquaculture' is aimed at ensuring that seafood is safe for human consumption. To ensure the EQO is met, thermotolerant coliforms (TTC) and algal biotoxins are monitored. The social health EQO of 'Seafood Safe for Human Consumption' must be met at the boundary of the Shellfish Harvesting Exclusion Zone (SHEZ, or S2 area), represented by a concentric ring 500 m from the diffuser (Figure 14). Shellfish compliance monitoring sites (C17–C32) are positioned at the boundary of the SHEZ, but only the five compliance sites directly down-current of the outlet are sampled during each monitoring period.

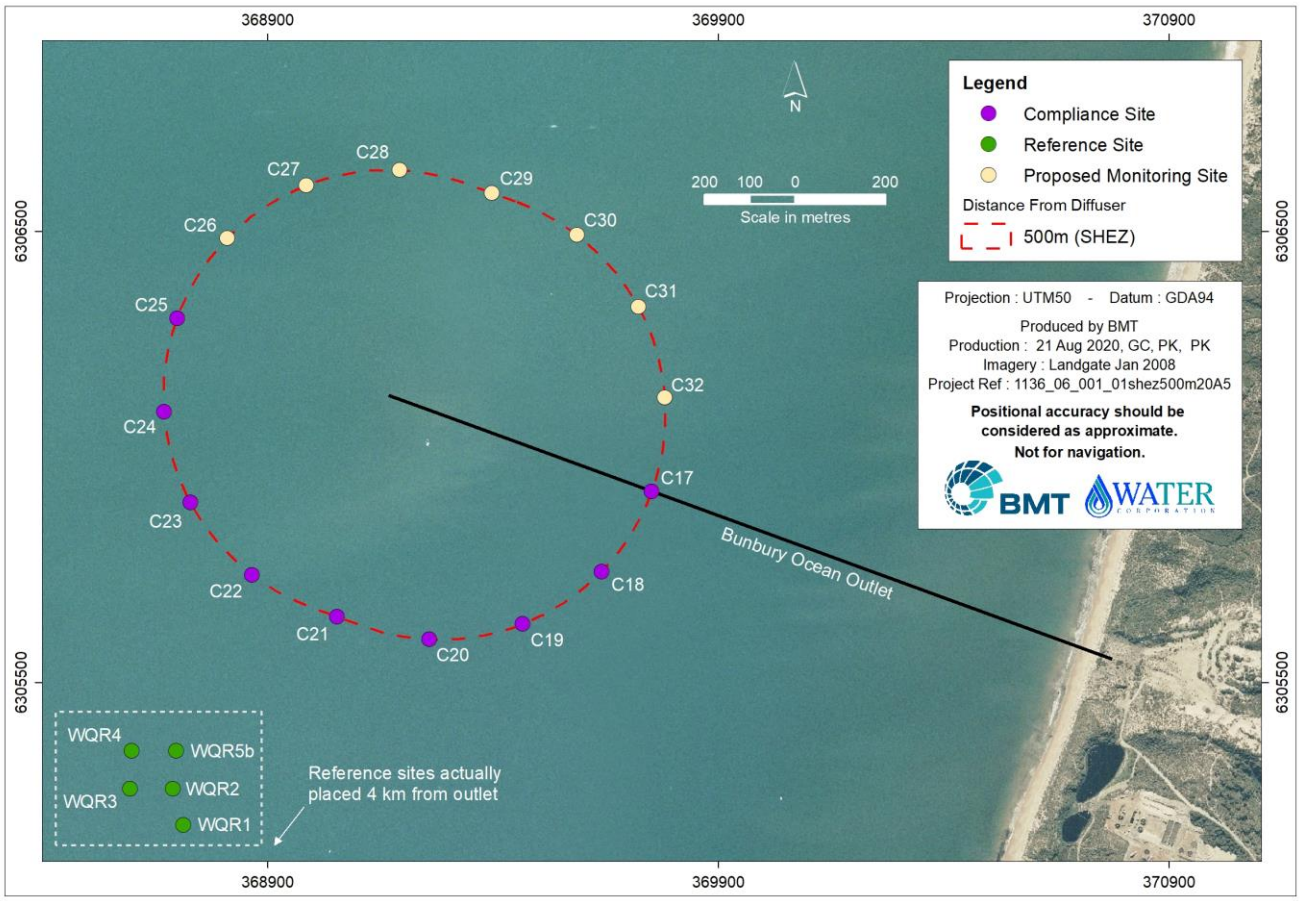


Figure 14 Aquatic life for human consumption compliance (C17–C32) and reference (WQR1-WQR5b) monitoring sites

The EQO, Maintenance of Seafood Safe for Human Consumption, is primarily concerned with the harvesting and consumption of raw shellfish (meaning filter-feeding bivalve molluscs including oysters, mussels, pipis, scallops, cockles and razor clams). The Department of Health (DoH) discourages the public from taking wild shellfish recommending that instead shellfish are only consumed if grown commercially under strict monitoring programs. The DoH has further indicated that "it is impossible to guarantee the safety of eating wild shellfish without having a comprehensive monitoring program that tests the waterway concerned for harmful microorganisms and toxins" (EPA 2005) and has formally advised the Department of Environment Regulation (DER) that, in the absence of a full monitoring program, the application of the TTC criteria (EPA 2005) is insufficient to protect those who wish to collect

and eat wild shellfish. There is no aquaculture within 250 m of the diffuser, and there are no licensed shellfish growing areas located in the Bunbury region (DoH 2015).

4.2 Thermotolerant coliforms sampling

Many disease-causing organisms are transferred from human and animal faeces to water via TWW and can then be ingested by marine fauna, adversely affecting the suitability of such fauna for human consumption. TTCs are bacteria that primarily originate in the intestines of warm-blooded animals. By testing for TTC, it can be determined whether the ocean water around the Bunbury TWW ocean outlet has been exposed to faecal contamination.

Water samples were taken from the surface and bottom of the water column for TTC analyses at compliance monitoring sites, shoreline monitoring sites, plume tracking sites and reference sites over the three sampling dates 19 January, 17 February and 24 March 2021. Samples were collected in pre-sterilised bottles before being chilled to 4 C and placed in the dark. On completion of sampling, the samples were transferred to the PathWest Laboratory and analysed to NATA-accredited methods.

4.3 Thermotolerant coliforms results

The EQG for microbial contaminants for the protection of aquatic life for human consumption is outlined in Table 11.

Table 11 Environmental Quality Guideline for thermotolerant coliforms

EQG	Median TTC concentrations across compliance sites are not to exceed 14 CFU/100 mL and that no more than 10% of samples are to exceed 21 CFU/100 mL

All concentrations of TTC in both surface and bottom waters and at all compliance monitoring sites were below the analytical limit of detection (<10 CFU/mL; Table 12). Median concentrations of TTC were below 14 CFU/mL and less than 10% of samples exceeded 21 CFU/100 mL (Table 12), meeting the EQG (Table 11).

Table 12 Confirmed thermotolerant coliform concentrations downstream of the Bunbury treated wastewater ocean outlet

Date	Compliance Site	TTC is surface waters	TTC in bottom waters
19 January 2021	C17	<10	<10
	C18	<10	<10
	C19	<10	<10
	C20	<10	<10
	C21	<10	<10
17 February 2021	C17	<10	<10
	C29	<10	<10
	C30	<10	<10
	C31	<10	<10
	C32	<10	<10
24 March 2021	C25	<10	<10
	C26	<10	<10
	C27	<10	<10
	C28	<10	<10
	C29	<10	<10

Notes:

1. Water quality samples for microbiological contaminants were sampled ~1 m below the surface of the water and 2 m above the seabed (Water Corporation 2012).
2. TTC = thermotolerant coliforms.

4.4 Algal biotoxins sampling

Nutrient enrichment (as a result of the TWW discharge) can induce shifts in the naturally occurring planktonic algae community to more harmful species. Water Corporation (2012) includes a requirement to monitor for potentially toxic phytoplankton species (as per DoF 2007) in the area surrounding Bunbury TWW ocean outlet. Although most algal blooms are non-toxic, some may contain species that produce toxins and/or have a potentially harmful effect on the surrounding marine environment. For example, algae species *Heterosigma akashiwo and Prymnesium parvum* (*Prymnesiophyta*) cause large and recurrent fish mortalities. In terms of trophic consequences of algal biotoxins (i.e. flow-on effects up the food chain), there are ~2000 species that can induce poisonings in humans (DoF 2013).

Water samples were taken from the surface and bottom of the water column at compliance monitoring sites and reference sites (outlined in Figure 14), at the SHEZ – 500 m, boundary from the diffuser, and analysed for toxic species of phytoplankton (defined by Western Australian Shellfish Quality Assurance Program (WASQAP) guidelines; DoF 2007). Phytoplankton samples were preserved in Lugol's iodine solution and transported to the lowest taxonomic level possible.

4.5 Algal biotoxins results

The EQG for toxic phytoplankton species (Table 13) states that concentrations of potentially toxic algae are not to exceed the WASQAP trigger concentrations in any samples (DoF 2007). Table 15 lists the phytoplankton species known to produce toxins that may be concentrated in shellfish and their WASQAP (DoF 2007) guideline trigger concentrations.

Table 13 Environmental Quality Guideline for toxic phytoplankton species

EQG	Concentrations of potentially toxic algae at the boundary of the SHEZ are not to exceed the WASQAP[1] trigger concentrations in any sample for any of the following: • *Alexandrium* spp. (100 cells/L) • *Gymnodinium catenatum* (1000 cells/L) • *Karenia* spp. (1000 cells/L) • *Dinophysis* spp. (500 cells/L) • *Dinophysis acuminata* (3000 cells/L) • *Prorocentrum lima* (500 cells/L) • *Pseudo-nitzschia* spp. (250 000 cells/L) • *Gonyaulax cf. spinifera* (100 cells/L) • *Protoceratium reticulatum* (50 000 cells/L)

Notes:

1. Western Australian Shellfish Assurance Program (WASQAP; DoF 2007) as stipulated by Water Corporation 2012.

There were no instances where toxic phytoplankton species were present at densities greater than the WASQAP (DoF 2007) guideline values (Table 14).

Table 14 Estimated cell density of phytoplankton species known to produce toxins that may be concentrated in shellfish downstream of the Bunbury treated wastewater ocean outlet

Date	Site	Depth	Species	Estimated cell density	WASQAP[1]	Compliance
19 January 2021	C17	S	*Gymnodinium spp.*	160	1000	■
			Pseudo-nitzschia "delicatissima" group	160	250 000	■
	C17	B	*Gymnodinium spp.*	400	1000	■
	C18	S	*Gymnodinium spp.*	480	1000	■
	C18	B	No toxic species detected	-	-	■
	C19	S	*Gymnodinium spp.*	320	1000	■
	C19	B	No toxic species detected	-	-	■
	C20	S	*Gymnodinium spp.*	400	1000	■
	C20	B	*Gymnodinium spp.*	160	1000	■
	C21	S	*Gymnodinium spp.*	320	1000	■
	C21	B	*Gymnodinium spp.*	240	1000	■
17 February 2021	C17	S	No toxic species detected	-	-	■
	C17	B	*Pseudo-nitzschia "delicatissima" group*	320	250 000	■
	C29	S	*Gymnodinium spp.*	80	1000	■
	C29	B	*Pseudo-nitzschia "delicatissima" group*	240	250 000	■
	C30	S	*Gymnodinium spp.*	80	1000	■
			Pseudo-nitzschia "delicatissima" group	160	250 000	■
	C30	B	*Pseudo-nitzschia "delicatissima" group*	320	250 000	■
	C31	S	No toxic species detected	-	-	■
	C31	B	No toxic species detected	-	-	■
	C32	S	No toxic species detected	-	-	■
	C32	B	No toxic species detected	-	-	■
24 March 2021	C25	S	No toxic species detected	-	-	■
	C25	B	*Pseudo-nitzschia "delicatissima" group*	320	250 000	■
	C26	S	No toxic species detected	-	-	■
	C26	B	*Pseudo-nitzschia "delicatissima" group*	160	250 000	■
	C27	S	No toxic species detected	-	-	■
	C27	B	No toxic species detected	-	-	■
	C28	S	No toxic species detected	-	-	■
	C28	B	*Pseudo-nitzschia "delicatissima" group*	160	250 000	■
	C29	S	No toxic species detected	-	-	■
	C29	B	No toxic species detected	-	-	■

Notes:

1. WASQAP = Western Australian Quality Assurance Program (DoF 2007, as per Water Corporation 2012).
2. C = compliance sites, WQR = reference sites.
3. Compliance only assessed against compliance monitoring sites (not reference sites).
4. NA = not applicable.
5. Green symbols indicate the estimated cell density was below the WASQAP toxic algae trigger concentration.

5 Primary and secondary contact recreation

5.1 Sampling approach and site locations

The EQO for the EV 'Recreation' [and Aesthetics] is aimed at ensuring coastal waters are safe for primary and secondary contact recreation activities such as swimming and boating, respectively. To meet the EQO, water quality around the Bunbury TWW ocean outlet is to be maintained so that primary and secondary contact recreation is safe in all waters except those areas designated otherwise. Water quality monitoring sites (C1–C16) are positioned along the boundary of the LEPA, but on any sampling occasion, only the five directly down current of the diffuser are sampled (Figure 15).

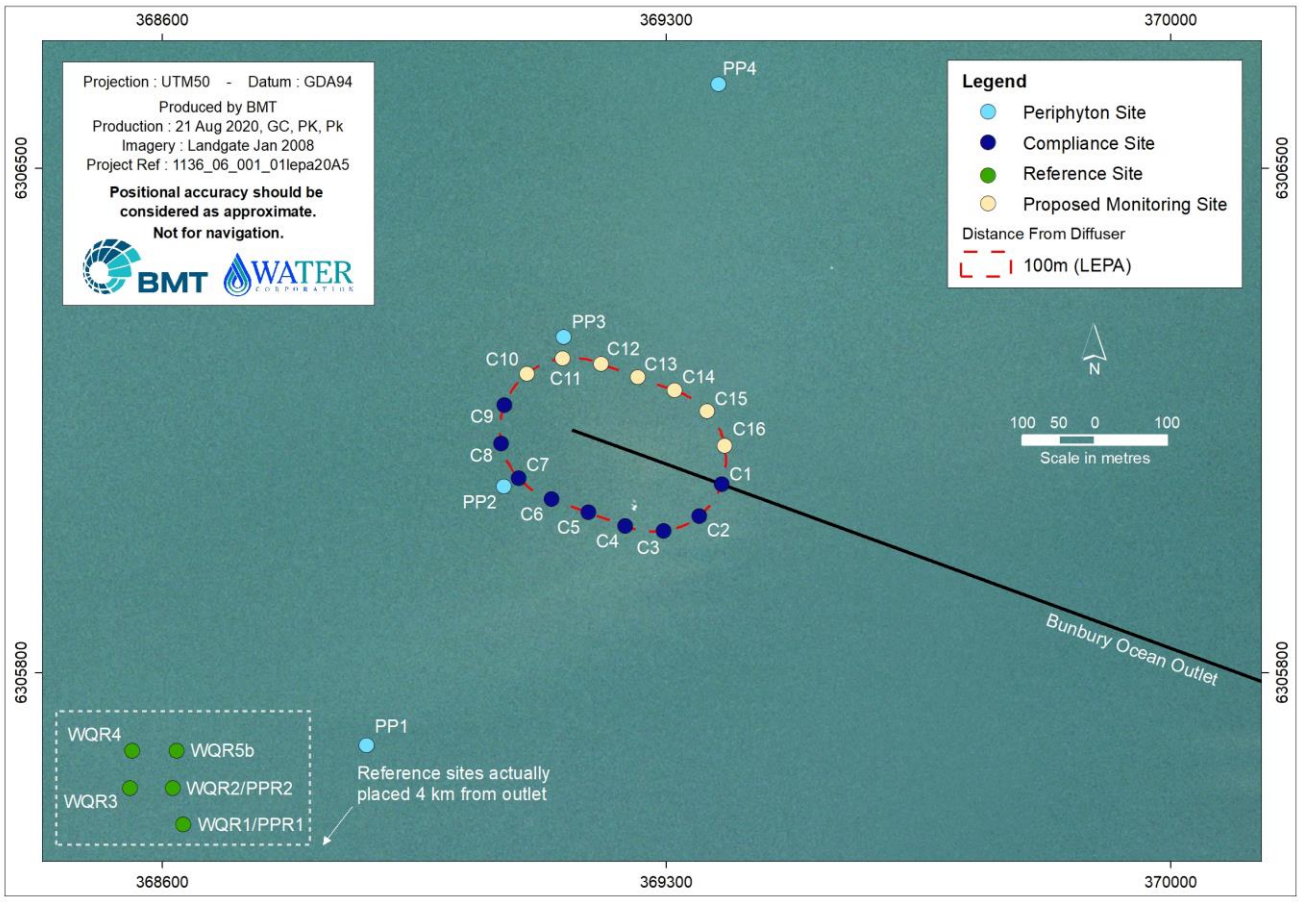


Figure 15 Primary and secondary recreational contact compliance (C1-C16) sites and reference monitoring sites (WQR1–WQR5b)

5.2 Faecal pathogens sampling

Disease-causing microorganisms (pathogens) associated with bathing areas include salmonellae, shigellae, enteropathogenic *Escheria coli*, cysts of *Entamoeba histolytica*, parasite ova and infectious hepatitis (Hart 1974, McNeil 1985; cited in ANZECC/ARMCANZ 2000). The most common types of diseases associated with water borne pathogens are eye, ear, nose and throat infections, skin diseases and gastrointestinal disorders (ANZECC/ARMCANZ 2000). Detecting faecal pathogens within water samples is difficult, therefore 'indicator' micro-organisms are used to assess the health risks associated with pathogens in recreational waters (Elliot & Colwell 1985; cited in ANZECC/ARMCANZ 2000).

To test for presence of pathogens, water samples were taken from the surface and bottom of the water column at compliance monitoring sites, shoreline monitoring sites, plume tracking sites and reference sites on 19 January, 17 February and 27 March 2021 and analysed for *Enterococci* spp. Samples were collected in pre-sterilised bottles before being chilled and placed in the dark. On completion of sampling, the samples were transferred to the PathWest Laboratory and analysed according to NATA-accredited methods.

5.3 Faecal pathogen results

The EQG for faecal pathogens is outlined in Table 15.

Table 15 Environmental Quality Guideline for faecal pathogens

EQG	The 95th percentile of pooled Enterococci spp. concentrations in surface waters is not to exceed 40 MPN/100 mL outside the LEPA boundary

Source: Water Corporation (2012)

Notes:

1. MPN = most probable number; LEPA = low ecological protection area.

The 95th percentile of pooled *Enterococci spp.* concentrations in surface waters was 10 MPN/100 mL (Table 16) and the EQG was met.

Table 16 *Enterococci* spp. concentrations downstream of the Bunbury ocean outlet

Date	Compliance Site	*Enterococci* spp. in surface waters MPN/100 mL	*Enterococci* spp. in bottom waters MPN/100 mL
19 January 2021	C1	<10	<10
	C2	10	<10
	C3	10	<10
	C4	<10	<10
	C5	<10	<10
17 February 2021	C1	<10	<10
	C13	<10	<10
	C14	<10	<10
	C15	<10	<10
	C16	<10	<10
24 March 2021	C9	<10	<10
	C10	<10	<10
	C11	<10	<10
	C12	<10	<10
	C13	10	<10
95th percentile of compliance sites		**10**	

5.4 Algal biotoxins sampling

Algal biotoxins resulting from increased nutrient loads can be harmful to human/animal health if encountered via ingestion or skin contact. Although most algal blooms are considered harmless, some may contain species that produce toxins that are harmful to humans. For this reason, phytoplankton cell counts were monitored on three sampling occasions during summer (19 January, 17 February, and

24 March 2021) to ensure concentrations are occurring within acceptable guideline limits (NHMRC 2008).

5.5 Algal biotoxin results

The EQG for algal biotoxins is outlined in Table 17.

Table 17 Environmental Quality Guideline for algal biotoxins

EQG	Median total phytoplankton cell count (either from one sampling occasion or from a single site over an agreed period of time) should not exceed 10 cells/mL *Karenia brevis* and/or have *Lyngbya majuscula* and/or *Pfiesteria* present in high numbers outside the LEPA

Source: Water Corporation (2012)

Note:

1. LEPA = low ecological protection area

Toxic algae species *Karenia brevis, Lyngbya majuscula* and *Pfiesteria* spp. were not recorded at compliance monitoring sites at the boundary of the LEPA during the 2021 summer monitoring and the EQG relevant to algal biotoxins (for the EQO, Maintenance of Primary and Secondary Contact Recreation) was met.

6 References

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The following Appendices are available from Water Corporation on request:

Appendix A Initial dilution modelling

Appendix B Detailed methods for water quality in the receiving environment

Appendix C Nutrient results

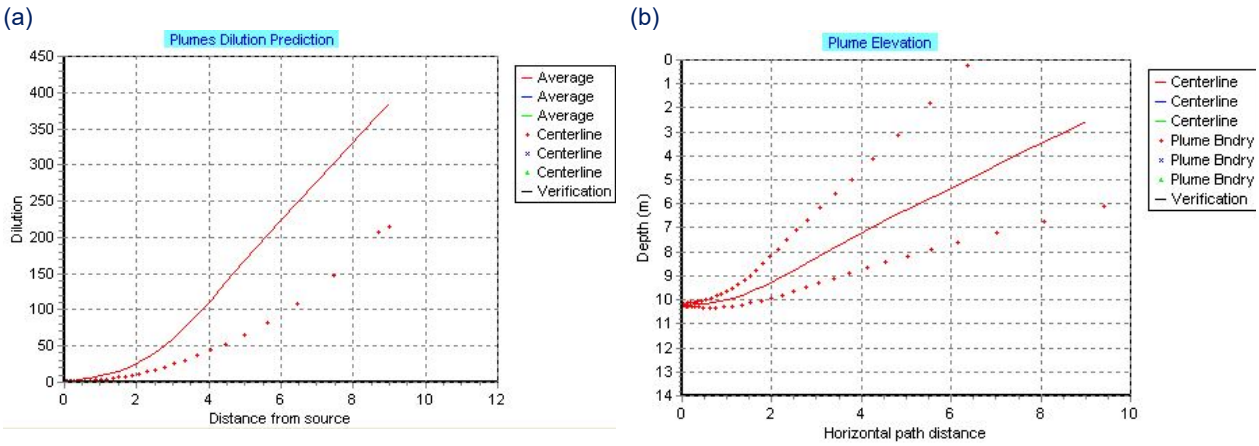
Appendix D Microbiological results

Appendix E Phytoplankton results

Appendix F Seagrass results

Initial dilution modelling for the ambient conditions and treated wastewater flows for the 1 January 2021 was completed using the VPLUMES initial dilution model. The VPLUMES model is accepted for use by the United States Environmental Protection Agency (http://www.epa.gov) and captures simple features concerning the surrounding environment such as depth at point of discharge, net current and wind speed. VPLUMES is designed to predict the near-field behaviour of wastewater effluent plumes in the region where the plume first jets into the surrounding waters and then, in the case of positively buoyant plumes, rises and mixes with the surrounding waters (generally <10 m from the diffuser). Additional dilution is expected between the point that the plume reaches the surface and the notional low ecological protection area (LEPA) boundary. Although initial dilution therefore underestimates the dilution at the notional LEPA boundary, it is favoured as it represents a highly conservative approach.

For the ambient conditions at the time of the survey, the modelling predicted an average initial dilution of 1:384 and a centreline dilution of 1:219 (Figure 1 and Figure 2).



Notes:
1. a = predicted average and centreline dilution
2. b = predicted plume elevation

Figure 1 Initial dilution modelling plume elevation (right) and predicted average and centreline dilutions (left) from Bunbury ocean outlet on 19 January 2021

```
/ Windows UM3. 8/12/2021 3:17:22 PM
Case 1; ambient file c:\plumes\VP plume 18.001.db; Diffuser table record 1: ---------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C       kg/kg        s-1        m/s        deg   m0.67/s2
        0.0     0.0722     -152.0      36.25       22.3         0.0     0.0001  2.1416E+8  2.1416E+8        0.0
       11.0     0.0722     -152.0      36.25      22.31         0.0     0.0001  2.1416E+8  2.1416E+8        0.0
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
     (m)      (m)   (deg)   (deg)       ()      (m)      (m)      (m)   (m3/s)   (psu)     (C) (kg/kg)
    0.08      0.8     0.0  242.01     21.0      4.0    100.0    150.0    10.2   0.133    0.51    27.5      0.1
Froude number:      8.445
      Depth  Amb-cur    P-dia  Polutnt   Dilutn   x-posn   y-posn
Step     (m)   (cm/s)      (m)  (kg/kg)       ()      (m)      (m)
   0    10.2     7.22     0.08      0.1      1.0      0.0      0.0;
 100   10.07     7.22    0.481   0.0138    7.072   -0.453   -0.712;
 200     8.5     7.22    1.769   0.0019    51.06    -1.85    -2.05;
 257    6.44     7.22    3.445 0.000614    157.8   -3.595   -3.189; axial vel  0.0143 merging,
 300   2.818     7.22    7.002 0.000261    369.8   -7.018   -5.167;
 302   2.557     7.22    7.271  0.00025    384.7   -7.265   -5.307; axial vel  0.0722 surface,
 ;
3:17:22 PM. amb fills: 2
/ Windows UM3. 8/12/2021 3:17:52 PM
Case 1; ambient file c:\plumes\VP plume 18.001.db; Diffuser table record 1: ---------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C       kg/kg        s-1        m/s        deg   m0.67/s2
        0.0     0.0722     -152.0      36.25       22.3         0.0     0.0001  2.1416E+8  2.1416E+8        0.0
       11.0     0.0722     -152.0      36.25      22.31         0.0     0.0001  2.1416E+8  2.1416E+8        0.0
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
     (m)      (m)   (deg)   (deg)       ()      (m)      (m)      (m)   (m3/s)   (psu)     (C) (kg/kg)
    0.08      0.8     0.0  242.01     21.0      4.0    100.0    150.0    10.2   0.133    0.51    27.5      0.1
Froude number:      8.445
      Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (m)   (cm/s)      (m)  (kg/kg)       ()       ()      (m)      (m)
   0    10.2     7.22     0.08      0.1      1.0      1.0      0.0      0.0;
 100   10.07     7.22    0.481   0.0138    7.072    3.205   -0.453   -0.712;
 200     8.5     7.22    1.769   0.0019    51.06    21.41    -1.85    -2.05;
 257    6.44     7.22    3.445 0.000614    157.8    61.57   -3.595   -3.189; axial vel  0.0143 merging,
 300   2.818     7.22    7.002 0.000261    369.8    210.7   -7.018   -5.167;
 302   2.557     7.22    7.271  0.00025    384.7    219.2   -7.265   -5.307; axial vel  0.0722 surface,
 ;
3:17:52 PM. amb fills: 2
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Figure 2 Initial dilution modelling tabulated output from Bunbury ocean outlet on 19 January 2021

Detailed methods for water quality in the receiving environment

A.1.1 Water quality sampling approach and site locations

A.1.1.1 Compliance monitoring

Water samples were collected during three separate surveys on 19 January, 17 February and 24 March 2021. During each survey, sampling was undertaken at compliance monitoring sites ~100 m from the TWW outlet diffuser (Figure 1). At each compliance monitoring site, water samples were collected from one of eight sampling grids – aligned either north, south, east, west, northeast, southeast or southwest of the diffuser. – depending on the direction of the prevailing surface currents at the time of sampling (Figure 2 and Figure 3). To determine the flow direction of surface currents, a drogue was released prior to each sampling survey. The bearing of the drogue drift was then used to select the sampling grid, according to the eight grid scenario bearings in Table 1, Figure 2 and Figure 3.

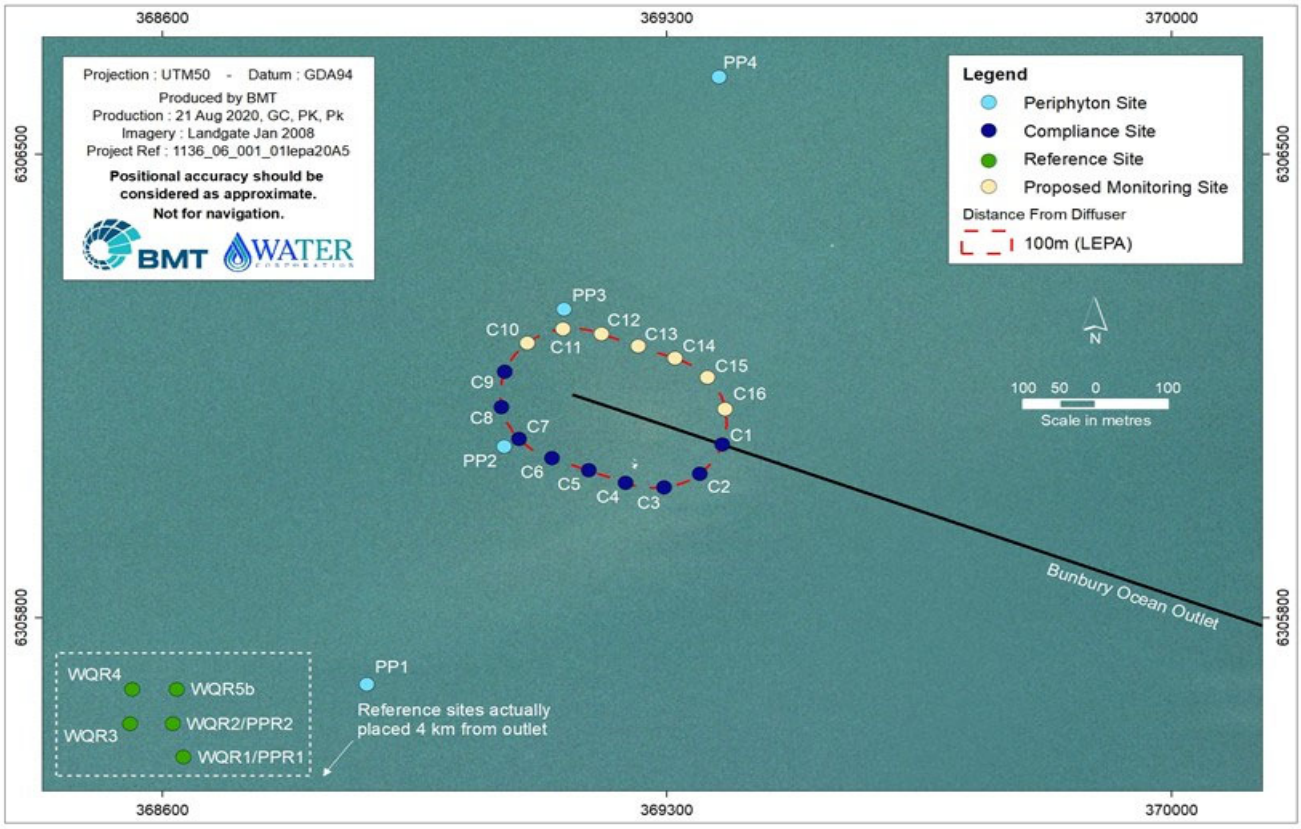

Figure 1 Compliance monitoring and reference sites around the Bunbury treated wastewater ocean outlet

Table 1 Grid scenarios based on drogue displacement bearings

Grid scenario	Bearing 1	Bearing 2
Northerly	357.5	42.5
North-easterly	42.5	87.5
Easterly	87.5	132.5
South-easterly	132.5	177.5
Southerly	177.5	222.5
South-westerly	222.5	267.5
Westerly	267.5	312.5
North-westerly	312.5	357.5

Source: Water Corporation (2012)

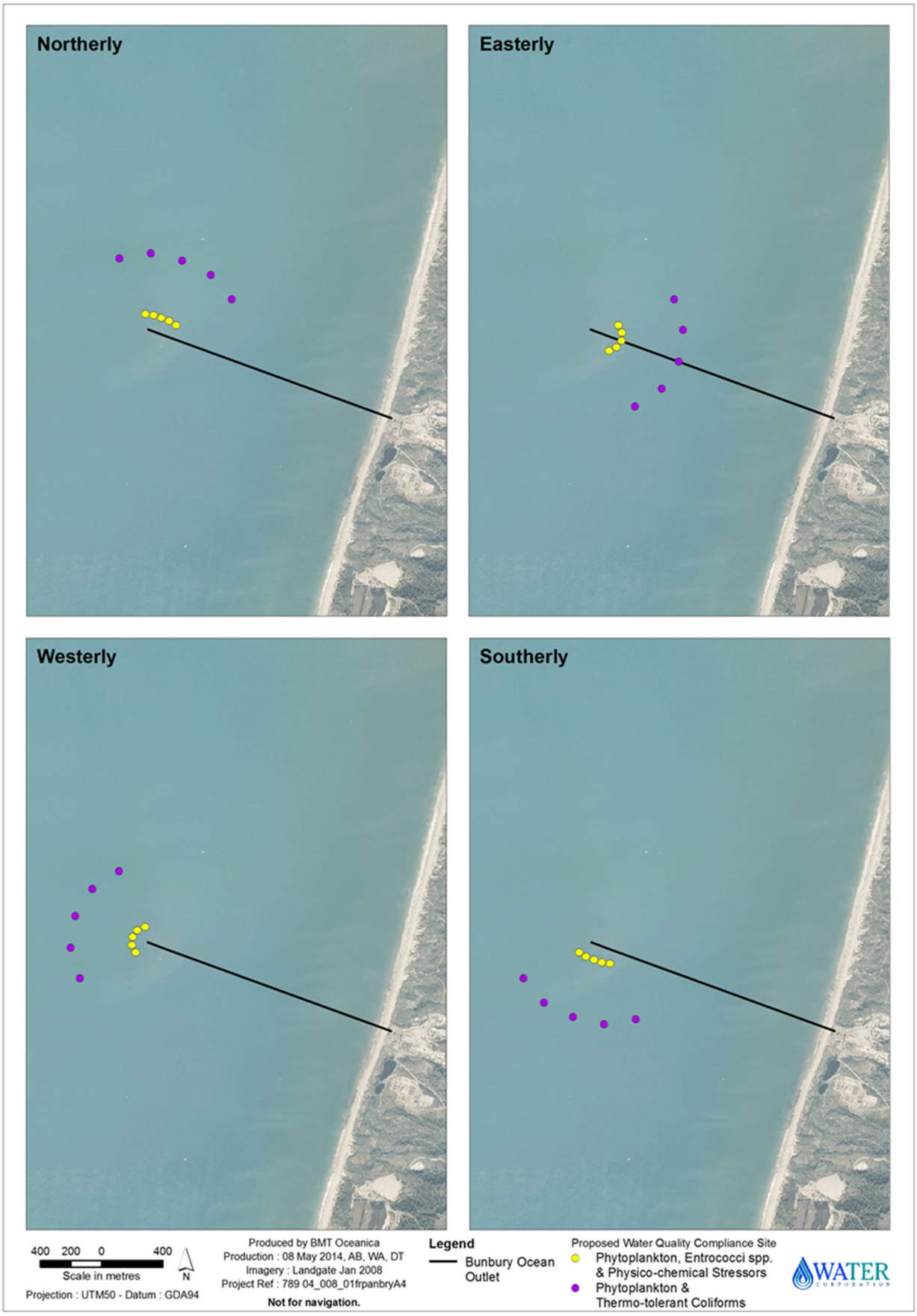

Figure 2 Compliance monitoring sites samples for the northerly, easterly, westerly and southerly sampling grid

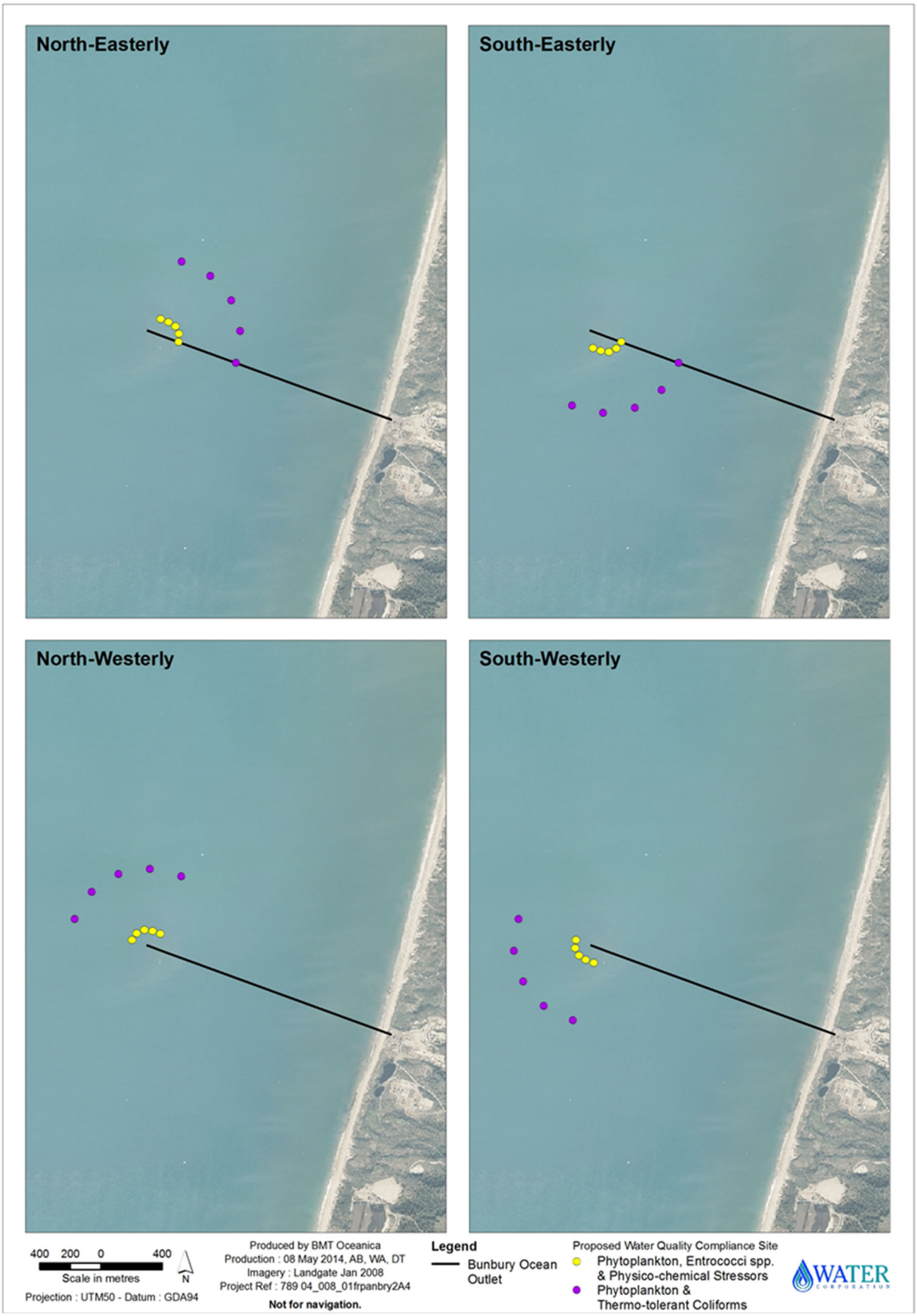

Figure 3 Compliance monitoring sites sampled for the north-easterly, south-easterly, north-westerly and south-westerly grid scenarios

The field design incorporates 16 possible fixed compliance monitoring sites (C1–C16) distributed along a 100 m radius from the diffuser, from which five are selected (using the drifter technique described above) that lie directly down-current of the outlet on each sampling occasion. Compliance sites sampled in 2021 are listed in Table 2. Five reference sites, located ~4km from the TWW outlet, were also sampled on each sampling occasion in 2021 (Figure 1, Table 2). The location of these sites is permanently fixed, they do not alter between sampling occasion.

Table 2 Compliance monitoring and reference sites for Bunbury treated wastewater ocean outlet sampling during 2021

Date	Compliance sites	Reference sites	Parameters
19 January	C11	WQR1	• Chlorophyll-a • Light attenuation • Dissolved oxygen
	C12	WQR2	
	C13	WQR3	
	C14	WQR4	
	C15	WQR5b	
17 February	C1	WQR1	
	C13	WQR2	
	C14	WQR3	
	C15	WQR4	
	C16	WQR5b	
24 March	C10	WQR1	
	C11	WQR2	
	C12	WQR3	
	C13	WQR4	
	C9	WQR5b	

Chlorophyll-a was measured 1 m below the surface and 2 m above the seabed at each compliance site. Chlorophyll-a was collected using the organic material retained on GF/C filters, chlorophyll-a samples were immediately placed on ice out of direct sunlight, before being transported to the laboratory for analysis.

Dissolved oxygen was measured at 1 m intervals from the surface down to the seabed using a Sea-Bird Electronics SBE19plusV2 vertical profiling sensor. At each site, light measurements were collected simultaneously at two locations within the water column (using a LI-COR Model LI-400 probe), with one sensor positioned 1 m below the surface and the second sensor 7 m below the surface (6 m apart) to assess change (attenuation) in light with depth. LAC was calculated using the formula:

LAC= [log10(irradiance at depth)–log10(irradiance at surface)/depth interval]

Plume tracking

On each sampling occasion (January, February and March), seven plume tracking sites were samples using a gradient approach with distance from the outlet (Table 3). Site locations were determined by following the direction of the water movement from the diffuser (established by releasing a drogue; Table 3).

Water samples from each site were analysed for chlorophyll-a ammonia, nitrate+nitrite and ortho-phosphate (Table 3). Immediately following collection, water samples were passed through a 0.45 µm GF/C filter and then placed on ice out of direct sunlight, before being transported to the laboratory for analysis.

Table 3 Plume tracking sites for Bunbury treated wastewater ocean outlet sampling during 2021

Plume tracking site	Distance	Parameters
T0	0	• Chlorophyll-a • Ammonia • Nitrate+nitrite • Ortho-phosphate
T1	50	
T2	100	
T3	300	
T4	500	
T5	750	
T6	1000	

Periphyton monitoring

Periphyton collectors provide a time-integrated measure of attached algal growth (epiphytes). Increased periphyton biomass on artificial substrata (measured as chlorophyll-a,-b and -c) in response to nutrient enrichment has been confirmed as an indicator of productivity resulting from wastewater discharge in Perth's coastal waters (Cosgrove et al. 2004).

Assimilation of dissolved nitrogen from wastewater by periphyton generally leads to a high tissue nitrogen stable isotope analysis (δ15N) in microalgae that that associated with the assimilation of naturally occurring nitrogen from seawater (Costanzo et al. 2001). Therefore, the nitrogen isotopic signature of periphyton can be used as evidence that elevated periphyton growth may have been stimulated from nutrients in wastewater (Costanzo et al. 2001, DALSE 2003). Accordingly, the periphyton samples were analysed for nitrogen isotopic composition, to determine if the periphyton growth patterns can be attributed to nutrient-rich wastewater around the Bunbury TWW ocean outlet.

Periphyton biomass was measured using periphyton collectors at four monitoring sites (PP1–PP4) around the diffuser (two positioned ~100 m and two positioned ~500 m to the north and south of the diffuser, respectively), and at two reference sites ~4 km to the south of the diffuser (PPR1 and PPR2) (Figure 4). At each site, two collectors were deployed as follows:

- One collector with four settlement plates (150x150 mm) suspended at ~2 m depth (surface)
- One collector with four settlement plates (150x150 mm) suspended at 8 m depth (bottom), noting the water column depth was generally ~10-11 m across the study area.

The stratified sample design (depth and distance from the outlet) gives an indication of the spatial and vertical extent of epiphyte growth, which can be related to plume behaviour and hydrodynamics. Collector plates were deployed on mooring lines on 18 January and retrieved on 17 February 2021. After retrieval, the periphyton collected was split equally for chlorophyll analysis and isotopic nitrogen analysis.

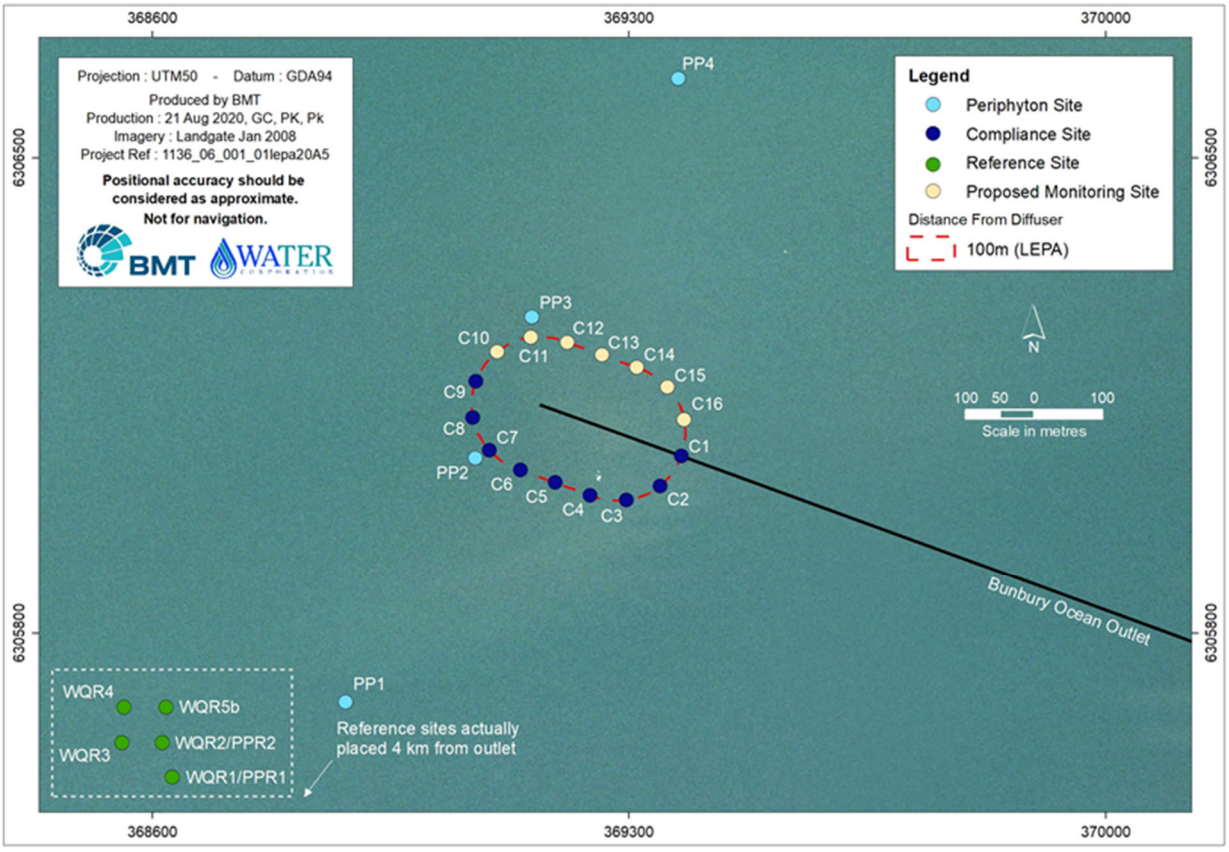

Figure 4 Periphyton compliance (PP1-PP4), ecological compliance (C1-C16) and water quality reference monitoring sites

Seagrass health

Seagrass shoot density is measured as part of the BOOM program to assess for potential sublethal responses by seagrass to elevated nutrients associated with wastewater discharges. The EPA has established two EQC for seagrass shoot density specifically relevant for assessing the health of species of Posidonia (in the Bunbury region, Posidonia angustifolia is the dominant species). The EQC from the BOOM Management Plan (Water Corporation 2012) were applied. These EQC have been set at the EQS level by the EPA and are:

- EQS 1: requires that the ambient [median] values for seagrass meadow shoot density measured in two consecutive years is greater than the 20th percentile of shoot density measured at an appropriate reference site.
- EQS 2: required that the ambient [median] values for seagrass meadow shoot density in any one year is greater than the 5th percentile of meadow shoot density measured at an appropriate reference site.

To ensure compliance with the EQO for ecosystem health, the nutrient enrichment EQG (surface chlorophyll-a, periphyton and light attenuation coefficient) must first be met. If any of the nutrient enrichment EQG are exceeded, assessment against the EQS is triggered and the EQS (seagrass health) must then be met. If no nutrient enrichment EQG are exceeded, then the EQO is met and assessment against the EQS is not triggered, however seagrass health results are still provided for contextual purposes.

A.1.1.2 Monitoring sites and sampling techniques

From 2002 to 2011, shoot density has been measured at five reference sites (SGR1–SGR5) ~4 km south of the outlet, and at four compliance sites in close proximity (≤500 m) to the north and south

of the outlet (SG1–SG4). Seagrass monitoring around the outlet over this time generally revealed high natural spatial and temporal variability in shoot density at sites SG1–SG3, although site SG4 consistently had low seagrass shoot density relative to reference sites. In response to low shoot density at SG4, Water Corporation increased the level of spatial replication of seagrass monitoring around this site during 2011/2012, and site SG4d was added permanently to the seagrass health monitoring program (Figure 5).

On 20 and 21 January 2021, the density of seagrass shoots were measured at four compliance sites (SG1–SG4), five reference sites (SGR1–SGR5b) and at site SG4d. At each site, the number of P.angustifolia shoots in ten fixed, permanently located quadrats (n=10; 0.25 x 0.25 m2), were counted by SCUBA divers. The number of *P.australis* and *Amphibolis antarctica* seagrass stems were also recorded for contextual purposes (i.e. where these were observed in quadrats).

During seagrass monitoring, additional qualitative measures of seagrass health were collected in situ, namely:

- Photograph of all quadrats
- Adjacent bare sand areas examined for remains of seagrass rhizome
- Visual observation index for epiphyte algae loading (rated on a scale of 0–3, where 0 = no algae and 3 = high algae cover)
- Visual assessment of the type of epiphyte algae: filamentous, encrusting and/or corticose (foliose)
- Visual observation of presence or absence of detritus and dead rhizome.

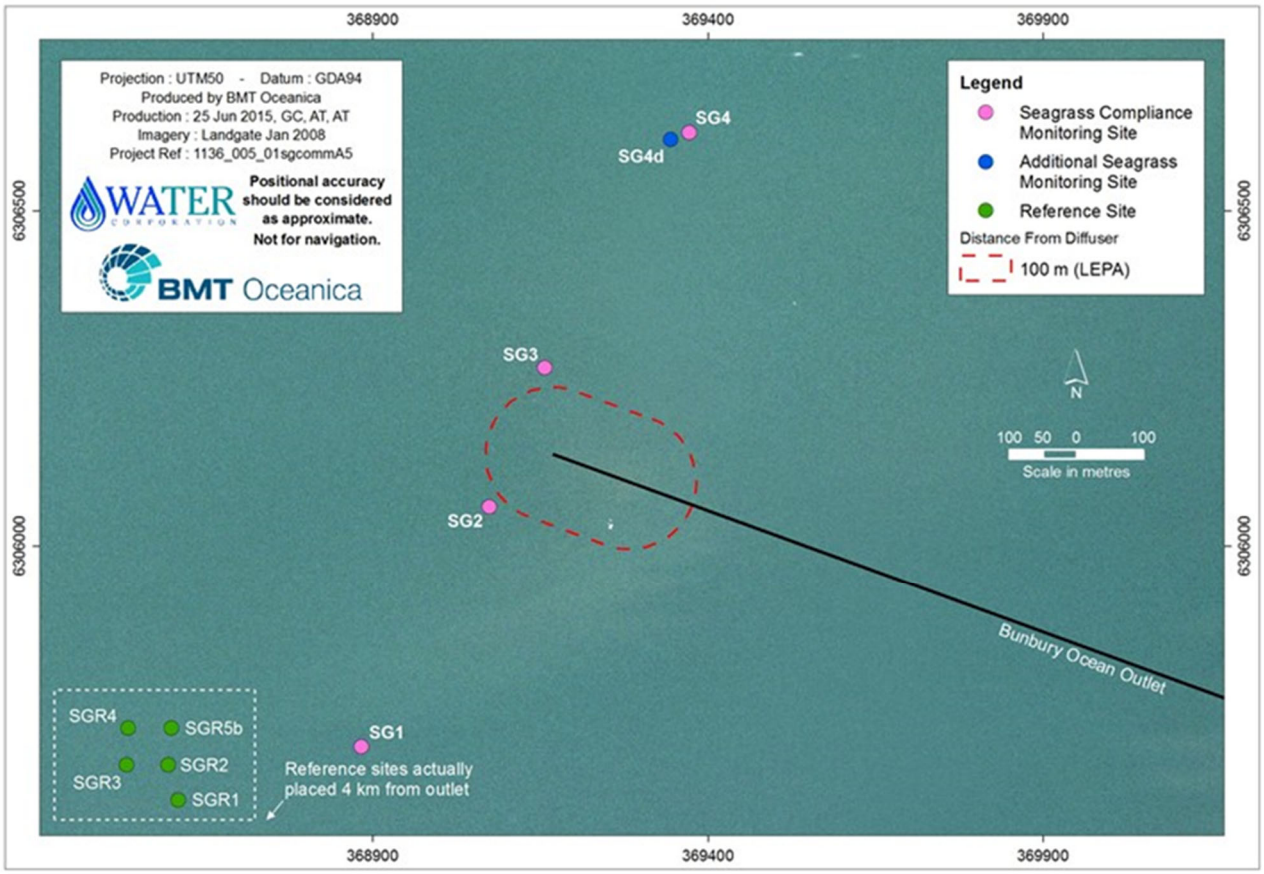

Figure 5 Seagrass health monitoring sites

References

Cosgrove J, Walker D, Morrison P, Hillman K (2004) Periphyton indicate effects of wastewater discharge in the near-coastal zone, Perth (Western Australia). Estuarine, Coastal and Shelf Science 61:331–338

Costanzo SD, O'Donohue MJ, Dennison WC, Loneragan NR, Thomas M (2001) A new approach for detecting and mapping sewage impacts. Marine Pollution Bulletin 42:149-156

DALSE (2003) Tracing Treated Wastewater from Bunbury Ocean Outfall using 15N. Prepared for Water Corporation of Western Australia by DAL Science & Engineering Pty Ltd, Report No. 275/01, Perth, Western Australia, May 2003

Water Corporation (2012) Bunbury Ocean Outlet Operations EMP – Marine Impacts Monitoring and Management Plan. Water Corporation, Report No. 5542160 v3A, June 2012

Nutrients

On each sampling occasion (January, February and March), seven plume tracking sites were sampled using a gradient approach with distance from the outlet (refer to Appendix B for methods). The median surface concentration of ammonia was 10 µg/L at the diffuser and decreased to <LoR from 300 m onwards downstream of the diffuser (Figure 1). Median bottom concentrations of ammonia were 1.5 µg/L at the diffuser and remained at this concentration onwards downstream of the diffuser. Median surface concentrations of orthophosphate were highest above the diffuser (25 µg/L) and decreased with increasing distance downstream from the diffuser, with the exception of a rise to 14 µg/L at 100 m downstream. Median bottom concentrations of ortho-phosphate were highest above the diffuser (3 µg/L) and were ≤2 µg/L at increasing distances from the diffuser (Figure 1). Median surface nitrate+nitrite was 8 µg/L above the ocean outlet and remained between 5–8 µg/L with increasing distance downstream from the diffuser to <LoR at 1000 m. Median bottom concentrations of nitrate+nitrite were <LoR at all sites (Figure 1). Median surface concentrations of chlorophyll ranged from 0.1–0.3 µg/L, while median bottom concentrations of chlorophyll ranged from 0.2–0.3 µg/L, and both did not have a clear pattern with distance from the diffuser (Figure 1).

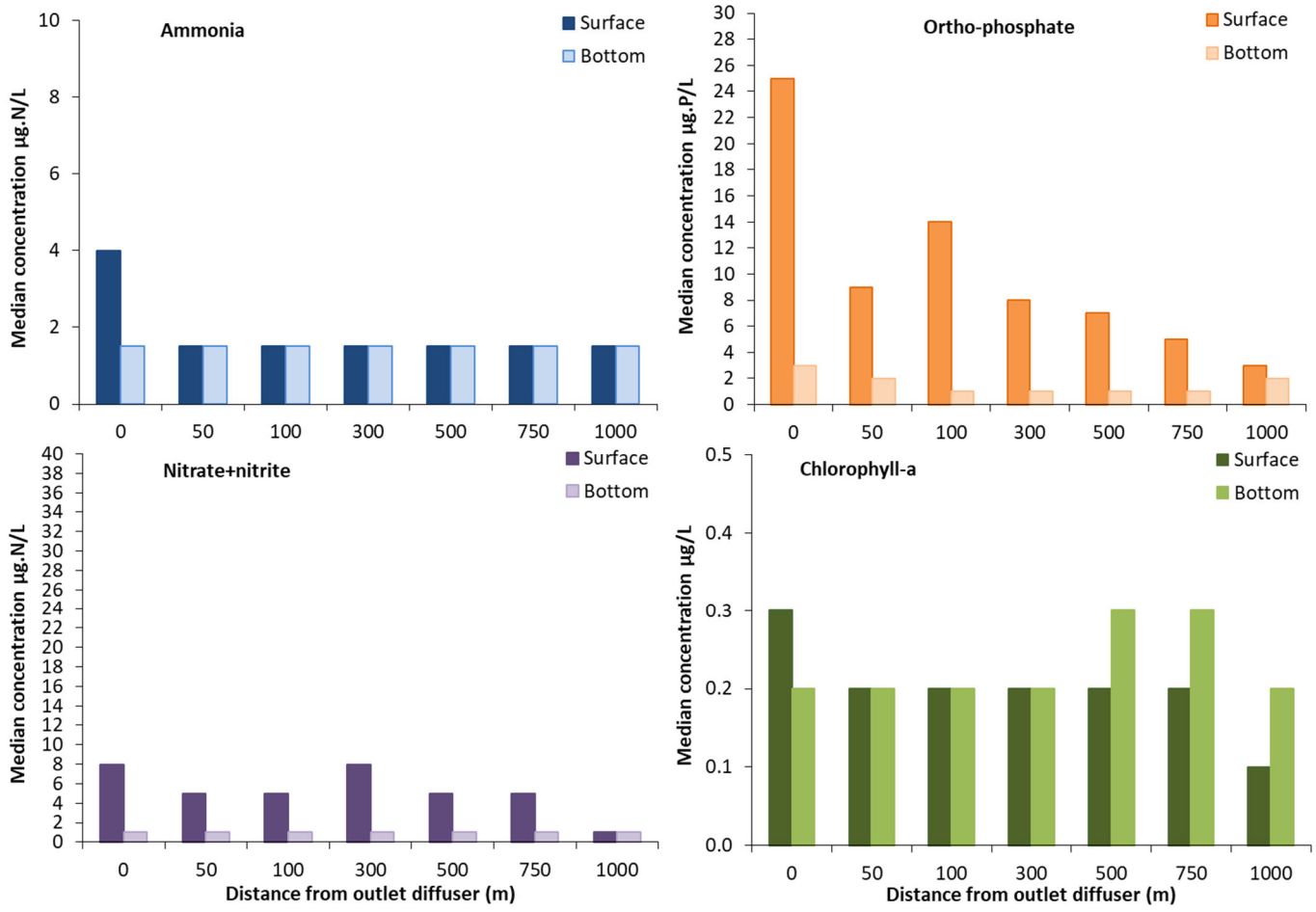

Figure 1 Median nutrient and chlorophyll-a concentrations measured in surface and bottom waters at fixed distances downstream of the Bunbury treated wastewater ocean outlet

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Date of Issue: 9/02/2021
Date Received: 21/01/2021
Our Reference: BMT21-1
Your Reference: WAT_1136_07

METHOD SAMPLE CODE	Sampling Date	2000 AMMONIA µg.N/L	4100 ORTHO-P µg.P/L	2100 NO3+NO2 µg.N/L	3000 CHLOROPHYLL'a' µg/L	3000 PHAEOPHYTIN'a' µg/L
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WQR5-T	19/01/2021	<3	<2	<2	0.1	<0.2
WQR5-B	19/01/2021	<3	<2	<2	0.1	<0.2
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C12 -B	19/01/2021				0.2	<0.2
C13 -T	19/01/2021				0.2	<0.2
C13 -B	19/01/2021				0.2	<0.2
C14 -T	19/01/2021				0.3	<0.2
C14 -B	19/01/2021				0.2	<0.2
C11 -T	19/01/2021				0.3	<0.2
C11 -B	19/01/2021				0.1	<0.2
C15 -T	19/01/2021				0.2	<0.2

Signatory: Jamie Woodward
Date: 9/02/2021

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T5 -T	19/01/2021	29	22	5	0.1	<0.2
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B	19/01/2021	<3	3	7	0.1	0.2
C	19/01/2021	<3	3	7	0.3	<0.2
D	19/01/2021	<3	3	7	0.2	<0.2

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Reporting Limit		<3	<2	<2	<0.1	<0.2
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G	19/01/2021	<3	4	7	0.3	0.2
H	19/01/2021	4	3	3	0.2	<0.2
I	19/01/2021	<3	3	4	0.3	<0.2
J	19/01/2021	<3	4	25	0.3	0.2
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L	19/01/2021	6	4	10	0.2	<0.2
M	19/01/2021	<3	4	5	0.2	0.3
N	19/01/2021	<3	3	34	0.2	0.4

Note: For results for compliance purposes uncertainity of measurement (MU) will sometimes affect the interpretation whether the result passes or fails the compliance limit.
Tables for measurement uncertainity are available online at www.mafrl.murdoch.edu.au

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Our Reference: BMT21-1
Your Reference: WAT_1136_07

METHOD SAMPLE CODE	Sampling Date	9200 EC 25ºC ms/cm	9200 SALINITY psu	2200 NO2 µg.N/L	2000 AMMONIA µg.N/L	2100 NO3+NO2 µg.N/L	4700 TOTAL-P µg.P/L	2540D TSS mg/L
Reporting Limit				**<2**	**<3**	**<2**	**<5**	**<1**
File		**22/01/2021 210122**	**22/01/2021 210122**	**22/01/2021 21012201**	**27/01/2021 21012701**		**3/02/2020 20020302**	**22/01/2021 210122**
TWW	19/01/2021	1.10	0.3	340	9900	1600	8000	13

Note: For results for compliance purposes uncertainity of measurement (MU) will sometimes affect the interpretation whether the result passes or fails the compliance limit.
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METHOD SAMPLE CODE	Sampling Date	ICP001 Ag mg/L	ICP001 As mg/L	ICP001 Cd mg/L	ICP001 Cr mg/L	ICP001 Cu mg/L	ICP001 Mo mg/L	ICP001 Ni mg/L	ICP001 Pb mg/L	ICP001 Se mg/L	ICP001 Zn mg/L	ICP006 Hg mg/L
Reporting Limit		**<0.01**	**<0.02**	**<0.0006**	**<0.001**	**<0.001**	**<0.004**	**<0.007**	**<0.01**	**<0.02**	**<0.002**	**<0.0001**
File		**28/01/2021 21012801**	**28/01/2021 21012801**	**28/01/2021 21012801**	**28/01/2021 21012801**	**28/01/2021 21012801**	**28/01/2021 21012801**	**28/01/2021 21012801**	**28/01/2021 21012801**	**28/01/2021 21012801**	**28/01/2021 21012801**	**9/02/2021 21020901**
TWW	19/01/2021	<0.01	<0.02	<0.0006	<0.001	0.003	<0.004	<0.007	<0.01	<0.02	0.032	<0.0001

Note: For results for compliance purposes uncertainity of measurement (MU) will sometimes affect the interpretation whether the result passes or fails the compliance limit.
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Date Received: 18/02/2021
Our Reference: BMT21-2
Your Reference: 1136_07

METHOD SAMPLE CODE	Sampling Date	2000 AMMONIA µg.N/L	4100 ORTHO-P µg.P/L	2100 NO3+NO2 µg.N/L	3000 CHLOROPHYLL'a' µg/L	3000 PHAEOPHYTIN'a' µg/L
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C16-B	17/02/2021				0.2	<0.2
C1-T	17/02/2021				0.1	<0.2

Signatory: Jamie Woodward
Date: 5/03/2021

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T5 -T	17/02/2021	<3	5	5	0.2	<0.2
T5 -B	17/02/2021	<3	<2	<2	0.2	<0.2
T6 -T	17/02/2021	<3	3	<2	0.1	<0.2
T6 -B	17/02/2021	<3	<2	<2	0.2	<0.2
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B	17/02/2021	<3	7	10	0.3	0.3
C	17/02/2021	<3	7	9	0.3	0.3
D	17/02/2021	<3	7	10	0.4	0.4

Signatory: Jamie Woodward
Date: 5/03/2021

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Reporting Limit		<3	<2	<2	<0.1	<0.2
Analysis Date			19/02/2021		2/03/2021	
File			21021902		21030201	
E	17/02/2021	<3	6	14	0.3	0.5
F	17/02/2021	<3	5	8	0.6	0.5
G	17/02/2021	<3	4	9	0.7	0.5
H	17/02/2021	<3	5	22	0.3	0.4
I	17/02/2021	<3	6	29	0.3	0.3
J	17/02/2021	<3	5	10	0.2	0.3
K	17/02/2021	<3	6	9	0.2	0.3
L	17/02/2021	4	6	8	0.2	0.3
M	17/02/2021	<3	3	<2	1.6	0.7
N	17/02/2021	<3	5	17	0.9	1.1

Note: For results for compliance purposes uncertainity of measurement (MU) will sometimes affect the interpretation whether the result passes or fails the compliance limit.
Tables for measurement uncertainity are available online at www.mafrl.murdoch.edu.au

Signatory: Jamie Woodward
Date: 5/03/2021

The results only apply to the sample tested.
Spare test items will be held for two months unless otherwise requested.

Marine and Freshwater
Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

WATER QUALITY DATA

Contact: Gabrielle Cummins
Customer: BMT
Address: Level 4, 20 Parkland Road, Osborne Park 6017

Date of Issue: 21/04/2021
Date Received: 24/03/2021
Our Reference: BMT21-14
Your Reference: 1136_07

METHOD SAMPLE CODE	Sampling Date	2000 AMMONIA µg.N/L	4100 ORTHO-P µg.P/L	2100 NO3+NO2 µg.N/L	3000 CHLOROPHYLL'a' µg/L	3000 PHAEOPHYTIN'a' µg/L
Reporting Limit		**<3**	**<2**	**<2**	**<0.1**	**<0.2**
Analysis Date			**6/04/2021**		**1/04/2021**	
File			**21040601**		**21040102**	
WQR1-T	24/03/2021	<3	2	<2	0.3	<0.2
WQR1-B	24/03/2021	<3	3	<2	0.3	<0.2
WQR2-T	24/03/2021	<3	2	<2	0.3	<0.2
WQR2-B	24/03/2021	<3	3	<2	0.3	<0.2
WQR3-T	24/03/2021	<3	<2	<2	0.2	<0.2
WQR3-B	24/03/2021	<3	<2	<2	0.3	<0.2
WQR4-T	24/03/2021	<3	<2	<2	0.4	<0.2
WQR4-B	24/03/2021	<3	<2	<2	0.3	<0.2
WQR5-T	24/03/2021	<3	2	<2	0.2	<0.2
WQR5-B	24/03/2021	<3	2	<2	0.3	<0.2
C9-T	24/03/2021				0.4	<0.2
C9-B	24/03/2021				0.4	0.2
C10-T	24/03/2021				0.4	<0.2
C10-B	24/03/2021				0.4	0.2
C11-T	24/03/2021				0.4	<0.2
C11-B	24/03/2021				0.4	0.2
C12-T	24/03/2021				0.4	0.2
C12-B	24/03/2021				0.4	0.3
C13-T	24/03/2021				0.4	0.3

Signatory: Jamie Woodward
Date: 21/04/2021

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Murdoch UNIVERSITY

WATER QUALITY DATA

Contact: Gabrielle Cummins
Customer: BMT
Address: Level 4, 20 Parkland Road, Osborne Park 6017

Date of Issue: 21/04/2021
Date Received: 24/03/2021
Our Reference: BMT21-14
Your Reference: 1136_07

METHOD SAMPLE CODE	Sampling Date	2000 AMMONIA µg.N/L	4100 ORTHO-P µg.P/L	2100 NO3+NO2 µg.N/L	3000 CHLOROPHYLL'a' µg/L	3000 PHAEOPHYTIN'a' µg/L
Reporting Limit		**<3**	**<2**	**<2**	**<0.1**	**<0.2**
Analysis Date			**6/04/2021**		**1/04/2021**	
File			**21040601**		**21040102**	
C13-B	24/03/2021				0.4	0.3
T0 -T	24/03/2021	4	25	38	0.3	0.2
T0 -B	24/03/2021	<3	3	<2	0.4	0.3
T1 -T	24/03/2021	<3	4	3	0.3	<0.2
T1 -B	24/03/2021	<3	2	<2	0.4	0.2
T2 -T	24/03/2021	<3	2	<2	0.3	<0.2
T2 -B	24/03/2021	<3	2	<2	0.4	0.2
T3 -T	24/03/2021	<3	6	8	0.2	<0.2
T3 -B	24/03/2021	<3	3	<2	0.3	<0.2
T4 -T	24/03/2021	<3	4	3	0.3	<0.2
T4 -B	24/03/2021	<3	<2	<2	0.4	<0.2
T5 -T	24/03/2021	<3	2	2	0.2	<0.2
T5 -B	24/03/2021	<3	<2	<2	0.4	<0.2
T6 -T	24/03/2021	<3	2	<2	0.3	<0.2
T6 -B	24/03/2021	<3	2	<2	0.4	<0.2
A	24/03/2021	<3	5	14	0.3	0.4
B	24/03/2021	<3	4	9	0.4	0.4
C	24/03/2021	<3	4	7	0.3	0.4
D	24/03/2021	<3	5	9	0.3	0.4

Signatory: Jamie Woodward
Date: 21/04/2021

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Environmental Science
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Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

Murdoch UNIVERSITY

WATER QUALITY DATA

Contact: Gabrielle Cummins
Customer: BMT
Address: Level 4, 20 Parkland Road, Osborne Park 6017

Date of Issue: 21/04/2021
Date Received: 24/03/2021
Our Reference: BMT21-14
Your Reference: 1136_07

METHOD SAMPLE CODE	Sampling Date	2000 AMMONIA µg.N/L	4100 ORTHO-P µg.P/L	2100 NO3+NO2 µg.N/L	3000 CHLOROPHYLL'a' µg/L	3000 PHAEOPHYTIN'a' µg/L
Reporting Limit		**<3**	**<2**	**<2**	**<0.1**	**<0.2**
Analysis Date			**6/04/2021**		**1/04/2021**	
File			**21040601**		**21040102**	
E	24/03/2021	<3	5	10	0.3	0.3
F	24/03/2021	<3	6	10	0.2	0.4
G	24/03/2021	<3	5	7	0.3	0.4
H	24/03/2021	<3	4	13	0.3	0.3
I	24/03/2021	<3	4	11	0.3	0.3
J	24/03/2021	<3	4	10	0.2	0.3
K	24/03/2021	<3	3	4	0.3	0.2
L	24/03/2021	<3	5	5	0.3	<0.2
M	24/03/2021	<3	3	4	0.3	0.5
N	24/03/2021	<3	4	33	0.5	0.5

Sample Condition: Chlorophyll samples for A through to N were received outside recommended holding time and preservation

Signatory: Jamie Woodward
Date: 21/04/2021

The results only apply to the sample as received and to the sample tested.
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Water Examination Laboratory

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Facsimile: (08) 9381 7139

PathWest
LABORATORY MEDICINE WA

BMT Commercial Australia Pty Ltd
Level 4/20 Parkland Road
OSBORNE PARK WA 6017

Certificate of Analysis

Project Number: PW-681962 **Collected**: 19-Jan-2021 **Received**: 20-Jan-2021 10:40 am **Analysed**: 20-Jan-2021
Temperature (Chilled): 15.1 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-004691 **Time Collected:** 14:00
Collection Point: A Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004692 **Time Collected:** 13:45
Collection Point: B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	10	MPN/100 mL	MWM018

Lab Number: W21-004693 **Time Collected:** 13:30
Collection Point: C Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004694 **Time Collected:** 13:20
Collection Point: D Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-681962

Lab Number: W21-004695 **Time Collected:** 13:05

Collection Point: E Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004696 **Time Collected:** 12:45

Collection Point: F Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004697 **Time Collected:** 12:30

Collection Point: G Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004698 **Time Collected:** 11:55

Collection Point: H Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004699 **Time Collected:** 11:40

Collection Point: I Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-681962

Lab Number: W21-004700 **Time Collected:** 11:25

Collection Point: J Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004701 **Time Collected:** 11:15

Collection Point: K Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004702 **Time Collected:** 10:55

Collection Point: L Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004703 **Time Collected:** 09:45

Collection Point: M Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004704 **Time Collected:** 10:05

Collection Point: N Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Report Type: Final **Report Number**: 779008 **Authorised By**: HE88162 - Approved Signatory
on 21/01/2021

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****End Of Report****

Water Examination Laboratory

2nd Floor, J Block, Hospital Ave
Nedlands WA 6009

Phone: (08) 6457 2583
Facsimile: (08) 9381 7139

PathWest
LABORATORY MEDICINE WA

BMT Commercial Australia Pty Ltd
Level 4/20 Parkland Road
OSBORNE PARK WA 6017

Certificate of Analysis

Project Number: PW-681964 **Collected**: 19-Jan-2021 **Received**: 20-Jan-2021 10:40 am **Analysed**: 20-Jan-2021
Temperature (Chilled): 15.1 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-004714 **Time Collected:** 13:40
Collection Point: T1T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. 50	CFU/100 mL	MWM002
Escherichia coli	est. 30	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004715 **Time Collected:** 13:40
Collection Point: T1-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004716 **Time Collected:** 13:51
Collection Point: T2-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. 10	CFU/100 mL	MWM002
Escherichia coli	est. 10	CFU/100 mL	MWM002
Confirmed Enterococci	20	MPN/100 mL	MWM018

Lab Number: W21-004717 **Time Collected:** 13:51
Collection Point: T2-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-681964

Lab Number: W21-004718 **Time Collected:** 14:04

Collection Point: T3-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004719 **Time Collected:** 14:04

Collection Point: T3-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004720

Collection Point: T4-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004721

Collection Point: T4-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004722

Collection Point: T5-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-681964

Lab Number: W21-004723

Collection Point: T5-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004724

Collection Point: T6-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004725

Collection Point: T6-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Report Type: Final **Report Number**: 779011 **Authorised By**: HE88162 - Approved Signatory on 21/01/2021

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****End Of Report****

Water Examination Laboratory

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PathWest
LABORATORY MEDICINE WA

BMT Commercial Australia Pty Ltd
Level 4/20 Parkland Road
OSBORNE PARK WA 6017

Certificate of Analysis

Project Number: PW-681967 **Collected**: 19-Jan-2021 **Received**: 20-Jan-2021 10:40 am **Analysed**: 20-Jan-2021
Temperature (Chilled): 15.1 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-004737 **Time Collected:** 10:10
Collection Point: WQR1-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004738 **Time Collected:** 10:10
Collection Point: WQR1-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004739 **Time Collected:** 10:30
Collection Point: WQR2-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004740 **Time Collected:** 10:30
Collection Point: WQR2-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-681967

Lab Number: W21-004741 **Time Collected:** 10:46

Collection Point: WQR3-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004742 **Time Collected:** 10:46

Collection Point: WQR3-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004743 **Time Collected:** 11:02

Collection Point: WQR4-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004744 **Time Collected:** 11:02

Collection Point: WQR4-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004745 **Time Collected:** 11:15

Collection Point: WQR56-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-681967

Lab Number: W21-004746 **Time Collected:** 11:15

Collection Point: WQR56-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004747 **Time Collected:** 13:26

Collection Point: TO-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. 10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	20	MPN/100 mL	MWM018

Lab Number: W21-004748 **Time Collected:** 13:26

Collection Point: TO-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Report Type: Final **Report Number**: 779017 **Authorised By**: HE88162 - Approved Signatory on 21/01/2021

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****End Of Report****

Water Examination Laboratory

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PathWest
LABORATORY MEDICINE WA

BMT Commercial Australia Pty Ltd
Level 4/20 Parkland Road
OSBORNE PARK WA 6017

Certificate of Analysis

Project Number: PW-681970 **Collected**: 19-Jan-2021 **Received**: 20-Jan-2021 10:40 am **Analysed**: 20-Jan-2021
Temperature (Chilled): 15.1 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-004753 **Time Collected:** 13:00
Collection Point: C17-T Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-004754 **Time Collected:** 13:00
Collection Point: C17-B Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-004755 **Time Collected:** 13:04
Collection Point: C18-T Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-004756 **Time Collected:** 13:04
Collection Point: C18-B Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-004757 **Time Collected:** 13:07
Collection Point: C19-T Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Project Number: PW-681970

Lab Number: W21-004758 **Time Collected:** 13:07

Collection Point: C19-B Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-004759 **Time Collected:** 13:12

Collection Point: C20-T Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. 20	CFU/100 mL	MWM002
Escherichia coli	est. 10	CFU/100 mL	MWM002

Lab Number: W21-004760 **Time Collected:** 13:12

Collection Point: C20-B Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-004761 **Time Collected:** 13:17

Collection Point: C21-T Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-004762 **Time Collected:** 13:17

Collection Point: C21-B Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Report Type: Final **Report Number**: 779001 **Authorised By**: HE39880 - Approved Signatory on 21/01/2021

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LABORATORY MEDICINE WA

BMT Commercial Australia Pty Ltd
Level 4/20 Parkland Road
OSBORNE PARK WA 6017

Certificate of Analysis

Project Number: PW-681971 **Collected**: 19-Jan-2021 **Received**: 20-Jan-2021 10:40 am **Analysed**: 20-Jan-2021
Temperature (Chilled): 15.1 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-004763 **Time Collected:** 11:55
Collection Point: C1-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004764 **Time Collected:** 11:55
Collection Point: C1-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004765 **Time Collected:** 12:10
Collection Point: C2-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	10	MPN/100 mL	MWM018

Lab Number: W21-004766 **Time Collected:** 12:10
Collection Point: C2-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004767 **Time Collected:** 12:37
Collection Point: C3-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	10	MPN/100 mL	MWM018

Project Number: PW-681971

Lab Number: W21-004768 **Time Collected:** 12:37

Collection Point: C3-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004769 **Time Collected:** 13:12

Collection Point: C4-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004770 **Time Collected:** 13:12

Collection Point: C4-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004771 **Time Collected:** 13:17

Collection Point: C5-T Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-004772 **Time Collected:** 13:17

Collection Point: C5-B Natural Seawater Near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Report Type: Final **Report Number**: 779021 **Authorised By**: HE88162 - Approved Signatory on 21/01/2021

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Certificate of Analysis

Project Number: PW-685439 **Collected**: 17-Feb-2021 **Received**: 18-Feb-2021 10:30 am **Analysed**: 18-Feb-2021
Temperature (Chilled): 15.0 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-012254 **Customer Reference**: C29-T **Time Collected:** 12:37
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-012255 **Customer Reference**: C29-B **Time Collected:** 12:37
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-012256 **Customer Reference**: C30-T **Time Collected:** 12:42
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-012257 **Customer Reference**: C30-B **Time Collected:** 12:42
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-012258 **Customer Reference**: C31-T **Time Collected:** 12:43
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Project Number: PW-685439

Lab Number: W21-012259 **Customer Reference**: C31-B **Time Collected:** 12:43

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-012260 **Customer Reference**: C32-T **Time Collected:** 12:45

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-012261 **Customer Reference**: C32-B **Time Collected:** 12:45

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-012262 **Customer Reference**: C17-T **Time Collected:** 12:47

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-012263 **Customer Reference**: C17-B **Time Collected:** 12:47

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Report Type: Final **Report Number**: 782661 **Authorised By**: HE39880 - Approved Signatory on 19/02/2021

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Certificate of Analysis

Project Number: PW-685440 **Collected**: 17-Feb-2021 **Received**: 18-Feb-2021 10:30 am **Analysed**: 18-Feb-2021
Temperature (Chilled): 15.0 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-012264 **Customer Reference**: C13-T **Time Collected:** 11:42
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012265 **Customer Reference**: C13-B **Time Collected:** 11:42
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012266 **Customer Reference**: C14-T **Time Collected:** 11:50
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012267 **Customer Reference**: C14-B **Time Collected:** 11:50
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012268 **Customer Reference**: C15-T **Time Collected:** 12:03
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-685440

Lab Number: W21-012269 **Customer Reference**: C15-B **Time Collected:** 12:03

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012270 **Customer Reference**: C16-T **Time Collected:** 12:15

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012271 **Customer Reference**: C16-B **Time Collected:** 12:15

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012272 **Customer Reference**: C1-T **Time Collected:** 12:27

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012273 **Customer Reference**: C1-B **Time Collected:** 12:27

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Report Type: Final **Report Number**: 782664 **Authorised By**: HE39880 - Approved Signatory on 19/02/2021

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Certificate of Analysis

Project Number: PW-685441 **Collected**: 17-Feb-2021 **Received**: 18-Feb-2021 10:30 am **Analysed**: 18-Feb-2021
Temperature (Chilled): 15.0 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-012274 **Customer Reference**: WQR1-T **Time Collected:** 09:48
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012275 **Customer Reference**: WQR1-B **Time Collected:** 09:48
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012276 **Customer Reference**: WQR2-T **Time Collected:** 10:02
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012277 **Customer Reference**: WQR2-B **Time Collected:** 10:02
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-685441

Lab Number: W21-012278 **Customer Reference**: WQR3-T **Time Collected:** 10:22

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012279 **Customer Reference**: WQR3-B **Time Collected:** 10:22

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012280 **Customer Reference**: WQR4-T **Time Collected:** 10:35

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012281 **Customer Reference**: WQR4-B **Time Collected:** 10:35

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012282 **Customer Reference**: WQR5b-T **Time Collected:** 10:50

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-685441

Lab Number: W21-012283 **Customer Reference**: WQR5b-B **Time Collected:** 10:50

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012284 **Customer Reference**: TO-T **Time Collected:** 12:58

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012285 **Customer Reference**: TO-B **Time Collected:** 12:58

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012286 **Customer Reference**: T1-T **Time Collected:** 13:11

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. 20	CFU/100 mL	MWM002
Escherichia coli	est. 10	CFU/100 mL	MWM002
Confirmed Enterococci	20	MPN/100 mL	MWM018

Lab Number: W21-012287 **Customer Reference**: T1-B **Time Collected:** 13:11

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-685441

Lab Number: W21-012288 **Customer Reference**: T2-T **Time Collected:** 13:21

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. 30	CFU/100 mL	MWM002
Escherichia coli	est. 20	CFU/100 mL	MWM002
Confirmed Enterococci	20	MPN/100 mL	MWM018

Lab Number: W21-012289 **Customer Reference**: T2-B **Time Collected:** 13:21

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012290 **Customer Reference**: T3-T **Time Collected:** 13:34

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. 20	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	10	MPN/100 mL	MWM018

Lab Number: W21-012291 **Customer Reference**: T3-B **Time Collected:** 13:34

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012292 **Customer Reference**: T4-T **Time Collected:** 13:47

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-685441

Lab Number: W21-012293 **Customer Reference**: T4-B **Time Collected:** 13:47

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012294 **Customer Reference**: T5-T **Time Collected:** 13:58

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012295 **Customer Reference**: T5-B **Time Collected:** 13:58

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012296 **Customer Reference**: T6-T

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012297 **Customer Reference**: T6-B

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-685441

Lab Number: W21-012298 **Customer Reference**: A **Time Collected:** 13:40

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012299 **Customer Reference**: B **Time Collected:** 13:20

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012300 **Customer Reference**: C **Time Collected:** 13:07

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012301 **Customer Reference**: D **Time Collected:** 13:00

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012302 **Customer Reference**: E **Time Collected:** 12:40

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-685441

Lab Number: W21-012303 **Customer Reference**: F **Time Collected:** 12:05

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012304 **Customer Reference**: G **Time Collected:** 11:55

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012305 **Customer Reference**: H **Time Collected:** 11:40

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012306 **Customer Reference**: I **Time Collected:** 11:25

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012307 **Customer Reference**: J **Time Collected:** 11:05

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-685441

Lab Number: W21-012308 **Customer Reference**: K **Time Collected:** 10:50

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012309 **Customer Reference**: L **Time Collected:** 10:30

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-012310 **Customer Reference**: M **Time Collected:** 09:20

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	10	MPN/100 mL	MWM018

Lab Number: W21-012311 **Customer Reference**: N **Time Collected:** 09:50

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Report Type: Final **Report Number**: 782679 **Authorised By**: HE39880 - Approved Signatory on 19/02/2021

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Certificate of Analysis

Project Number: PW-689661 **Collected**: 24-Mar-2021 **Received**: 25-Mar-2021 6:00 am **Analysed**: 25-Mar-2021
Temperature (Chilled): 5.6 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-021265 **Customer Reference**: C9-T **Time Collected:** 11:07
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021266 **Customer Reference**: C9-B **Time Collected:** 11:07
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021267 **Customer Reference**: C10-T **Time Collected:** 11:20
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021268 **Customer Reference**: C10-B **Time Collected:** 11:20
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021269 **Customer Reference**: C11-T **Time Collected:** 11:32
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-689661

Lab Number: W21-021270 **Customer Reference**: C11-B **Time Collected:** 11:32

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021271 **Customer Reference**: C12-T **Time Collected:** 11:50

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021272 **Customer Reference**: C12-B **Time Collected:** 11:50

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021273 **Customer Reference**: C13-T **Time Collected:** 12:05

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	10	MPN/100 mL	MWM018

Lab Number: W21-021274 **Customer Reference**: C13-B **Time Collected:** 12:05

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Report Type: Final **Report Number**: 787430 **Authorised By**: HE08453 - Approved Signatory on 26/03/2021

The submitting agency is responsible for the collection and transportation of samples. These results relate only to the items tested.
****End Of Report****

Water Examination Laboratory

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Nedlands WA 6009

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PathWest
LABORATORY MEDICINE WA

BMT Commercial Australia Pty Ltd
Level 4/20 Parkland Road
OSBORNE PARK WA 6017

Certificate of Analysis

Project Number: PW-689682 **Collected**: 24-Mar-2021 **Received**: 25-Mar-2021 6:00 am **Analysed**: 25-Mar-2021
Temperature (Chilled): 5.6 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-021318 **Customer Reference**: C25-T **Time Collected:** 12:20
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-021319 **Customer Reference**: C25-B **Time Collected:** 12:20
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-021320 **Customer Reference**: C26-T **Time Collected:** 12:25
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-021321 **Customer Reference**: C26-B **Time Collected:** 12:25
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-021322 **Customer Reference**: C27-T **Time Collected:** 12:27
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Project Number: PW-689682

Lab Number: W21-021323 **Customer Reference**: C27-B **Time Collected:** 12:27

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-021324 **Customer Reference**: C28-T **Time Collected:** 12:31

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. 10	CFU/100 mL	MWM002
Escherichia coli	est. 10	CFU/100 mL	MWM002

Lab Number: W21-021325 **Customer Reference**: C28-B **Time Collected:** 12:31

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-021326 **Customer Reference**: C29-T **Time Collected:** 12:37

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Lab Number: W21-021327 **Customer Reference**: C29-B **Time Collected:** 12:37

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002

Report Type: Final **Report Number**: 787330 **Authorised By**: HE08453 - Approved Signatory on 26/03/2021

The submitting agency is responsible for the collection and transportation of samples. These results relate only to the items tested.
****End Of Report****

Water Examination Laboratory

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PathWest
LABORATORY MEDICINE WA

BMT Commercial Australia Pty Ltd
Level 4/20 Parkland Road
OSBORNE PARK WA 6017

Certificate of Analysis

Project Number: PW-689689 **Collected**: 24-Mar-2021 **Received**: 25-Mar-2021 6:00 am **Analysed**: 25-Mar-2021
Temperature (Chilled): 5.6 °C

Order Number: BMT_BOOM 1136

Lab Number: W21-021341 **Customer Reference**: A **Time Collected:** 14:20
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021342 **Customer Reference**: B **Time Collected:** 14:10
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021343 **Customer Reference**: C **Time Collected:** 14:00
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021344 **Customer Reference**: D **Time Collected:** 13:50
Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-689689

Lab Number: W21-021345 **Customer Reference**: E **Time Collected:** 13:40

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021346 **Customer Reference**: F **Time Collected:** 13:30

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021347 **Customer Reference**: G **Time Collected:** 12:55

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021348 **Customer Reference**: H **Time Collected:** 12:40

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021349 **Customer Reference**: I **Time Collected:** 12:30

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-689689

Lab Number: W21-021350 **Customer Reference**: J **Time Collected:** 12:05

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021351 **Customer Reference**: K **Time Collected:** 11:30

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021352 **Customer Reference**: L **Time Collected:** 11:40

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021353 **Customer Reference**: M **Time Collected:** 09:00

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021354 **Customer Reference**: N **Time Collected:** 09:30

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-689689

Lab Number: W21-021355 **Customer Reference**: WQR4-T **Time Collected:** 10:23

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021356 **Customer Reference**: WQR4-B **Time Collected:** 10:23

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021357 **Customer Reference**: WQR5B-T **Time Collected:** 10:38

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021358 **Customer Reference**: WQR5B-B **Time Collected:** 10:38

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021359 **Customer Reference**: T0-T **Time Collected:** 12:55

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	130	CFU/100 mL	MWM002
Escherichia coli	100	CFU/100 mL	MWM002
Confirmed Enterococci	20	MPN/100 mL	MWM018

Project Number: PW-689689

Lab Number: W21-021360 **Customer Reference**: T0-B **Time Collected:** 12:55

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021361 **Customer Reference**: T1-T **Time Collected:** 13:12

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021362 **Customer Reference**: T1-B **Time Collected:** 13:12

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021363 **Customer Reference**: T2-T **Time Collected:** 13:29

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021364 **Customer Reference**: T2-B **Time Collected:** 13:29

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-689689

Lab Number: W21-021365 **Customer Reference**: T3-T **Time Collected:** 13:51

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021366 **Customer Reference**: T3-B **Time Collected:** 13:51

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021367 **Customer Reference**: T4-T **Time Collected:** 14:07

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021368 **Customer Reference**: T4-B **Time Collected:** 14:07

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021369 **Customer Reference**: T5-T **Time Collected:** 14:19

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-689689

Lab Number: W21-021370 **Customer Reference**: T5-B **Time Collected:** 14:19

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021371 **Customer Reference**: T6-T **Time Collected:** 14:35

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021372 **Customer Reference**: T6-B **Time Collected:** 14:35

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021373 **Customer Reference**: WQR1-T **Time Collected:** 09:23

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021374 **Customer Reference**: WQR1-B **Time Collected:** 09:23

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Project Number: PW-689689

Lab Number: W21-021375 **Customer Reference**: WQR2-T **Time Collected:** 09:52

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021376 **Customer Reference**: WQR2-B **Time Collected:** 09:52

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021377 **Customer Reference**: WQR3-T **Time Collected:** 10:07

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Lab Number: W21-021378 **Customer Reference**: WQR3-B **Time Collected:** 10:07

Collection Point: Natural seawater near Diffuser

Analysis	Result	Units	Method
Confirmed Thermotolerant Coliforms	est. <10	CFU/100 mL	MWM002
Escherichia coli	est. <10	CFU/100 mL	MWM002
Confirmed Enterococci	<10	MPN/100 mL	MWM018

Report Type: Final **Report Number**: 787438 **Authorised By**: HE08453 - Approved Signatory on 26/03/2021

The submitting agency is responsible for the collection and transportation of samples. These results relate only to the items tested.
****End Of Report****

dalcon environmental

NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

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Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
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Project	BOOM
Samples	5
Date Received	2/02/2021

LABORATORY DETAILS

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Dalcon Environmental Reference	DE01619
Report Number	DE01619.R0
Date Reported	6/02/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
This report may only be reproduced in full.

SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

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Project	BOOM
Samples	5
Date Received	2/02/2021

LABORATORY DETAILS

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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01619
Report Number	DE01619.R0
Date Reported	6/02/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01619.1 - **DE01619.5**: Sample clear and colourless.

Sample Notes:

SAMPLE DETAILS

DE Sample Number	DE01619.1	DE01619.2	DE01619.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	WQR1-T	WQR2-T	WQR3-T
Sample Date	19/01/2021	19/01/2021	19/01/2021
Test Method:	**DE-AM-03**		
Analysis Date	4/02/2021	4/02/2021	4/02/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**400**	**55.56**	**1200**	**55.56**	**720**	**10.84**
Amphora spp.			80	3.70		
Chaetoceros spp.			80	3.70		
Cylindrotheca spp.						
Fragilaria spp.			80	3.70	240	3.61
Licmophora spp.						
Nitzschia spp.	400	55.56	880	40.74	480	7.23
Pinnularia spp.						
Synedra spp.			80	3.70		
Chlorophyceae					**80**	**1.20**
Chlamydomonas spp.					80	1.20
Cyanobacteria					**5440**	**81.93**
Trichodesmium erythraeum					5440	81.93
Dinophyceae	**320**	**44.44**	**960**	**44.44**	**400**	**6.02**
Ceratium furca	80	11.11	80	3.70	80	1.20
Ceratium lineatum	80	11.11				
Ceratium trichoceros					160	2.41
Gymnodinium spp.	80	11.11	560	25.93	80	1.20
Gyrodinium spp.			240	11.11		
Heterocapsa spp.					80	1.20
Prorocentrum sigmoides	80	11.11	80	3.70		
TOTAL	**720**	**100**	**2160**	**100**	**6640**	**100**

SAMPLE DETAILS

DE Sample Number	DE01619.4	DE01619.5
Sample Type	Marine	Marine
Client Sample Desc.	WQR4-T	WQR5b-T
Sample Date	19/01/2021	19/01/2021
Test Method:	**DE-AM-03**	
Analysis Date	4/02/2021	4/02/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**2720**	**80.95**	**240**	**4.17**		
Amphora spp.						
Chaetoceros spp.	240	7.14				
Cylindrotheca spp.	80	2.38				
Fragilaria spp.			80	1.39		
Licmophora spp.	240	7.14				
Nitzschia spp.	2080	61.90	160	2.78		
Pinnularia spp.	80	2.38				
Synedra spp.						
Chlorophyceae						
Chlamydomonas spp.						
Cyanobacteria			**5440**	**94.44**		
Trichodesmium erythraeum			5440	94.44		
Dinophyceae	**640**	**19.05**	**80**	**1.39**		
Ceratium furca	80	2.38				
Ceratium lineatum						
Ceratium trichoceros						
Gymnodinium spp.	480	14.29	80	1.39		
Gyrodinium spp.	80	2.38				
Heterocapsa spp.						
Prorocentrum sigmoides						
TOTAL	**3360**	**100**	**5760**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
Telephone	(08) 6272 0000
Facsimile	
Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	2/02/2021

LABORATORY DETAILS

Principal	Stuart Helleren
Laboratory	Dalcon Environmental
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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01620
Report Number	DE01620.R0
Date Reported	6/02/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
This report may only be reproduced in full.

SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
Telephone	(08) 6272 0000
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Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	2/02/2021

LABORATORY DETAILS

Principal	Stuart Helleren
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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01620
Report Number	DE01620.R0
Date Reported	6/02/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01620.1 - **DE01620.5**: Sample clear and colourless.

Sample Notes:

SAMPLE DETAILS

DE Sample Number	DE01620.1	DE01620.2	DE01620.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	WQR1-B	WQR2-B	WQR3-B
Sample Date	19/01/2021	19/01/2021	19/01/2021
Test Method: DE-AM-03			
Analysis Date	4/02/2021	4/02/2021	4/02/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**3360**	**79.25**	**1760**	**84.62**	**640**	**88.89**
Achnanthes spp.	80	1.89			80	11.11
Amphora spp.	480	11.32	160	7.69		
Chaetoceros spp.	160	3.77				
Cyclotella spp.			80	3.85		
Cylindrotheca spp.	720	16.98	640	30.77	80	11.11
Entomoneis spp.					80	11.11
Fragilaria spp.	800	18.87	320	15.38	240	33.33
Guinardia spp.						
Hantzschia spp.						
Licmophora spp.	320	7.55	160	7.69		
Mastogloia spp.	80	1.89				
Navicula spp.	480	11.32			80	11.11
Nitzschia spp.	240	5.66	160	7.69	80	11.11
Synedra spp.			160	7.69		
Tryblionella spp.			80	3.85		
Dinophyceae	**880**	**20.75**	**320**	**15.38**	**80**	**11.11**
Ceratium lineatum						
Gonyaulax spp.	80	1.89	160	7.69		
Gyrodinium spp.						
Gymnodinium spp.	320	7.55	160	7.69	80	11.11
Heterocapsa spp.	80	1.89				
Protoperidinium spp.	400	9.43				
TOTAL	**4240**	**100**	**2080**	**100**	**720**	**100**

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SAMPLE DETAILS

DE Sample Number	DE01620.4	DE01620.5
Sample Type	Marine	Marine
Client Sample Desc.	WQR4-B	WQR5b-B
Sample Date	19/01/2021	19/01/2021
Test Method:	**DE-AM-03**	
Analysis Date	4/02/2021	4/02/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**7440**	**92.08**	**1120**	**100.00**		
Achnanthes spp.						
Amphora spp.	80	0.99	80	7.14		
Chaetoceros spp.			80	7.14		
Cyclotella spp.						
Cylindrotheca spp.	80	0.99	320	28.57		
Entomoneis spp.						
Fragilaria spp.	560	6.93	80	7.14		
Guinardia spp.						
Hantzschia spp.	80	0.99				
Licmophora spp.	80	0.99	240	21.43		
Mastogloia spp.						
Navicula spp.			160	14.29		
Nitzschia spp.	6480	80.20	160	14.29		
Synedra spp.	80	0.99				
Tryblionella spp.						
Dinophyceae	**640**	**7.92**				
Ceratium lineatum	80	0.99				
Gonyaulax spp.						
Gyrodinium spp.	240	2.97				
Gymnodinium spp.	240	2.97				
Heterocapsa spp.						
Protoperidinium spp.	80	0.99				
TOTAL	**8080**	**100**	**1120**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

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Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	2/02/2021

LABORATORY DETAILS

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Dalcon Environmental Reference	DE01621
Report Number	DE01621.R0
Date Reported	11/02/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
This report may only be reproduced in full.

SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

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Project BOOM
Samples 5
Date Received 2/02/2021

LABORATORY DETAILS

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Dalcon Environmental Reference DE01621
Report Number DE01621.R0
Date Reported 11/02/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01621.1 - **DE01621.5**: Sample clear and colourless.

Sample Notes:

SAMPLE DETAILS

DE Sample Number	DE01621.1	DE01621.2	DE01621.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	C1-T (INT)	C2-T (INT)	C3-T (INT)
Sample Date	19/01/2021	19/01/2021	19/01/2021
Test Method: DE-AM-03			
Analysis Date	9/02/2021	9/02/2021	9/02/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**3600**	**88.24**	**3040**	**84.44**	**3840**	**81.36**
Achnanthes spp.						
Amphora spp.	320	7.84	480	13.33	480	10.17
Chaetoceros spp.	640	15.69	1040	28.89	480	10.17
Cyclotella spp.			80	2.22		
Cylindrotheca spp.	160	3.92	80	2.22	240	5.08
Entomoneis spp.	160	3.92	320	8.89	320	6.78
Eucampia spp.	160	3.92			320	6.78
Fragilaria spp.	240	5.88	160	4.44		
Grammatophora spp.	160	3.92				
Hantzschia spp.						
Licmophora spp.	80	1.96	160	4.44	320	6.78
Mastogloia spp.					80	1.69
Navicula spp.	160	3.92	80	2.22	160	3.39
Nitzschia spp.	880	21.57	480	13.33	1200	25.42
Pseudo-nitzschia "delicatissima" group (PT)	320	7.84	160	4.44		
Rhizosolenia spp.	80	1.96				
Skeletonema spp.					240	5.08
Thalassionema spp.	240	5.88				
Cyanobacteria						
Trichodesmium erythraeum						
Dinophyceae	**480**	**11.76**	**560**	**15.56**	**880**	**18.64**
Ceratium furca			80	2.22	80	1.69
Ceratium trichoceros						
Gymnodinium spp.			240	6.67	480	10.17
Gyrodinium spp.	320	7.84	80	2.22	80	1.69
Prorocentrum cordatum (PT)						
Prorocentrum micans	160	3.92	80	2.22	240	5.08
Prorocentrum sigmoides						
Protoperidinium spp.			80	2.22		
TOTAL	**4080**	**100**	**3600**	**100**	**4720**	**100**

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SAMPLE DETAILS

DE Sample Number	DE01621.4	DE01621.5
Sample Type	Marine	Marine
Client Sample Desc.	C4-T (INT)	C5-T (INT)
Sample Date	19/01/2021	19/01/2021
Test Method:	**DE-AM-03**	
Analysis Date	9/02/2021	9/02/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**2240**	**70.00**	**1600**	**28.57**		
Achnanthes spp.			80	1.43		
Amphora spp.	240	7.50	80	1.43		
Chaetoceros spp.	720	22.50	480	8.57		
Cyclotella spp.			80	1.43		
Cylindrotheca spp.			80	1.43		
Entomoneis spp.						
Eucampia spp.						
Fragilaria spp.	240	7.50	320	5.71		
Grammatophora spp.						
Hantzschia spp.			80	1.43		
Licmophora spp.			80	1.43		
Mastogloia spp.						
Navicula spp.	80	2.50				
Nitzschia spp.	800	25.00	320	5.71		
Pseudo-nitzschia "delicatissima" group (PT)						
Rhizosolenia spp.						
Skeletonema spp.						
Thalassionema spp.	160	5.00				
Cyanobacteria			**3360**	**60.00**		
Trichodesmium erythraeum			3360	60.00		
Dinophyceae	**960**	**30.00**	**640**	**11.43**		
Ceratium furca						
Ceratium trichoceros			80	1.43		
Gymnodinium spp.	560	17.50	400	7.14		
Gyrodinium spp.	240	7.50				
Prorocentrum cordatum (PT)	80	2.50				
Prorocentrum micans			80	1.43		
Prorocentrum sigmoides	80	2.50	80	1.43		
Protoperidinium spp.						
TOTAL	**3200**	**100**	**5600**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

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Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
Telephone	(08) 6272 0000
Facsimile	
Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	2/02/2021

LABORATORY DETAILS

Principal	Stuart Helleren
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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01622
Report Number	DE01622.R0
Date Reported	11/02/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
This report may only be reproduced in full.

SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

Contact Martin Loury
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LABORATORY DETAILS

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Project BOOM
Samples 5
Date Received 2/02/2021

Dalcon Environmental Reference DE01622
Report Number DE01622.R0
Date Reported 11/02/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01622.1 - **DE01622.5**: Sample clear and colourless.

Sample Notes:

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SAMPLE DETAILS

DE Sample Number	DE01622.1	DE01622.2	DE01622.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	C17-T	C18-T	C19-T
Sample Date	19/01/2021	19/01/2021	19/01/2021
Test Method:	**DE-AM-03**		
Analysis Date	9/02/2021	9/02/2021	9/02/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**2320**	**87.88**	**640**	**53.33**	**640**	**53.33**
Achnanthes spp.						
Amphora spp.			80	6.67		
Cylindrotheca spp.					80	6.67
Chaetoceros spp.	240	9.09	240	20.00	80	6.67
Cyclotella spp.	80	3.03				
Fragilaria spp.	80	3.03	80	6.67	80	6.67
Entomoneis spp.					80	6.67
Licmophora spp.	80	3.03	80	6.67	80	6.67
Navicula spp.			80	6.67		
Nitzschia spp.	1680	63.64	80	6.67	240	20.00
Eucampia spp.						
Pseudo-nitzschia "delicatissima" group (PT)	160	6.06				
Dactyliosolen spp.						
Dictyochophyceae						
Dictyocha spp.						
Dinophyceae	**320**	**12.12**	**560**	**46.67**	**560**	**46.67**
Ceratium furca			80	6.67	80	6.67
Gyrodinium spp.					80	6.67
Gymnodinium spp.	160	6.06	480	40.00	320	26.67
Prorocentrum cordatum (PT)					80	6.67
Prorocentrum sigmoides	80	3.03				
Ceratium trichoceros						
Ceratium lineatum	80	3.03				
TOTAL	**2640**	**100**	**1200**	**100**	**1200**	**100**

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SAMPLE DETAILS

DE Sample Number	DE01622.4	DE01622.5
Sample Type	Marine	Marine
Client Sample Desc.	C20-T	C21-T
Sample Date	19/01/2021	19/01/2021
Test Method:	**DE-AM-03**	
Analysis Date	9/02/2021	9/02/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**1200**	**65.22**	**1680**	**67.74**		
Achnanthes spp.	80	4.35				
Amphora spp.	80	4.35	80	3.23		
Cylindrotheca spp.						
Chaetoceros spp.	480	26.09	1360	54.84		
Cyclotella spp.						
Fragilaria spp.	160	8.70				
Entomoneis spp.	160	8.70				
Licmophora spp.	80	4.35				
Navicula spp.						
Nitzschia spp.			160	6.45		
Eucampia spp.	160	8.70				
Pseudo-nitzschia "delicatissima" group (PT)						
Dactyliosolen spp.			80	3.23		
Dictyochophyceae			**80**	**3.23**		
Dictyocha spp.			80	3.23		
Dinophyceae	**640**	**34.78**	**720**	**29.03**		
Ceratium furca						
Gyrodinium spp.			240	9.68		
Gymnodinium spp.	400	21.74	320	12.90		
Prorocentrum cordatum (PT)						
Prorocentrum sigmoides	160	8.70	160	6.45		
Ceratium trichoceros	80	4.35				
Ceratium lineatum						
TOTAL	**1840**	**100**	**2480**	**100**		

dalcon environmental

NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Martin Loury
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Project	BOOM
Samples	5
Date Received	2/02/2021

LABORATORY DETAILS

Principal	Stuart Helleren
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Dalcon Environmental Reference	DE01623
Report Number	DE01623.R0
Date Reported	11/02/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
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SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

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LABORATORY DETAILS

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Project BOOM
Samples 5
Date Received 2/02/2021

Dalcon Environmental Reference DE01623
Report Number DE01623.R0
Date Reported 11/02/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01623.1 - **DE01623.5**: Sample clear and colourless.

Sample Notes:

SAMPLE DETAILS

DE Sample Number	DE01623.1	DE01623.2	DE01623.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	C17-B	C18-B	C19-B
Sample Date	19/01/2021	19/01/2021	19/01/2021
Test Method:	**DE-AM-03**		
Analysis Date	9/02/2021	9/02/2021	9/02/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**1440**	**72.00**	**1920**	**60.00**	**160**	**33.33**
Achnanthes spp.					80	16.67
Amphora spp.	240	12.00	80	2.50		
Chaetoceros spp.	80	4.00				
Cyclotella spp.	80	4.00				
Cylindrotheca spp.	80	4.00	400	12.50		
Eucampia spp.			80	2.50		
Fragilaria spp.	320	16.00	400	12.50	80	16.67
Grammatophora spp.			240	7.50		
Hantzschia spp.						
Licmophora spp.	160	8.00				
Mastogloia spp.						
Navicula spp.	80	4.00	160	5.00		
Nitzschia spp.	400	20.00	480	15.00		
Paralia sulcata			80	2.50		
Rhizosolenia spp.						
Thalassionema spp.						
Cyanobacteria			**960**	**30.00**		
Anabaena spp. (PT)			960	30.00		
Dinophyceae	**560**	**28.00**	**320**	**10.00**	**320**	**66.67**
Ceratium furca	160	8.00				
Ceratium trichoceros			80	2.50		
Gymnodinium spp.	400	20.00				
Gyrodinium spp.					80	16.67
Heterocapsa spp.						
Protoperidinium spp.			240	7.50	240	50.00
TOTAL	**2000**	**100**	**3200**	**100**	**480**	**100**

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SAMPLE DETAILS

DE Sample Number	DE01623.4	DE01623.5
Sample Type	Marine	Marine
Client Sample Desc.	C20-B	C21-B
Sample Date	19/01/2021	19/01/2021
Test Method: DE-AM-03		
Analysis Date	9/02/2021	9/02/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**5920**	**93.67**	**8320**	**94.55**		
Achnanthes spp.	160	2.53	80	0.91		
Amphora spp.	560	8.86	640	7.27		
Cylindrotheca spp.	400	6.33	640	7.27		
Chaetoceros spp.	240	3.80	1360	15.45		
Cyclotella spp.						
Fragilaria spp.	1200	18.99	1760	20.00		
Licmophora spp.	1440	22.78	1920	21.82		
Navicula spp.	480	7.59	80	0.91		
Nitzschia spp.	1280	20.25	1520	17.27		
Eucampia spp.			80	0.91		
Mastogloia spp.			80	0.91		
Rhizosolenia spp.			80	0.91		
Thalassionema spp.	160	2.53				
Hantzschia spp.			80	0.91		
Grammatophora spp.						
Paralia sulcata						
Cyanobacteria						
Anabaena spp. (PT)						
Dinophyceae	**400**	**6.33**	**480**	**5.45**		
Ceratium furca						
Ceratium trichoceros						
Gymnodinium spp.	160	2.53	240	2.73		
Gyrodinium spp.			80	0.91		
Heterocapsa spp.	80	1.27				
Protoperidinium spp.	160	2.53	160	1.82		
TOTAL	**6320**	**100**	**8800**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
Telephone	(08) 6272 0000
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Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	19/02/2021

LABORATORY DETAILS

Principal	Stuart Helleren
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Telephone	+61 (0)8 9368 3616
Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01650
Report Number	DE01650.R0
Date Reported	5/03/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
This report may only be reproduced in full.

SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
Telephone	(08) 6272 0000
Facsimile	
Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	19/02/2021

LABORATORY DETAILS

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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01650
Report Number	DE01650.R0
Date Reported	5/03/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01650.1 - **DE01650.5**: Sample clear and colourless.

Sample Notes:

dalcon environmental

SAMPLE DETAILS

DE Sample Number	DE01650.1	DE01650.2	DE01650.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	WQR1-T	WQR2-T	WQR3-T
Sample Date	17/02/2021	17/02/2021	17/02/2021
Test Method:	**DE-AM-03**		
Analysis Date	25/02/2021	25/02/2021	25/02/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**960**	**80.00**	**1040**	**76.47**	**880**	**68.75**
Achnanthes spp.	80	6.67			80	6.25
Amphora spp.	80	6.67	80	5.88	80	6.25
Cerataulina spp.					560	43.75
Chaetoceros spp.			240	17.65		
Climacodium spp.						
Cylindrotheca spp.			160	11.76	80	6.25
Dactyliosolen spp.						
Fragilaria spp.	80	6.67	80	5.88	80	6.25
Hantzschia spp.						
Licmophora spp.	240	20.00	160	11.76		
Microtabella spp.			80	5.88		
Navicula spp.	320	26.67	240	17.65		
Nitzschia spp.	160	13.33				
Rhizosdolenia spp.						
Cryptophyceae					**80**	**6.25**
Cryptomonas spp.					80	6.25
Dinophyceae	**240**	**20.00**	**320**	**23.53**	**320**	**25.00**
Ceratium furca					160	12.50
Ceratium lineatum						
Ceratium trichoceros					80	6.25
Gonyaulax spp.	80	6.67				
Gymnodinium spp.	80	6.67	80	5.88		
Gyrodinium spp.	80	6.67	80	5.88		
Heterocapsa spp.			160	11.76		
Prorocentrum sigmoides					80	6.25
TOTAL	**1200**	**100**	**1360**	**100**	**1280**	**100**

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SAMPLE DETAILS

DE Sample Number	DE01650.4	DE01650.5
Sample Type	Marine	Marine
Client Sample Desc.	WQR4-T	WQR5b-T
Sample Date	17/02/2021	17/02/2021
Test Method:	**DE-AM-03**	
Analysis Date	25/02/2021	25/02/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**560**	**63.64**	**400**	**62.50**		
Achnanthes spp.						
Amphora spp.	80	9.09				
Cerataulina spp.						
Chaetoceros spp.	80	9.09				
Climacodium spp.	160	18.18				
Cylindrotheca spp.						
Dactyliosolen spp.	160	18.18				
Fragilaria spp.						
Hantzschia spp.	80	9.09				
Licmophora spp.						
Microtabella spp.						
Navicula spp.			160	25.00		
Nitzschia spp.			160	25.00		
Rhizosdolenia spp.			80	12.50		
Cryptophyceae						
Cryptomonas spp.						
Dinophyceae	**320**	**36.36**	**240**	**37.50**		
Ceratium furca						
Ceratium lineatum			160	25.00		
Ceratium trichoceros						
Gonyaulax spp.						
Gymnodinium spp.	240	27.27	80	12.50		
Gyrodinium spp.						
Heterocapsa spp.						
Prorocentrum sigmoides	80	9.09				
TOTAL	**880**	**100**	**640**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Martin Loury
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Project	BOOM
Samples	5
Date Received	19/02/2021

LABORATORY DETAILS

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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01651
Report Number	DE01651.R0
Date Reported	5/03/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
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SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
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Facsimile	
Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	19/02/2021

LABORATORY DETAILS

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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01651
Report Number	DE01651.R0
Date Reported	5/03/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01651.1 - **DE01651.5**: Sample clear and colourless.

Sample Notes:

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SAMPLE DETAILS

DE Sample Number	DE01651.1	DE01651.2	DE01651.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	WQR1-B	WQR2-B	WQR3-B
Sample Date	17/02/2021	17/02/2021	17/02/2021
Test Method:	**DE-AM-03**		
Analysis Date	25/02/2021	25/02/2021	25/02/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**960**	**80.00**	**880**	**78.57**	**480**	**75.00**
Achnanthes spp.						
Amphora spp.	80	6.67				
Cerataulina spp.			240	21.43	80	12.50
Chaetoceros spp.	240	20.00	160	14.29	80	12.50
Cylindrotheca spp.	80	6.67				
Dactyliosolen spp.						
Eucampia spp.			320	28.57		
Hantzschia spp.	80	6.67			160	25.00
Licmophora spp.	160	13.33	80	7.14		
Mastogloia spp.						
Navicula spp.					80	12.50
Nitzschia spp.	240	20.00			80	12.50
Pinnularia spp.			80	7.14		
Pseudo-nitzschia "delicatissima" group (PT)						
Synedra spp.	80	6.67				
Dinophyceae	**240**	**20.00**	**240**	**21.43**	**160**	**25.00**
Ceratium furca	80	6.67				
Ceratium lineatum					80	12.50
Gonyaulax spp.			80	7.14		
Gymnodinium spp.			80	7.14		
Gyrodinium spp.	160	13.33				
Heterocapsa spp.					80	12.50
Prorocentrum rathymum			80	7.14		
TOTAL	**1200**	**100**	**1120**	**100**	**640**	**100**

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SAMPLE DETAILS

DE Sample Number	DE01651.4	DE01651.5
Sample Type	Marine	Marine
Client Sample Desc.	WQR4-B	WQR5b-B
Sample Date	17/02/2021	17/02/2021
Test Method:	**DE-AM-03**	
Analysis Date	25/02/2021	25/02/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**1440**	**85.71**	**960**	**92.31**		
Achnanthes spp.	80	4.76				
Amphora spp.	80	4.76	80	7.69		
Cerataulina spp.						
Chaetoceros spp.						
Cylindrotheca spp.	240	14.29				
Dactyliosolen spp.			320	30.77		
Eucampia spp.						
Hantzschia spp.	80	4.76				
Licmophora spp.	80	4.76				
Mastogloia spp.			80	7.69		
Navicula spp.	160	9.52	320	30.77		
Nitzschia spp.	400	23.81	160	15.38		
Pinnularia spp.						
Pseudo-nitzschia "delicatissima" group (PT)	320	19.05				
Synedra spp.						
Dinophyceae	**240**	**14.29**	**80**	**7.69**		
Ceratium furca						
Ceratium lineatum	80	4.76				
Gonyaulax spp.						
Gymnodinium spp.	80	4.76	80	7.69		
Gyrodinium spp.						
Heterocapsa spp.						
Prorocentrum rathymum	80	4.76				
TOTAL	**1680**	**100**	**1040**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Martin Loury
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Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
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Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	19/02/2021

LABORATORY DETAILS

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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01652
Report Number	DE01652.R0
Date Reported	5/03/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
This report may only be reproduced in full.

SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
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Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	19/02/2021

LABORATORY DETAILS

Principal	Stuart Helleren
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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01652
Report Number	DE01652.R0
Date Reported	5/03/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01652.1 - **DE01652.5**: Sample clear and colourless.

Sample Notes:

dalcon environmental

SAMPLE DETAILS

DE Sample Number	DE01652.1	DE01652.2	DE01652.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	C13-T (INT)	C14-T (INT)	C15-T (INT)
Sample Date	17/02/2021	17/02/2021	17/02/2021
Test Method:	**DE-AM-03**		
Analysis Date	30/03/2021	30/03/2021	30/03/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**2160**	**25.47**	**1840**	**85.19**	**80**	**25.00**
Achnanthidium spp.						
Achnanthes spp.	160	1.89	320	14.81		
Amphora spp.	160	1.89	80	3.70		
Aulacoseira spp.			640	29.63		
Bacteriastrum spp.						
Cerataulina spp.	80	0.94	80	3.70		
Chaetoceros spp.						
Cylindrotheca spp.	80	0.94				
Cymbella spp.	80	0.94				
Diploneis						
Entomoneis spp.						
Eucampia spp.	160	1.89				
Fragilaria spp.						
Grammatophora spp.						
Hantzschia spp.						
Licmophora spp.	80	0.94	240	11.11		
Mastogloia spp.						
Navicula spp.	160	1.89	80	3.70		
Nitzschia spp.	560	6.60	80	3.70	80	25.00
Pseudo-nitzschia "delicatissima" group (PT)	640	7.55	320	14.81		
Rhizosdolenia spp.						
Cyanobacteria	**5760**	**67.92**				
Anabaena spp. (PT)	480	5.66				
Limnothrix spp.	1280	15.09				
Trichodesmium erythraeum	4000	47.17				
Dinophyceae	**560**	**6.60**	**320**	**14.81**	**240**	**75.00**
Ceratium furca	240	2.83	160	7.41		
Ceratium lineatum	80	0.94				
Ceratium trichoceros			80	3.70		
Gymnodinium spp.	160	1.89	80	3.70	80	25.00
Gyrodinium spirale	80	0.94			160	50.00
Gyrodinium spp.						
Katodinium spp.						
Prorocentrum cordatum (PT)						
TOTAL	**8480**	**100**	**2160**	**100**	**320**	**100**

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SAMPLE DETAILS

DE Sample Number	DE01652.4	DE01652.5
Sample Type	Marine	Marine
Client Sample Desc.	C16-T (INT)	C17-T (INT)
Sample Date	17/02/2021	17/02/2021
Test Method:	**DE-AM-03**	
Analysis Date	30/03/2021	30/03/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**1680**	**87.50**	**2320**	**39.19**		
Achnanthidium spp.			160	2.70		
Achnanthes spp.						
Amphora spp.			80	1.35		
Aulacoseira spp.						
Bacteriastrum spp.	240	12.50				
Cerataulina spp.						
Chaetoceros spp.	400	20.83				
Cylindrotheca spp.						
Cymbella spp.						
Diploneis			80	1.35		
Entomoneis spp.			80	1.35		
Eucampia spp.						
Fragilaria spp.	80	4.17	80	1.35		
Grammatophora spp.	240	12.50				
Hantzschia spp.			80	1.35		
Licmophora spp.	240	12.50				
Mastogloia spp.			720	12.16		
Navicula spp.			160	2.70		
Nitzschia spp.	480	25.00	400	6.76		
Pseudo-nitzschia "delicatissima" group (PT)			400	6.76		
Rhizosdolenia spp.			80	1.35		
Cyanobacteria			**3200**	**54.05**		
Anabaena spp. (PT)						
Limnothrix spp.						
Trichodesmium erythraeum			3200	54.05		
Dinophyceae	**240**	**12.50**	**400**	**6.76**		
Ceratium furca	80	4.17	160	2.70		
Ceratium lineatum						
Ceratium trichoceros						
Gymnodinium spp.	80	4.17	80	1.35		
Gyrodinium spirale						
Gyrodinium spp.			80	1.35		
Katodinium spp.	80	4.17				
Prorocentrum cordatum (PT)			80	1.35		
TOTAL	**1920**	**100**	**5920**	**100**		

dalcon environmental

NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Martin Loury
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Project	BOOM
Samples	5
Date Received	19/02/2021

LABORATORY DETAILS

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Dalcon Environmental Reference	DE01653
Report Number	DE01653.R0
Date Reported	5/03/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
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SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
Telephone	(08) 6272 0000
Facsimile	
Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	19/02/2021

LABORATORY DETAILS

Principal	Stuart Helleren
Laboratory	Dalcon Environmental
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Telephone	+61 (0)8 9368 3616
Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01653
Report Number	DE01653.R0
Date Reported	5/03/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01653.1 - **DE01653.5**: Sample clear and colourless.

Sample Notes:

dalcon environmental

SAMPLE DETAILS

DE Sample Number	DE01653.1	DE01653.2	DE01653.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	C29-T	C30-T	C31-T
Sample Date	17/02/2021	17/02/2021	17/02/2021
Test Method:	**DE-AM-03**		
Analysis Date	4/03/2021	4/03/2021	4/03/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**1520**	**90.48**	**2000**	**86.21**	**880**	**91.67**
Achnanthidium spp.	80	4.76	80	3.45	160	16.67
Amphora spp.	80	4.76	160	6.90		
Aulacoseira spp.			640	27.59		
Chaetoceros spp.	560	33.33	400	17.24	160	16.67
Cocconeis spp.					80	8.33
Cyclotella spp.	160	9.52				
Dactyliosolen spp.			80	3.45		
Fragilaria spp.	80	4.76			80	8.33
Licmophora spp.	320	19.05	240	10.34		
Mastogloia spp.						
Navicula spp.	80	4.76	80	3.45	80	8.33
Nitzschia spp.	80	4.76			320	33.33
Pseudo-nitzschia "delicatissima" group (PT)			160	6.90		
Rhizosdolenia spp.	80	4.76				
Thalassiosira spp.			80	3.45		
Tropidoneis spp.			80	3.45		
Dinophyceae	**160**	**9.52**	**320**	**13.79**	**80**	**8.33**
Ceratium furca			240	10.34		
Gymnodinium spp.	80	4.76	80	3.45		
Gyrodinium spp.					80	8.33
Prorocentrum micans	80	4.76				
Protoperidinium spp.						
TOTAL	**1680**	**100**	**2320**	**100**	**960**	**100**

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SAMPLE DETAILS

DE Sample Number	DE01653.4	DE01653.5
Sample Type	Marine	Marine
Client Sample Desc.	C32-T	C17-T
Sample Date	17/02/2021	17/02/2021
Test Method:	**DE-AM-03**	
Analysis Date	4/03/2021	4/03/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**1680**	**87.50**	**1280**	**94.12**		
Achnanthidium spp.	80	4.17	80	5.88		
Amphora spp.						
Aulacoseira spp.						
Chaetoceros spp.			800	58.82		
Cocconeis spp.						
Cyclotella spp.						
Dactyliosolen spp.						
Fragilaria spp.	240	12.50	80	5.88		
Licmophora spp.	560	29.17	80	5.88		
Mastogloia spp.	80	4.17	80	5.88		
Navicula spp.	160	8.33	80	5.88		
Nitzschia spp.	560	29.17	80	5.88		
Pseudo-nitzschia "delicatissima" group (PT)						
Rhizosdolenia spp.						
Thalassiosira spp.						
Tropidoneis spp.						
Dinophyceae	**240**	**12.50**	**80**	**5.88**		
Ceratium furca						
Gymnodinium spp.	160	8.33	80	5.88		
Gyrodinium spp.						
Prorocentrum micans						
Protoperidinium spp.	80	4.17				
TOTAL	**1920**	**100**	**1360**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
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Facsimile	
Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	19/02/2021

LABORATORY DETAILS

Principal	Stuart Helleren
Laboratory	Dalcon Environmental
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Telephone	+61 (0)8 9368 3616
Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01654
Report Number	DE01654.R0
Date Reported	5/03/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
This report may only be reproduced in full.

SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
Telephone	(08) 6272 0000
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Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	19/02/2021

LABORATORY DETAILS

Principal	Stuart Helleren
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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01654
Report Number	DE01654.R0
Date Reported	5/03/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01654.1 - **DE01654.5**: Sample clear and colourless.

Sample Notes:

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SAMPLE DETAILS

DE Sample Number	DE01654.1	DE01654.2	DE01654.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	C29-B	C30-B	C31-B
Sample Date	17/02/2021	17/02/2021	17/02/2021
Test Method:	**DE-AM-03**		
Analysis Date	4/03/2021	4/03/2021	4/03/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**1840**	**95.83**	**2160**	**90.00**	**1600**	**25.97**
Achnanthidium spp.					160	2.60
Amphora spp.	160	8.33				
Ardissonea spp.						
Cerataulina spp.					320	5.19
Chaetoceros spp.	480	25.00				
Climacodium spp.			320	13.33		
Cocconeis spp.			80	3.33		
Diploneis			80	3.33		
Entomoneis spp.	80	4.17	80	3.33		
Eucampia spp.	160	8.33				
Fragilaria spp.	160	8.33	480	20.00	80	1.30
Guinardia spp.			80	3.33		
Licmophora spp.			160	6.67	720	11.69
Mastogloia spp.						
Navicula spp.	80	4.17	160	6.67	160	2.60
Nitzschia spp.	480	25.00	400	16.67	160	2.60
Pseudo-nitzschia "delicatissima" group (PT)	240	12.50	320	13.33		
Dinophyceae	**80**	**4.17**	**240**	**10.00**	**4560**	**74.03**
Gymnodinium spp.			160	6.67	80	1.30
Gyrodinium spp.					80	1.30
Heterocapsa spp.	80	4.17	80	3.33		
Protoperidinium spp.					4400	71.43
TOTAL	**1920**	**100**	**2400**	**100**	**6160**	**100**

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SAMPLE DETAILS

DE Sample Number	DE01654.4	DE01654.5
Sample Type	Marine	Marine
Client Sample Desc.	C32-B	C17-B
Sample Date	17/02/2021	17/02/2021
Test Method:	**DE-AM-03**	
Analysis Date	4/03/2021	4/03/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**640**	**88.89**	**1760**	**84.62**		
Achnanthidium spp.	80	11.11	160	7.69		
Amphora spp.						
Ardissonea spp.	80	11.11				
Cerataulina spp.						
Chaetoceros spp.						
Climacodium spp.						
Cocconeis spp.			80	3.85		
Diploneis						
Entomoneis spp.						
Eucampia spp.						
Fragilaria spp.			80	3.85		
Guinardia spp.						
Licmophora spp.	320	44.44	400	19.23		
Mastogloia spp.			80	3.85		
Navicula spp.			160	7.69		
Nitzschia spp.	160	22.22	480	23.08		
Pseudo-nitzschia "delicatissima" group (PT)			320	15.38		
Dinophyceae	**80**	**11.11**	**320**	**15.38**		
Gymnodinium spp.	80	11.11	240	11.54		
Gyrodinium spp.			80	3.85		
Heterocapsa spp.						
Protoperidinium spp.						
TOTAL	**720**	**100**	**2080**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

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Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
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Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	1/04/2021

LABORATORY DETAILS

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Dalcon Environmental Reference	DE01718
Report Number	DE01718.R0
Date Reported	25/04/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
This report may only be reproduced in full.

SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

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LABORATORY DETAILS

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Project BOOM
Samples 5
Date Received 1/04/2021

Dalcon Environmental Reference DE01718
Report Number DE01718.R0
Date Reported 25/04/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01718.1 - **DE01718.5**: Sample clear and colourless.

Sample Notes:

SAMPLE DETAILS

DE Sample Number	DE01718.1	DE01718.2	DE01718.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	WQR1-T	WQR2-T	WQR3-T
Sample Date	24/03/2021	24/03/2021	24/03/2021
Test Method:	**DE-AM-03**		
Analysis Date	15/04/2021	15/04/2021	15/04/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**4880**	**95.31**	**3520**	**28.95**	**2000**	**83.33**
Achnanthes spp.	80	1.56				
Amphora spp.			160	1.32		
Chaetoceros peruvianus						
Cocconeis spp.	80	1.56			80	3.33
Cylindrotheca spp.			80	0.66	80	3.33
Eucampia spp.	400	7.81	160	1.32		
Hantzschia spp.			160	1.32		
Licmophora spp.	3440	67.19	1440	11.84	1040	43.33
Navicula spp.	400	7.81	320	2.63	160	6.67
Nitzschia spp.	320	6.25	1040	8.55	480	20.00
Pseudo-nitzschia "delicatissima" group (PTP)	160	3.13	160	1.32	160	6.67
Cryptophyceae						
Cryptophytes (unknown)						
Cyanobacteria			**8320**	**68.42**		
Trichodesmium erythraeum			8320	68.42		
Dinophyceae	**240**	**4.69**	**320**	**2.63**	**400**	**16.67**
Ceratium furca			160	1.32		
Gymnodinium spp.	160	3.13				
Gyrodinium spp.					160	6.67
Prorocentrum gracile					80	3.33
Prorocentrum micans			80	0.66		
Prorocentrum rhathymum (PTP)			80	0.66		
Prorocentrum sigmoides					160	6.67
Protoperidinium spp.	80	1.56				
TOTAL	**5120**	**100**	**12160**	**100**	**2400**	**100**

SAMPLE DETAILS

DE Sample Number	DE01718.4	DE01718.5
Sample Type	Marine	Marine
Client Sample Desc.	WQR4-T	WQR5b-T
Sample Date	24/03/2021	24/03/2021
Test Method:	**DE-AM-03**	
Analysis Date	15/04/2021	15/04/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**3040**	**95.00**	**5360**	**93.06**		
Achnanthes spp.						
Amphora spp.						
Chaetoceros peruvianus	80	2.50				
Cocconeis spp.			80	1.39		
Cylindrotheca spp.						
Eucampia spp.	160	5.00				
Hantzschia spp.						
Licmophora spp.	1200	37.50	2800	48.61		
Navicula spp.	160	5.00	480	8.33		
Nitzschia spp.	1280	40.00	1760	30.56		
Pseudo-nitzschia "delicatissima" group (PTP)	160	5.00	240	4.17		
Cryptophyceae	**80**	**2.50**				
Cryptophytes (unknown)	80	2.50				
Cyanobacteria						
Trichodesmium erythraeum						
Dinophyceae	**80**	**2.50**	**400**	**6.94**		
Ceratium furca	80	2.50	80	1.39		
Gymnodinium spp.						
Gyrodinium spp.						
Prorocentrum gracile						
Prorocentrum micans			80	1.39		
Prorocentrum rhathymum (PTP)						
Prorocentrum sigmoides			160	2.78		
Protoperidinium spp.			80	1.39		
TOTAL	**3200**	**100**	**5760**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
Telephone	(08) 6272 0000
Facsimile	
Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	1/04/2021

LABORATORY DETAILS

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Dalcon Environmental Reference	DE01719
Report Number	DE01719.R0
Date Reported	25/04/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
This report may only be reproduced in full.

SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

Contact	Martin Loury
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Project	BOOM
Samples	5
Date Received	1/04/2021

LABORATORY DETAILS

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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01719
Report Number	DE01719.R0
Date Reported	25/04/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01719.1 - **DE01719.5**: Sample clear and colourless.

Sample Notes:

SAMPLE DETAILS

DE Sample Number	DE01719.1	DE01719.2	DE01719.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	WQR1-B	WQR2-B	WQR3-B
Sample Date	24/03/2021	24/03/2021	24/03/2021
Test Method:	**DE-AM-03**		
Analysis Date	15/04/2021	15/04/2021	20/04/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**3760**	**95.92**	**2480**	**96.88**	**4960**	**73.81**
Achnanthes spp.			80	3.13		
Achnanthidium spp.						
Amphora spp.					80	1.19
Chaetoceros "singles" spp.					80	1.19
Chaetoceros spp.					400	5.95
Cocconeis spp.						
Eucampia spp.					160	2.38
Hantzschia spp.						
Licmophora spp.	2320	59.18	1600	62.50	2400	35.71
Mastogloia spp.	80	2.04				
Navicula spp.	400	10.20	400	15.63	80	1.19
Nitzschia reversa					80	1.19
Nitzschia spp.	720	18.37	400	15.63	1120	16.67
Pseudo-nitzschia "delicatissima" group (PTP)	240	6.12			560	8.33
Synedra spp.						
Cyanobacteria					1680	25.00
Limnothrix spp.					80	1.19
Pseudanabaena spp.					1600	23.81
Dinophyceae	**160**	**4.08**	**80**	**3.13**	80	1.19
Ceratium furca	80	2.04			80	1.19
Gymnodinium spp.	80	2.04				
Prorocentrum rhathymum (PTP)			80	3.13		
Prorocentrum sigmoides						
Prasinophyceae						
Tetraselmis spp.						
TOTAL	**3920**	**100**	**2560**	**100**	**6720**	**100**

SAMPLE DETAILS

DE Sample Number	DE01719.4	DE01719.5
Sample Type	Marine	Marine
Client Sample Desc.	WQR4-B	WQR5b-B
Sample Date	24/03/2021	24/03/2021
Test Method:	**DE-AM-03**	
Analysis Date	20/04/2021	20/04/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**3760**	**94.00**	**3840**	**96.00**		
Achnanthes spp.						
Achnanthidium spp.			80	2.00		
Amphora spp.			80	2.00		
Chaetoceros "singles" spp.			80	2.00		
Chaetoceros spp.	960	24.00	80	2.00		
Cocconeis spp.			80	2.00		
Eucampia spp.						
Hantzschia spp.			80	2.00		
Licmophora spp.	1280	32.00	2160	54.00		
Mastogloia spp.						
Navicula spp.	480	12.00	480	12.00		
Nitzschia reversa	160	4.00				
Nitzschia spp.	560	14.00	640	16.00		
Pseudo-nitzschia "delicatissima" group (PTP)	320	8.00				
Synedra spp.			80	2.00		
Cyanobacteria						
Limnothrix spp.						
Pseudanabaena spp.						
Dinophyceae	**240**	**6.00**	**160**	**4.00**		
Ceratium furca	160	4.00				
Gymnodinium spp.			160	4.00		
Prorocentrum rhathymum (PTP)						
Prorocentrum sigmoides	80	2.00				
Prasinophyceae	**80**	**2.00**				
Tetraselmis spp.	80	2.00				
TOTAL	**4000**	**102**	**4000**	**100**		

dalcon environmental

NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Martin Loury
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Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	1/04/2021

LABORATORY DETAILS

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Telephone	+61 (0)8 9368 3616
Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01720
Report Number	DE01720.R0
Date Reported	25/04/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
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SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

Contact	Martin Loury
Client	BMT
Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
Telephone	(08) 6272 0000
Facsimile	
Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	1/04/2021

LABORATORY DETAILS

Principal	Stuart Helleren
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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01720
Report Number	DE01720.R0
Date Reported	25/04/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01720.1 - **DE01720.5**: Sample clear and colourless.

Sample Notes:

SAMPLE DETAILS

DE Sample Number	DE01720.1	DE01720.2	DE01720.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	C9-T	C10-T	C11-T
Sample Date	24/03/2021	24/03/2021	24/03/2021
Test Method:	**DE-AM-03**		
Analysis Date	20/04/2021	20/04/2021	20/04/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**3360**	**58.33**	**3440**	**74.14**	**2400**	**88.24**
Achnanthidium spp.	160	2.78				
Amphora spp.	80	1.39				
Cylindrotheca spp.	160	2.78	160	3.45	320	11.76
Eucampia spp.					320	11.76
Fragilaria spp.			80	1.72		
Hantzschia spp.			80	1.72		
Licmophora spp.	2240	38.89	2560	55.17	1360	50.00
Mastogloia spp.						
Navicula spp.	240	4.17	160	3.45	160	5.88
Nitzschia spp.	480	8.33	400	8.62	80	2.94
Rhizosolenia stolterfothii					160	5.88
Cyanobacteria	**1760**	**30.56**	**960**	**20.69**		
Pseudanabaena spp.	1760	30.56	960	20.69		
Dinophyceae	**640**	**11.11**	**240**	**5.17**	**320**	**11.76**
Ceratium furca	240	4.17	80	1.72	160	5.88
Gymnodinium spp.	80	1.39				
Gyrodinium spp.					80	2.94
Katodinium glaucum						
Prorocentrum micans	80	1.39				
Prorocentrum rhathymum (PTP)						
Prorocentrum sigmoides	240	4.17	160	3.45		
Protoperidinium spp.					80	2.94
TOTAL	**5760**	**100**	**4640**	**100**	**2720**	**100**

SAMPLE DETAILS

DE Sample Number	DE01720.4	DE01720.5
Sample Type	Marine	Marine
Client Sample Desc.	C12-T	C13-T
Sample Date	24/03/2021	24/03/2021
Test Method:	**DE-AM-03**	
Analysis Date	20/04/2021	20/04/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**2960**	**88.10**	**2560**	**91.43**		
Achnanthidium spp.						
Amphora spp.	80	2.38				
Cylindrotheca spp.	80	2.38	160	5.71		
Eucampia spp.						
Fragilaria spp.						
Hantzschia spp.			80	2.86		
Licmophora spp.	2480	73.81	1920	68.57		
Mastogloia spp.	80	2.38				
Navicula spp.	80	2.38	80	2.86		
Nitzschia spp.	160	4.76	320	11.43		
Rhizosolenia stolterfothii						
Cyanobacteria						
Pseudanabaena spp.						
Dinophyceae	**400**	**11.90**	**240**	**8.57**		
Ceratium furca	160	4.76	80	2.86		
Gymnodinium spp.						
Gyrodinium spp.	160	4.76				
Katodinium glaucum			80	2.86		
Prorocentrum micans						
Prorocentrum rhathymum (PTP)	80	2.38				
Prorocentrum sigmoides			80	2.86		
Protoperidinium spp.						
TOTAL	**3360**	**100**	**2800**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

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Telephone	(08) 6272 0000
Facsimile	
Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	1/04/2021

LABORATORY DETAILS

Principal	Stuart Helleren
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Dalcon Environmental Reference	DE01721
Report Number	DE01721.R0
Date Reported	25/04/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
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SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

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Project	BOOM
Samples	5
Date Received	1/04/2021

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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01721
Report Number	DE01721.R0
Date Reported	25/04/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01721.1 - **DE01721.5**: Sample clear and colourless.

Sample Notes:

SAMPLE DETAILS

DE Sample Number	DE01721.1	DE01721.2	DE01721.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	C25-T	C26-T	C27-T
Sample Date	24/03/2021	24/03/2021	24/03/2021
Test Method:	**DE-AM-03**		
Analysis Date	20/04/2021	20/04/2021	20/04/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**2480**	**91.18**	**3200**	**86.96**	**3520**	**88.00**
Achnanthidium spp.	80	2.94	80	2.17	80	2.00
Cerataulina spp.					80	2.00
Chaetoceros "singles" spp.			160	4.35		
Cocconeis spp.	80	2.94	80	2.17		
Cylindrotheca spp.	160	5.88	400	10.87		
Hantzschia spp.			80	2.17		
Licmophora spp.	1280	47.06	1840	50.00	2960	74.00
Navicula spp.	240	8.82	240	6.52	80	2.00
Nitzschia spp.	640	23.53	320	8.70	320	8.00
Rhizosolenia spp.						
Dinophyceae	**240**	**8.82**	**480**	**13.04**	**480**	**12.00**
Ceratium furca	160	5.88			320	8.00
Gyrodinium spirale			80	2.17		
Heterocapsa spp.			80	2.17		
Prorocentrum micans					80	2.00
Prorocentrum rhathymum (PTP)	80	2.94				
Prorocentrum sigmoides			160	4.35	80	2.00
Protoperidinium spp.			80	2.17		
Scrippsiella spp.			80	2.17		
TOTAL	**2720**	**100**	**3680**	**100**	**4000**	**100**

SAMPLE DETAILS

DE Sample Number	DE01721.4	DE01721.5
Sample Type	Marine	Marine
Client Sample Desc.	C28-T	C29-T
Sample Date	24/03/2021	24/03/2021
Test Method:	**DE-AM-03**	
Analysis Date	20/04/2021	21/04/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**2800**	**87.50**	**4160**	**94.55**		
Achnanthidium spp.			80	1.82		
Cerataulina spp.						
Chaetoceros "singles" spp.						
Cocconeis spp.	80	2.50				
Cylindrotheca spp.	80	2.50	400	9.09		
Hantzschia spp.			160	3.64		
Licmophora spp.	2240	70.00	2400	54.55		
Navicula spp.	80	2.50	720	16.36		
Nitzschia spp.	240	7.50	400	9.09		
Rhizosolenia spp.	80	2.50				
Dinophyceae	**400**	**12.50**	**240**	**5.45**		
Ceratium furca	320	10.00				
Gyrodinium spirale						
Heterocapsa spp.						
Prorocentrum micans			80	1.82		
Prorocentrum rhathymum (PTP)						
Prorocentrum sigmoides			80	1.82		
Protoperidinium spp.	80	2.50				
Scrippsiella spp.			80	1.82		
TOTAL	**3200**	**100**	**4400**	**100**		

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NATA WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS

Contact	Martin Loury
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Email	martin.lourey@bmtoceanica.com.au
Project	BOOM
Samples	5
Date Received	1/04/2021

LABORATORY DETAILS

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Dalcon Environmental Reference	DE01722
Report Number	DE01722.R0
Date Reported	25/04/2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing.
NATA accredited laboratory 20077.

These results apply only to the sample(s) as received and tested.
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SIGNATORY

Dr Stuart Helleren
Principal/Senior Scientist

CLIENT DETAILS

Contact	Martin Loury
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Address	Level 4/20 Parkland Rd, Osborne Park, WA, 6017
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Project	BOOM
Samples	5
Date Received	1/04/2021

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Email	stuart.helleren@dalconenvironmental.com.au
Dalcon Environmental Reference	DE01722
Report Number	DE01722.R0
Date Reported	25/04/2021

LABORATORY COMMENTS

Sample preserved with Lugol's Iodine Solution (by Client).
Preservation adequate.
Sample integrity intact.

Sample analysed using method DE-AM-03 (version 25/0.5). Limit of Reporting = 80 cells L-1

Suffix (PT) = potential toxin producer
Suffix (t) = trichome/filamentSuffix (unknown) = unidentifiable to genus level

Where (PT) is indicated next to a genus, it should be noted that not all (and, in most cases, only a few) species within that genus are responsible for producing these compounds.

No exceedances of WASQAP (2015)/MBMMP (2016) Trigger Values.

OTHER COMMENTS

Purchase Order: NA

Sample Description:
DE01722.1 - **DE01722.5**: Sample clear and colourless.

Sample Notes:

SAMPLE DETAILS

DE Sample Number	DE01722.1	DE01722.2	DE01722.3
Sample Type	Marine	Marine	Marine
Client Sample Desc.	C25-B	C26-B	C27-B
Sample Date	24/03/2021	24/03/2021	24/03/2021
Test Method:	**DE-AM-03**		
Analysis Date	21/04/2021	21/04/2021	20/04/2021
Chamber Type	TPC	TPC	TPC
Chamber Volume	25 ml	25 ml	25 ml
Concentration Factor	NA	NA	NA
Units	Cells L^{-1}	Cells L^{-1}	Cells L^{-1}
LOR	80	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%	Abund.	%
Bacillariophyceae	**3120**	**95.12**	**2640**	**91.67**	**3360**	**100.00**
Achnanthidium spp.						
Cocconeis spp.			80	2.78		
Cylindrotheca spp.	320	9.76			80	2.38
Eucampia spp.					160	4.76
Gyrosigma spp.						
Hantzschia spp.			80	2.78		
Licmophora spp.	1200	36.59	1520	52.78	2400	71.43
Mastogloia spp.						
Navicula spp.	480	14.63	240	8.33	160	4.76
Nitzschia spp.	800	24.39	560	19.44	560	16.67
Pseudo-nitzschia "delicatissima" group (PTP)	320	9.76	160	5.56		
Dinophyceae	**160**	**4.88**	**240**	**8.33**		
Dinophysis caudata (PTP)	160	4.88				
Prorocentrum micans						
Prorocentrum rhathymum (PTP)			80	2.78		
Prorocentrum sigmoides			160	5.56		
Protoperidinium spp.						
TOTAL	**3280**	**100**	**2880**	**100**	**3360**	**100**

SAMPLE DETAILS

DE Sample Number	DE01722.4	DE01722.5
Sample Type	Marine	Marine
Client Sample Desc.	C28-B	C29-B
Sample Date	24/03/2021	24/03/2021
Test Method:	**DE-AM-03**	
Analysis Date	21/04/2021	21/04/2021
Chamber Type	TPC	TPC
Chamber Volume	25 ml	25 ml
Concentration Factor	NA	NA
Units	Cells L^{-1}	Cells L^{-1}
LOR	80	80

Analytical Results

Taxon	Abund.	%	Abund.	%		
Bacillariophyceae	**2560**	**91.43**	**4240**	**98.15**		
Achnanthidium spp.			80	1.85		
Cocconeis spp.						
Cylindrotheca spp.			160	3.70		
Eucampia spp.						
Gyrosigma spp.			80	1.85		
Hantzschia spp.			80	1.85		
Licmophora spp.	2320	82.86	3280	75.93		
Mastogloia spp.	80	2.86				
Navicula spp.			80	1.85		
Nitzschia spp.			480	11.11		
Pseudo-nitzschia "delicatissima" group (PTP)	160	5.71				
Dinophyceae	**240**	**8.57**	**80**	**1.85**		
Dinophysis caudata (PTP)						
Prorocentrum micans	80	2.86				
Prorocentrum rhathymum (PTP)						
Prorocentrum sigmoides						
Protoperidinium spp.	160	5.71	80	1.85		
TOTAL	**2800**	**100**	**4320**	**100**		

BOOM Seagrass monitoring 2021						
SITE:	SG1	**DATE:**	20/01/2021		**OBSERVER:**	SC, AG
Quadrat	Shoot density (P. aus) ((Amphib))	% cover est	colonisers (Hz, Hal)	Epiphytes (F,E,C 1,2,3)*	Comments	
1A	0	-	-	-		
2A	0	-	-	-		
3A	0	-	-	-		
4A	1	<1	-	E1	2 pins left	
5A	3	<5	-	E2F1		
6	70	100	-	E2F2		
7	79	100	-	E2F1		
8	11	10	-	E2F2		
9	53	100	-	E1F2		
10	28	70	Hal	E1		
Random 1	43	90	-	-		
Random 2	56	100	-	E1F2		
Random 3	49	100	-	E1F2		
Random 4	43	90	-	E1		

*__F__ = Filamentous, __E__ = Encrusting, __C__ = Corticose (foliose)

__1__ = Low loading , __2__ = Medium loading, __3__ = High loading

E.g. F2 = Medium filamentous

F1 E3 = Low filamentous and high encrusting

BOOM Seagrass monitoring 2021						
SITE:	SG2	**DATE:**	21/01/2021		**OBSERVER:**	KW, IB
Quadrat	Shoot density (P. aus) ((Amphib))	% cover est	colonisers (Hz, Hal)	Epiphytes (F,E,C 1,2,3)*	Comments	
1A	6(1)	2	-	E2F1	Macroalgae	
3A	7(3)	5	-	E2F1	Exposed rhizome	
4A	4	2	-	E2F1	Rock and macroalgae	
6	78	90	-	E2F2		
7	0(4)	-	-	-	Macroalgae	
8	27	30	-	E2F1		
9	33(5)	40	-	E2F1		
10	50	60	-	E2F1		
11	0	0	-	-	Macroalgae with sediment over rock	
12	21	30	Hal	E2F3	Macroalgae with sediment over rock	

***F** = Filamentous, **E** = Encrusting, **C** = Corticose (foliose) E.g. F2 = Medium filamentous

1 = Low loading , **2** = Medium loading, **3** = High loading 3 = Low filamentous and high encrusting

BOOM Seagrass monitoring 2021						
SITE:	SG3	**DATE:**	21/01/2021		**OBSERVER:**	SC, AG
Quadrat	Shoot density (P. aus) ((Amphib))	% cover est	colonisers (Hz, Hal)	Epiphytes (F,E,C 1,2,3)*	Comments	
3A	18	40	Hal	E2F3		
4A	37	60	Hal	E2F3		
5A	0	-	-	-	Rope	
6	39(2)	70	Hal	E2F3		
7	53	100	Hal	E2F3		
8	57	100	Hal	E2F3		
9	49	100	Hal	E2F3		
10	71	100	-	E2F3		
11	48	90	-	E2F2		
12	65	90	Hal	E3F2		

*__F__ = Filamentous, __E__ = Encrusting, __C__ = Corticose (foliose)
__1__ = Low loading , __2__ = Medium loading, __3__ = High loading

E.g. F2 = Medium filamentous
F1 E3 = Low filamentous and hi

BOOM Seagrass monitoring 2021						
SITE:	SG4	**DATE:**	20/01/2021		**OBSERVER:**	KW, IB
Quadrat	Shoot density (P. aus) ((Amphib))	% cover est	colonisers (Hz, Hal)	Epiphytes (F,E,C 1,2,3)*	Comments	
1B	12	15	-	E2	Rock and macroalgae	
2A	0	-	-	-	Rock and macroalgae	
3A	7	5	-	E1F2	Rock and macroalgae	
4B	30	30	Hal	E2F3	Next to large sandy area	
5A	4	5	-	E2F2	Macroalgae	
6	5	5	-	E1F1	Macroalgae	
7	41	50	-	E2F3		
8	47	50	-	E2F3		
9	44	50	-	E2F3		
10	4	<5	-	E1	Rhizomes exposed	

*__F__ = Filamentous, __E__ = Encrusting, __C__ = Corticose (foliose) E.g. F2 = Medium filamentous

__1__ = Low loading , __2__ = Medium loading, __3__ = High loading F1 E3 = Low filamentous and high

BOOM Seagrass monitoring 2021						
SITE:	SG4d	**DATE:**	20/01/2021		**OBSERVER:**	KW, AG
Quadrat	Shoot density (P. aus) ((Amphib))	% cover est	colonisers (Hz, Hal)	Epiphytes (F,E,C 1,2,3)*	Comments	
1B	49	80	-	E2F3		
2A	43	90	-	E2F3		
3A	38	80	-	E2F3		
4A	36	60	-	E2F3		
5A	32	40	-	E2F3		
6	32	50	-	E1F2		
7	35	70	-	E2F2		
8	7	<10	-	E1F2		
9	53	100	-	E2F3		
10	28	50	-	E2F2		

*__F__ = Filamentous, __E__ = Encrusting, __C__ = Corticose (foliose) E.g. F2 = Medium filamentous

__1__ = Low loading , __2__ = Medium loading, __3__ = High loading 3 = Low filamentous and high encrusting

BOOM Seagrass monitoring 2021						
SITE:	SGR1	**DATE:**	20/01/2021		**OBSERVER:**	SC AG
Quadrat	Shoot density (P. aus) ((Amphib))	% cover est	colonisers (Hz, Hal)	Epiphytes (F,E,C 1,2,3)*	Comments	
1A	34	80	-	F2E1		
2A	64	100	-	F2E1		
3B	60	80	-	F2E1		
4A	0	-	-	-	Blow from rope	
5A	48	80	-	F2E1		
6	57	80	-	F2E1		
7	39	80	-	F2E1		
8	65	100	-	F1E1		
9	82	100	-	F2E1		
10	28	60	-	F2E1		

NOTE: this site was very confusing underwater. The photos may be hard to work out which quadrat they relate too. The wrong quadrats were sampled and noted on field sheet as the Clump weight was missing. All quadrats samples though.

***F** = Filamentous, **E** = Encrusting, **C** = Corticose (foliose) E.g. F2 = Medium filamentous

1 = Low loading , **2** = Medium loading, **3** = High loading F1 E3 = Low filamentous and high encrusting

BOOM Seagrass monitoring 2021						
SITE:	SGR2	**DATE:**	20/01/2021		**OBSERVER:**	IB, KW
Quadrat	Shoot density (P. aus) ((Amphib))	% cover est	colonisers (Hz, Hal)	Epiphytes (F,E,C 1,2,3)*	Comments	
1A	19	40	-	F1E2	1 pin missing	
2A	70	80	-	F2E1		
3A	-	0	-	F1		
4A	(1)0	0	-	-	Rock and macroalgae	
6	22(2)	40	Hal	F1E1		
7	63	60	-	F2E1		
8	38	60	-	F1E2	1 pin missing	
9	33(1)	50	-	F2E1		
10	36(2)	50	-	F1E2		
11	59	50	-	F2E2		

*__F__ = Filamentous, __E__ = Encrusting, __C__ = Corticose (foliose) E.g. F2 = Medium filamentous

__1__ = Low loading , __2__ = Medium loading, __3__ = High loading F1 E3 = Low filamentous and high encrusting

BOOM Seagrass monitoring 2021						
SITE:	SGR3	**DATE:**	20/01/2021		**OBSERVER:**	KW, IB
Quadrat	Shoot density (P. aus) ((Amphib))	% cover est	colonisers (Hz, Hal)	Epiphytes (F,E,C 1,2,3)*	Comments	
1A	51	70	-	E2F1		
2A	20	30	-	E2F2		
3A	33	40	-	E2F1		
5A	30	40	-	E2F1		
6	41	60	-	E2F1		
7	47	70	-	E2F1		
8	34	50	-	E2F2		
9	28	40	-	E2F1		
10	39	40	-	E2F1		
11	54	70	-	E2F1		

*__F__ = Filamentous, __E__ = Encrusting, __C__ = Corticose (foliose) E.g. F2 = Medium filamentous

__1__ = Low loading , __2__ = Medium loading, __3__ = High loading F1 E3 = Low filamentous and high encrusting

BOOM Seagrass monitoring 2021						
SITE:	SGR4	**DATE:**	20/01/2021		**OBSERVER:**	SC, AG
Quadrat	Shoot density (P. aus) ((Amphib))	% cover est	colonisers (Hz, Hal)	Epiphytes (F,E,C 1,2,3)*	Comments	
1A	4	45	-	E2F1	Olympus	
2A	32	65	-	E2F2	Olympus	
3B	40	70	-	E2F2		
4A	21	50	-	E2F2	Gopro	
5B	27	50	-	E2F2		
6	57	90	-	E2F2		
7	43	80	-	E2F2		
8	37	65	-	E2F3		
9	1	<1	-	E2		
10	29	50	-	E1F2		

*__F__ = Filamentous, __E__ = Encrusting, __C__ = Corticose (foliose) E.g. F2 = Medium filamentous

__1__ = Low loading , __2__ = Medium loading, __3__ = High loading F1 E3 = Low filamentous and high encrusting

BOOM Seagrass monitoring 2021						
SITE:	SGR5b	**DATE:**	20/01/2021		**OBSERVER:**	SC, AG
Quadrat	Shoot density (P. aus) ((Amphib))	% cover est	colonisers (Hz, Hal)	Epiphytes (F,E,C 1,2,3)*	Comments	
1A	20	30	-	E1F3		
2A	15	25	-	E1F3		
3A	3	<5	-	E1F3	Reef and macroalgae	
4A	42	100	-	E2F3		
5A	43(1)	70	-	E1F2		
6	47	90	-	E1F2		
7	56	100	-	E1F2		
8	37	60	Hal	E2F2		
9	62	100	Hal	E2F3		
10	38(2)	70	-	E2F2		

*__F__ = Filamentous, __E__ = Encrusting, __C__ = Corticose (foliose) E.g. F2 = Medium filamentous

__1__ = Low loading , __2__ = Medium loading, __3__ = High loading F1 E3 = Low filamentous and high encrusting

ATTACHMENT 6

MS572 Triennial Reuse Report 2021

https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/124064654

STATUS REPORT

DATE: 9 September 2021

TO: Department of Water and Environmental Regulation – EP Services

FROM: Water Corporation

SUBJECT: **MS572 Ocean Outlet for Treated Wastewater – Bunbury WWTP Triennial Wastewater Reuse Report**

Requirement for Triennial Wastewater Reuse Report

Water Corporation is subject to conditions and commitments in Ministerial Statement 572 (MS572), dated 14 September 2001, issued under the Environmental Protection Act 1986. Schedule 2 of MS572 details the actions for 'Wastewater Management'. From the audit table:

-P1.*1 'Continue to investigate options for viable wastewater re-use at Bunbury',*
-*P1.2 'Provide a triennial report to the community and DEP. This needs to detail options investigated during the previous three years and plans for the next three years' and*
-*P1.3 'Review requirement after each triennial report'.*

This Status Report constitutes the Triennial Wastewater Reuse Report compiled in accordance with commitments P1.1 and P1.3. The report is submitted to DWER as required by P1.2.

Wastewater recycling overview

Water Corporation is committed to increasing the amount of treated wastewater recycled through fit-for-purpose uses that are both environmentally and socially sustainable.

Water Forever - Towards Climate Resilience included a target to increase water recycling to 30% across Western Australia by 2030. Currently we have over 80 water recycling schemes across the State, which provide about 21 gigalitres of recycled water for industry, public open space and agriculture. These recycled water schemes make a significant contribution to reducing demand for scheme water, while helping to make WA a great place to live and invest.

In the South West, recycled water is used for commercial uses, mainly tree farms and irrigating public facilities such as golf courses and public open spaces. Major recycling schemes include ;

- Shire Augusta Margaret River Recycled Water Scheme
- Busselton Golf Club,
- Manjimup Country Club
- Bridgetown Golf Club,

- Pemberton Sports Oval
- Tree farms (Margaret River, Dunsborough, Kemerton, Manjimup, Nannup & Donnybrook)

Bunbury WWTP – Local Context.
The Water Corporation's Bunbury Wastewater Treatment Plant (WWTP) is situated in the Shire of Capel just south of the City of Bunbury's boundary and currently treats over 11 megalitres per day (ML/d) of domestic wastewater from Bunbury, Eaton and Dalyellup residents. Some of the treated wastewater from the plant is reused (on site (114,686 m^3 in 2020/21); however the majority is discharged to the ocean via the outfall located adjacent to the WWTP.

Update 2011 -2014
Water Corporation contacted City of Bunbury in January 2011 (Appendix 1) to advise they are able to provide treated wastewater free of charge for reuse projects that benefit the community.

In May 2011, the Water Corporation provided a letter of support to the City of Bunbury regarding their Regional Development Australia Fund (RDAF) funding application for the proposed Bunbury Wastewater Recyling Project (Appendix 2). This funding application was unsuccessful.

In 2014, the City of Bunbury commenced further investigation in the reuse scheme, and in partnership with the Shire Capel, the Bunbury Waste Water Reuse Project (Appendix 3) was initiated. In November 2014, Water Corporation provided a letter to the City of Bunbury stating the in-principle support by the Corporation of the Bunbury Wastewater Re-Use Project (Appendix 4). The concept has since been made known to the greater community through an article in the West Australian newspaper of 18 May 2015 (Appendix 5).

The City of Bunbury subsequently engaged a consultant to investigate the feasibility of a recycling scheme using Bunbury WWTP treated wastewater. A report was prepared (*City of Bunbury Wastewater Reuse July 2015)* which estimated the capital expenditure of the scheme to approximately $5.1 million.

2015-2018
In July 2017, the City of Bunbury approached the Water Corporation (Appendix 6) to gauge if we still supported the reuse of Bunbury WWTP treated wastewater as outlined in the City of Bunbury Wastewater Reuse Report. City of Bunbury expressed desire to progress a reuse scheme as a result of increasing constraints on future groundwater allocations. Water Corporation advised that we continue to be supportive of reuse of treated wastewater from Bunbury WWTP, although, all necessary infrastructure would need to be funded by the proponent.

During a meeting held between the City of Bunbury (CEO) and the Water Corporation (Manager-Customer and Stakeholder SWR) on the 20th February 2018, the Corporation re-confirmed our commitment again to support a reuse scheme using Bunbury WWTP treated wastewater.

Ultimately, the lack of adequate funding was the key constraint causing the delay in the implementation of this reuse scheme.

2018-2021

The State Government announced on 2 September 2020 (see appendix 7) plans to invest $11.9 million into a wastewater recycling scheme for Bunbury. The Bunbury Water Resource Recovery Scheme will include the construction of a new wastewater recycling facility (adjacent to Bunbury WWTP) and associated infrastructure to supply non-potable water for use on major infrastructure projects and irrigation of public open spaces.

The project is an initiative of AgWest, which will build and operate the new facility. The project will reduce the amount wastewater discharged via the ocean outlet during summer and provide much needed water for industry and irrigation.

The Water Corporation is fully supportive of this project and is currently working closely with AqWest to ensure access to the WWTP.

Appendix 1

MS 572 Triennial Reuse Report - Appendix 1 - Letter to City of Bunbury - treated wastewater avl for reuse - Jan2011
https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/50200903

Your Ref:
Our Ref: Aqua 4388946
Enquiries: David Van Wyk
Telephone: (08) 9791 0448

31 January 2011

Chief Executive Officer
City of Bunbury
PO Box 21
BUNBURY WA 6231

Attn: Geoff Klem

Dear Mr Klem,

AVAILABILITY OF TREATED WASTEWATER FROM BUNBURY WASTEWATER TREATMENT PLANT FOR POTENTIAL REUSE PURPOSES

The Water Corporation's Bunbury wastewater treatment plant (WWTP) is situated in the Shire of Capel just South of the City's boundary (see enclosed aerial photograph for plant location) and treats on average 7.5 million litres per day of domestic wastewater from Bunbury and Dalyellup residents. Some of the treated wastewater from the plant is reused on-site, however the majority is discharged into the ocean outfall located adjacent to the WWTP.

The Water Corporation is committed to increasing the amount of treated wastewater recycled through "fit for purpose" uses that are both environmentally and socially sustainable. Accordingly Water Corporation wishes to notify the City that treated wastewater is available from the Bunbury WWTP and could potentially be utilised for reuse purposes such as irrigation of public open spaces..

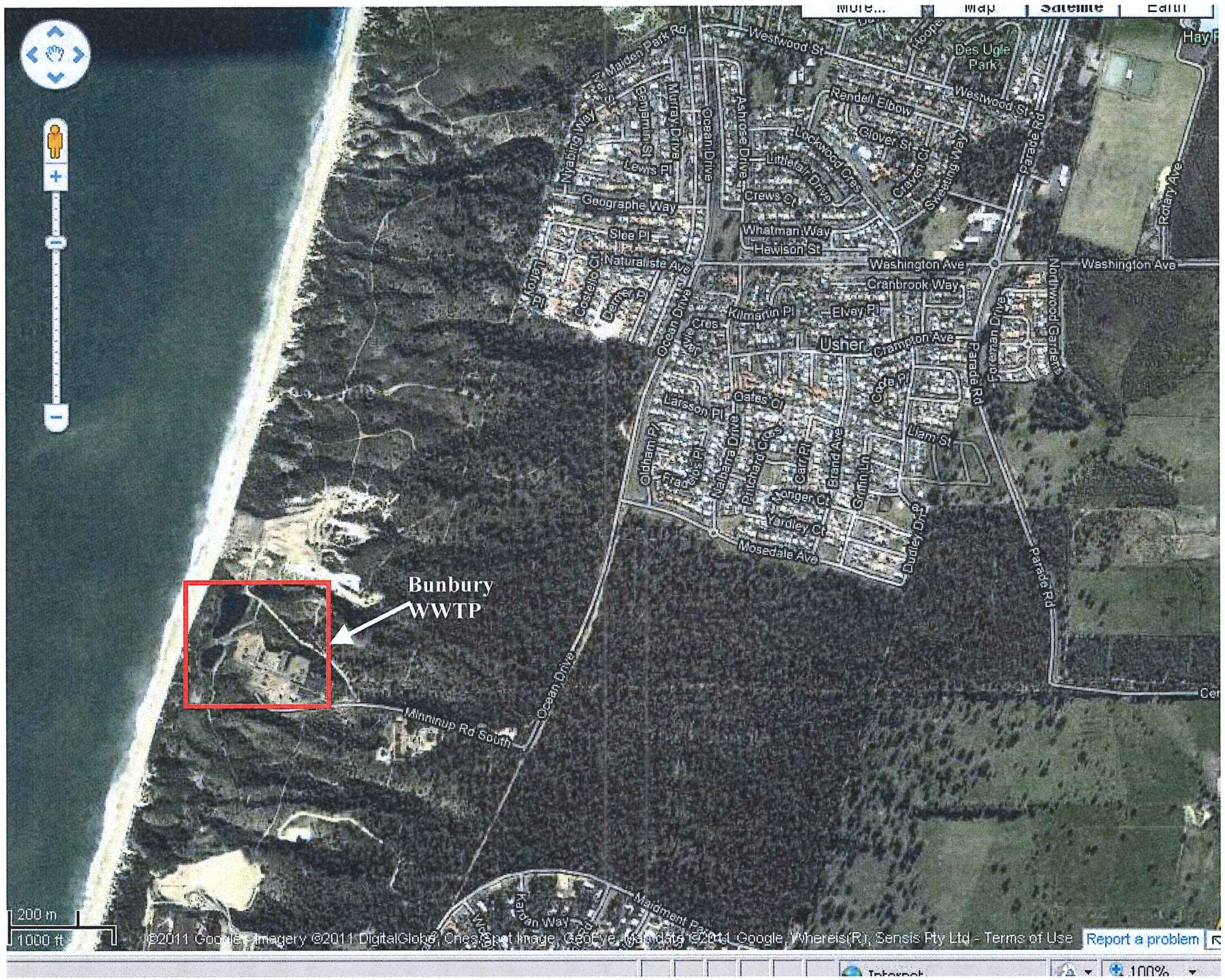
The treated wastewater is available 'as is' free of charge for reuse projects that benefit the community. Examples of such projects include irrigation of public open space, school ovals or Government woodlots and environmental recharge.

Although the treated water itself is free of charge, it should be noted that Corporation funding is not available to build the infrastructure (chlorination systems, pump stations, pipelines, irrigation systems etc) required for a reuse scheme - thus any reuse project would have to meet requisite capital and operational funding needs. There are various grants available that may be suitable for this purpose.

In summary Water Corporation is committed to increasing recycling from its wastewater treatment plants. If the City of Bunbury has identified, or wishes to discuss, any potential reuse opportunities then please don't hesitate to contact me on 9791 0448.

Yours sincerely

David Van Wyk
WASTEWATER MANAGER
South West Region


Bunbury
WWTP
Ocean Drive
Minninup Rd South
Washington Ave
Parade Rd
Westwood St
Usher
Des Ugle Park
Rendell Elbow
Cranbrook Way
Crampton Ave
Northwood Gardens
Foreman Drive
Rotary Ave
Mosedale Ave
Dudley Drive
Liam St
Geographe Way
Naturaliste Ave
Slee Pl
Lewis Pl
Murray Drive
Ashrose Drive
Crews Ct
Whatman Way
Hawison St
Kilmartin Pl
Elvey Pl
Larsson Pl
Oates Ct
Nalbarra Drive
Pritchard Cres
Carr Pl
Brand Ave
Griffin Ln
Yardley Ct
Longer Ct
Oldham Pl
Nyabing Way
Maiden Park Rd
Lockwood Cres
Littlefair Drive
Glover St
Craven Ct
Sweeting Way
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Appendix 2

Bunbury Wastewater Recycling Project Letter of Support
https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/48600595

Your Ref: RDAF/BWWRP
Our Ref: PM#4800186
Enquiries: Dr Debbie Reed
Telephone: 08 9420 2767

12 May 2011

Jason Gick (City Engineer)
City of Bunbury
4 Stephen Street
Bunbury W A 6230

Dear Mr Gick

BUNBURY WASTEWATER RECYCLING PROJECT

The Water Corporation fully supports the proposed Bunbury Wastewater Recycling Project (BWWRP) application to the Regional Development Australia Fund (RDAF).

The Corporation is committed to increasing the amount of treated wastewater recycled in Western Australia through 'fit for purpose' uses that are environmentally and socially responsible and cost effective, and to this end has been working with the City of Bunbury (CoB) to progress this project. Irrigating more than 40 hectares of grassed sporting fields with recycled water rather than groundwater would be of significant community benefit.

In kind contributions that the Water Corporation can commit to the project consist of:

- Transfer of an existing pipeline to CoB.
- Ongoing supply of the treated wastewater at no cost (although ongoing cost recovery will be required such that the total impact of the project is cost neutral to the Corporation).
- Feasibility report on Bunbury water recycling undertaken in 2002.
- Passing-on savings realised from reduced fees for ocean discharge from the Bunbury Wastewater Treatment Plant.
- Staff contribution to future feasibility investigations to expand the project to other areas in Bunbury and Dalyellup.
- Staff support for CoBs management of the project.

The estimated value of these 'in-kind' contributions totals approximately $3.5 million, as detailed in attachment C of the RDAF application. A Recycled Water Supply Agreement would also need to be agreed between the parties, along with health and environmental approvals, before these in-kind contributions could be fully realised.

I look forward to progressing this water recycling opportunity with the CoB. Should you require any further information, please do not hesitate to contact Dr Debbie Reed.

Yours sincerely

Chris Higgs
Water Recycling Manager

Appendix 3

MS572 Triennial Reuse Report - Appendix 3 - City of Bunbury WW reuse plan
https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/48845423

Bunbury Waste Water Recycling Project
Executive Summary

August 2014

Project Scope

The City of Bunbury, in partnership with the Water Corporation and the Shire of Capel, plan to develop and implement a water re-use scheme that will have a range of social, economic and environmental benefits at district and regional levels.

Following initial discussions, many agencies and organisations have expressed interest in the project, and a list of high level stakeholders has been identified which includes Aqwest, Private and Government schools in the vicinity, Department of Health, Department of Environmental Regulation, Department of Water, Department of Planning , Bunbury Turf and Trotting Association and the broader community.

The proposal is to take tertiary treated wastewater from the Dalyellup wastewater treatment plant (DWWTP) and use it to irrigate district and regional sporting grounds, passive recreational areas and existing dry parks.

Part of the project requires an upgrade at the DWWTP to install a chlorine dosing plant. Once the water is treated it is to be gravity fed along an existing pipeline to a holding tank at Hay Park. The recycled water will be used to offset current use of groundwater (2.7ML per day) for playing fields and other irrigated areas.

The project scope also includes investigation into the feasibility of increasing the scheme to include existing Dalyellup sporting fields, future Dalyellup recreation areas, schools, other parks and reserves and the South West Sports Centre. There is currently 7ML per day of wastewater available, which allows significant room for expansion.

At present, stakeholder engagement is in its infancy and the project scope may be subject to change dependent on stakeholder commitment, needs and participation in the proposed project.

Project Area

Hay Park, Hands Oval and Forrest Park are the primary sporting venues in the Greater Bunbury region. These facilities are used for multiple sporting activities, regional sporting carnivals, high level cricket and AFL representative matches, open air music events and themed shows.

Other key facilities and potential participants include the Bunbury Trotting Track, Bunbury Turf Club, Private and Government schools (ovals and grounds).

There is also the opportunity to expand the network into new greenfield site developments to irrigate lawns, gardens and public open space. For example, the Tuart Brook site and future Dalyellup and Capel developments.

Dalyellup is the fastest growing district of the Shire of Capel and is one of the fastest growing districts of the South West. The existing Dalyellup sporting fields are used for multiple sporting activities, open air music events and special fundraising sporting events. There are plans to develop more sporting areas in the future which will require irrigation.

Project Benefits

The proposal will further enhance water and energy management practices in the South West. It will promote a community focus on water efficiency, protection of groundwater resources, and nutrient management. It will ensure the South West is participating in best water management practices. The range of benefits achieved by this project includes:

Social

- Better water management for parks and sporting facilities in the short and long term
- Increased opportunities to better use irrigated areas for events
- Opportunity to irrigate existing dry parks (e.g. Des Ugle Park)
- Identification of future expansion areas in Bunbury and Dalyellup

Economic

- Capital expenditure in the Greater Bunbury Region
- Reduced discharge licence costs
- Reduced water pumping costs
- Reduced nutrient application costs
- Potential to increase use of park areas for new events resulting in tourism
- Freeing up of groundwater sources for other potential uses such as drinking water

Environmental

- Reduced nutrient and other contaminant pollution to Geographe Bay
- Reduced need for fertiliser application on parkland areas
- Reduced demand on fully allocated groundwater resources of around 650ML per year.
- Reduced energy requirements to pump water from deep bores

Project Costs

The cost of the project has been roughly estimated at between $2.5m to $7.5m and is dependent on scale. These estimates have been based on a preliminary desktop analysis and comparisons to similar projects.

Following further stakeholder engagement and commitment, a refined project scope will provide a more specific estimated project cost.

Project Support

Reducing dependency on ground water resources is an important element to best water management practice. This project represents a major response to what is "the most water challenged region of Australia" (CSIRO 2010) at a time of expanding population and a 15% decline in rainfall (Bureau of

Meteorology). The project will support sustainable regional growth through innovation and address challenges through climate change (National Sustainability Council).

The project aligns with the following strategic plans:

- South West Regional Plan 2010 (Regional Development Australia South West, 2010)
- South West Regional Water Plan 2010 – 2030 (Department of Water, 2010)
- City Vision (City of Bunbury, 2007).
- Water Forever – Towards climate resilience (Water Corporation, 2009)

Very recently The Department of Water (Government of Western Australian) has developed a network and has commenced investigation into South West Non-Potable Urban Water Needs.

Conclusion

The project will benefit local, district and regional communities and contribute to best water management practice in the South West.

Summary of Waste Water Re-Use Meetings with Stakeholders

Organisation	Preferred contact Person/s	Possible considerations	Offers of assistance and support
AQWEST	Gary Hallsworth Caleb Maguire	• Aqwest have an interest in the ongoing management of the system/treated waste water (potential management fee) • Taking ground water for the large recreational areas is detrimental to quality of the aquifer (creates saliency issue) • If treated waste water was stored in tanks approx. 50m high – the water could be gravity fed through pipes into Bunbury	• Raising the issue with senior stakeholders through quarterly Industry Leader meetings • Can readily seek Recycled Water licence & Health Compliance due to existing requirement and relationship with ERA and Health Dept. • Aqwest have offered to produce schematic drawings/designs based on COBs current consumption in peak times.
Dept Environmental Regulation Dept Parks & Wildlife Dept Planning Dept Water	Neville Welsh Kim Williams Kath La Nauze and Verity Lee Mike McKenna	• All supportive of project- very positive • Identification of DOH requirements and DER Licensing requirements(details to be forwarded) • DOP keen to get highest level Planning approval and government support e.g. Water Corp pipeline- to include additional infrastructure.	• All to provide written support, alignment to strategic documents and addition information to consider (has been requested awaiting responses)
Water Corporation	Roman Harasymow Business Development Manager Infrastructure Markets Branch	• Treating water further than is currently being treated, and removing treated water from the site will be at COBs cost • 50c-$1 per kilolitre to treat the water • Will be ongoing costs for Management Plan to satisfy DoH and DER	• If COB can provide the number of megalitres used per day, and the size of our pipes, Water Corp will provide cost estimates.
Bunbury Trotting Club	Julie Caldwall (Steve De Campo – Groundsman/Board member)	• Willing to provide in principle support to the project, will need to consult Board • Using 100,000mgl of water per day in summer.	• Will provide letter of support from Board
AECOM (private consultants)	Chris Davison Dr Fabiana Tessele John Braid	• Have done a similar project in Carnarvon • Some complications with gravity feeding (pressure/ leakages) May need to pump all water which increases costs • Recommended not building a full pipe all the way through to Bunbury CBD, but using trucks to move water from pump to grounds, to reduce infrastructure costs. • Based on experience, estimated that making water potable and recharging into the aquifer could be $50-80m	Fabiana offered to provide a 1 to 1 1/2 page document for consideration and support of project, incorporating examples and lessons learned
Department of Health	Clemencia Rodriguez	• Low risk vs medium risk rating based on our use • Consult Economic Regulation Authority if we plan to on-sell water – costs involved in license • As WWTP already exists, we do not need approval to treat the water, but need approval to use the treated water • ongoing sampling required for medium risk water (monthly) • If Aqwest were to manage, need to obtain non-potable license	Happy to meet in the future, also attending the SW Non-Potable taskforce meetings.

Organisation	Preferred contact Person/s	Possible considerations	Offers of assistance and support
Department of Education	Darryl Todd, Snr Environmental Service Officer - Grounds	• Schools using treated waste water have had the water blocked due to Councils inability to monitor health requirements properly • Safety of students paramount, support would be subject to strict health standards being met.	• Happy to provide letter of support • Will provide figures detailing water usage at Bunbury schools
St Joseph's Catholic Primary School	Principal – Riley Horrocks	• Physical infrastructure works could impact parking/traffic flow during peak times • Need to communicate all health approvals with parents to alleviate concerns around risks/safety.	• Happy to provide letter of support from the Board, stating support is conditional on health approvals. • Will provide information on current water usage.

Appendix 4

City of Bunbury recycled water scheme letter of support Nov 2014
https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/48797221

watercorporation.com.au South West Region
3rd Floor, Bunbury Tower
61 Victoria Street Bunbury WA 6230
PO Box 305
Bunbury WA 6231
Faults, Emergencies and Security 13 13 75
Account Enquiries 13 13 85
Building and Subdivision 13 13 95

Your Ref:
Our Ref: #11960819
Enquiries: Roman Harasymow
Telephone: 9420 2600

WATER CORPORATION

26th November 2014

Phil Harris
Director Works and Services
City of Bunbury
PO Box 21
BUNBURY WA 6230

Dear Mr Harris

Bunbury Wastewater Re-Use Project

This letter states the in-principle support by the Corporation of the City of Bunbury's Bunbury Wastewater Re-Use Project.

The Corporation owns and operates the Bunbury No 2 Wastewater Treatment Plant which currently disposes of treated wastewater to the ocean through a dedicated ocean outfall.

The City of Bunbury's proposal is to use some of this water for a regional recycled water scheme and will be subject to the negotiation of a Recycled Water Supply Agreement with the Corporation.

To build a business case for the proposal, the City of Bunbury needs to determine infrastructure requirements and to define the economic considerations of the proposal.

The Corporation supports the City of Bunbury's application for the funding of this independent investigation from the South West Development Commission and will work closely with the City of Bunbury in developing its proposal.

Yours sincerely

John Janssen
Regional Manager
South West Region

Appendix 5

Bunbury RW plan West Australian 18 May 2015
https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/50241965

Wastewater plan for Bunbury parks

Lincoln Bertelli, SOUTH WESTERN TIMES
May 15, 2015, 8:59 am

Wastewater plan for Bunbury parks

Recycled water from Dalyellup's wastewater treatment plant could be used to maintain nearly one million square metres of sporting grounds in Bunbury.

If funding can be obtained for the project, recycled water would be pumped to Bunbury and used on Hay Park, Hands Oval, Forrest Park and Des Ugle Park.

The four public areas together require 500,000kl a year.

Early discussions on the project have been held by the Water Corporation and Bunbury City Council.

Council chief executive Andrew Brien said he considered the project "viable" and was working toward securing funding.

"This project is considered viable if capital funding can be obtained," he said.

"The city will continue to work towards securing the funding for the project.

"While there is a financial benefit in the longer term, the environmental aspects are also significant drivers for this project."

The cost of the project is not yet known but it would require State and Federal government funding.

Mr Brien said the use of recycled water would have wide-reaching benefits.

"Operation costs at sporting venues and recreational parks will reduce," he said.

"And reduced discharge of wastewater into Geographe Bay will generate savings to the Water Corporation and, in theory, to the taxpayers of Western Australia.

"The project has the potential to deliver economic, environmental and social benefits for the Greater Bunbury region and it will create employment during the project delivery and subsequent operation."

Mr Brien said it would also lessen dependency on inefficient bores, decrease costs for fertiliser and electricity, allow groundwater resources to be used elsewhere and increase the water supply's sustainability.

He also flagged the possibility of expanding the scheme into other parts of Greater Bunbury.

Water Corporation South West regional manager John Janssen said almost four billion litres of water was already recycled throughout the South West each year.

"Across the State, Water Corporation provides free recycled water from its wastewater treatment plants for recycling schemes that benefit the community," Mr Janssen said.

"This would be the case if the City of Bunbury went forward with its use of recycled wastewater for public open space irrigation."

Mr Janssen said the council would need to secure an agreement with the Water Corporation regarding volumes and intended use of the treated wastewater.

He also said the council would be responsible for installing the necessary infrastructure.

Niece repays war debt to Timor

His sister's battle inspired Brant Garvey to be an Ironman - with one leg

West Wheels: Reviews, video, news - all you need to know about cars

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Appendix 6

E from CoB re Wastewater reuse - Bunbury & Capel (Dalyellup) July 2017 (19132625)
https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/62091567

Brian Scott

From: Ryan Munro
Sent: Thursday, 19 April 2018 9:02 AM
To: Ryan Munro
Subject: FW: Wastewater reuse - Bunbury & Capel (Dalyellup)

From: James Shepherd [mailto:jshepherd@bunbury.wa.gov.au]
Sent: Tuesday, 18 July 2017 4:38 PM
To: SW.WaterForever
Cc: Roman Harasymow
Subject: Wastewater reuse - Bunbury & Capel (Dalyellup)

Hi

The City has tried to secure funding for the initiation of wastewater reuse on areas of its public open space on 2 previous occasions, both times without success; the funding application was made with support from various agencies (including Water Corporation) and would have benefitted both the City and Shire of Capel (for public open space within Dalyellup).

I note that the Water Forever: South West refers to wastewater reuse opportunities but does not identify the City & Shire of Capel as potential opportunities whereas Collie, Busselton, Margaret River, Pemberton & Manjimup are all considered as potential locations for recycling of this type. I am assuming that other options will be considered by Water Corporation on merit and as such would be interested to know what the organisation's current position is with regard to reusing wastewater from the Dalyellup WWTP.

I have copied Roman into this contact as he has been involved from a Water Corporation perspective previously and so will have some background. At this stage I am only making early stage enquiries to gauge interest from you as a key stakeholder should we look to progress this again.

I look forward to hearing back from you.

Regards
James

<image003.jpg> <image004.png>

James Shepherd
MANAGER PROJECT PLANNING

4 Stephen Street, Bunbury WA 6230 – PO Box 21 Bunbury WA 6231
T: (08) 9792 7340 **M:** 0407 445 052 **TTY:** 133 677 **F:** (08)9792 7184
E: jshepherd@bunbury.wa.gov.au **W:** www.bunbury.wa.gov.au

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Appendix 7

$11.9 million investment in new water recycling scheme for Bunbury
https://www.mediastatements.wa.gov.au/Pages/McGowan/2020/09/11-point-9-million-dollar-investment-in-new-water-recycling-scheme-for-Bunbury.aspx

Text copied from media article:

$11.9 million investment in new water recycling scheme for Bunbury Wednesday, 2 September 2020

New $11.9 million water recycling facility and pipeline to be constructed in Bunbury
Bunbury water recycling scheme will alleviate demand on the city's groundwater supplies
Construction project to support local jobs and respond to climate change
Water Minister Dave Kelly today announced an $11.9 million investment by the McGowan Government into Bunbury's water infrastructure.

The Bunbury Water Resource Recovery Scheme will see the construction of a new water recycling facility and pipeline alongside the Bunbury Wastewater Treatment Plant in Dalyellup, to supply water for use on major infrastructure projects and irrigation of public open spaces.

Climate change has particularly impacted the South-West, resulting in reduced rainfall, reduced streamflow and reduced recharge into our groundwater resources.

The use of treated recycled water to meet Bunbury's non-potable water requirements for infrastructure projects and irrigation will alleviate the need to use high quality potable water from the Yarragadee Aquifer, while reducing the amount of treated wastewater discharged out to sea.

The project will support local jobs by contracting local companies during construction.

The project is an initiative led by Aqwest, which will build and operate the new facility, and source water for the scheme from Water Corporation's Bunbury Wastewater Treatment Plant.

This facility will join around 80 other water recycling schemes in operation in Western Australia providing climate resilient, fit-for-purpose water to communities and industry.

Comments attributed to Water Minister Dave Kelly:

"This initiative helps to address the impact climate change is having on our water supplies by ensuring the sustainability of the Yarragadee Aquifer and the future supply of potable water to homes in Bunbury.

"The fit-for-purpose, recycled water generated will provide a much needed water resource for industry and irrigation, and deliver far reaching benefits to the city of Bunbury community by greening the environment and improving liveability."

Comments attributed to Bunbury MLA Don Punch:

"Already our local water supply is constrained, with a number of local parks going without reticulation so a project that will recycle water, protect our environment and allow for the watering of public open space to improve our suburbs is a fantastic outcome for our community.

"This project shows we have the capacity to be innovative and develop new and sustainable ways of meeting the ongoing needs of our community, all while supporting jobs for local people."

Minister's office - 6552 6100

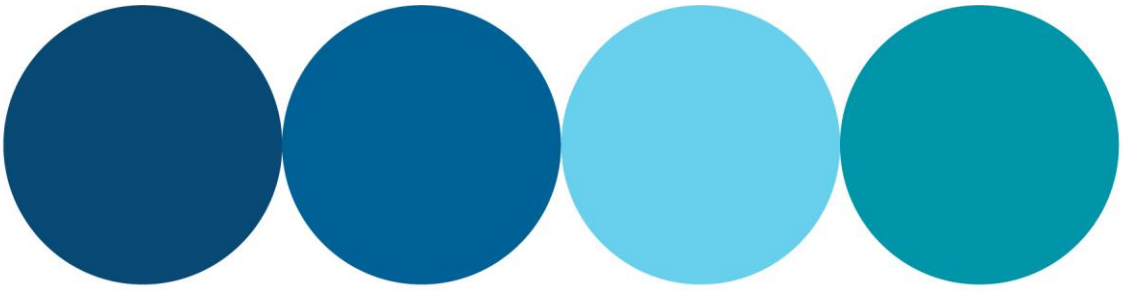
ATTACHMENT 7

5-Yearly BOOM Sediment Sampling Report May 2019

https://nexus.watercorporation.com.au/otcs/cs.exe/app/nodes/82223944

Bunbury Ocean Outlet Sediment Monitoring Survey

2019 Sediment Sampling Report



WATER CORPORATION

This report has been prepared for Hewlett-Packard Company by BMT, April, 2019, Report Number R-1136_00-1.

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Revision	Author	Recipients	Organisation	No. copies & format	Date
A	G Cummins	M Lourey	BMT	1 x docm	17/04/2019
B	G Cummins	M Lourey	BMT	1 x docm	13/05/2019
C	G Cummins	R Munro	Water Corporation	1 x PDF	15/05/2019

Review

Revision	Reviewer	Intent	Date
A	M Lourey	Technical Review	13/05/2019
B	M Lourey	Editorial Review	13/05/2019
C	R Munro	Client Review	

Quality Assurance

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BMT Western Australia Pty Ltd has prepared this report in accordance with our Integrated Management System, in compliance with OHSAS18001, ISO14001 and ISO9001

Status

This report is 'Draft' until approved for final release, as indicated below by inclusion of signatures from: (i) the author and (ii) a Director of BMT Western Australia Pty Ltd (BMT) or their authorised delegate. A Draft report may be issued for review with intent to generate a 'Final' version, but must not be used for any other purpose.

Approved for final release:

Author
Date: 15/05/2019

Director (or delegate)
Date: 15/05/2019

Contents

Introduction

Sediments in the area surrounding the Bunbury treated wastewater (TWW) ocean outlet are sampled every 5 years as part of Water Corporation's commitments in the Bunbury Wastewater Treatment Plant Marine Impacts Monitoring and Management Plan (MIMMP; Water Corporation 2012). Sediment monitoring near Bunbury ocean outlet was previously completed in January 2014 and was therefore required again in early 2019. Water Corporation must demonstrate that sediments in the vicinity of the outfall meet the relevant ANZECC/ARMCANZ (2000) criteria (Water Corporation 2012). This report documents the results of the sediment quality monitoring survey near the Bunbury ocean outlet completed in February 2019. Where appropriate, sediment contaminant levels (metals and organic compounds) are compared against ANZECC/ARMCANZ (2000) ISQG. As there are presently no ISQG values for nutrients, sediment nutrient concentrations are discussed in the context of spatial and temporal changes only.

Sediment monitoring methods

Sediments samples were collected on 7 February 2019 from eight compliance sites (S1-S8; Table 1, Figure 1) and five reference sites (SR1-SR5b; Table 1, Figure 1). Four compliance sites (S2, S5, S7 and S8) were located on the boundary of the Low Ecological Protection Area (LEPA). Compliance sites S1 and S6 were located on the Shellfish Harvesting Exclusion Zone boundary and compliance sites S3 and S4 were located within the LEPA. The five reference sites (SR1-SR5b) were located ~4 km south-west of the TWW outlet (Table 1, Figure 1).

Table 1 Bunbury sediment sampling sites

Site	Location relative to diffuser	Label	Easting	Northing
S1	500 m south	SHEZ boundary	369226	6305616
S2	100 m south	LEPA boundary	369226	6306016
S3	50 m south	Inside LEPA	369226	6306066
S4	50 m north	Inside LEPA	369226	6306166
S5	100 m north	LEPA boundary	369226	6306216
S6	500 m north	SHEZ boundary	369226	6306616
S7	100 m east	LEPA boundary	369226	6306096
S8	100 m west	LEPA boundary	369383	6306137
SR1	4 km south-west	Reference site	367724	6302352
SR2	4 km south-west	Reference site	367672	6302492
SR3	4 km south-west	Reference site	367422	6302494
SR4	4 km south-west	Reference site	367419	6302746
SR5b	4 km south-west	Reference site	367705	6302749

Note:

1. m – metre; km = kilometre; SHEZ = Shellfish Harvesting Exclusion Zone; LEPA = Low Ecological Protection Area

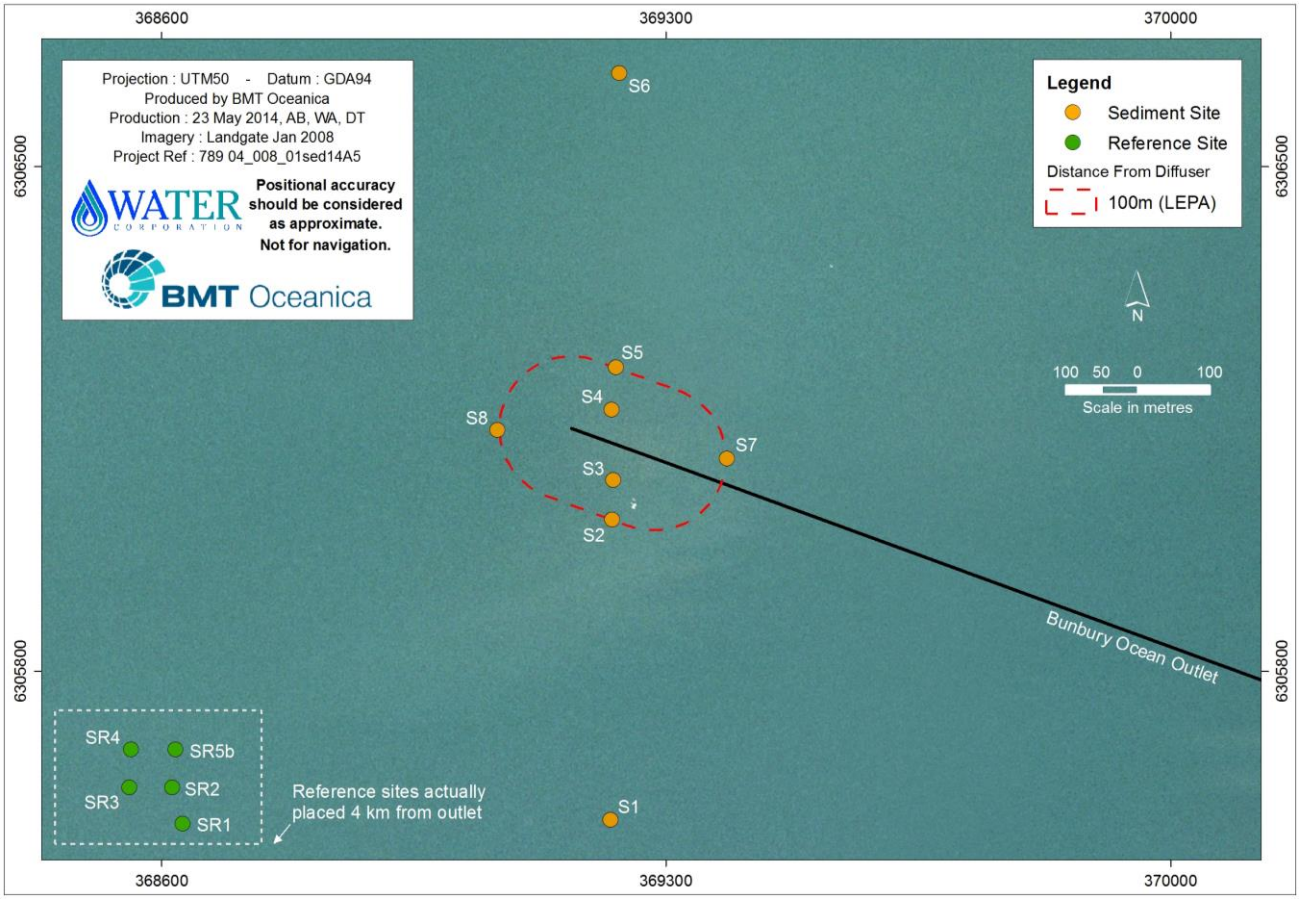


Figure 1 Bunbury ocean outlet monitoring summer 2019 sediment sampling sites

Three replicate samples were collected at each site. For each replicate, five 10 cm polycarbonate cores were collected from within a separate randomly placed 1 x 1m quadrat (one from each corner and one from the centre of the quadrat) resulting in 15 cores per site; (Figure 2). Each core was pushed into the sediment and sealed with a rubber bung before being pulled from the sediment by hand using the suction created by the bung to extract the sample. A second bung was then inserted into the bottom of the plastic core to secure the sample.

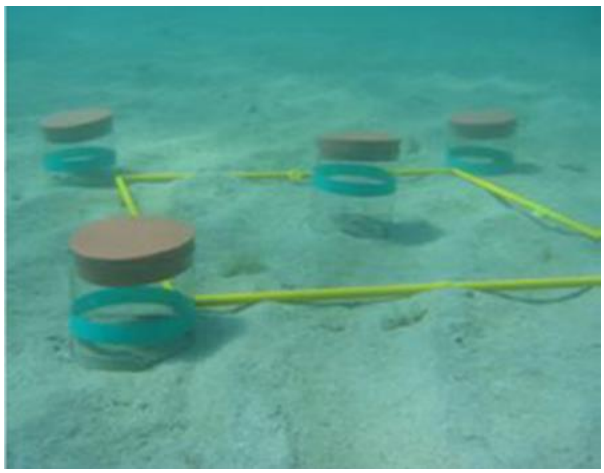


Figure 2 Example quadrat for one replicate sample

The top 2 cm of the 5 cores collected from each individual quadrat were homogenised in a Pyrex bowl and transferred to sterile 100 mL jars. Each replicate was stored in the dark at 4˚C and transported to a NATA accredited laboratory for analysis. Sediment samples were analysed for:

- metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn)
- loss on ignition (LOI) at 550˚C
- total organic carbon (TOC)
- extractable organohalogens (EOX)
- nutrients (total kjeldahl nitrogen (TKN) and total phosphorus (TP))
- organochlorine pesticides

Sediment contaminant concentrations (for metals and organochlorine pesticides) were compared against ANZECC/ARMCANZ (2000) ISQG, where available. Organic material (LOI and TOC) were reported and compared to 2014 sediment sampling results. As there are presently no ISQG values for nutrients, sediment nutrient concentrations were explored in the context of spatial and temporal changes only.

One replicate from each site was analysed initially with the remaining replicates (two per site) archived for analysis in the event of an exceedance of ANZECC/ARMCANZ (2000) Interim Sediment Quality Guideline (ISQG)-Low trigger value.

Sediment survey results

Metals

Concentrations of total metals in sediment samples collected on 7 February 2019 were below ANZECC/ARMCANZ (2000) ISQG-Low and ISQO-High guideline trigger values and/or less than the limit of reporting at all sites (Table 2).

Table 2 Concentrations of total metals measured at sediment compliance and reference sites at the Bunbury ocean outlet

Site	Analyte (mg/kg)								
	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
ISQG-Low	1	20	1.5	80	65	0.15	21	50	200
ISQG-High	3.7	70	10	370	270	1	52	220	410
LoR	<1	<2	<0.1	<0.2	<0.2	<0.01	<0.7	<1	<0.5
S1	<1	4	<0.1	6.1	<0.2	<0.01	<0.7	<1	0.9
S2	<1	11	<0.1	7.6	0.3	<0.01	<0.7	<1	1.2
S3	<1	12	<0.1	7.3	0.2	<0.01	0.8	<1	1.3
S4	<1	7	<0.1	7.1	0.2	<0.01	<0.7	<1	1.2
S5	<1	10	<0.1	7.1	<0.2	<0.01	<0.7	<1	1.1
S6	<1	11	<0.1	7.5	0.2	<0.01	<0.7	<1	1.1
S7	<1	9	<0.1	7.1	<0.2	<0.01	<0.7	<1	1.0
S8	<1	11	<0.1	6.7	0.2	<0.01	<0.7	<1	1.0
SR1	<1	7	<0.1	5.2	0.3	<0.01	<0.7	<1	1.3
SR2	<1	13	<0.1	5.7	0.2	<0.01	<0.7	<1	1.2
SR3	<1	14	<0.1	6.0	0.2	<0.01	<0.7	<1	1.8
SR4	<1	15	<0.1	6.6	0.3	<0.01	1.0	<1	1.6
SR5b	<1	12	<0.1	6.1	0.3	<0.01	0.8	<1	1.2

Notes:

1. Results expressed as dry weight basis
2. Ag = silver, As = arsenic, Cd = cadmium, Cr = chromium, Cu = copper, Hg = mercury, Ni = nickel, Pb = lead, Zn = zinc

Pesticides

Concentrations of the suite of organochlorine pesticides were all below the LoR (0.01 mg/kg) and were 0.025 mg/kg once normalised to 1% TOC. ANZECC/ARMCANZ (2000) guidelines for endrin, chlordane, lindane, dieldrin, DDT and DDE were typically lower than the LoRs used in the sediment monitoring and compliance cannot be formally assessed. However, organo-pesticide concentrations were <LoR in the TWW for the previous three years of monitoring (BMT 2018, BMT Oceanica 2017, 2016) and unlikely to be concentrated enough to accumulate in the sediments.

EOX

Sediment concentrations of extractable organohalogens (EOX) were typically low, ranging from <LoR (0.01) to 0.02 mg/kg wet weight and 0.025 to 0.1 % when normalised to 1% TOC (Table 3). There is no evidence to suggest concentrations are being elevated by the TWW.

Table 3 Extractable organohalogen concentrations in sediments at Bunbury ocean outlet

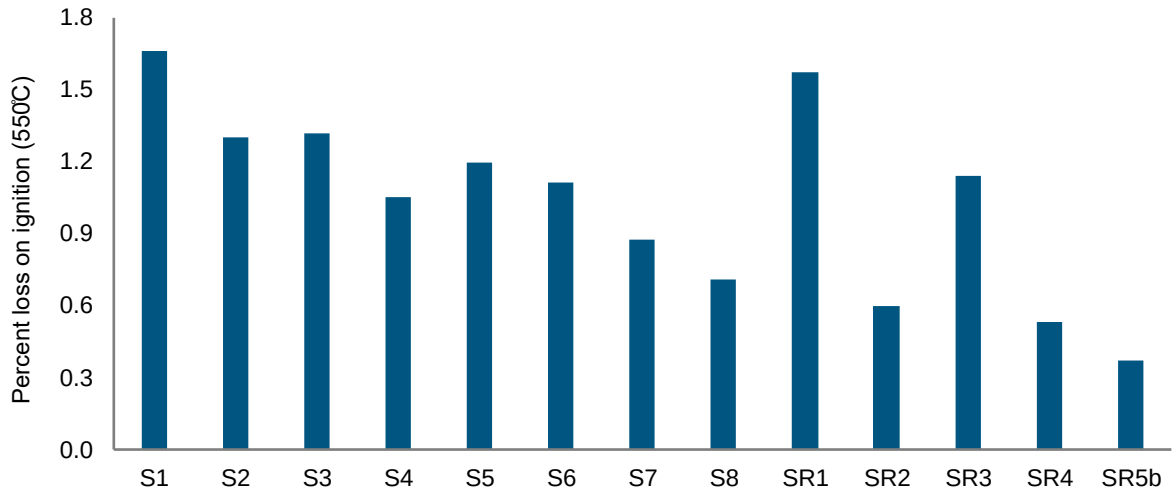
Site	EOX (mgm/kg wet weight)	EOX normalised to 1% TOC
S1	0.01	0.05
S2	<0.01	0.025
S3	0.01	0.05
S4	0.01	0.05
S5	0.02	0.1
S6	<0.01	0.025
S7	<0.01	0.025
S8	0.02	0.1
SR1	0.02	0.1
SR2	<0.01	0.025
SR3	<0.01	0.025
SR4	<0.01	0.025
SR5b	<0.01	0.025

Note:

1. EOX = extractable organohalogens, TOC = total organic carbon

Organic carbon

Organic material within the sediments (estimated from LOI at 550˚C) was generally low; ranging from 0.37 to 1.66% LOI at 550˚C (Figure 3). Organic material within the sediments from the 2019 sediment monitoring were slightly lower than the 2014 Bunbury sediment monitoring survey, where LOI ranged from 1.2 to 2.3% (BMT Oceanica 2014). TOC was below LoR <0.2% C at all sites in 2019 and 2014.



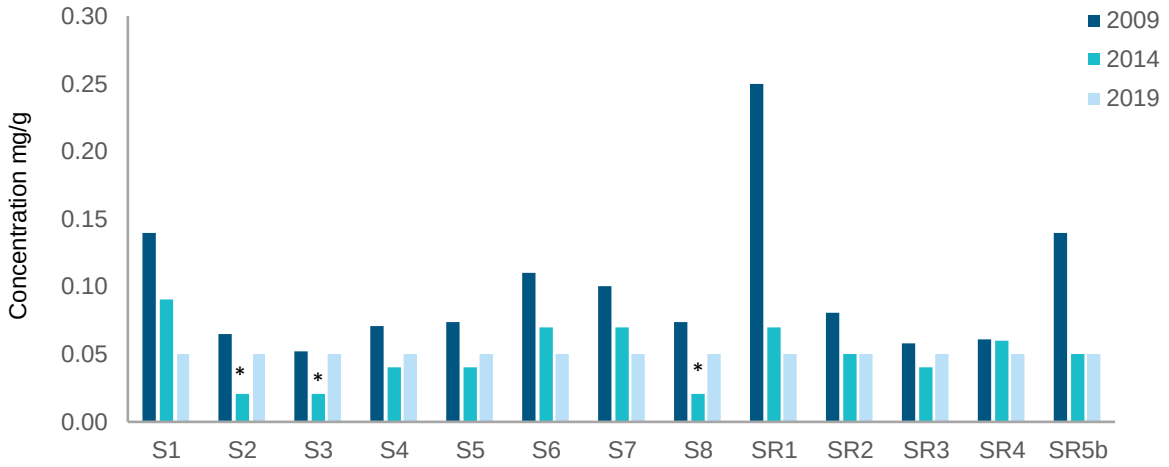
Note:

1. S1-S8 = sediment compliance sites; SR1 – SR5b = sediment reference sites

Figure 3 Percent loss on ignition measured at sediment compliance and reference sites

Nutrients

Concentrations of TKN were below the LoR at all sites (0.1 mg.N/g; Figure 4). Concentrations of TKN appear to have fallen slightly over the last decade (Figure 4). Concentrations of TP ranged from 0.08 – 0.25 mg.P/g, with the highest concentrations measured at reference site SR3 (Figure 5). Concentrations of TP are comparable to 2014 and 2009 results with slightly elevated TP concentrations at reference sites compared to compliance sites (Figure 5; BMT Oceanica 2014, Oceanica 2009).



Notes:

1. * = Limit of reporting (LoR) for 2014 (<0.04)
2. Concentration at all sites for 2019 was <LoR
3. When concentration was <LoR half LoR value was used

Figure 4 Total kjeldahl nitrogen at sediment compliance and reference sites at Bunbury ocean outlet

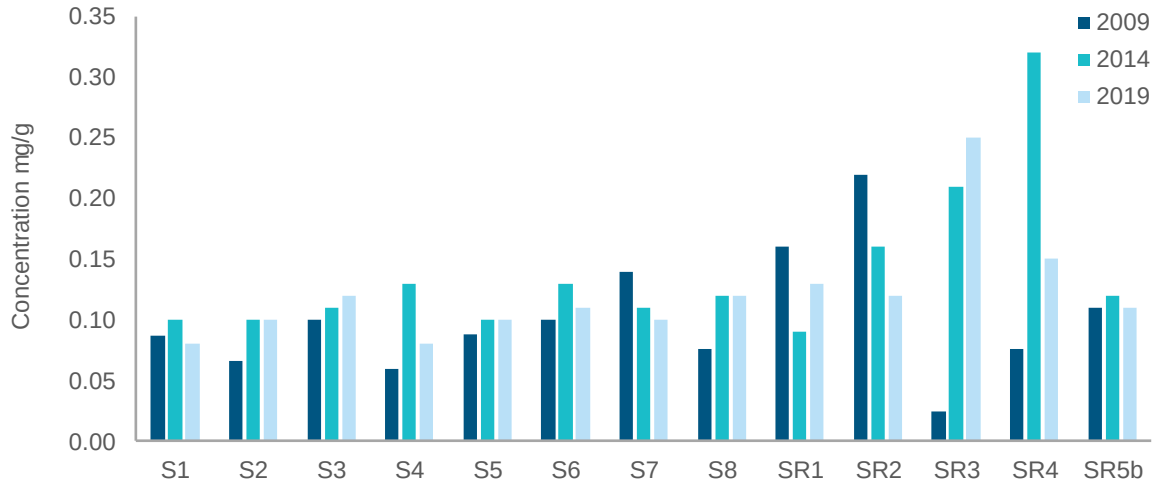


Figure 5 Total phosphorus at sediment compliance and reference sites at Bunbury ocean outlet

Conclusions

Concentrations of total metals were below ANZECC/ARMCANZ (2000) ISQG-Low and ISQG-High guideline trigger values in sediments at Bunbury ocean outlet compliance and reference sites indicating contaminants from the TWW are not accumulating in the sediment.

Concentrations of organochlorine pesticides were all below the LoR and did not vary between compliance and reference sites, indicating no evidence to suggest concentrations are being elevated by the TWW.

There was no evidence to suggest EOX or organic carbon concentrations are being elevated by TWW. Concentrations of TKN were below LoR at all compliance and reference sites suggesting that concentrations are unchanged by TWW. Concentrations of TP at compliance sites were lower than at reference sites suggesting TP is not elevated by TWW at the Bunbury ocean outlet.

References

ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1: The Guidelines. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, Canberra, Australian Capital Territory, October 2000

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EPA (2017) Environmental Quality Criteria Reference Document for Cockburn Sound – A supporting document to the State Environmental (Cockburn Sound) Policy 2015. Prepared for Cockburn Sound by Environmental Protection Agency, Perth, Western Australia, April 2017

Oceanica (2009) Bunbury Ocean Outfall Monitoring Five-Yearly Sediment Monitoring Report. Prepared for Water Corporation of Western Australia by Oceanica Consulting Pty Ltd, Report No.775_001/1, Perth, Western Australia, August 2009

ATTACHMENT 8

State Government Media Release New Bunbury Water Recycling Scheme Sept 2020

https://www.mediastatements.wa.gov.au/Pages/McGowan/2020/09/11-point-9-million-dollar-investment-in-new-water-recycling-scheme-for-Bunbury.aspx

Text on following page copied directly from the website:

$11.9 million investment in new water recycling scheme for Bunbury
Wednesday, 2 September 2020

New $11.9 million water recycling facility and pipeline to be constructed in Bunbury
Bunbury water recycling scheme will alleviate demand on the city's groundwater supplies
Construction project to support local jobs and respond to climate change
Water Minister Dave Kelly today announced an $11.9 million investment by the McGowan Government into Bunbury's water infrastructure.

The Bunbury Water Resource Recovery Scheme will see the construction of a new water recycling facility and pipeline alongside the Bunbury Wastewater Treatment Plant in Dalyellup, to supply water for use on major infrastructure projects and irrigation of public open spaces.

Climate change has particularly impacted the South-West, resulting in reduced rainfall, reduced streamflow and reduced recharge into our groundwater resources.

The use of treated recycled water to meet Bunbury's non-potable water requirements for infrastructure projects and irrigation will alleviate the need to use high quality potable water from the Yarragadee Aquifer, while reducing the amount of treated wastewater discharged out to sea.

The project will support local jobs by contracting local companies during construction.

The project is an initiative led by Aqwest, which will build and operate the new facility, and source water for the scheme from Water Corporation's Bunbury Wastewater Treatment Plant.

This facility will join around 80 other water recycling schemes in operation in Western Australia providing climate resilient, fit-for-purpose water to communities and industry.

Comments attributed to Water Minister Dave Kelly:

"This initiative helps to address the impact climate change is having on our water supplies by ensuring the sustainability of the Yarragadee Aquifer and the future supply of potable water to homes in Bunbury.

"The fit-for-purpose, recycled water generated will provide a much needed water resource for industry and irrigation, and deliver far reaching benefits to the city of Bunbury community by greening the environment and improving liveability."

Comments attributed to Bunbury MLA Don Punch:

"Already our local water supply is constrained, with a number of local parks going without reticulation so a project that will recycle water, protect our environment and allow for the watering of public open space to improve our suburbs is a fantastic outcome for our community.

"This project shows we have the capacity to be innovative and develop new and sustainable ways of meeting the ongoing needs of our community, all while supporting jobs for local people."

Minister's office - 6552 6100