Bunbury Ocean Outlet

Marine Impacts Monitoring and Management Plan

June 2012

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WATER CORPORATION

Bunbury Wastewater Treatment Plant

Marine Impacts Monitoring and Management Plan (2012)

Prepared by

Water Corporation

June 2012

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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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.

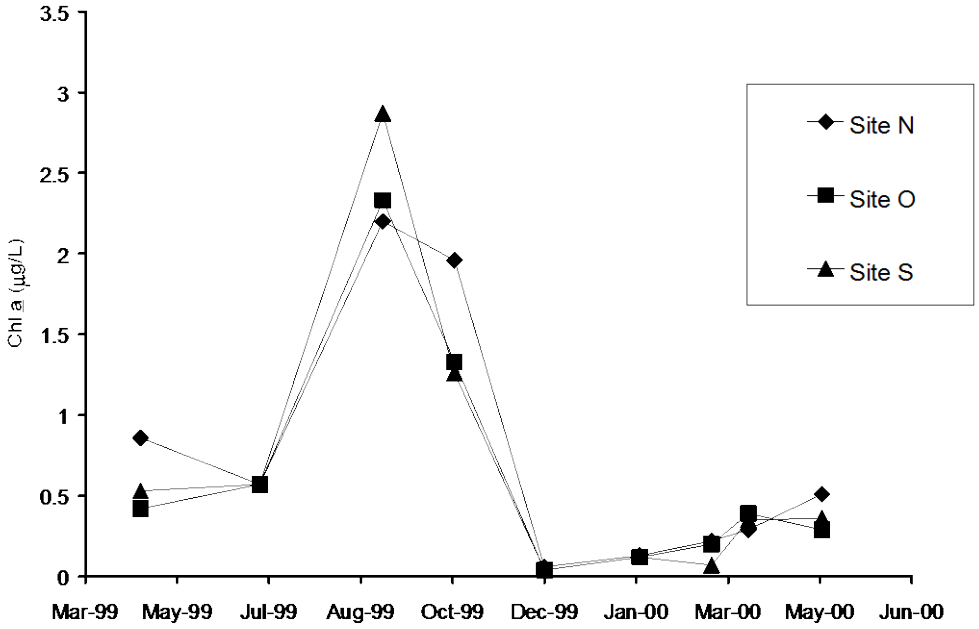

Figure 2.1 Seasonal variation in depth-averaged chlorophyll concentrations offshore from Bunbury WWTP (Waite and Alexander, 2000)

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.

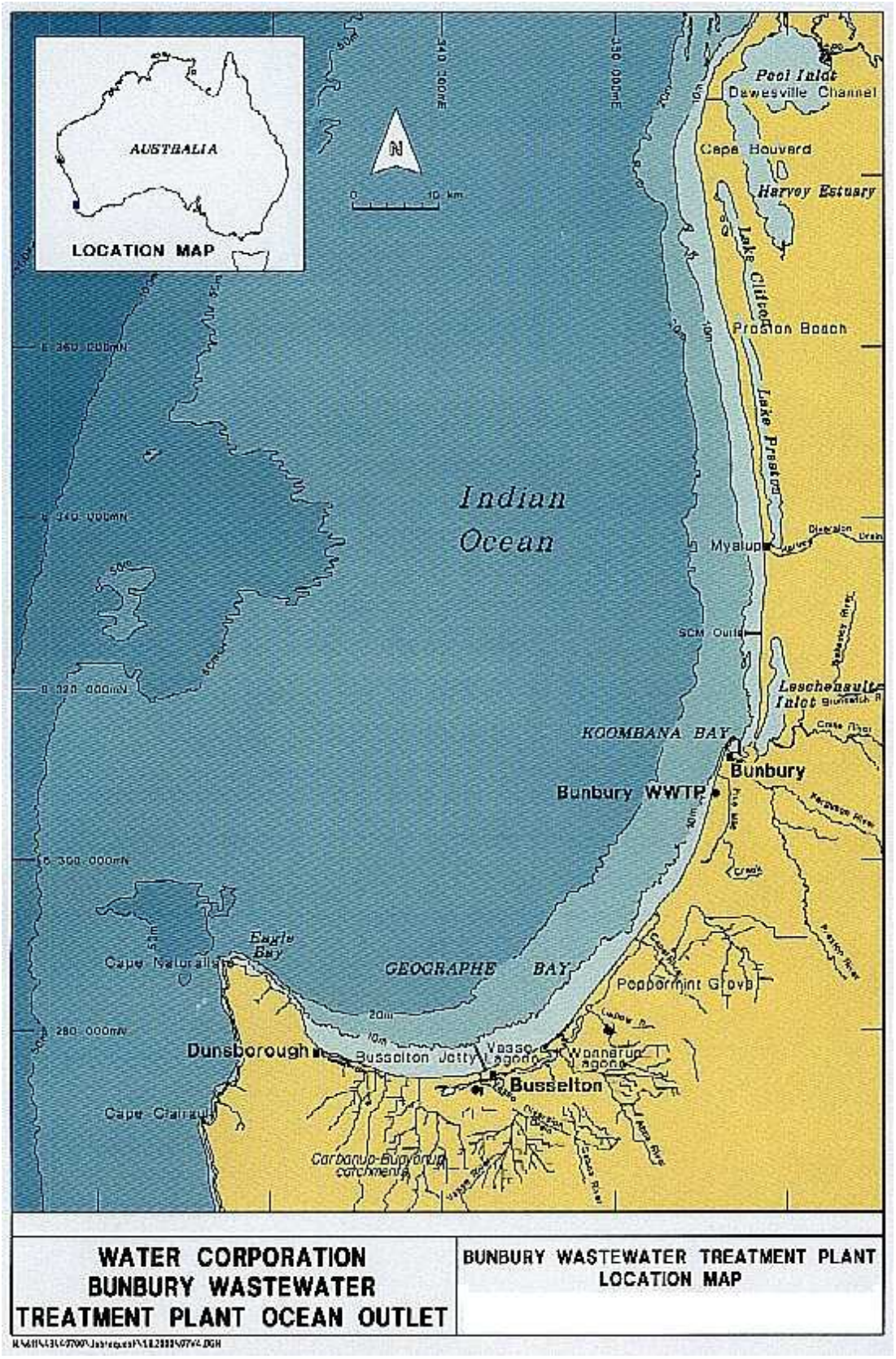

Figure 2.2 Bunbury WWTP location map

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).

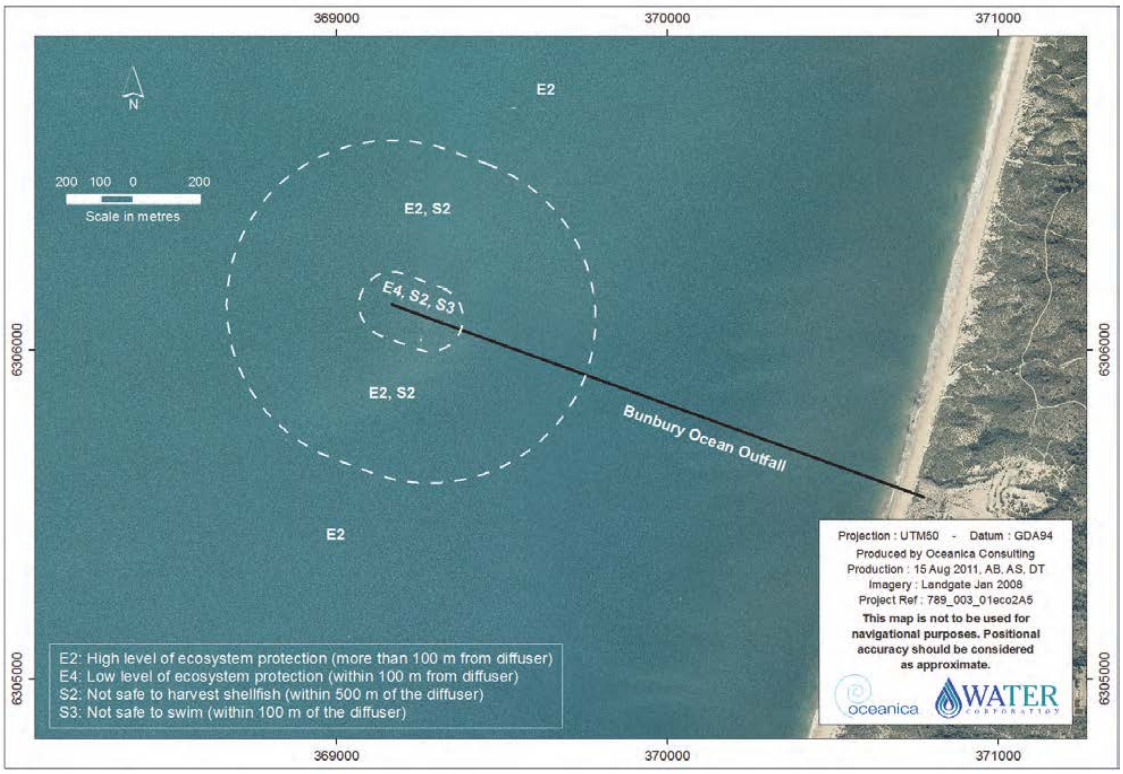

Figure 3.1 Bunbury ocean outfall: Schematic diagram showing levels of protection (EPA, 2001a)

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.

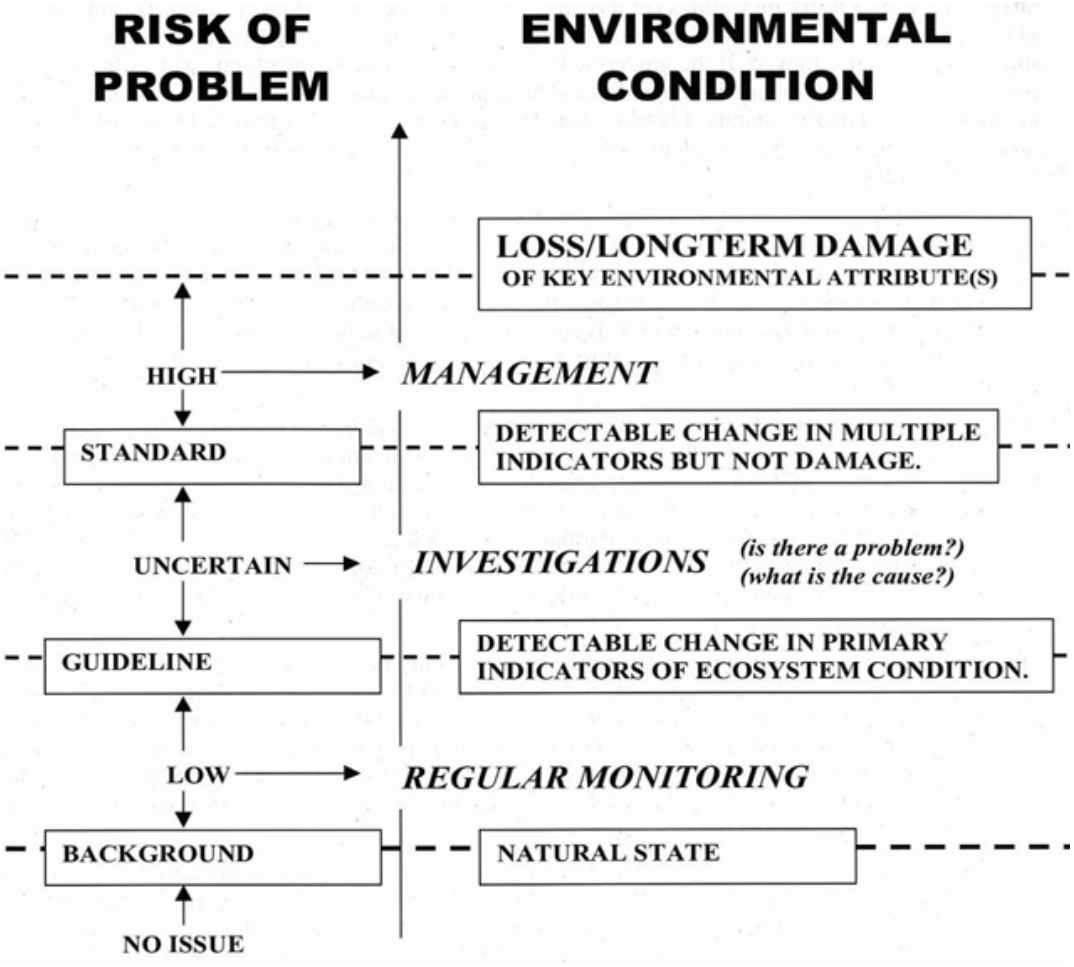

Figure 4.1 Management response protocol from EPA (2005): Conceptual diagram showing the relationship between the two types of EQC on the left hand side with the associated environmental condition on the right hand side

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 95^{th} 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.

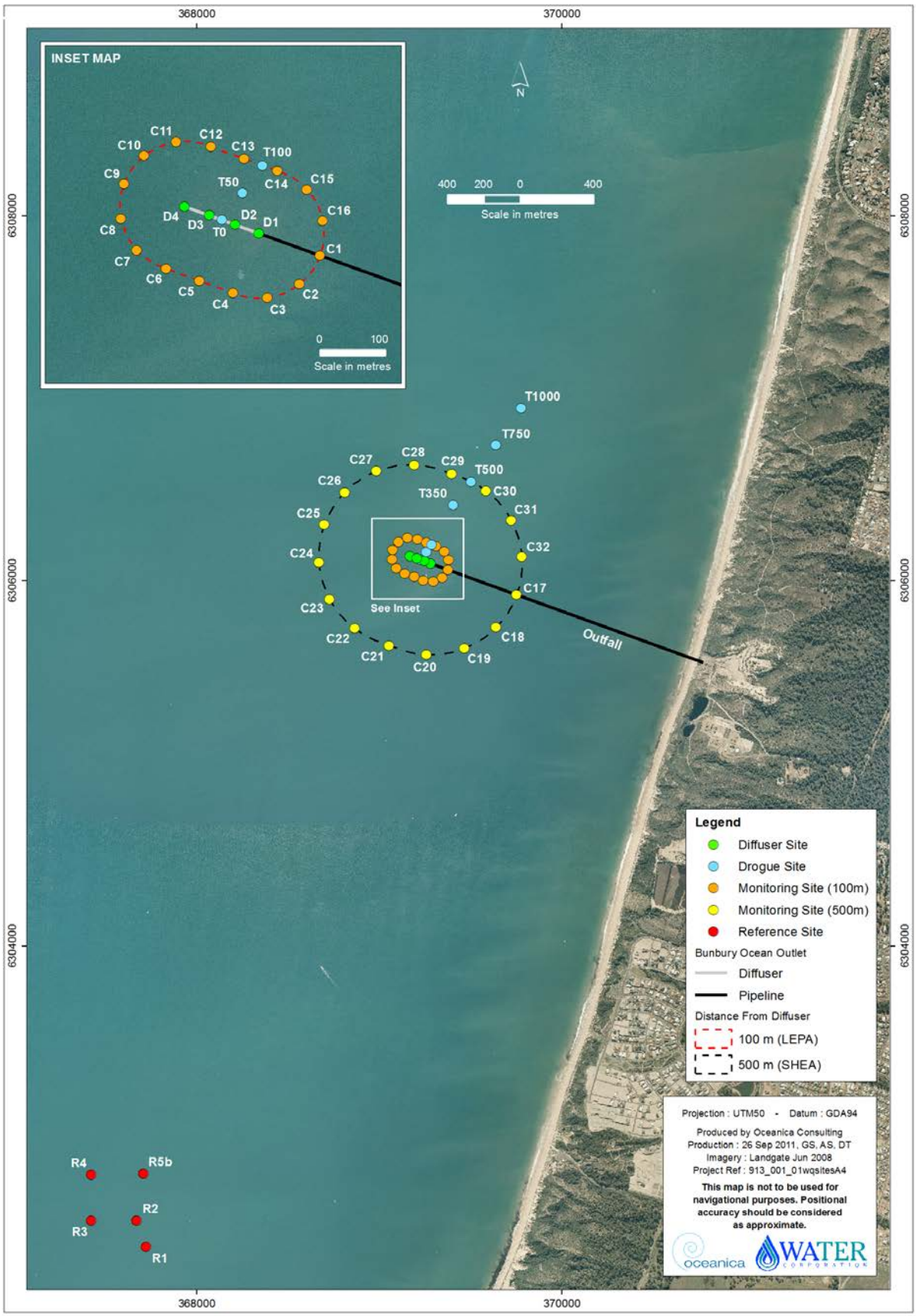

Figure 5.1 Schematic showing compliance (monitoring), diffuser, drogue and reference sites for water quality monitoring program and EQC boundaries at 100 m and 500 m distance from the diffuser

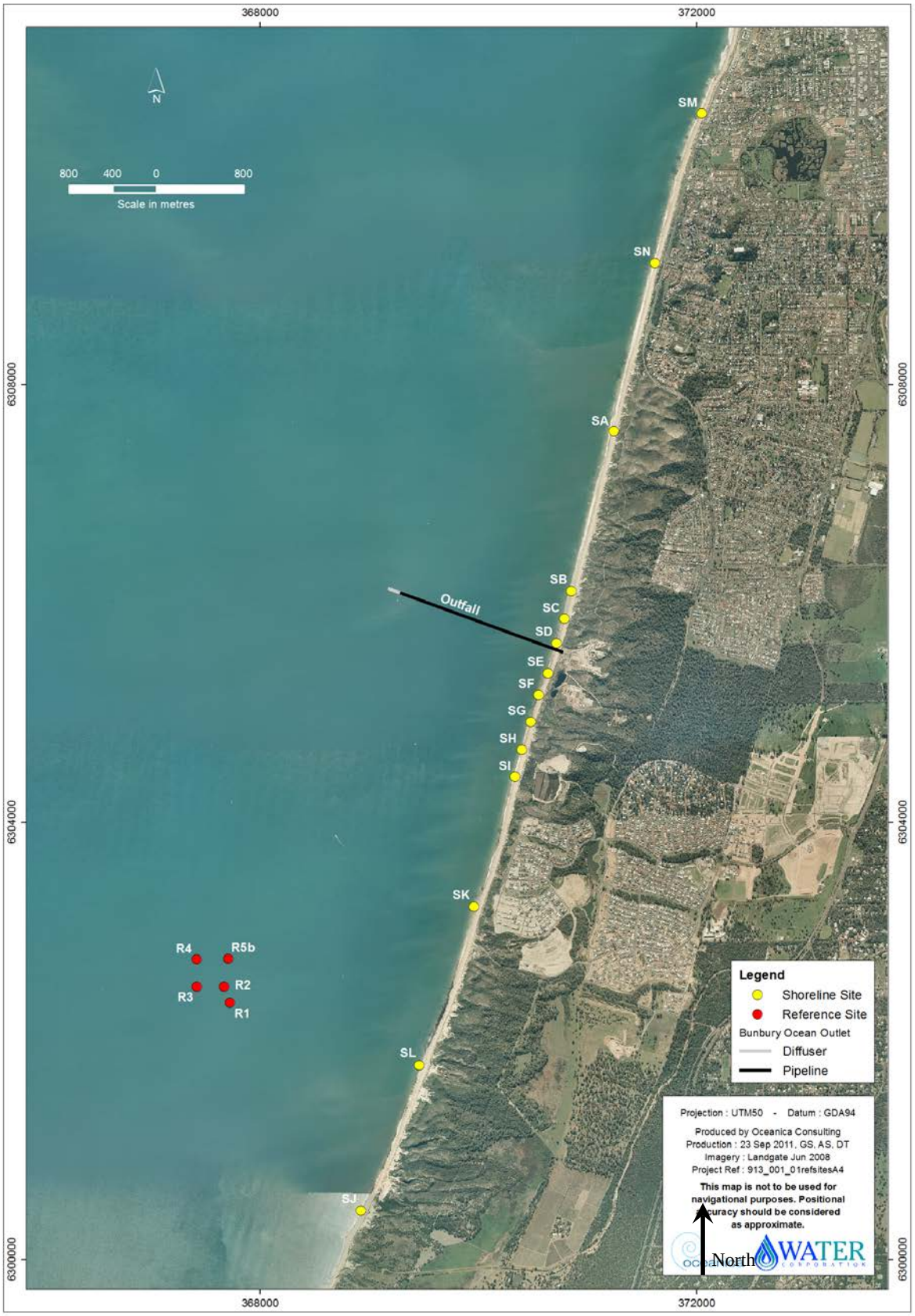

Figure 5.2 Approximate shoreline sampling and reference site monitoring site locations

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).

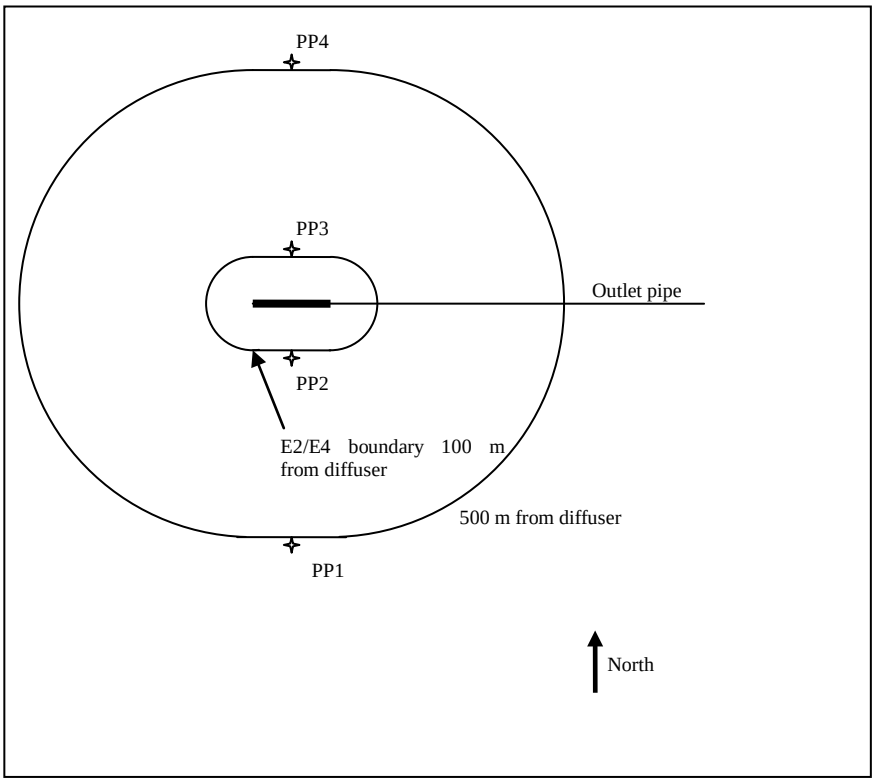

Figure 6.1 Periphyton collector locations

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).

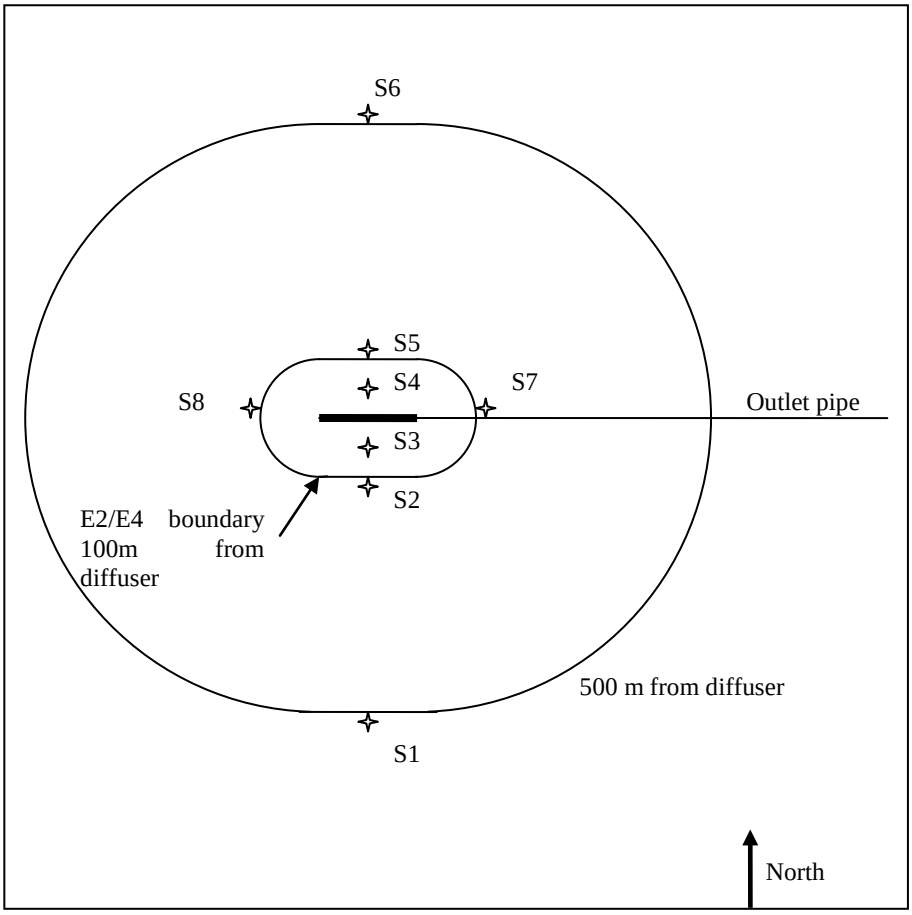

Figure 8.1 Sediment quality survey sites

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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