3.6 Anti-Fouling Coating Residues

Anti-fouling paints contain biocides which prevent the growth of biota on boat hulls but also slowly leach into the water column and can exert their biocidal activity on benthic organisms. The two primary biocides in use are based on copper containing, or tri (n-butyl) tin (TBT) containing, compounds with the tin based types being more effective and replacing the copper types (Hall & Pinkney, 1985). TBT oxide (TBTO) has been shown to be ten times more toxic to marine copepods than copper (Uren, 1983) and in general the TBT coatings are far more of a problem than the copper based ones. Concern overseas with the effect of TBT compounds, particularly on oyster farms, has slowly led to bans on their use on small boats in France, Sweden, the UK and parts of the US, however with Australia's fragmented environmental response pattern they are still the most common anti-fouling coatings in use in Australia. While there are no data available to estimate their toxicity to coral or effects on a coral reef the figures for their toxicity to molluscs, fish, zooplankton, crustaceans, bacteria and fungi suggest similar effects would occur with coral. Effects occur at extremely low levels (down to a few ng/l) making analytical monitoring extremely difficult and the long term environmental effects of chronic low level contamination difficult to predict (Laughlin & Linden, 1985).

3.7 Other Contaminants

A number of other contaminants which have a deleterious effect on corals but are only likely to be present in small amounts from the development include detergents and other surfactants from moored boats and the sewage effluent, trace metals from bilge water and discarded metallic debris in the marina.

4. MONITORING PARAMETERS

The monitoring parameters chosen for the baseline study reflect the concerns highlighted in Section 3 and are directly related to possible contaminants from the construction and operation of the development.

As the sediment/turbidity study was run independently, in terms of sampling, from the general water quality study it is reported separately throughout the rest of this report.

4.1 General Water Quality Study

4.1.1 Physical and meteorological parameters

These were cloud cover (by visual estimation); wind speed (by digital anemometer); wind direction (by vane and compass); wave direction (by compass); wave height (by estimation); total depth (by marked, weighted line); temperature and visual observations such as sediment plumes, Trichodesmium (Oscillatoria) slicks and Gustav Creek conditions. (Details of methodology are provided in Appendix One and of sampling methods in Section 7).

4.1.2 Sediment parameters

Even though a separate sediment monitoring programme was being carried out sediment parameters were also measured at the general water quality survey sites. The parameters measured were clarity (by Secchi disc); turbidity (using a field nephelometric meter - discontinued after pilot project) and suspended solids (non filterable residue - by a gravimetric method).

4.1.3 Nutrient parameters

These were orthophosphate (by colorimetry); nitrate and nitrite (by colorimetry); ammonia (by colorimetry); silicate (by colorimetry); total phosphorus (by oxidation and colorimetry); particulate nitrogen (by filtration, combustion and thermal conductivity detection) and chlorophyll-a (by colorimetry).

4.1.4 Anti-fouling coating residues

These were tri-(n-butyl) tin oxide (by hydride formation and atomic absorption spectroscopy) and copper (by concentration on ion-exchange resin and atomic absorption spectroscopy). In addition a survey of Nassarius sp. gastropods was undertaken as a baseline for a biological-indicator monitoring programme for TBT residues (see Section 8).

4.1.5 Petroleum hydrocarbons

These were aromatic hydrocarbons (by fluorescence) and petroleum hydrocarbon utilizing bacteria in water and sediments (by culturing).

4.1.6 Faecal matter parameters

These were total coliforms; faecal coliforms and total heterotrophic plate count (all by membrane filtration and plate culturing).

4.1.7 Other physico-chemical parameters

These were salinity profile (by measurement of conductance on an SCT meter); dissolved oxygen profile (by polarographic membrane DO meter) and biochemical oxygen demand, 5 day (by dilution and dissolved oxygen reduction measurements).

4.2 Sediment/Turbidity Study

The parameters measured were as in the general water quality programme under Sections 4.1.1 and 4.1.2.

Table 1. GBR Water Quality Summary

AREA	Chlorophyll-a (µg/l)	NO_2	NO_3	NH_4 µg-at/l	PO_4	$Si(OH)_4$
Shelf 1						
Mean	0.35	0.00	0.02	0.15	0.16	1.06
S.D.	0.42	0.01	0.04	0.12	0.05	0.56
Reef lagoons[2]						
Mean	0.37	0.04	0.39	0.15	0.17	1.23
S.D.	0.32	0.04	0.33	0.15	0.04	0.46
Whitsundays[3]						
Mean	1.17	0.00	0.20	0.22	0.23	1.72
S.D.	0.25	0.00	0.14	0.14	0.03	0.41
Shelf[3]						
Mean	0.68	0.00	0.11	0.12	0.16	0.93
S.D.	0.13	0.00	0.11	0.06	0.04	0.43
Barron R.-Green Is.[4]						
Mean		0.16	1.62	0.098	0.17	
S.D.		0.06	3.59	0.037	0.11	
Cleveland Bay[5]						
Mean			0.26		0.20	
S.D.						
Hayman Island[6]						
Range of	0.14	0.01	0.15	1.74	0.46	
means	-0.64	-0.17	-0.56	-15.4	-0.73	
Whitsunday Fringing Reefs[7]						
Mean	0.04	0.35	0.70	0.43	5.9	
S.D.	0.06	0.12	0.39	0.17	4.8	

1. Furnas and Mitchell, 1984
2. Furnas and Mitchell, 1988
3. Furnas, et al., 1988
4. Brady, 1989
5. Walker and O'Donnell, 1981
6. Steven and van Woesik, 1989
7. Blake and Johnson, 1988