RESEARCH SUMMARY

CRUISE FR 1/92

Sailed	Sydney	2200 hrs	Tuesday	21 January 1992
Called	Watsons Bay	0800 hrs	Friday	24 January 1992
Called	Watsons Bay	1600 hrs	Sunday	26 January 1992
Called	Watsons Bay	0900 hrs	Wednesday	29 January 1992
Arrived	Sydney	1400 hrs	Friday	31 January 1992

Peter Nichols, George Cresswell, Rhys Leeming
CSIRO Division of Oceanography

TRACING SEWAGE IN SYDNEY'S COASTAL WATERS AND SEDIMENTS USING ORGANIC MARKERS

Phase II

Post Commissioning of the Deep Ocean Outfall

March 1992

Research Summary

Franklin Cruise FR 1/92

Sydney Outfall Studies

Scientific Objectives

The study was designed to repeat sampling and subsequent chemical analyses for sites examined during the Division's 1989 cruise aboard Franklin in Sydney's nearshore waters. The 1989 work was undertaken before the commissioning of the deep ocean outfalls. The expanded 1992 program repeats the earlier sampling after the three deep ocean outfalls had been commissioned (1991). In time, comparison of results outlined for the two cruises will enable the impact of the deep ocean outfalls to be better assessed.

- To determine the distribution, fate and impact of Sydney's sewage effluent using combined chemical, microbiological and physical oceanographic data.
- To collect water and sediment and related samples for laboratory determinations of organic marker compounds, other chemical and biological parameters and indicator micro-organisms.
- To determine the physical oceanographic features of near-shore coastal waters adjacent to Sydney, with particular reference to major deep water sewage outfalls.

Cruise Objectives

- Conduct regular CTD stations and underway ADCP measurements along the cruise track.
- Deploy and recover chemistry moorings, one at site of DOOM and one at DOOB.
- Collect water and sediments at stations adjacent to the NSW east coast in the Sydney region. Multiple casts will be required at a large number of stations.
- Collect underway surface water temperature, salinity pH and fluorescence data.
- Conduct daily ADCP transects to the1000 m contour in addition to the continuous ADCP measurements routinely performed.
- Provide appropriate sample collection and preparation facilities for external organisations (ANSTO, metals; CSIRO Centre for Advanced Analytical Chemistry, rapid detection methods; Sydney Water Board, viruses and microbiology; NSW State Pollution Control Commission, Oceanography, microbiology; University of Western Sydney, Microbiology) undertaking collaborative studies with the Division of Oceanography.

Cruise Summary

For convenience this report divides the FR1/92 cruise into four legs:

leg 1: Sydney to Jervis Bay and return comprising two sections (T1,T2) to the 1000m contour

leg 2: Sydney to Malabar and return including three sections (T3,T5,T7) to the 1000m contour. Two chemistry moorings were deployed in the vicinity of the Bondi and Malabar deep ocean outfalls (Table 1).

leg 3: Sydney to Bondi and Malabar vicinity and return with three sections to 1000m (T6, T8, T10) and one 10 nautical mile section from the mouth of Botany Bay (T4).

leg 4: Sydney to Bondi and North Head regions and return with two sections to 1000m (T9, T11) and one 5 nautical mile section off Dee Why Point (T12). The two moorings were recovered prior to commencing the transect. An additional personnel change was made on the last day of the cruise prior to conducting a final two stations within Sydney Harbour at Watsons Bay and Farm Cove.

Cruise tracks for the four legs are shown in Figures 1-5, with Figure 2 illustrating the position of all transects in the Sydney area.

Leg 1

Two east-west transects were undertaken, one commencing inside Jervis Bay (T1) and the second south of Jervis Bay (T2, Fig 1).

Station details (all legs):

1. CTD dip(s) with samples taken for hydrology (2-4 depths or more) and other chemical and biological assays.

2. Grab sample for sediment

Further details on station location and samples collected are provided in Table 2.

The station positions were chosen based on their occupation on a previous RV Franklin cruise (FR 13/89; Cresswell 1989).

Aquisition of ADCP data was commenced on leg 1 upon leaving Sydney Harbour and was continued for the duration of the cruise. Current and salinity and temperature data will only be referred to briefly in this summary. For further details on both ADCP measurements and a preliminary description of salinity and temperature features from FR1/92 refer to Cresswell and Peterson (1992).

Leg 2

On departing Sydney Harbour two small chemistry moorings were deployed in the vicinity of the Malabar and Bondi deep ocean outfalls (DOOM, M2 and DOOB, M1; Table 1, Figure 3). Both moorings comprised a dual chamber sediment trap (4m from bottom), dialysis bags containing either triolein, hexane or octanol for concentrating dissolved organics (4m, CSIRO CAAL) and a Seastar *in situ* water sampler (3m) which collects both particulate and dissolved material. Both moorings were fitted with Seastar acoustic releases. The moorings were designed so that all chemical instrumentation could be suspended under the rear A-frame during deployment.

Following mooring deployment CTD sections were performed with sampling details as for leg 1 and as given in Table 2. Multiple dips were required at many stations. Sections were completed in the following order:

Section T3, west to east, mouth of Botany Bay to 1000m contour. Stations were undertaken at 0.5, 1, 2, 3, 4, 5 nautical miles (nm) from the shore and at the 1000m contour. Franklin then steamed inshore to commence T7.

Section T7, west to east, Stations as for T3 with additional stations at 10 and 15 nm. This section reoccupied stations undertaken on cruise FR 13/89 (Nichols and Bavor, 1989). Of particular interest was the observation of a strong transmissometer signal at stations 28-31 (Figure 6). All stations are north of DOOM and the result is consistent with the observed inshore northerly current based on ADCP measurements (Cresswell and Peterson, 1992). T7 was also the transect concentrated on by external collaborators aboard Franklin on leg 2 (Table 2, see also Appendix). Surface water fluorescence, temperature and salinity plots for section T7 (Figure 7) indicate several of the oceanographic features described in Cresswell and Peterson (1992). Of interest is the occurrence of lower salinity surface water between stations 28 and 29 (close to DOOM). Fluorescence generally decreased along the section, although higher fluorescence was associated with cooler waters observed at station 34 (10 nm).

Upon completion of section T7, we steamed south approximately 2 miles and commenced Section T5. Five stations (0.5, 1, 2, 3, 4 nm) were first occupied in an east to west direction, with the sixth station (5 nm) following. As for section T7, this section (T5) occupied stations previously undertaken on cruise FR13/89. Franklin then steamed to Watsons Bay for personnel changeover prior to commencement of leg 3.

Leg 3

Section T10 was commenced (west to east) with stations undertaken as for Section T7 (Figure 4). This section again reoccupied stations from cruise FR13/89. On finishing CTD stations along T10, Franklin steamed back inshore along T10 then proceeded south to commence section T8 (west to east).

Section T8 was completed (stations 0.5, 1, 2, 3, 4, 5 nm and 1000m contour). Franklin then proceeded south and completed sections T6 (east to west) and T4 west to east. The latter section was to 5nm only offshore.

In addition to the CTD sections the rubber duck was deployed at six stations (43,48,51,52,57,60) during leg 3 for collection of surface waters for metal assays (ANSTO).

On completing section T4 we steamed again to Watsons Bay for further personnel changes.

Leg 4

The two chemistry moorings were successfully recovered at the commencement of leg 4. The acoustic release for M1 (DOOB) did not release and the mooring was recovered by using the surface float line (added to the mooring as a safety measure). M2 released as expected. The sediment trap for M2 was recovered inverted and appeared to have tangled with other components of the mooring upon deployment. Care will be required with future similar moorings to ensure this is avoided. The particulate matter samples obtained from the Seastar water samples (over 500L filtered at both sites) were both very rich and had a distinctive sewage odor, suggesting transport of sewage effluent material is occuring in bottom waters.

Three CTD sections (Figure 5) were then undertaken as follows:

Section T9 (west to east) with stations at 0.5, 1, 2, 3, 4, 5 nm and at the 1000m contour. This section occupied stations performed on cruise FR13/89.

Section T11 (east to west) with stations as for section T9.

Section T12 off Dee Why Point (west to east) with stations at 0.5, 1, 2, 3, 4 and 5nm. Upon completion of CTD stations on section T12, a number of ADCP sections (both west to east and east to west) were performed for calibration purposes along this section.

Further personnel were picked up at Watsons Bay on the final day of the cruise. Two stations were undertaken within Sydney Harbour at Watsons Bay and Farm Cove. These two stations were performed to provide information on material entering Sydney's coastal waters from estuarine environments.

Franklin docked at White Bay, Balmain at 1400. Visitors from the NSW State Pollution Control Commission, the Sydney Water Board and Naval architects were provided with tours of the vessel.

General comment

The temperature and salinity data from the CTD casts and the current data from the ADCP have been examined in a preliminary manner (Cresswell and Peterson 1992). The oceanographic features that they revealed in the Sydney area included an East Australian Current eddy, a northward undercurrent, mid shelf currents that appeared independent of those further on and off shore, nearshore currents, a slope water intrusion that reached the inner half of the shelf, and a cold filament of water that had upwelled as much as 100 miles further north and was advected southward along the edge of the eddy.

It will be some months before all the data and samples collected during the cruise are analysed in detail. Together the data from this multidisciplinary study will provide a wealth of information on the complex interaction of the chemistry, physics and biology (in particular microbiology) in Sydney's coastal water. These results will aid future management strategies and decisions to be made on the disposal of Sydney's sewerage effluent.

References

Cresswell G. (1987) Temperate eastern Australian Continental Advection Study. CSIRO Division of Oceanography FR13/89 Cruise summary.

Cresswell G.R. & Peterson J.L. (1992) Shipboard measurements of current variability on the Sydney continental shelf.Preliminary Report 29 pp.

Nichols P.D. and Bavor H.J. (1989) Tracking sewage in sludges coastal waters and sediments adjacent to Sydney using organic markers. CSIRO Division of Oceanography FR13/89 piggyback cruise summary.

Scientific Personnel

Peter Nichols	CSIRO Division of Oceanography	Chief Scientist Leg 2-4
Rhys Leeming	CSIRO Division of Oceanography	Chief Scientist Leg 1
Mark Rayner	CSIRO Division of Oceanography	
Val Latham	CSIRO Division of Oceanography	
David Terhell	CSIRO ORV	
Phil Adams	CSIRO ORV	
Jeff Dunn	CSIRO ORV	
George Cresswell	CSIRO Division of Oceanography	Legs 1, 2,4
Jan Peterson	CSIRO Division of Oceanography	
John Bavor	University Western Sydney	Leg 2
Simon Apte	CSIRO Centre Advanced Chemistry	Leg 2
Christine Geortsis	Sydney Water Board	Leg 2
David Waite	ANSTO	Leg 3
Ron Szymczak	ANSTO	Leg 3
Randell Lee	NSW SPCC	Leg 3
John Stocker	CSIRO Headquarters	Leg 4
Christian Peterson	CSIRO Oceanography	Leg 4
Richard Jeffrey	CAMCARE	Leg 4
Jo Findlay	ABC	Leg 4, 31/1/92
Rebecca	ABC	Leg 4, 31/1/92
Steve	ABC	Leg 4, 31/1/92
Nick Ashbolt	Sydney Water Board	Leg 4, 31/1/92
Graeme Batley	CSIRO Centre for Advanced Chemistry	Leg 4, 31/1/92

Leg 1	January 21-24	Leg 3	January 26-29
Leg 2	January 24-26	Leg 4	January 29-31

Ships Crew

Don Gordon	Master
Dick Dougall	
Paul Joussart-Jackson	
Peter Noble	
Phil Coombes	
John Hensliff	
Norm Marsh	
Bluey Hughes	
Jim Smith	
Kris Hallen	
Phil French	
Gary Hall	
Bob Clayton	
Steve Corridon	

Acknowledgement

We extend our sincere thanks to the master and crew of RV Franklin and to our fellow CSIRO colleagues and external collaborators for their co-operation and assistance throughout the cruise. The Division of Oceanography workshop manufactured the grab that enabled sediment to be successfully collected.

Peter D. Nichols George Cresswell Rhys Leeming

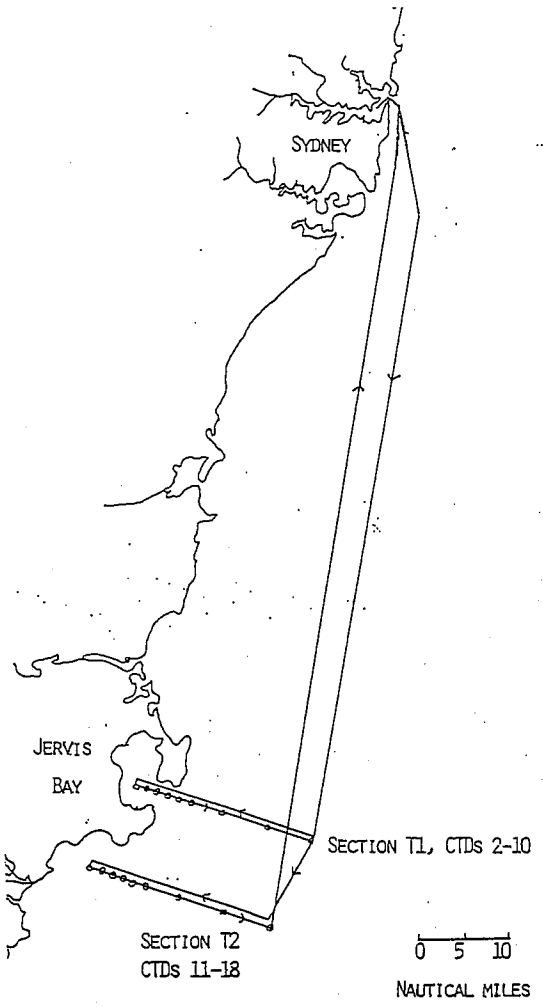

Figure 1 Cruise track leg 1. Numbers indicate sections and stations (Table 2)

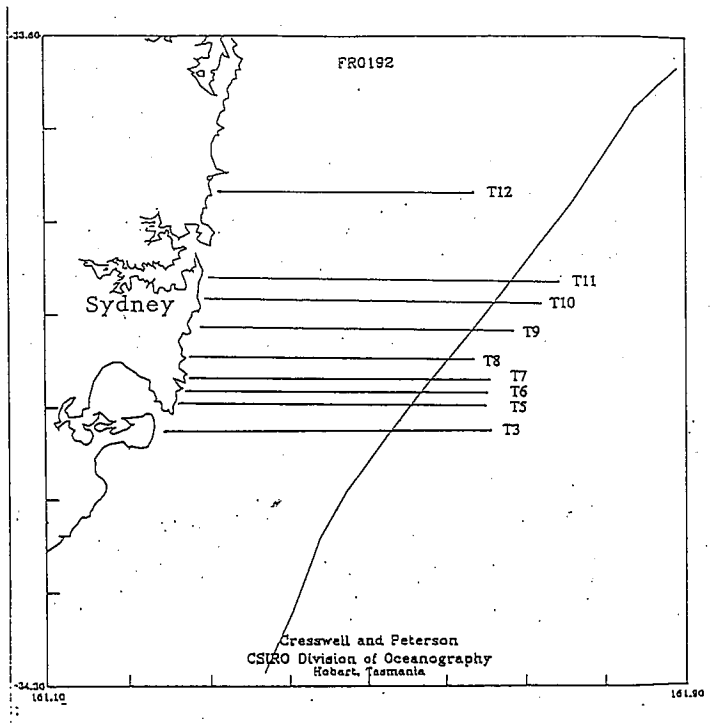

Figure 2. Sydney survey area showing positions of all transects undertaken on legs 2-4 (from Cresswell and Peterson, 1992)

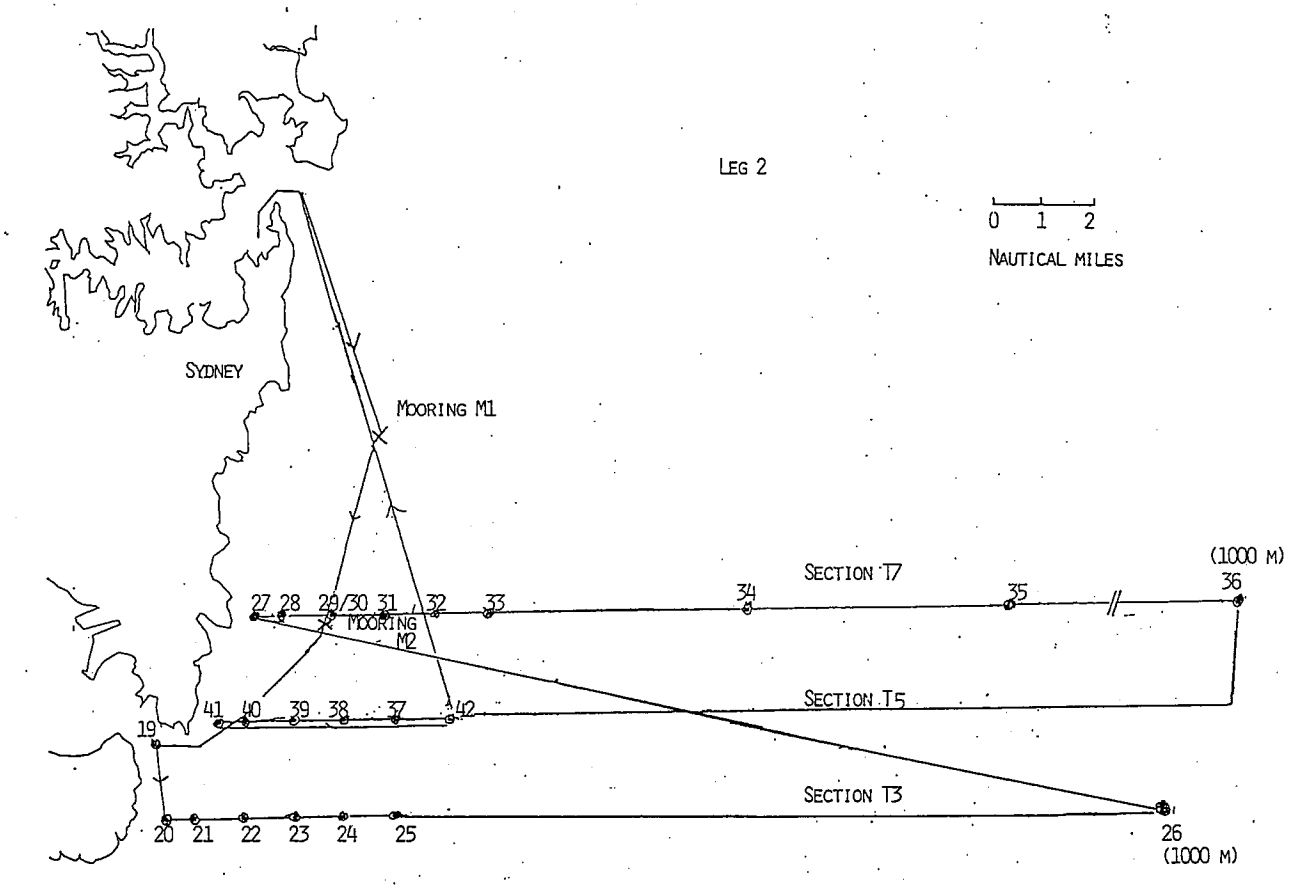

Figure 3. Cruise track leg 2. Numbers indicate sections and stations (Table 2) and moorings (Table 1).

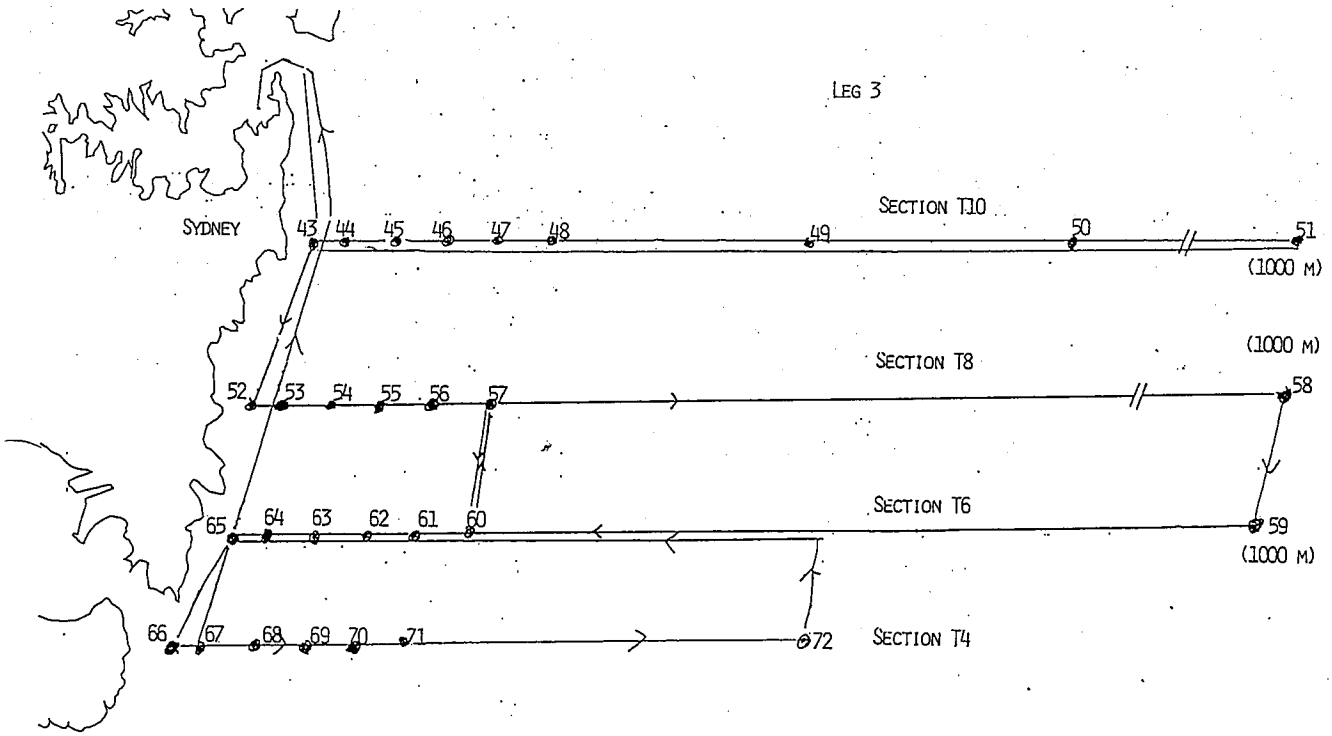

Figure 4. Cruise track leg 3. Numbers indicate sections and stations (Table 2)

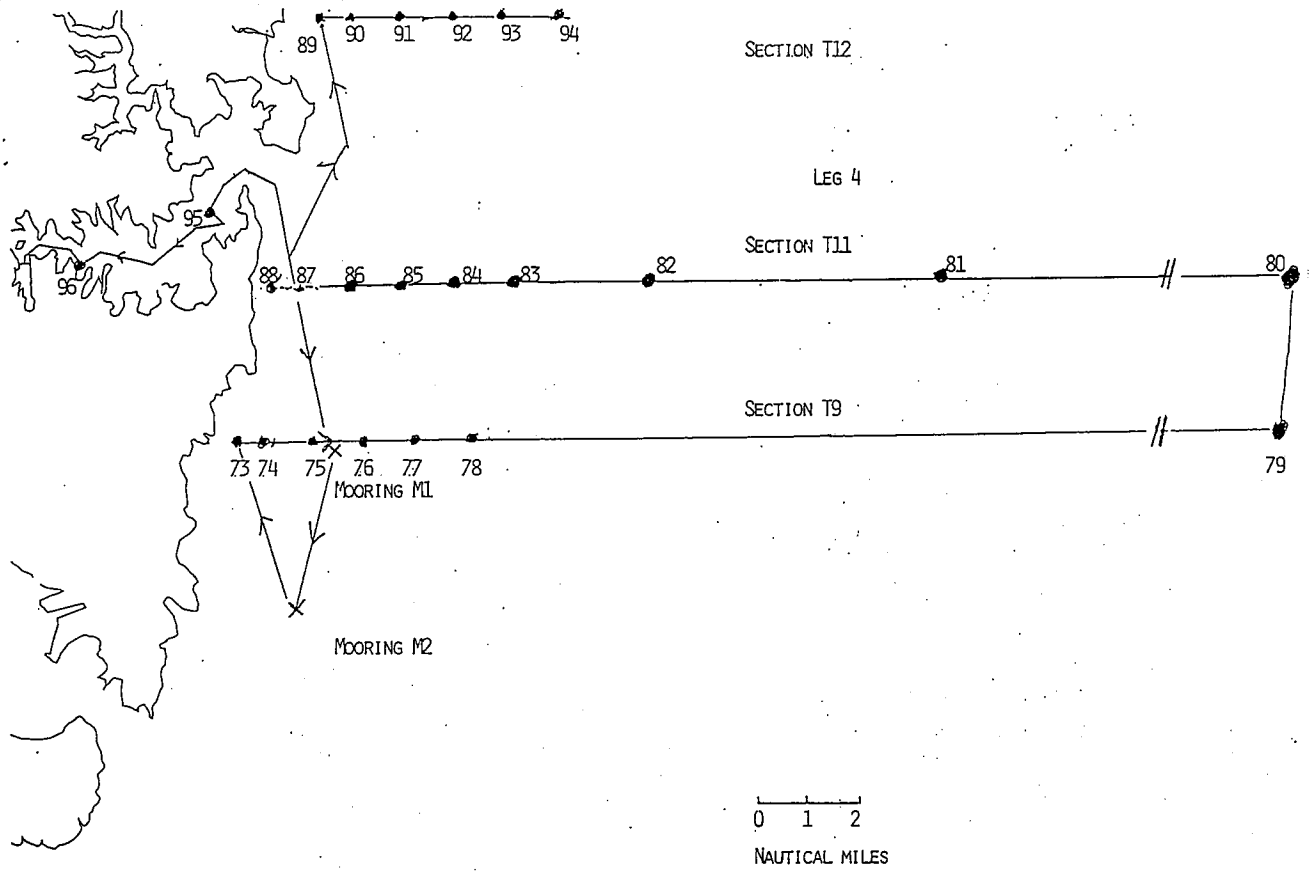

Figure 5. Cruise track leg 4. Numbers indicate sections and stations (Table 2).

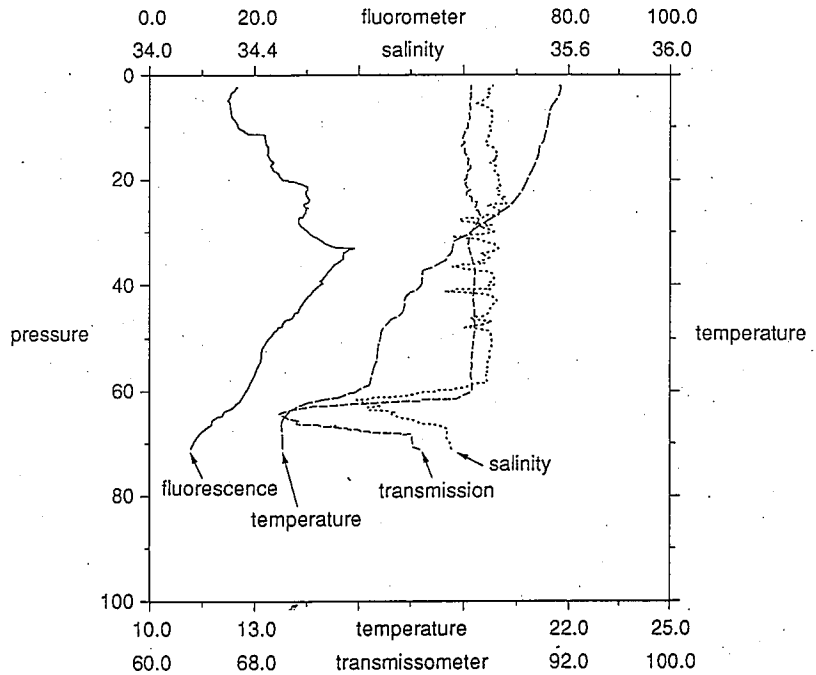

Figure 6. CTD profiles of temperature, fluorescence, salinity and transmission for station 30

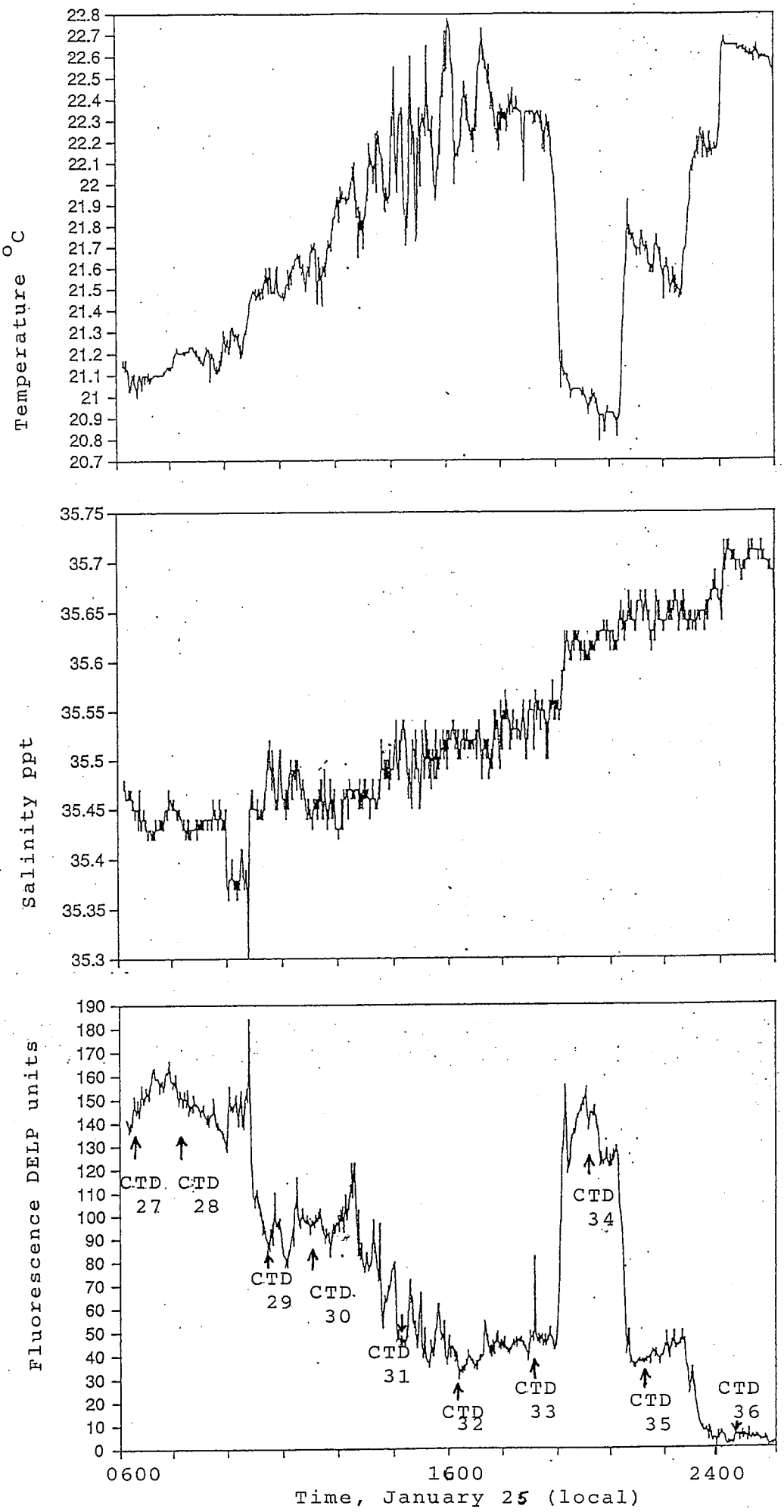

Figure 7. Section T7 (west to east) surface water fluorescence, salinity and temperature. Station positions as shown

Table 1: Mooring details

Number	Location*	Equipment
M1	33°55.02'S 151°18.40'E (Bondi)	Acoustic release, Seastar water sampler, sediment trap, dissolved organics concentrating equipment
M2.	33°58 21'S 151° 17.64'E (Malabar)	Acoustic release, Seastar water sampler, sediment trap, dissolved organics concentrating equipment

Abbreviations

ADCP	Acoustic Doppler Current Profiler
ANSTO	Australian Nuclear Science and Technology Organisation
CTD	Conductivity, Temperature, depth
DOOM	Deep Ocean Outfall Malabar
DOOB	Deep Ocean Outfall Bondi
SPCC	State Pollution Control Commission (NSW

Table 2: **FR1/92 station locations and sampling details**

CTD No	Location lat. (S)	Location long.(E)	Date (UTC)	Time (UTC)	Water Depth	Sampling Depth	Hydrology Sampling	Pig Water	Isotope Water	CHN Water	DOC Water	Lipids Water	Lipids Sediment	SPOC NH4	SPOC micro	SWB micro*	UWS micro	CAAS RDS	ANSTO metals#
Leg 1																			
Section T1																			
2	35 04 84	150 44 21	21/1/92	2339	27	0,20	x	x	x	x	x	x	x						
3	35 05 93	150 45 82	22/1/92	159	33	25	x	x	x	x	x	x	x						
4	35 06 36	150 47 38	22/1/92	333	45	18,40	x	x	x	x	x	x	x						
5	35 07 51	150 48 08	22/1/92	517	71	17,64	x	x	x	x	x	x	x						
6	35 07 58	150 49 89	22/1/92	710	105	11,90	x	x	x	x	x	x	x						
7	35 08 03	150 50 66	22/1/92	855	116	20,108	x	x	x	x	x	x	x						
8	35 10 20	150 56 06	22/1/92	1018	135	40,131	x	x	x	x	x	x	x						
9	35 12 82	151 01 79	22/1/92	1206	775	40,765	x	x	x	x	x	x	x						
10	35 13 90	151 07 53	22/1/92	1518	1470	45,1500	x	x	x	x	x	x	x						
Section T2																			
11	35 13 73	150 36 74	22/1/92	2056	40	20,35	x	x	x	x	x	x	x						
12	35 14 23	150 37 76	22/1/92	2157	51	20,45	x	x	x	x	x	x	x						
13	35 14 70	150 39 16	22/1/92	2305	68	20,60	x	x	x	x	x	x	x						
14	35 15 16	150 40 31	23/1/92	14	93	20,85	x	x	x	x	x	x	x						
15	35 15 59	150 41 46	23/1/92	143	107	20,96	x	x	x	x	x	x	x						
16	35 15 94	150 42 63	23/1/92	311	116	37,102	x	x	x	x	x	x	x						
17	35 18 07	150 48 19	23/1/92	441	136	46,131	x	x	x	x	x	x	x						
18	35 19 82	150 53 95	23/1/92	638	353	50,320	x	x	x	x	x	x	x						
Leg 2																			
Section T3																			
19	30 00 41	151 14 59	24/1/92	245	30	0,28	x						x	x				x	
20	34 01 67	151 14 12	24/1/92	404	38	0,36	x	x	x	x	x	x	x	x	x	s	x	x	
21	24 01 71	151 14 88	24/1/92	523	51	0,25,46	x	x	x	x	x	x	x	x	x		x	x	
22	34 01 77	151 16 11	24/1/92	630	80	0,26,51,79	x	x	x	x	x	x	x	x	x	s	x	x	
23	34 01 64	151 17 43	24/1/92	753	98	0,25,50,95	x	x	x	x	x	x	x	x	x		x	x	
24	34 01 48	151 18 41	24/1/92	859	107	0,25,50,100	x	x	x	x	x	x	x	x	x	s	x	x	
25	34 01 67	151 19 86	24/1/92	1021	125	0,25,50,120	x	x	x	x	x	x	x	x	x		x	x	
26	34 01 75	151 46 92	24/1/92	1326	1116	0,500,1110	x						x	x	x	s	x	x	
Section T7																	x		
27	33 58 27	151 16 61	24/1/92	1911	49	0,40	x	x	x	x		x	x	x	x	s	x	x	
28	33 58 14	151 17 25	24/1/92	2106	70	0,25,60	x	x	x	x	x	x	x	x	x	s w	x	x	
29	33 58 00	151 18 13	24/1/92	2347	78	0,25,50,70	x	x	x	x	x	x	x	x	x	s	x	x	
30	33 50 07	151 18 19	25/1/92	59	78	0,25,50,65	x	x	x	x		x	x	x	x	s	x	x	
31	33 58 31	151 19 50	25/1/92	327	88	0,26,50,61	x	x	x	x	x	x	x	x	x	s w	x	x	
32	33 58 23	151 20 74	25/1/92	515	91	0,25,50,85	x	x	x	x	x	x	x	x	x	s	x	x	
33	33 58 03	151 22 02	25/1/92	629	95	0,25,50,90	x	x	x	x	x	x	x	x	x	s w	x	x	
34	33 57 90	151 27 88	25/1/92	839	141	0,30,50,133	x	x	x	x	x	x	x	x	x	s w	x	x	
35	33 58 18	151 33 74	25/1/92	1048	169	0,35,50,165	x	x	x	x	x	x	x	x	x	s w	x	x	
36	33 58 83	151 49 26	25/1/92	1334	1031	0,35,50,100,200 500, 1023	x						x	x	x	s	x	x	
Section T5																			
37	34 00 03	151 19 74	25/1/92	1917	100	0,25,50,95	x	x	x	x	x	x	x	x	x		x	x	
38	34 00 01	151 18 56	25/1/92	2043	90	0,25,50,85	x	x	x	x	x	x	x	x	x		x	x	
39	33 59 98	151 17 34	25/1/92	2206	84	0,25,50,80	x	x	x	x	x	x	x	x	x		x	x	
40	34 00 03	151 15 96	25/1/92	2322	51	0,25,45,	x	x	x	x	x	x	x	x	x			x	
41	33 59 96	151 15 60	26/1/92	53	50	0,25,40	x	x	x	x	x	x	x	x			x	x	
42	34 00 09	151 21 02	26/1/92	211	108	0,25,75,105	x	x	x	x	x	x	x	x			x	x	
Section T10																			
43	33 53 35	151 17 75	26/1/92	647	48	0,25,42	x	x	x	x	x	x	x	x					s w
44	33 53 38	151 18 24	26/1/92	759	61	0,25,55	x	x	x	x	x	x	x	x					s
45	33 53 22	151 19 39	26/1/92	910	70	0,25,50,65	x	x	x	x	x	x	x	x					s
46	33 53 23	151 20 63	26/1/92	1030	76	0,25,50,70	x	x	x	x	x	x	x	x					s
47	33 53 38	151 22 02	26/1/92	1155	83	0,25,50,77	x	x	x	x	x	x	x	x					s
48	33 53 46	151 23 06	26/1/92	1355	105	0,25,50,100	x	x	x	x	x	x	x	x					s w
49	33 53 61	151 29 22	26/1/92	1538	133	0,25,50,125	x	x	x	x	x	x	x						s
50	33 53 48	151 34 97	26/1/92	1708	151	0,25,50,145	x	x	x	x	x	x	x	x					s
51	33 53 17	151 47 82	26/1/92	1921	638	0,25,50,630	x	x	x	x	x	x	x	x					s w

Table 2: FR1/92 station locations and sampling details

CTD No	Location lat. (S) long.(E)	Date (UTC)	Time (UTC)	Water Depth	Sampling Depth	Hydrology Sampling	Pig Water	Isotope Water	CHN Water	DOC Water	Lipids Water	Lipids Sediment	SPCC NH4	SPCC micro	SWB micro*	UWS micro	CAAS RDS	ANSTO metals#
Section T8																		
52	33 56 68 151 16 64	27/1/92	229	40	0,25,35	x	x	x	x	x	x	x	x	x				s w
53	33 56 62 151 17 21	27/1/92	406	59	0,25,54	x	x	x	x	x	x	x	x	x				s
54	33 56 72 151 18 25	27/1/92	600	70	0,25,50,65	x	x	x	x	x	x	x	x	x				s
55	33 56 59 151 19 63	27/1/92	721	72	0,25,50,65	x	x	x	x	x	x	x	x	x				s
56	33 56 64 151 20 80	27/1/92	902	85	0,25,50,80	x	x	x	x	x	x	x	x	x				s
57	33 56 68 151 22 09	27/1/92	1043	91	0,25,50,88	x	x	x	x	x	x	x	x	x				s w
58	33 55 81 151 49 74	27/1/92	1415	1032	0,25,50,100,200 500,1000	x						x	x	x				
Section T6																		
59	33 59 11 151 49 03	27/1/92	1647	1016	0,25,50,100, 200 500,1000	x						x	x	x				
60	33 59 09 151 21 61	27/1/92	2017	98	0,25,50,80	x						x	x	x				s w
61	33 59 15 151 20 32	27/1/92	2304	92	0,25,50,85	x	x	x	x	x	x	x	x	x				s
62	33 58 91 151 19 03	28/1/92	38	87	0,25,50,80	x	x	x	x	x	x	x	x	x				s
63	33 59 09 151 17 80	28/1/92	219	85	0,25,50,80	x	x	x	x	x	x	x	x	x				s
64	33 55 05 151 16 69	28/1/92	341	51	0,25,45	x	x	x	x	x	x	x	x	x				s
65	33 59 01 151 15 95	28/1/92	501	50	0,25,45	x	x	x	x	x	x	x	x	x				s
Section T4																		
66	34 00 82 151 15 08	28/1/92	632	45	0,25,40	x	x	x	x	x	x	x	x	x				
67	34 00 71 151 15 78	28/1/92	753	54	0,25,50	x	x	x	x	x	x	x	x	x				
68	34 00 79 151 17 06	28/1/92	921	90	0,25,50,85	x	x	x	x	x	x	x	x	x				
69	34 00 69 151 18 20	28/1/92	1049	100	0,25,50,85	x	x	x	x	x	x	x	x	x				
70	34 00 79 151 19 46	28/1/92	1223	105	0,25,50,100	x	x	x	x	x	x	x	x	x				
71	34 00 77 151 20 62	28/1/92	1356	118	0,25,50,112	x	x	x	x	x	x	x	x	x				
72	34 00 82 151 34 75	28/1/92	1620	264	0,25,50,100, 200,250	x						x	x	x				
Leg 4																		
Section T9																		
73	33 54 87 151 17 40	29/1/92	326	46	0,25,40	x	x		x	x	x	x	x	x				
74	33 54 91 151 18 01	29/1/92	444	65	0,25,50,60	x	x		x	x	x	x	x	x				
75	33 55 00 151 19 24	29/1/92	633	70	0,25,50,65	x	x		x	x	x	x	x	x				
76	33 55 05 151 20 51	29/1/92	746	81	0,25,50,75	x	x		x	x	x	x	x	x				
77	33 54 97 151 21 66	29/1/92	903	86	0,25,50,80	x	x		x	x	x	x	x	x				
78	33 54 93 151 22 83	29/1/92	1029	104	0,25,50,100	x	x		x	x	x	x	x	x				
79	33 55 07 151 52 26	29/1/92	1324	1018	0,25,50,100,200 500,1000	x												
Section T11																		
80	33 51 98 151 54 79	29/1/92	1514	1027	0,25,50,100,200 500,1000	x												
81	33 52 03 151 46 35	29/1/92	1703	500	0,25,50,100,200 500	x												
82	33 52 05 151 33 28	29/1/92	1900	147	0,25,50,100,140	x	x						x					
83	33 50 02 151 23 08	29/1/92	2031	96	0,25,50,90	x	x		x	x	x	x	x					
84	33 51 98 151 21 86	29/1/92	2205	76	0,25,50,70	x	x		x	x	x	x	x					
85	33 52 00 151 20 65	29/1/92	2337	73	0,25,50,65	x	x		x	x	x	x	x					
86	33 51 92 151 19 33	30/1/92	50	65	0,25,55	x	x		x	x	x	x	x					
87	33 51 95 151 18 24	30/1/92	222	53	0,25,48	x	x		x	x	x	x	x	x				
88	33 51 96 151 17 45	30/1/92	400	37	0,25,33	x	x		x	x	x	x	x	x				
Section T12																		
89	33 46 20 151 18 82	30/1/92	614	31	0,25	x	x	x	x	x	x	x		x				
90	33 46 22 151 19 44	30/1/92	746	43	0,25,36	x	x	x	x	x	x	x		x				
91	33 46 24 151 20 61	30/1/92	906	43	0,25,39	x	x	x	x	x	x	x		x				
92	33 46 23 151 21 83	30/1/92	1045	53	0,25,45	x	x	x	x	x	x	x		x				
93	33 46 17 151 23 21	30/1/92	1218	70	0,25,50,65	x	x	x	x	x	x	x		x				
94	33 46 17 151 24 22	30/1/92	1332	90	0,25,50,82	x	x	x	x	x	x	x		x				
95	33 50 54 151 15 96	31/1/92	2304	20	15		x	x	x	x	x	x						
96	33 51 63 151 13 18	31/1/92	202	10	5		x	x	x	x	x	x						

CHN,carbon hydrogen nitrogen ; DOC dissolved organic carbon ; UWS University Western Sydney ; SPCC, NSW State Pollution Control Commision; SWB , Sydney Water Board; CAAC, CSIRO, Centre for Advanced Analytical Chemistry ; RDS, rapid detection sampling; ANSTO, Australian Nuclear Science and Technology Organization. * includes viruses, # metal sampling included sedimentsf rom grab and surface water obtained using a rubber dingy.

Appendix

External collaboraters - brief project details (see Table 2 for site locations)

CSIRO Centre for Advanced Analytical Chemistry (leg 2)

1. Solvent filled dialysis cells were successfully deployed at two moorings located close to the Malabar and Bondi deep ocean outfalls. Following sample analysis, the following information will be obtained:

(i) a comparison of the dialysis and Seastar preconcentration methods for monitoring organic pollutants (in collaboration with CSIRO Oceanography, Hobart)

(ii) a field comparison of hexane, octanol and triolein as in situ preconcentration solvents

(iii) time-integrated concentrations of "bioavailable" organochlorine pollutants discharged from the outfalls

2. A rapid fluorimetric assay for faecal coliforms, based on the detection of beta-galactosidase activity, was set up onboard ship. Satisfactory operation was maintained over three days. Depth profiles of enzyme activity were obtained at each CTD station sampled during Leg 2. Preliminary inspection of results indicated that the assay data is consistent with the hydrographic data on plume dispersal. Data to be provided by the University of Western Sydney and Sydney Water Board will allow correlation of the assay results with microbiological parameters such as faecal coliforms.

Sydney Water Board (Leg 2)

An intensive three day study of the water column and sediments from the Malabar offshore area was carried out in collaboration with the CSIRO Division of Oceanography as part of the post-commissioning program of the Malabar deep ocean outfall.

The aims of the study are to investigate the distribution and survival of health-related micro-organisms in the water column and examine the role marine sediments may play in storing and resuspending micro-organisms in the water column.

The CTD was used to collect 120L of water at selected sites (surface and bottom samples). The samples were then ultrafiltrated to 1.2L. The concentrated water sample was used for human virus (Enteroviruses, Adenoviruses, Reoviruses) and bacterial testing. The membrane filtration method was used to enumerate and identify indicator bacteria (faecal coliforms, faecal streptococci and *Clostridium perfringens* spores) and the bacteriophage MS2. Sediment samples were also collected at the same sites by the use of a sediment grab. Virus and bacterial testing was also carried out on these samples.

University of Western Sydney (Leg 2)

Standard Methods - Membrane Filtration (APHA) were used to enumerate faecal caliform populations (a routinely used bacterial assay to indicate recent sewage contamination in water) in surface and bottom water samples for the following sampling stations:

20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40 (no sample), 41 and 42.

Samples were collected, filtered and incubated in transit (note - samples 38, 37 and 42 were refrigerated at 4°C and filtered upon arrival at the Water Research Laboratory, UWS-Hawkesbury, approximately 5 hrs following collection). Typical colonies were confirmed from positive plates, onshore in the laboratory.

Australian Nuclear Science and Technology Organisation (Leg 3)

Broad project objectives were to:

1. To collect particulate trace metals samples for the determination of concentration transects seawards form the Sydney coastline for a range of trace heavy metals.

2. To characterise the nature of marine particulates in the Sydney coastal region both away from and associated with the Sydney deep-water sewage effluent outfalls.

3. To determine the reactivity of particular bound iron species forming surface coatings on natural particular matter.

4. To elucidate the kinetics and mechanisms involved in phase transformations of natural and terriginous marine particles in the Sydney coastal region through the interpretation of data regarding the nature, composition and oceanic residence times of these particles in association with other ancillary oceanographic data (pH, salinity, dissolved oxygen, light, currents and dissolved organic matter).

Surface water was collected using Go-Flo bottles deployed from the rubber dinghy at selected stations. In addition sediment was obtained from the Smith MacIntyre grab. Both types of samples will be analysed for a wide range of metals.

NSW State Pollution Control Commission (Leg 3)

The aim of this study was to obtain a regular array of microbiological assays to compliment the CSIRO CTD/fluorometer/transmissometer casts and sewage tracer (coprostanol) sampling. These samples were collected in duplicate during legs 2-4, and have undergone subsequent analysis.

The SPCC conducted a parallel experiment which included a month long deployment of 5 current meter moorings, and an intensive 2 day experiment (during leg 4) tracing and sampling effluent from DOOM. Samples from the labelled effluent plume will be analysed for ammonia (AIMS), coprostanol (CSIRO) and microbiological indicators including *Clostridium perfringens*. Analysis of this experiment will be done in consultation with the complementary FR1/92 data.

Electronics Section Cruise Report: Technician: P Adams

Exabyte Tape Drives

The Exabyte tape drives were picked up from Karinsky's, in Sydney, after a ROM update, and reinstalled on the boat.

The drives did not function correctly due to:

1. The ROM update was not compatible with the Vax tape driver

2. Bus terminator resistors had been inserted during testing and not removed

3. The drive ID number had been changed during testing and hadn't been restored

After rectifying the above the Unit functioned correctly for the rest of the cruise.

Acoustic Releases/Moorings

Seastar Acoustic Releases were tested and installed on two shallow moorings. One unit, serial No R20J03 would not communicate with the deck unit and had to be recovered with the anchor still attached.

Ship's Intercom

This became very noisy during the cruise. The amplifier boards were removed, cleaned and reinstalled, fixing the problem.

GO Block

Upon initial testing the displays would register nothing but zero's. Large amounts of corrosion were found on the connector to the electronics board on the block itself. This connector was removed and a flying connector was installed in it's place. This enabled the rate to function correctly but not cable out.

A faulty hall effect transducer was drilled out and a makeshift part manufactured with parts sent from Hobart.

The block was installed and tested for cable out and cable rate. The strain indicator was not working, however this parameter has not been available from some time due to the missing cable angle arm.

CTD System

The NEC Pinwriter proved to be very fragile regarding the paper feed mechanism.

Approximately 15% of the time the paper appeared to stick to the platen at the end of the station when the screen dump had finished. This did not generate any error messages and when the bottle firing file was printed out, it would jam.

No fault could be found with the printer feed mechanism.

One possible cause of the problem is the large temperature and humidity variations within the OP's room causing the moisture content in the printer paper to change, this is not helped when the doors are left open in an attempt to maintain a comfortable working temperature.

NEC APCIV

The Compaq portable computer and EGA screen were returned to Hobart after all files and relevant software had been backed up.

A NEC APCIV was installed in it's place. All relevant software was installed on this machine along with all files from the Compaq.

Electronics Documentation

The manual listing for the electronics section was updated and new shelving was installed in the workshop to accommodate the data books. Some obsolete manuals were returned to Hobart.