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SALINE BASELINE WATER QUALITY SURVEY OF THE WAITEMATA HARBOUR AND HAURAKI GULF

FIRST ANNUAL REPORT

Auckland Regional Council

A.R.C. Environment
Technical Publicaton No. 30, September 1993.

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ENVIRONMENT
Auckland Regional Council

ARC Environment
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1. INTRODUCTION

This report presents the first year of water quality data for saline water quality of the Waitemata Harbour and Hauraki Gulf. It follows a similar format to the Manukau Harbour water quality surveys reported in various Auckland Regional Council Technical Publications.

The purpose of the survey was to:

i. Determine the temporal variability of selected water quality parameters at different sites; and

ii. Provide a saline water quality baseline for future trend analysis.

The major difference from the Manukau Harbour programme is that for these surveys samples were collected exclusively by helicopter instead of by boat. Data collected in this way is considered more comparable in that;

i. Samples can be collected at approximately the same stage of the tide and within a relatively narrow timeframe,

ii. The time of travel for samples from collection to the laboratory is greatly reduced,

iii. Sampling can be undertaken under a more adverse conditions than is generally possibly by small boat,

iv. Substantial cost savings are involved in terms of equipment and staff time,

Naturally there are also disadvantages involved in the use of helicopters for sampling. Chiefly instrumentation problems have beset the survey from the beginning with most problems stemming from electrical interference from the helicopter. Field measurements of dissolved oxygen and salinity have been seriously compromised by these problems. Salinity can be generated from other measurements such as chloride however dissolved oxygen levels have been presented but not discussed due to lack of confidence in the integrity of the data.

Secchi depths may also be affected by sampling from the helicopter. Vant (1992) found that for the Manukau Harbour secchi depths measured from a helicopter were considerably lower than those taken from a boat at the same place and time. However insufficient comparative information is available at this stage of the survey to formulate a correction factor using statistical analysis.

2. SAMPLING SITES AND SURVEY DETAILS

Sites were selected so that water leaving main catchments or areas of high public interest were sampled. Nine sites were selected, four within the Waitemata Harbour, and five along the northern coastline, as shown in figure 1. Results are intended to indicate the influence of catchment use on "bulk" saline water quality.

Ti Point and Mahurangi were chosen as integrators of the Whangateau and Mahurangi catchments respectively. Kawau Bay, Orewa and Browns Bay sites were chosen for their high recreational value and therefore public interest and to represent inner Hauraki Gulf water quality.

Four sites were chosen in the middle Waitemata Harbour. Hobsonville acts as an integrator for the subcatchments influencing the Upper Harbour while the Henderson Creek and Whau river represent the other main subcatchments. Chelsea was chosen as a site remote from immediate catchment influence and also an indicator of the "inner harbour" water quality.

Specific times of sampling relative to high tide at each site on each sampling occasion are presented in table 1.

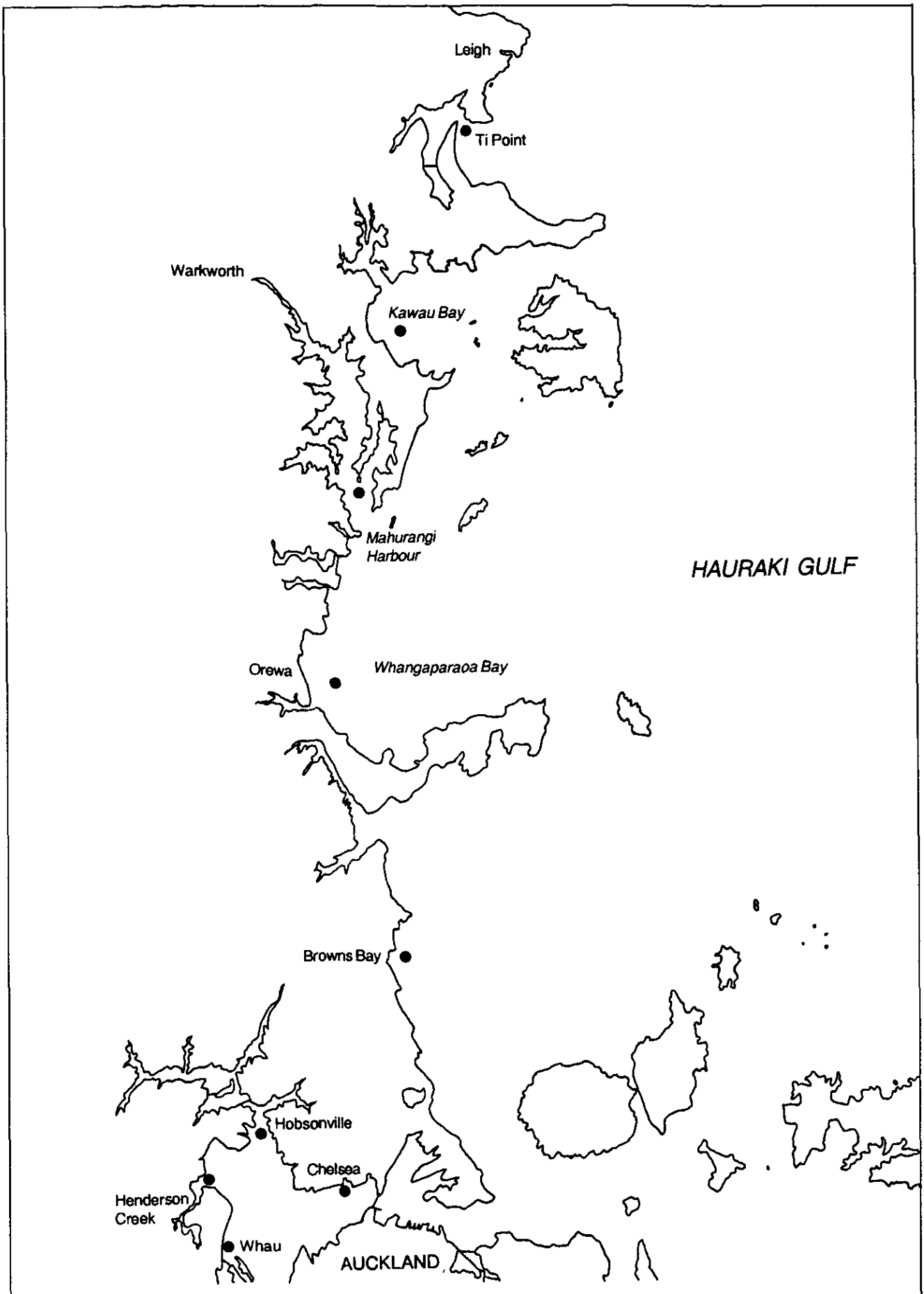


Figure 1 **Saline Baseline Monitoring Sites**

Q64BM3ZJ.DOC

TABLE 1

DATES AND TIMES OF SAMPLING APRIL 1991 - MARCH 1992

	SITE								
DATE	1	2	3	4	5	6	7	8	9
27.4.91*	7.38	7.75	7.88	8.02	8.20	8.42	8.55	8.68	8.77
16.5.91	0.62	0.82	0.97	1.22	1.30	1.47	1.60	2.00	2.12
17.6.91	0.70	0.96	1.08	1.22	1.55	1.72	2.00	2.08	1.80
15.7.91	1.00	1.17	1.30	1.45	1.68	1.87	2.02	2.12	2.22
14.8.91	1.07	1.32	1.57	1.73	1.98	2.23	2.40	2.57	2.90
11.9.91	1.00	1.13	1.27	1.42	1.58	1.77	1.88	2.00	2.13
11.10.91	0.88	1.07	1.17	1.33	1.50	1.72	1.83	1.97	2.10
12.11.91	1.28	1.67	1.82	1.97	2.33	2.57	2.70	2.82	2.92
9.12.91	1.08	1.40	1.53	1.65	1.83	2.02	2.15	2.33	2.43
23.1.92	1.00	1.18	1.33	1.48	1.65	1.73	2.05	2.22	2.33
21.2.92	1.13	1.22	1.37	1.47	1.60	1.78	1.88	2.00	2.10
23.3.92	0.82	0.98	1.10	1.27	1.48	1.63	1.75	1.88	1.97
MEAN	0.96	1.17	1.32	1.47	1.68	1.86	2.02	2.18	2.27
STANDARD DEVIATION	0.19	0.23	0.25	0.23	0.28	0.30	0.31	0.29	0.36

* Results for 27/4/91 omitted from mean calculation due to extreme variance from other dates.

The sampling order has been formulated to allow samples to be taken approximately within 2.5 hours of high tide at each site. Several dummy runs were held in the winter of 1990 to formalise the

sampling sites and a sampling protocol. A copy of the QA/QC checklist used for the saline helicopter runs is attached as Appendix 17.

Twelve surveys were conducted between April 1991 and March 1992 at approximately monthly intervals.

With the exception of the sampling run in April 1991 a relatively stable sampling regime has been established. All the sites are sampled within a 2.5 hour period after high water at Auckland as shown by the mean values in table 1. Standard deviations in this table indicate that generally speaking variations in sampling time increase as the sampling run progresses as might be expected. Variations about the mean range from plus or minus 12 to 22 minutes.

The first sampling run in April 1991 was approximately seven hours out of phase with subsequent surveys, therefore sampling occurred on an incoming tide.

3. METHODS AND DATA QUALITY ASSURANCE

At each site the instrumentation for in situ measurements were deployed and readings taken at the top and bottom of the water column. If these readings indicated that the waters were completely mixed (e.g. salinities within 2 parts per thousand) then a surface sample was taken with a Van Djorn bottle. Where incomplete mixing was indicated by greater salinity variances, both surface and bottom samples were taken for all parameters.

As a QA/QC test one site was selected randomly each run for duplicate sampling, top and bottom, irrespective of the mixing characteristics indicated by instrumentation.

In situ measurements taken were dissolved oxygen, temperature, salinity and secchi depth.

Samples for later determination in the laboratory were taken using a Van Djorn bottle. On only one occasion during the reporting period did this system fail to provide the full compliment of samples . Samples were subsequently analysed for the following parameters;

i. pH
ii. turbidity (NTU)
iii. non-filtrable residue (g/m^3)
iv. biochemical oxygen demand ($g0/m^3$)
v. chloride (gCl/m^3)
vi. salinity (ppt)
vii. ammonia (gN/m^3
viii. nitrate (gN/m^3)
ix. nitrite (gN/m^3)
x. total phosphorus (gP/m^3)
xi. soluble reactive phosphorus (gP/m^3)
xii. presumptive coliforms (MPN/100ml)
xiii. faecal coliforms (MPN/100ml)
xiv. enterococci (no./100ml)*

* Determination of enterococci was first included in the survey in July 1991 therefore no results are available prior to this date.

At all the sites location was achieved by triangulation with three stable reference points which were clearly visible in all weather conditions.

The equipment used and analytical techniques employed are summarised in table 2. Laboratory analyses are described in detail in the "Manual of Methods for Water Analysis" ARA Corporate Services Laboratory (1989). These methods generally follow the "Standard Methods for the Examination of Water

and Wastewater 16th Edition (1985) APHA AWWA WPCF".

TABLE 2 *Field Measurement Techniques Used*

Measurement	Units		Determination
Maximum depth	(m)	-	Hydrolab
Secchi depth	(m)	-	20cm black and white disk (Water and Soil Miscellaneous Publication 54)
Temperature	(°C)	-	Hydrolab
Dissolved Oxygen	(% saturation)	-	Hydrolab, Winkler, YSI
Salinity	(ppt)	-	Hydrolab, Yeo-Kal, Chloride determination

4. STATISTICAL ANALYSES

Statistical treatment of the data has followed the protocol adopted for the Manukau Harbour saline water quality surveys as described in various Auckland Regional Council Environment Technical Publications.

At this early stage of the survey little can be done in term of analysis for seasonal components or trends in water quality . Therefore analysis has been restricted to a description of the water quality at each site and intersite comparisons.

Detailed water quality results for each parameter are presented in Appendices 1-16.

In order to quantify spatial differences for each determinand, data was pooled for each site and compared using ANOVA analysis. ANOVA was undertaken to test if sample means were equal. Where differences were significant ($p<0.05$) a Tukey's pairwise comparison was used to determine which samples were significantly different.

Table 3 details significant results of ANOVA analysis.

Sites are arranged from right to left in increasing order of mean parameter concentration. Sites joined by lines are not significantly different from each other.

Box and whisker plots for selected parameters are presented as figures 2-4. In these plots the boxes represent the data between the 25th and 75th percentiles of the data and the whiskers 1.5 times the interquartile range.

5. RESULTS AND DISCUSSION

The protocol of using the helicopter for sampling resulted in a reduction in the tidal-state related variance between sites usually generated by other sampling regimes.

Meter readings were taken at each site to ensure waters were fully mixed.

In most instances there was either no change or a minimal amount of difference between top and bottom salinity values. Temperature and dissolved oxygen generally did not differ however instrumentations problems with the latter have precluded data interpretation. Considering the above results the water columns at all the sampling sites are described as well mixed.

5.1 WATER TEMPERATURE (Appendix 1)

Median temperatures were very similar for all the sites ranging over 0.4 degrees Celsius. The four harbour sites showed a greater degree of variability than the coastal sites. Maximum temperatures of the harbour sites were approximately one degree higher while minimum temperatures were one degree or more lower than the coastal sites.

TABLE 3 SIGNIFICANT DIFFERENCES BETWEEN SITES: TUKEY'S COMPARISON OF MEANS

PARAMETER	SITE								
Salinity	Orewa	Ti Point	Mahurangi	Browns Bay	Kawau Bay	Chelsea	Whau River	Hobsonville	Henderson Creek
Biochemical Oxygen Demand	Ti Point	Browns Bay	Mahurangi	Orewa	Kawau Bay	Whau River	Hobsonville	Henderson Creek	Chelsea
Secchi Disk Depth	Orewa	Mahurangi	Ti Point	Browns Bay	Kawau Bay	Chelsea	Hobsonville	Whau River	Henderson
Turbidity	Whau River	Henderson Creek	Hobsonville	Chelsea	Mahurangi	Kawau Bay	Browns Bay	Orewa	Ti Point
Non-filtrable Residue	Whau River	Henderson Creek	Hobsonville	Chelsea	Ti Point	Orewa	Browns Bay	Mahurangi	Kawau Bay
Log Presumptive Coliforms	Henderson Creek	Hobsonville	Whau River	Chelsea	Orewa	Kawau Bay	Mahurangi	Browns Bay	Ti Point
Log Faecal Coliforms	Henderson Creek	Hobsonville	Whau River	Chelsea	Browns Bay	Kawau Bay	Orewa	Ti Point	Mahurangi
Soluble Reactive Phosphorus	Whau River	Henderson Creek	Hobsonville	Chelsea	Browns Bay	Orewa	Mahurangi	Kawau Bay	Ti Point

All sites showed the expected seasonal pattern of elevated temperatures in the summer, with maximums in January or February, and lowest values around midwinter in July or August.

5.2 SALINITY (Appendix 2)

Difficulties were experienced with instrument measures of salinity from the helicopter using the HYDROLAB on numerous occasions. In all surveys additional samples were taken for determination in the laboratory. Therefore all values reported are salinity calculated from chloride rather than meter readings.

A comparison of meter and calculated salinities showed no clear margin of difference comparing between surveys therefore no "correction factor" could be calculated.

A box and whisker plot of salinity results is presented as figure 2. The median values for the coastal sites were all very similar ranging over 0.3 parts per thousand (ppt). The middle harbour sites were all significantly lower (greater than 1 ppt) than the coastal sites and showed range of approximately 2 ppt between Chelsea and Henderson Creek.

The middle harbour waters were also more variable with a gradient up harbour away from Auckland City. With the exception of Henderson Creek and Whau River sites the lowest values were recorded in September 1991. Highest values were recorded in March 1992 at all sites except Ti Point.

ANOVA analysis showed that Henderson Creek was significantly lower than all of the gulf sites but none of the harbour sites.

Seasonal differences in salinity were much more pronounced in the harbour than coastal sites due to the influence of stormwater input on the former.

5.3 DISSOLVED OXYGEN SATURATION (Appendix 3)

As discussed in the section on salinity, difficulties were experienced with instrumentation readings of dissolved oxygen from the helicopter using either the Hydrolab or YSI dissolved oxygen meter. The table of results show three surveys where no results were recorded due to interference and a number of instances occurred where suspiciously high or low values were recorded.

The highest median values were all recorded at the coastal sites at 75-77% saturation with all the harbour sites lower than this. Of the harbour sites Chelsea had the closest median to the coastal sites.

There were no significant differences between sites according to ANOVA analysis.

Almost all of these results were conspicuously lower than those reported by Vant (1992) for the Manukau Harbour over a five year period. Given the problems experienced with instrumentation it would be dangerous to draw conclusions as to oxygen saturation levels compared to other sites from this data set.

5.4 BIOCHEMICAL OXYGEN DEMAND (Appendix 4)

Biochemical oxygen demand (BOD) levels were generally low for all sites throughout the survey.

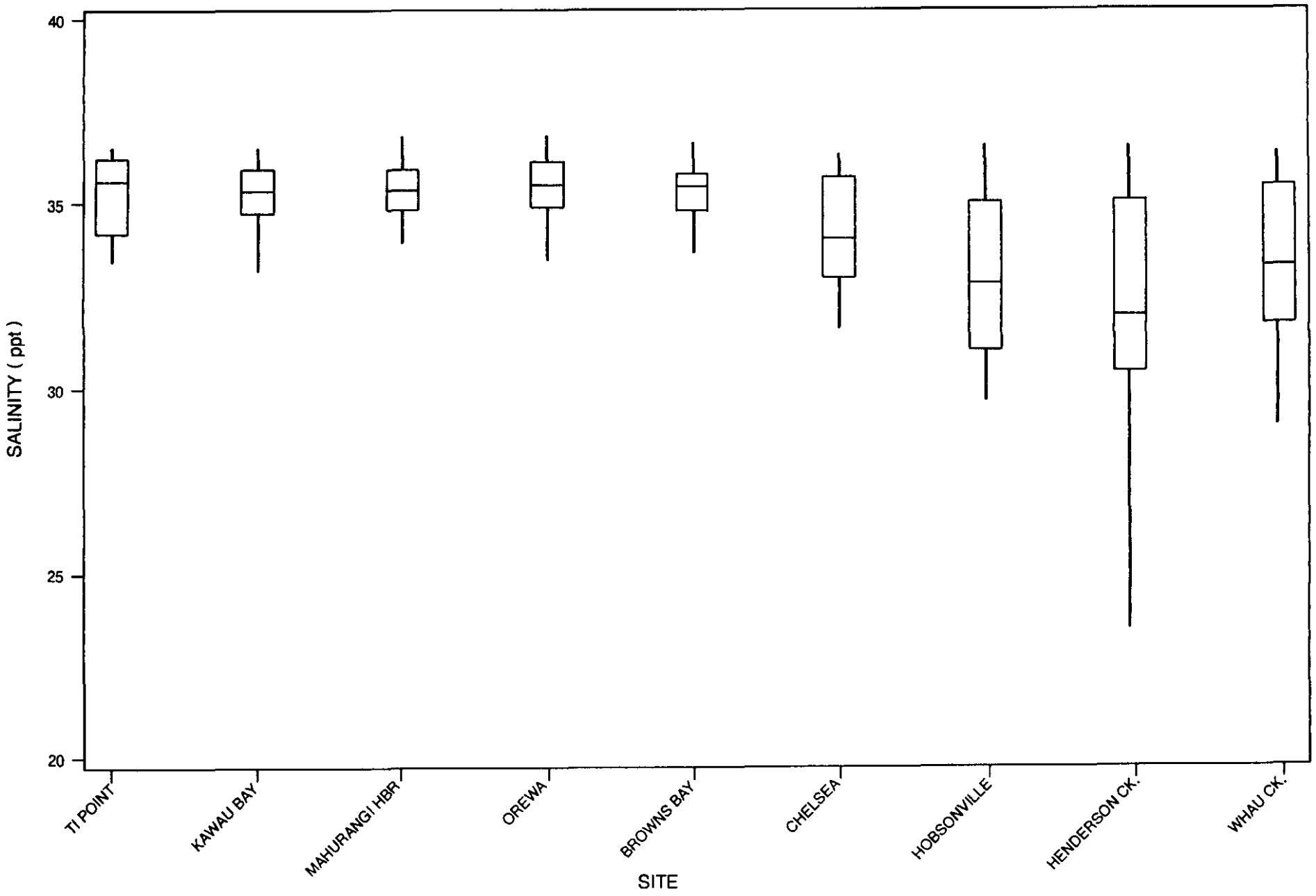
There were no conspicuous differences between coastal and harbour sites as indicated by median values which ranged over 0.5 g/m^3. Given the analytical confidence limits stated by the laboratory for BOD of 2 $g0/m^3$ differences of the magnitude found in this survey have little significance.

The lowest variability was found at Browns Bay while the Whau had the highest.

Ti Point with a median value of 1.6 g/m^3 had consistently higher values than most other sites. This was reflected in ANOVA results which showed Ti Point was significantly higher than Hobsonville, Henderson and Chelsea.

Figure 2

SALINITY



5.5 SECCHI DISK DEPTH (Appendix 5)

Secchi disk depths were not recorded until July 1991 therefore the number of values available for comparison is reduced to nine.

All of the Hauraki Gulf sites had conspicuously higher median secchi depths than those in the Harbour. The highest median was found at Orewa while the lowest was at Henderson Creek. ANOVA analysis showed that all the gulf sites were significantly higher than the Harbour sites. Chelsea was also significantly higher than Henderson. Of the harbour sites Chelsea had the highest median, twice as high as any of the other harbour sites. These results show the influence on secchi depth of suspended materials in catchment runoff or the resuspension of bottom sediments in the shallow harbour areas by wind and/or tidal action.

Vant (1992) compared measurements of secchi depth in the Manukau Harbour taken from a boat and helicopter at similar times. Helicopter values consistently underestimated the values recorded from the boat, although not in a precise manner so that a correction factor could not be calculated. Therefore the results of the helicopter survey may be an underestimate of water clarity as indicated by Secchi disk depth.

5.6 TURBIDITY (Appendix 6)

Sites with potential for input of suspended material associated with stormwater runoff or resuspension of fine settled materials by wind or wave action had conspicuously higher turbidity values.

Turbidity levels at the Hauraki Gulf sites with medians below 2 NTU were considerably lower than all the harbour sites which had medians ranging from 4 to 13 NTU. A box and whisker plot showing turbidity values is presented as Figure 3.

The Whau was significantly higher than all other sites except Henderson Creek according to ANOVA analysis. Henderson Creek was significantly higher than other sites except the Whau and Hobsonville. While Hobsonville was significantly higher than three of the gulf sites namely, Browns Bay, Orewa Beach and Whangateau.

The highest values were routinely recorded at the Whau River site and the lowest at Ti Point or Orewa. The lowest degree of variability (most consistent) results were found at Hobsonville while the most variable was Ti Point. Only one site showed an obvious seasonal pattern, Henderson Creek which had considerably higher values in winter than in summer.

5.7 NON-FILTRABLE RESIDUE (Appendix 7)

As found with many other parameters non-filtrable residue levels were highly variable at most sites. The least variable sites, Hobsonville and Henderson, also have higher levels indicating generally higher suspended materials at these sites rather than episodes of high levels in response to antecedent weather conditions.

Generally speaking the harbour sites were considerably higher, with medians from 9.5 to 27.8 g/m^3 that the Gulf sites. ANOVA analysis showed that the Whau was significantly higher than all the gulf sites and Chelsea, Henderson Creek was significantly higher than all the gulf sites.

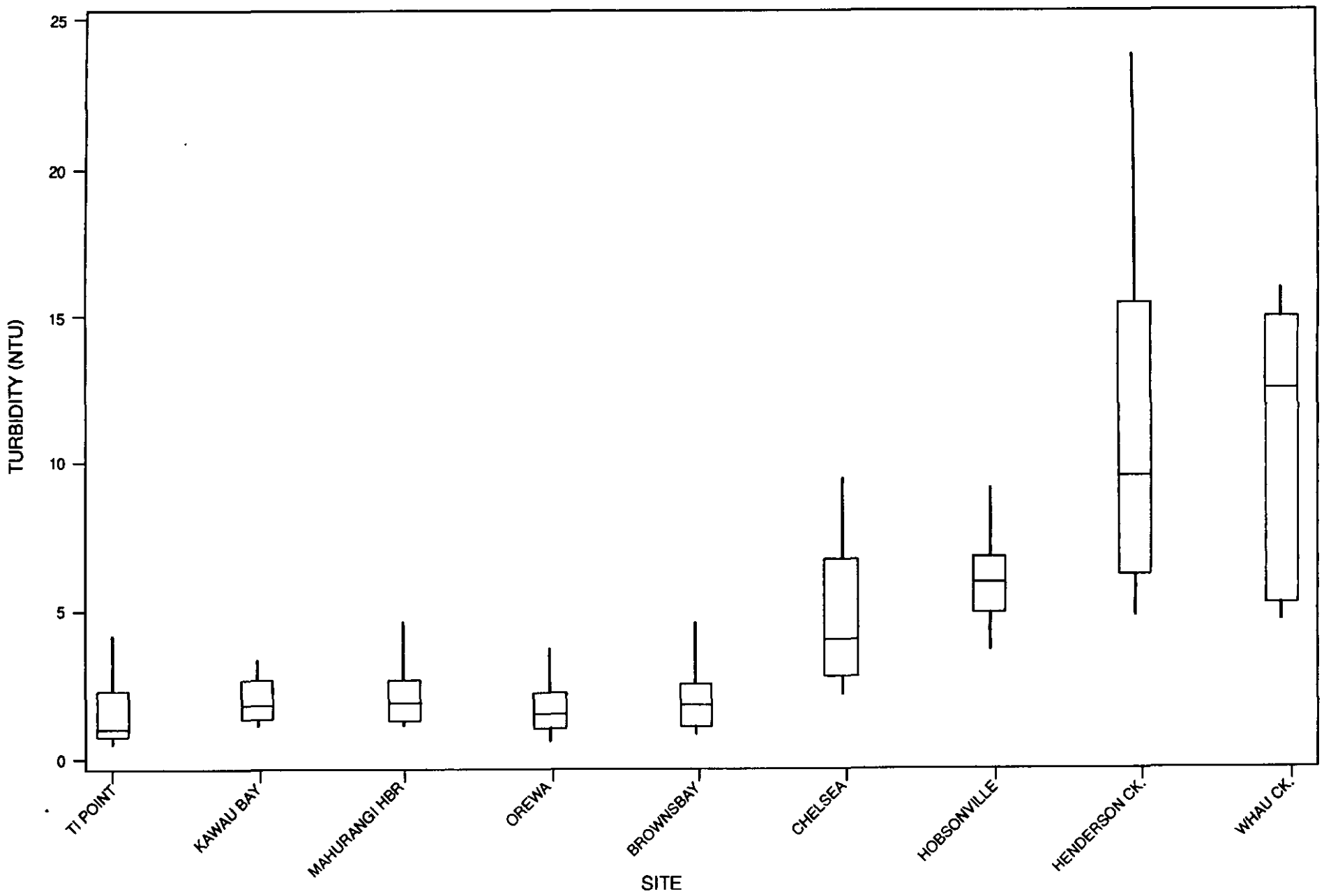
The highest results were routinely recorded at the Whau River, while Orewa generally had the lowest values.

5.8 PRESUMPTIVE COLIFORMS (Appendix 8)

As expected presumptive coliforms were one of the most variable parameters measured during the survey ranging up to three orders of magnitude at some sites. The least variable site was Ti Point while

Figure 3

TURBIDITY



Henderson was the most variable. Results from the December 1991 sampling run were not forwarded to the ARC due to an error at the laboratory therefore only eleven values have been reported.

All the Hauraki Gulf sites had generally low levels as indicated by median values of 5 MPN/100ml or less. All the harbour sites had considerably higher values with medians of 13 to 49 MPN/100ml. Henderson Creek generally recorded the highest values although Hobsonville also had occasional high results. All sites recorded high values in November 1991.

Prior to statistical treatment presumptive coliform results were log transformed to normalise the data. Subsequent ANOVA analysis showed that Henderson Creek was significantly higher than all of the gulf sites. There were no other significant differences.

The ubiquitous nature of presumptive coliforms within the terrestrial and aquatic environment makes linking high levels with sources extremely difficult. High presumptive coliforms does not necessarily indicate contamination by material of faecal origin, just that some source of organic matter has entered the waterway. Therefore high levels occasionally found may have come from general catchment runoff or resuspension of settled materials from the seabed by wind and/or tidal action.

5.9 FAECAL COLIFORMS (Appendix 9)

Faecal coliforms are the water quality parameter most frequently considered by members of the public to represent compromised water quality in terms of use, particularly contact recreation. Studies have shown that faecal coliforms are found in faeces other than mammalian origin and that the assumed relationship between pathogens and faecal coliforms may not be valid. In light of these results recent ARC bathing beach surveys have been using enterococci as a more reliable indicator of the presence of pathogens ARC EPD TP 13 (1992). However for the purposes of comparison between sites and determination of gross sources of contamination faecal coliforms are still seen as a useful water quality tool.

The gulf sites all had considerably lower median faecal coliform levels, ranging from <2 to 2 MPN/100ml, than the harbour sites which although low had with medians between 8 and 17 MPN/100ml.

Faecal coliform results were log transformed prior to ANOVA analysis which showed that Henderson Creek was significantly higher than all the gulf sites.

5.10 ENTEROCOCCI (Appendix 10)

As stated in the section on faecal coliforms enterococci have now been adopted by the ARC as a more reliable indicator of the presence of pathogens.

Monitoring of water samples for enterococci was initiated in July 1991. Since this time laboratory error has led to the omission of two sets of sampling results. Therefore only seven sets of data are available for comparison. Consequently no figure has been produced for inclusion in the appendix.

With the exception of the sampling run of March 1992 mosts sites showed low levels of enterocci.

Harbour sites with the exception of Chelsea had noticeably higher median levels of enterocci than the coastal sites.

The highest values were recorded at Henderson and the lowest at Orewa.

Enterococci data was log transformed prior to ANOVA analysis to normalise the data. ANOVA results show that Henderson Creek was significantly higher than both Orewa and Mahurangi but no other sites.

5.11 AMMONIA (Appendix 11)

The value reported in this document as Ammonia is a combination of the unionised ammonia (NH_3) and the ammonium ion (NH_4+). At natural water pH values the latter form predominates although it is the

unionised ammonia which is toxic to aquatic life. Several factors have been shown to modify the toxicity of ammonia, most notably temperature, salinity and pH (USEPA, 1989).

There is little information on the toxicity of ammonia to New Zealand marine organisms. Local regulatory agencies rely on overseas criteria such as USEPA.

Ammonia levels were variable ranging from the analytical limits of detection at 0.001 g/lm^3 to 0.04 g/m^3.

At the median pH (8.0), temperature (15^{o}C) and salinity (30 ppt) values found in Auckland marine waters on ammonia level of 1.6 g/m^3 would be toxic to sensitive marine biota if sustained over a period of time. Results of this survey indicate that ammonia levels were always at least forty times lower than this value.

Median values did not clearly partition the sites into harbour and coastal as was found for other parameters.

ANOVA comparisons revealed no significant differences between sites.

5.12 NITRATE (Appendix 12)

Nitrate results showed a wider degree of variability than other nitrogenous parameters. Orewa showed the greatest degree of variability and the Whau the lowest.

Median values partition the sites into gulf, ranging from 0.007 to 0.014 g/m^3, and harbour 0.020 to 0.028 g/m^3. ANOVA comparisons revealed no significant differences between sites.

There did not appear to be any substantial differences between rural and urbanised catchments such as Hobsonville, Henderson and Whau.

Most sites showed two clear peaks in nitrate. One in August and the other in December, exceptions were Mahurangi and Browns Bay. These peaks may have been associated with seasonal patterns of algal abundance. This situation will be clarified as more data becomes available.

5.13 NITRITE (Appendix 13)

Nitrite is the intermediate compound in the conversion of ammonia to nitrate. Elevated nitrate is usually taken as an indication of a waste source near the sampling site.

As would be expected for well oxygenated natural water most nitrite values were at or around the analytical limits of detection of 0.001 g/m^3. The highest value was recorded at Ti Point in August 1991. However, previous and subsequent results were more than an order of magnitude lower than this value which suggests laboratory error may be the cause rather than any source of waste.

There were no significant differences between any of the sites according to ANOVA analysis.

5.14 TOTAL PHOSPHORUS (Appendix 14)

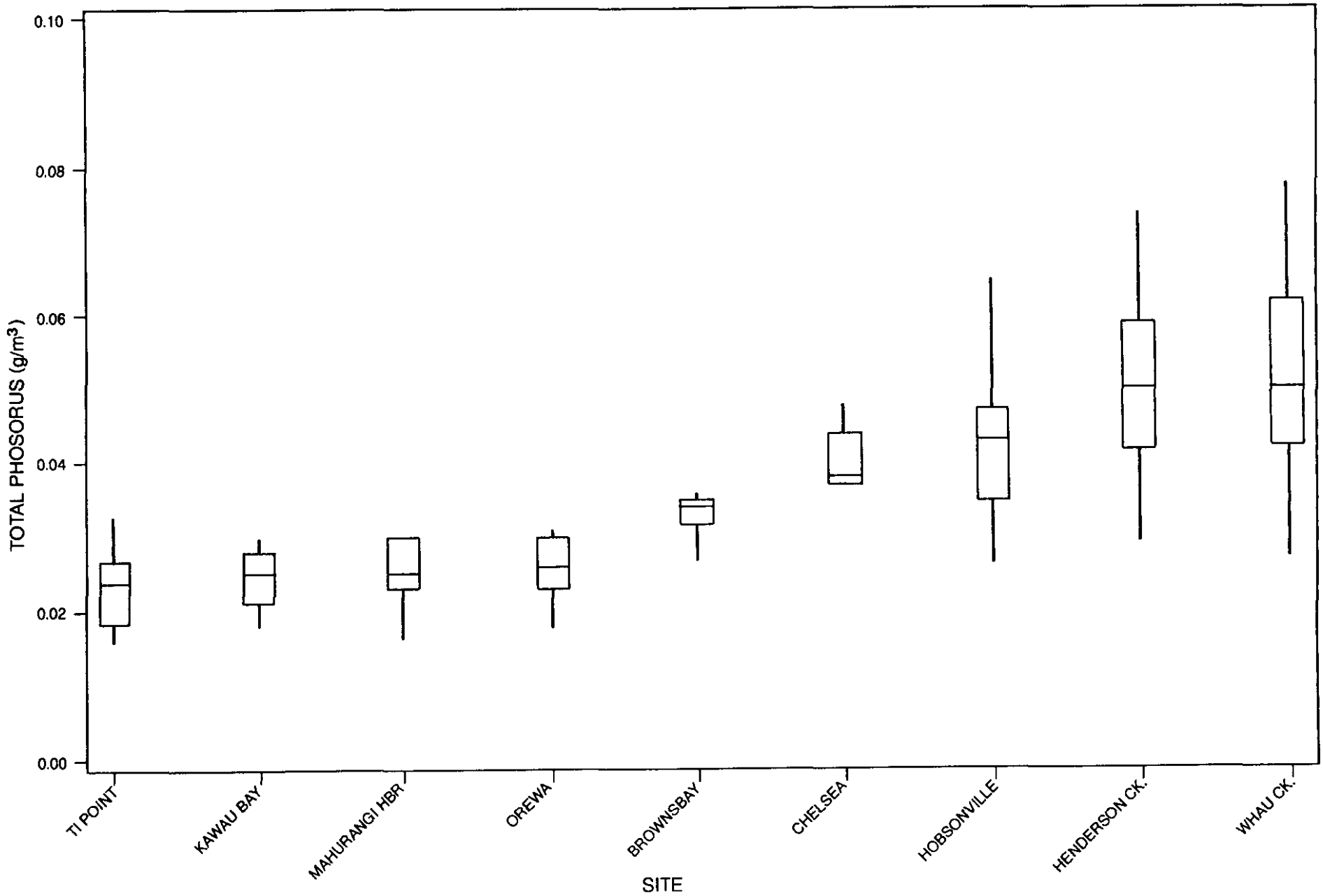
A box and whisker plot of total phosphorus is presented as figure 4. Total phosphorus is a measure of all the phosphorus present in the water column and includes the soluble "bioavailable" fraction, that adsorbed to sediment particles and present in the form of algae or other organic matter.

Median total phosphorus values showed a distinct partitioning between coastal sites, ranging from 0.025 to 0.035 g/m^3, and harbour sites at 0.039 to 0.053 g/m^3. The Whau showed a greater degree of variability than other sites. ANOVA comparisons showed that there were no significant differences between sites.

Four sites recorded high values in August 1991 relative to other sites and sampling dates. There is no obvious reason why this should occur as the sites were from both the coastal and harbour sites.

Figure 4

TOTAL PHOSPHORUS



5.15 SOLUBLE REACTIVE PHOSPHORUS (Appendix 15)

Soluble reactive phosphorus is considered an important indicator of water quality by water managers as it is taken as the "bioavailable" fraction of phosphorus present. It is frequently cited as the nutrient most often limiting the growth of algae and other aquatic plants in NZ. The presence of high levels of phosphorus may be important for monitoring the occurrence of algal blooms.

Most of the coastal sites had slightly lower median soluble reactive phosphorus levels than the harbour sites, the exception was Browns Bay. ANOVA analysis showed that the Whau was significantly higher than Ti Point and Orewa but no other sites. The highest data variability was found at Henderson and the lowest was Kawau.

All of the harbour sites show peak values between February and April with lower values in mid winter. This pattern was not so clearly defined in the gulf sites.

5.16 pH (Appendix 16)

pH showed the least amount of variability, both within sites over time and comparing between sites, of any parameter tested.

There was no obvious difference between median values for coastal and harbour sites and no statistical difference was found using ANOVA analysis.

6. SUMMARY AND CONCLUSIONS

The water quality at five sites along the eastern coastline of the Hauraki Gulf and four sites in the middle Waitemata Harbour have been monitored monthly from April 1991.

The aims of the programme detailed in the introduction have been achieved as follows:

1. Collected data has been used to describe the saline water quality at each site.

2. ANOVA analysis revealed significant differences between sites for some parameters, namely salinity, biochemical oxygen demand, Secchi disk depth, turbidity, non-filtrable residue, soluble reactive phosphorus, log presumptive coliforms, and log faecal coliforms.

3. Comparison of median values showed a clear partitioning of harbour and gulf sites for some parameters, namely; salinity, dissolved oxygen saturation, Secchi disk depth, turbidity, non-filtrable residue, presumptive coliforms, faecal coliforms, nitrate, and total phosphorus.

4. Plots of raw data show clear indications of seasonal patterns for some parameters.

5. No attempts at trend analysis have been made due to the limited amount of data available.

Problems have been experienced with instrumentation during the survey period, particularly measurement of salinity and dissolved oxygen. Salinities can and have been calculated from chloride determination or measured back in the laboratory where interference is not a problem. A number of remedies have been tried for the accurate field measurement of dissolved oxygen. To date apart from field preservation of samples for later laboratory determination no consistently accurate method has been found.

Overall the quality of saline water in the Auckland Region would be described as extremely good. The only exceptions are the inner harbour sites Hobsonville, Henderson and Whau which have slightly reduced water quality during times of high rainfall or strong winds. Catchment development leads to compromise of water quality due to stormwater runoff while windy conditions and wave action affect the water quality of these sites by stirring up bottom sediments.

TABLES OF RAW DATA

KEY:			
	NR	=	Not reported
	IQR/M	=	100 x Inter-quartite Range/Median

APPENDIX 1
TEMPERATURE (°C)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	15.00	13.50	14.50	14.50	14.00	14.00	13.50	13.00	0.00
16-May-91	15.50	15.00	15.50	16.00	15.50	15.00	14.50	14.00	14.00
17-Jun-91	15.00	14.00	14.00	14.00	14.00	13.50	13.00	13.00	13.00
15-Jul-91	13.00	12.00	11.50	11.00	11.00	10.50	10.00	8.00	10.00
14-Aug-91	13.50	13.50	12.50	13.00	12.50	12.50	12.50	12.00	12.50
11-Sep-91	13.50	13.50	13.50	13.50	13.50	13.00	13.00	13.00	13.00
11-Oct-91	14.00	14.90	14.50	14.20	14.00	15.00	15.50	15.50	15.00
12-Nov-91	15.70	16.50	16.20	16.20	15.40	16.40	16.90	17.80	16.40
9-Dec-91	16.60	17.30	16.90	17.10	16.50	17.00	17.80	17.70	17.50
23-Jan-92	20.00	18.00	20.50	21.00	21.00	21.00	20.50	21.50	20.70
21-Feb-92	20.40	21.60	21.20	21.40	21.40	21.90	22.20	22.20	22.10
23-Mar-92	17.50	18.20	18.30	18.00	18.20	18.10	17.50	17.50	16.40
Median	15.00	15.00	15.00	15.10	14.70	15.00	15.00	14.80	15.00
IQR/M	25.90	30.00	28.70	25.40	28.30	31.30	33.10	32.40	33.30

APPENDIX 2
SALINITY (ppt)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	35.70	35.60	35.70	35.60	35.60	35.70	35.60	35.60	35.70
16-May-91	36.50	35.70	35.60	36.30	35.40	33.90	32.90	30.30	32.50
17-Jun-91	36.10	36.10	36.10	35.70	35.60	34.80	33.20	32.30	33.20
15-Jul-91	35.70	35.50	35.30	35.10	34.50	33.40	31.80	31.60	32.00
14-Aug-91	33.90	35.00	34.80	34.80	35.00	32.40	29.50	28.30	28.90
11-Sep-91	33.40	33.10	32.90	32.70	32.90	31.50	29.50	30.30	NR
11-Oct-91	35.40	35.10	35.30	35.30	35.40	34.00	31.70	30.80	31.60
12-Nov-91	35.00	35.00	34.90	34.90	35.10	33.10	30.10	23.40	30.50
9-Dec-91	34.00	33.80	33.90	33.40	33.60	32.70	32.60	32.10	33.40
23-Jan-92	34.80	34.40	34.80	35.90	35.90	35.60	34.30	34.40	34.00
21-Feb-92	36.50	36.30	36.30	36.50	36.60	36.30	35.70	36.10	35.40
23-Mar-92	36.30	36.50	36.60	36.80	36.60	36.30	36.50	36.50	36.30
Median	35.60	35.30	35.30	35.50	35.40	34.00	32.80	31.90	33.20
IQR/M	6.60	3.70	3.80	4.90	4.80	7.10	13.00	10.50	10.60

APPENDIX 3
DISSOLVED OXYGEN SATURATION (%)

SITE DATE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
27-Apr-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
16-May-91	90.00	90.00	87.00	91.00	89.00	86.00	83.00	76.00	67.00
17-Jun-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
15-Jul-91	72.00	82.00	84.00	82.00	82.00	75.00	80.00	67.00	87.00
14-Aug-91	90.00	92.00	88.00	90.00	85.00	87.00	87.00	83.00	NR
11-Sep-91	77.00	75.00	76.00	75.00	75.00	74.00	67.00	67.00	65.00
11-Oct-91	95.00	95.00	76.00	78.00	74.00	75.00	71.00	71.00	64.00
12-Nov-91	70.00	75.00	72.00	73.00	60.00	72.00	71.00	73.00	71.00
9-Dec-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
23-Jan-92	75.00	72.00	74.00	76.00	82.00	71.00	71.00	73.00	71.00
21-Feb-92	71.00	69.00	68.00	69.00	69.00	67.00	68.00	68.00	69.00
23-Mar-92	72.00	75.00	75.00	77.00	75.00	74.00	74.00	73.00	75.00
Median	75.00	75.00	76.00	77.00	75.00	74.00	71.00	73.00	70.00
IQR/M	12.00	20.30	11.80	9.70	10.30	5.10	13.00	7.20	8.90

APPENDIX 4
BIOCHEMICAL OXYGEN DEMAND (gO/m^3)

SITE DATE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
27-Apr-91	1.80	0.40	0.40	0.50	0.90	0.70	0.50	0.40	0.60
16-May-91	1.00	1.00	1.00	0.80	1.10	0.90	1.20	0.90	1.10
17-Jun-91	1.20	1.30	1.10	1.30	1.40	1.00	1.00	1.10	1.10
15-Jul-91	1.70	0.50	0.10	0.70	0.80	0.30	0.50	0.50	0.50
14-Aug-91	1.60	1.70	2.20	1.30	1.30	1.30	1.30	1.40	1.30
11-Sep-91	0.90	1.00	0.90	1.20	1.00	0.90	0.90	0.90	NR
11-Oct-91	1.60	1.10	1.00	0.90	1.20	1.00	0.90	1.10	0.70
12-Nov-91	1.80	1.30	1.70	1.50	1.10	1.40	1.40	0.90	1.40
9-Dec-91	0.70	0.50	0.60	0.90	0.90	0.40	0.70	0.50	0.60
23-Jan-92	2.60	1.10	1.40	1.30	1.20	1.00	1.00	1.10	1.50
21-Feb-92	1.70	1.20	1.20	1.20	1.10	0.80	1.10	1.10	1.30
23-Mar-92	0.60	0.70	0.90	0.40	0.80	0.20	0.40	0.40	0.50
Median	1.60	1.10	1.00	1.10	1.00	0.90	1.00	0.90	1.10
IQR/M	50.00	54.50	67.50	69.00	28.60	55.80	66.70	70.00	73.00

APPENDIX 5
SECCHI DISC DEPTH (m)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
16-May-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
17-Jun-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
15-Jul-91	1.60	1.20	1.55	1.20	1.40	1.20	1.10	0.80	1.00
14-Aug-91	1.80	2.20	1.40	1.80	1.40	0.80	0.60	0.60	0.40
11-Sep-91	1.50	1.50	2.10	1.70	1.50	1.20	0.60	0.40	0.50
11-Oct-91	1.80	1.60	2.40	>2.8	2.00	1.20	0.40	0.40	0.50
12-Nov-91	1.00	1.20	1.50	1.40	1.70	1.20	0.70	0.40	0.50
9-Dec-91	1.80	1.20	1.80	1.80	1.50	0.70	0.50	0.60	0.40
23-Jan-92	1.40	1.60	1.20	1.80	1.00	0.60	0.40	0.30	0.30
21-Feb-92	2.00	1.60	2.00	2.20	2.20	0.70	0.70	0.50	0.50
23-Mar-92	1.60	1.60	1.60	1.50	1.50	1.30	0.70	0.40	0.70
Median	1.60	1.60	1.60	1.80	1.50	1.20	0.60	0.40	0.50
IQR/M *	*Insufficient data to calculate IQR/M								

APPENDIX 6
TURBIDITY (NTU)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	4.10	4.90	3.90	3.60	4.60	15.00	5.00	4.80	4.60
16-May-91	2.10	2.00	2.00	1.70	1.80	4.10	5.50	9.70	15.00
17-Jun-91	2.20	1.90	2.10	1.90	2.30	2.30	3.60	5.10	5.50
15-Jul-91	2.90	2.80	4.60	3.70	2.60	3.80	4.70	6.30	4.90
14-Aug-91	0.70	1.50	1.50	1.00	1.70	2.90	6.50	16.00	15.00
11-Sep-91	0.60	1.20	1.00	0.50	0.80	2.50	6.40	14.00	NR
11-Oct-91	0.60	1.00	1.10	1.00	1.00	2.10	4.90	24.00	13.00
12-Nov-91	0.70	1.10	1.60	0.90	0.90	7.60	7.10	17.00	12.00
9-Dec-91	0.90	3.30	2.00	1.40	2.00	5.90	9.20	9.50	15.00
23-Jan-92	2.20	2.40	3.10	2.40	3.00	9.50	18.00	15.00	31.00
21-Feb-92	0.80	1.50	1.30	1.40	1.00	5.40	6.40	6.10	16.00
23-Mar-92	0.40	1.30	1.00	0.70	1.10	3.20	4.90	7.30	8.20
Median	0.90	1.70	1.80	1.40	1.80	4.00	6.00	9.60	13.00
IQR/M	191.00	80.00	94.40	75.00	85.70	80.40	32.80	89.60	77.70

APPENDIX 7
NON-FILTRABLE RESIDUE (g/m^3)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	9.30	9.10	5.90	4.50	4.90	9.30	17.10	11.80	18.70
16-May-91	8.10	5.90	6.90	3.30	9.60	9.60	14.10	27.70	27.60
17-Jun-91	12.30	6.30	11.10	19.80	13.90	21.40	20.40	21.10	20.40
15-Jul-91	26.80	27.20	27.20	28.60	29.80	28.40	31.00	34.40	32.60
14-Aug-91	8.00	3.80	2.20	27.00	4.60	8.00	12.80	14.00	33.80
11-Sep-91	29.60	8.00	11.60	6.40	4.80	8.40	17.20	30.40	NR
11-Oct-91	3.40	2.30	2.10	1.80	2.30	4.20	9.50	64.40	20.40
12-Nov-91	1.60	2.40	4.60	4.00	4.00	9.20	17.80	24.60	17.70
9-Dec-91	6.80	2.00	5.20	2.60	6.20	14.00	20.80	21.20	31.20
23-Jan-92	16.00	15.00	9.00	6.20	8.00	22.00	71.00	67.00	106.00
21-Feb-92	8.20	6.20	3.40	5.50	6.60	18.00	18.00	21.00	35.00
23-Mar-92	2.50	4.00	4.10	3.40	4.80	8.40	13.00	21.50	27.80
Median	8.20	6.10	5.60	5.00	5.60	9.50	17.50	23.00	27.80
IQR/M	156.00	87.90	108.00	95.00	69.40	103.20	26.50	31.20	51.00

APPENDIX 8
PRESUMPTIVE COLIFORMS (MPN/100 ml)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	<2	<2	<2	<2	<2	6	2	6	2
16-May-91	<2	2	<2	<2	<2	2	2	4	<2
17-Jun-91	2	8	5	17	17	33	240	350	79
15-Jul-91	2	5	5	8	2	13	49	17	33
14-Aug-91	<2	<2	<2	<2	<2	23	17	790	70
11-Sep-91	0	2	5	0	0	13	23	130	NR
11-Oct-91	5	0	5	13	2	33	170	1600	49
12-Nov-91	79	110	130	1300	170	490	1700	490	460
9-Dec-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
23-Jan-92	23	23	23	23	33	49	49	49	23
21-Feb-92	2	7	<2	<2	2	11	13	9	22
23-Mar-92	49	23	<2	2	7	11	7	6	11
Median	2	5	5	2	2	13	23	49	28
IQR/M	14	350	60	600	750	169	254	988	371

APPENDIX 9
FAECAL COLIFORMS (MPN/100 ml)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	<2	<2	<2	<2	<2	4	2	6	2
16-May-91	<2	2	<2	<2	<2	<2	<2	2	<2
17-Jun-91	2	8	5	17	17	8	130	17	49
15-Jul-91	<2	5	5	2	2	8	8	2	11
14-Aug-91	<2	<2	<2	<2	<2	23	13	470	33
11-Sep-91	0	0	0	0	0	8	5	49	NR
11-Oct-91	2	0	2	13	2	22	130	920	49
12-Nov-91	<2	<2	<2	<2	49	8	17	490	7
9-Dec-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
23-Jan-92	<2	<2	2	<2	<2	5	23	17	8
21-Feb-92	2	5	<2	<2	2	5	5	7	5
23-Mar-92	11	23	<2	<2	2	7	7	4	5
Median	<2	<2	<2	<2	2	8	8	17	8
IQR/M	0	213	0	138	100	38	190	2859	437

APPENDIX 10
ENTEROCOCCI (No/100 ml)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
16-May-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
17-Jun-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
15-Jul-91	0	0	0	0	0	0	0	0	0
14-Aug-91	0	0	0	1	2	2	4	NR	8
11-Sep-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
11-Oct-91	0	0	0	0	0	2	24	110	30
12-Nov-91	1	1	0	0	3	2	2	350	2
9-Dec-91	NR	NR	NR	NR	NR	NR	NR	NR	NR
23-Jan-92	2	0	0	0	0	2	3	5	8
21-Feb-92	2	0	0	0	2	2	7	2	3
23-Mar-92	50	40	10	5	18	3	7	12	7
Median	1	0	0	0	2	2	4	9	7
IQR/M*	*Insufficient data to calculate IQR/M								

APPENDIX 11
AMMONIA (gN/m^3)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	0.01	0.03	0.01	0.00	0.01	0.04	0.03	0.03	0.04
16-May-91	0.01	<0.001	0.01	0.01	0.01	0.01	0.01	0.01	0.01
17-Jun-91	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
15-Jul-91	0.01	0.01	<0.001	0.00	0.00	<0.001	<0.001	<0.001	<0.001
14-Aug-91	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.03	0.01
11-Sep-91	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.01	NR
11-Oct-91	0.04	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.03
12-Nov-91	0.04	0.01	0.02	0.01	0.03	0.01	0.02	0.03	0.01
9-Dec-91	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
23-Jan-92	0.01	0.01	0.00	<0.001	0.00	0.02	0.02	0.01	0.03
21-Feb-92	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02
23-Mar-92	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
Median	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
IQR/M	131.00	144.00	100.00	200.00	108.00	120.00	100.00	147.00	218.00

APPENDIX 12
NITRATE (gN/m^3)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	0.01	0.01	0.01	0.00	0.00	0.02	0.05	0.04	0.04
16-May-91	0.01	0.00	0.00	0.00	0.01	0.02	0.03	0.02	0.02
17-Jun-91	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.02
15-Jul-91	0.04	0.02	0.01	0.01	0.02	0.07	0.03	0.05	0.02
14-Aug-91	0.06	0.04	0.02	0.05	0.03	0.08	0.08	0.07	0.06
11-Sep-91	0.00	0.01	0.01	0.02	0.01	0.01	0.02	0.02	NR
11-Oct-91	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01
12-Nov-91	0.04	0.03	0.03	0.04	0.05	0.00	0.05	0.09	0.03
9-Dec-91	0.09	0.07	0.05	0.10	0.06	0.09	0.10	0.11	0.09
23-Jan-92	0.01	0.01	0.02	0.02	0.07	0.01	0.03	0.01	0.01
21-Feb-92	0.01	0.03	0.06	0.01	0.01	0.02	0.01	0.01	0.01
23-Mar-92	0.02	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Median	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.02
IQR/M	171.00	288.00	303.00	660.00	318.00	230.00	211.00	224.00	113.00

APPENDIX 13
NITRITE (gN/m^3)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	0.00	0.00	0.00	<0.001	0.00	0.00	0.00	0.00	0.00
16-May-91	0.00	<0.001	<0.001	<0.001	0.00	0.00	0.00	0.00	0.00
17-Jun-91	0.00	0.00	0.00	<0.001	0.00	0.00	0.00	0.00	0.00
15-Jul-91	0.01	0.00	0.00	<0.001	0.00	0.00	0.00	0.00	0.00
14-Aug-91	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11-Sep-91	<0.001	<0.001	<0.001	<0.001	0.00	0.00	0.00	0.00	NR
11-Oct-91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12-Nov-91	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	0.00	0.00	0.00
9-Dec-91	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00	0.00
23-Jan-92	<0.001	<0.001	<0.001	<0.001	<0.001	0.00	0.00	0.00	0.00
21-Feb-92	0.00	0.00	<0.001	<0.001	<0.001	0.00	0.00	0.00	0.00
23-Mar-92	0.00	<0.001	<0.001	<0.001	<0.001	0.00	0.00	0.00	0.00
Median	0.00	0.00	<0.001	<0.001	0.00	0.00	0.00	0.00	0.00
IQR/M	100.00	100.00	0.00	50.00	75.00	50.00	100.00	75.00	50.00

APPENDIX 14
TOTAL PHOSPHORUS (gP/m^3)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE									
27-Apr-91	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05
16-May-91	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.06
17-Jun-91	0.05	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04
15-Jul-91	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
14-Aug-91	0.03	0.02	0.23	0.15	0.04	0.25	0.03	0.07	0.32
11-Sep-91	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	NR
11-Oct-91	0.03	0.02	0.03	0.02	0.03	0.04	0.04	0.07	0.04
12-Nov-91	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05
9-Dec-91	0.03	0.03	0.02	0.02	0.05	0.06	0.04	0.04	0.05
23-Jan-92	0.02	0.03	0.03	0.03	0.03	0.04	0.06	0.06	0.08
21-Feb-92	0.02	0.03	0.02	0.03	0.04	0.04	0.05	0.04	0.08
23-Mar-92	0.03	0.03	0.02	0.03	0.03	0.05	0.07	0.06	0.06
Median	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05
IQR/M	38.50	36.00	25.90	26.90	23.60	25.30	29.50	34.40	62.30

APPENDIX 15
SOLUBLE REACTIVE PHOSPHORUS (gP/m^3)

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.03	0.03
27-Apr-91	0.01	0.01	0.01	0.02	0.02	0.03	0.02	0.03	0.03
16-May-91	0.01	0.01	0.02	0.02	0.03	0.03	0.02	0.03	0.03
17-Jun-91	0.01	0.02	0.02	0.02	0.03	0.01	0.02	0.01	0.02
15-Jul-91	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
14-Aug-91	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	NR
11-Sep-91	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
11-Oct-91	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
12-Nov-91	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
9-Dec-91	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02
23-Jan-92	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.06
21-Feb-92	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.03	0.03
23-Mar-92	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.02
Median	66.70	27.30	76.20	100.00	111.00	96.40	84.20	136.00	95.00
IQR/M									

APPENDIX 16
pH

SITE	TI POINT	KAWAU	MAHURANGI	OREWA	BROWNS BAY	CHELSEA	HOBSONVILLE	HENDERSON	WHAU
DATE	8.20	8.20	8.10	8.20	8.30	8.20	8.10	8.10	8.20
27-Apr-91	8.20	8.20	8.10	8.10	8.00	8.10	8.00	8.10	8.00
16-May-91	8.10	8.10	8.10	8.20	8.20	8.20	8.10	8.10	8.10
17-Jun-91	8.00	8.10	8.10	8.20	8.30	8.30	8.30	8.30	8.40
15-Jul-91	7.90	8.10	8.00	8.00	8.00	8.00	8.00	7.90	8.00
14-Aug-91	8.10	8.10	8.00	7.90	8.00	8.10	8.00	8.00	NR
11-Sep-91	8.10	8.20	8.20	8.20	8.20	8.20	8.10	8.10	8.10
11-Oct-91	8.00	8.20	8.20	8.20	8.10	8.10	8.10	8.00	8.10
12-Nov-91	8.10	8.20	8.20	7.90	8.10	8.10	8.00	8.00	8.00
9-Dec-91	8.10	8.10	8.20	8.20	8.20	8.10	8.10	8.10	8.00
23-Jan-92	8.20	8.20	8.20	8.20	8.10	8.10	8.10	8.10	8.10
21-Feb-92	7.70	7.90	8.00	8.00	8.00	7.90	7.00	6.80	7.90
23-Mar-92	8.10	8.20	8.10	8.20	8.10	8.10	8.10	8.10	8.10
Median	2.00	1.60	1.80	2.30	2.70	1.10	1.30	1.20	1.20
IQR/M									

CHECK LIST FOR SALINE BASELINE

Saline run **Staff**

Date **Flying time**

High water

Depart Dairy Flat

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2 DAYS PRIOR TO RUN

Check tides

Confirm flight

Book vehicle

Remind RW (or other crew member) of impending run

RW to collect and label bottles

If Manukau run, RW to organise Shelly Beach sample

DAY OF RUN

RW to calibrate instruments

Contact laboratory with ETA

EQUIPMENT CHECKLIST

van Dorn bottle, line weight & messanger	bulk bottle & sling
sechi disk	bacto sling & line
DO meter	bulk bottles
Salinity meter	bacto bottles
funnel	chlorophyll-a bottles
lugols solution *	phytoplankton bottles *
spare van Dorn	
ropes for doors	
plastic for seat	* only for East Coast run

ADDITIONAL NOTES

East Coast Saline **Date:** **H/W** Start sampling at Goat Island 45 min after HW Auckland

	Time	Bottle No.	Sechi	Salinity	Temp	DO	Mixed	Chlor-A	Bacto	Bulk	Phyto
Goat Is		120									
Ti Point		121									
Algies		122						[redacted]			
Mahurangi		123									
Orewa		124						[redacted]			
Browns Bay		125									
Chelsea		126						[redacted]			
Hobsonville		127						[redacted]			[redacted]
Henderson		128						[redacted]			[redacted]
Whau		129						[redacted]			[redacted]
Depth Sample		130	[redacted]					[redacted]			

*LABORATORY - please fax this sheet to Barbara Hickey # 3662155