ADVISORY COUNCIL ON THE ENVIRONMENT
ACE
Room 924, 9th floor, Murray Building, Garden Road, Central, Hong Kong
Tel: 2848 2606 Fax: 2530 5264
香港中環花園道美利大廈 9 樓 924 室 • 電話： 2848 2606 傳真機： 2530 5264

(ACE Paper 20/97)
for information

WATER QUALITY OF DEEP BAY AND TIN SHUI WAI NULLAH

INTRODUCTION

This paper is a follow-up to ACE Paper 16/97 presented to the Council on 24 March 1997. It specifically addresses two possible causes for the decline of water quality in Deep Bay as suggested by members of the Council. These are:

(a) an increase in livestock population in the Deep Bay catchment;

(b) increases in pH and ammonia levels due to run-off from construction works in the Tin Shui Wai and other areas.

LIVESTOCK WASTE POLLUTION

2. Wastes from livestock farms have been a major source of pollution in Deep Bay for many years. Before the implementation of the Livestock Waste Control Scheme (LWCS) in 1987, the number of livestock farms in Deep Bay totalled 6,528 and the organic pollution discharged to watercourses was estimated at 68 tonnes of BOD per day (Table 1). By 1995, the number of farms in the catchment had substantially decreased to 1,971 and the BOD load to around 20 tonnes/day. By the end of 1996, the number of farms had further decreased to 922 and BOD to 16.5 tonnes/day. Although there has been an overall decline in livestock population since 1987, the pig population in the Deep Bay catchment showed a sudden increase in 1996 as compared to 1995. Despite this sudden increase, because of the progressive application of controls and also compensating decreases in other types of livestock, the estimated total BOD load discharged into the rivers on the Hong Kong side of the catchment still declined slightly.

3. As part of the phased implementation of the LWCS, Tin Shui Wai, San Tin and Lau Fau Shan (Control Areas 18 and 19) will be the last areas in Deep Bay to be brought under the control scheme (Fig. 1). These areas are currently the major source of livestock pollution in Deep Bay. In 1995, the organic load from these areas was estimated at 11 tonnes/day which accounted for over half of the load from livestock waste in the catchment (Table 2).

4. There was no significant decline in the water quality of the major rivers in the Deep Bay catchment in 1996 as compared with 1995 (Table 3). The River Beas and River Ganges in fact showed a reduction in BOD in 1996. The Tin Shui Wai Nullah was the only watercourse which showed a decline in water quality. This is discussed in more detail below.

WATER QUALITY OF TIN SHUI WAI NULLAH

5. The Tin Shui Wai Nullah is a concreted channel which drains the Tin Shui Wai catchment and discharges into inner Deep Bay. The water quality of the nullah is monitored on a monthly basis at two sampling stations (TSR1 and TSR2) (Fig.1). Comparing the monitoring data of 1996 and 1995, there was no sign of a decline in water quality in the upstream station

(TSR2) (Table 4). At the downstream station (TSR1) there was a significant increase in BOD and ammoniacal nitrogen in 1996 but this could have been due to changes which took place in 1995 in the operation of an inflatable dam downstream of this sampling point. The effect of these operational changes was to change the characteristics of the area upstream of the dam from an impoundment often diluted with seawater to a dry channel carrying only water from the upstream area. This is likely to have lead to an apparent decline in water quality as measured by regular monitoring.

6. Even if this apparent decline were due to an increase in livestock waste discharges, the effect on Deep Bay would by very small. Tin Shui Wai Nullah is a minor watercourse. We estimate that it contributes around 1% of the river flow from the Hong Kong side of the Deep Bay catchment and less than 1% of the BOD loading. Even a doubling of the load would have been unlikely to produce the observed poor water quality.

7. A slight increase in pH was detected in the Tin Shui Wai Nullah in 1996 at both the upper and lower stream stations (Tables 3 & 4, Figure 2 for TSR1 only). It is not known whether such an increase was a result of run-off from construction works in the Tin Shui Wai area. However, there was no significant change in pH in inner Deep Bay in 1996 as compared with 1995 and no significant trend at DM1. The long term trend for pH at DM2 and DM3 is in fact in the opposite direction, ie declining (Figure 3). This would lead to a reduction in ammonia levels, other things being equal. It is therefore unlikely that the (very small) pH increase in the Tin Shui Wai Nullah could in itself be a cause of the water quality decline in Deep Bay or the apparent decline in benthic organisms.

CONCLUSIONS

8. The number of livestock farms and the pollution load in the Deep Bay catchment have reduced substantially since the implementation of the Livestock Waste Control Scheme in 1987. Although there was a sudden increase in the pig population in the Deep Bay catchment generally, as well as in the Tin Shui Wai, Lau Fau Shan and San Tin areas in 1996, the overall pollution load from livestock farms in the catchment is in fact decreasing. A further reduction in livestock waste pollution is expected when control is extended to the Tin Shui Wai, Lau Fau Shan and San Tin areas on 1 July 1997.

9. There is little evidence that the increase in the pig population in Deep Bay or in the Tin Shui Wai, Lau Fau Shan and San Tin areas has produced a marked increase in loads or was responsible for the deterioration of water quality in inner Deep Bay in 1996. Further, there is also no evidence to suggest that the slight increase in the pH of the Tin Shui Wai Nullah had any effect on the water quality of Deep Bay.

Water Policy and Planning Group
Environmental Protection Department
April 1997

Table 1: Livestock statistics and pollution generated from livestock farms in the Deep Bay catchment

	1987	1995	1996
No. of Farms			
Pig	2,551	380	388
Chicken	2,888	1,326	357
Others	1,089	265	177
Total	6,528	1,971	922
Livestock Population			
Pig	563,000	190,000	336,000
Chicken	11,200,000	2,993,000	1,588,000
Others	5,765,000	820,000	615,000
Total	17,528,000	4,003,000	2,539,000
BOD Load to Rivers (tonnes/day)	68	20	16.5

Table 2: Livestock statistics and pollution generated from livestock farms in Tin Shui Wai, San Tin and Lau Fau Shan areas (Livestock Waste Control Scheme Control Areas 18 & 19)

	1987	1995	1996
No. of Farms			
Pig	536	135	134
Chicken	716	303	132
Others	296	70	48
Total	1,548	508	314
Livestock Population			
Pig	169,000	97,000	150,000
Chicken	3,227,000	935,000	679,000
Others	1,240,000	286,000	233,000
Total	4,636,000	1,318,000	1,062,000
BOD Load to Rivers (tonnes/day)	20	11	11.5

N.B. BOD estimation: Pig 0.08 kg/day, chicken 0.0034 kg/day, others —

Table 3 **A comparison of the 1995 and 1996 water quality data for the most downstream monitoring stations in Deep Bay rivers, using the Wilcoxon's Matched-Pairs Signed-Ranks Test**

River	Monitoring station	Results of the test ($p < 0.05$)			
		pH	NH_4-N	DO	BOD_5
River Indus	IN1	●	●	●	●
River Beas	RB3	V	●	●	V
River Ganges	GR1	●	●	●	V
Yuen Long Creek	YL3	●	●	●	●
	YL4	V	●	V	●
Kam Tin River	KT1	●	●	●	●
	KT2	●	●	●	●
Tin Shui Wai Nullah	TSR1*	Λ	Λ	●	Λ
	TSR2	Λ	●	Λ	V
Fairview Park Nullah	FVR1	V	●	●	●

Notes:

1. "Λ" or "V" indicates the results between 1995 and 1996 are significantly different at $p < 0.05$. "Λ" represents an increase and "V" represents a decrease in the level of the variables in 1996.

2. "●" indicates the results between 1995 and 1996 are not significantly different at $p < 0.05$.

3. * TSR1 is the most downstream monitoring station in Tin Shui Wai Nullah.

Table 4: A comparison of water quality of Tin Shui Wai Nullah in 1996 with 1995

Water Quality Parameters	TSR1 Downstream station		TSR2 Upstream station	
	1995	1996	1995	1996
BOD (mg/L)	23.2	37.9*	33.1	12.7*
Dissolved oxygen (mg/L)	4.9	5.2	7.2	10.1*
Ammonical-nitrogen (mg/L)	6.8	10.0*	7.5	7.9
pH	7.6	7.9*	7.8	8.5*

N.B. Figures are median values of the monthly monitoring data

* The difference is significant at $p < 0.05$ using the Wilcoxon Matched-Pair Signed-Ranks Test.

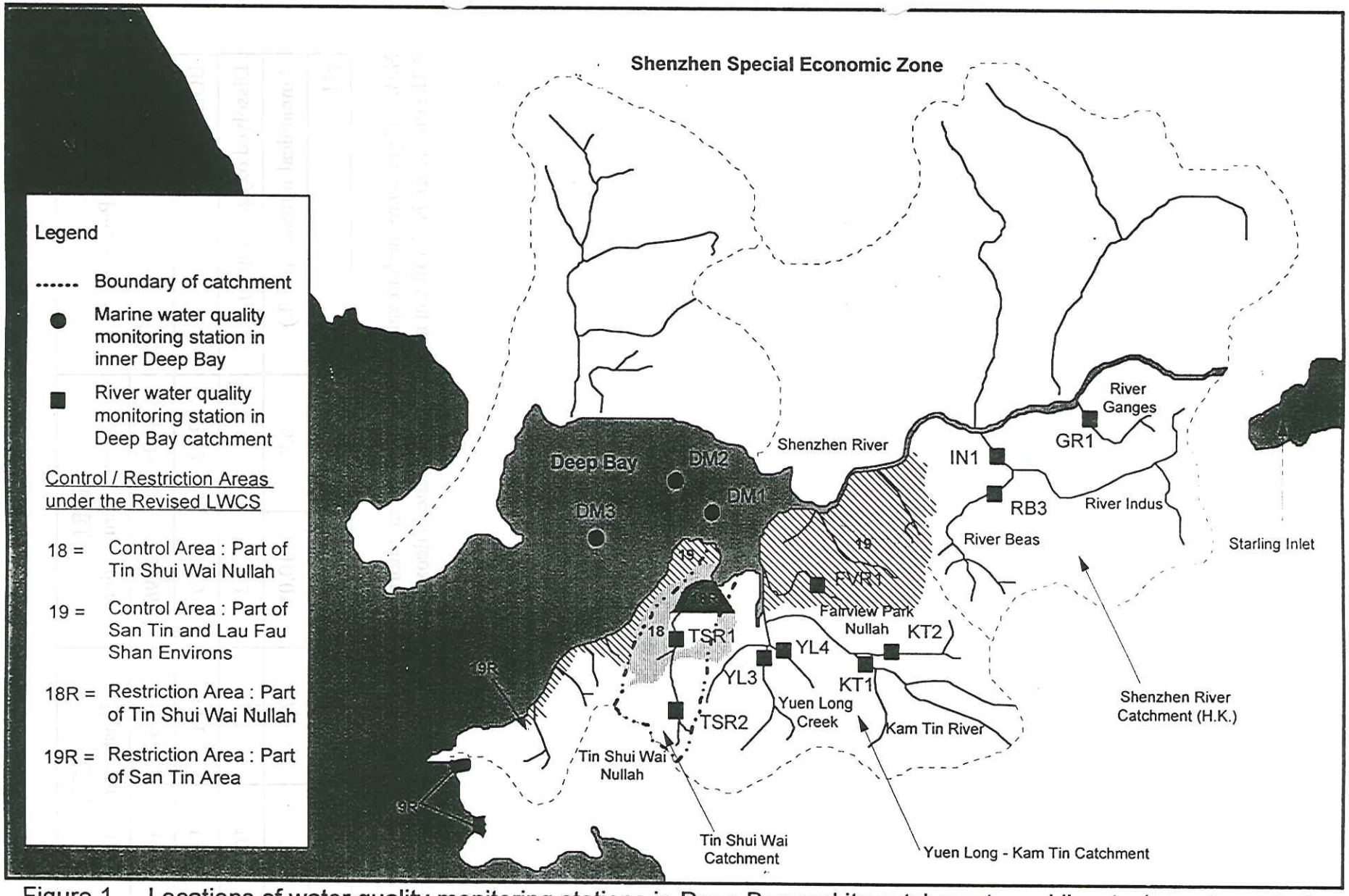
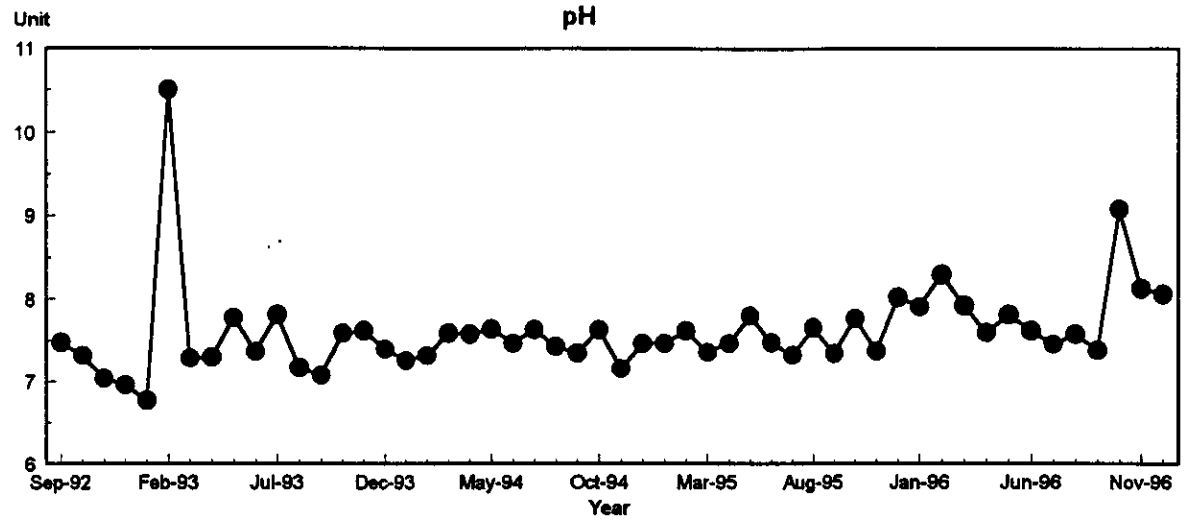
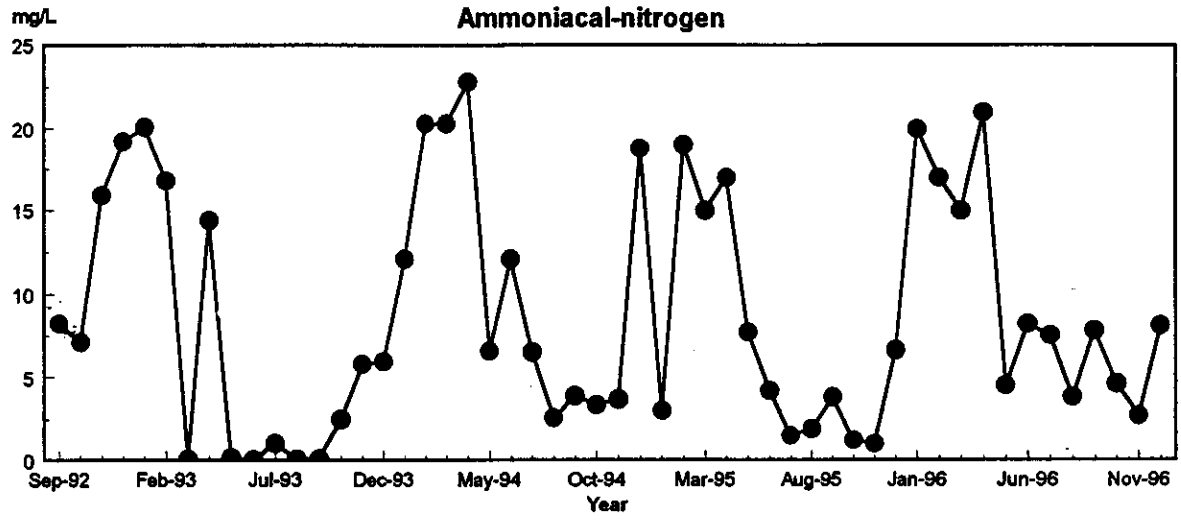


Figure 1 Locations of water quality monitoring stations in Deep Bay and its catchments and livestock waste control areas in Tin Shui Wai, Lau Fau Shan and San Tin.

Figure 2 Variation in parameters (pH, ammoniacal-nitrogen and BOD_5 which show statistically significant changes at $p<0.05$ for 1995 and 1996) at the monitoring station TSR1 in Tin Shui Wai Nullah





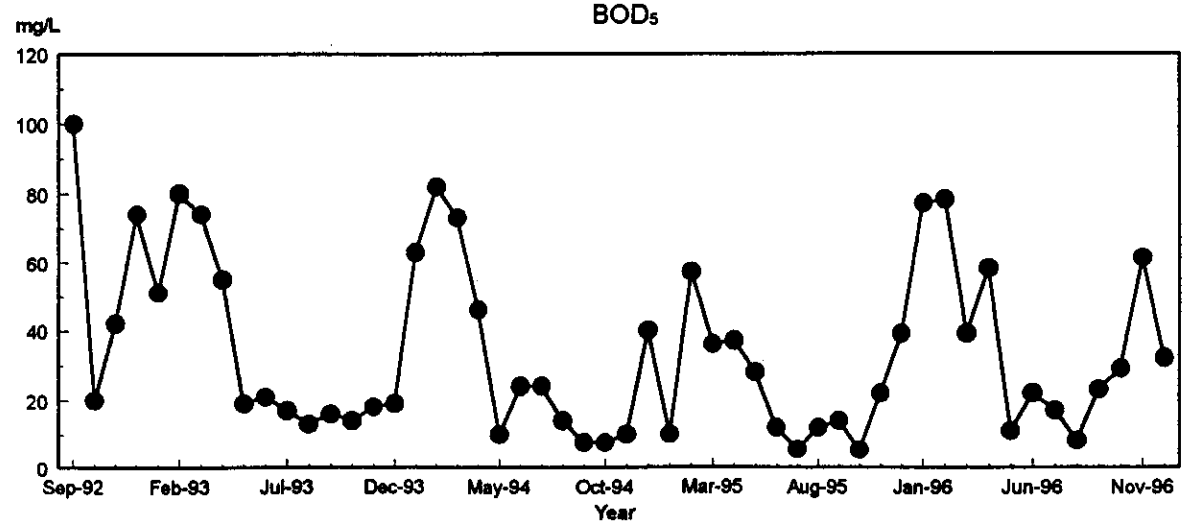


Figure 3 Trends in pH for inner Deep Bay during 1988 - 1996