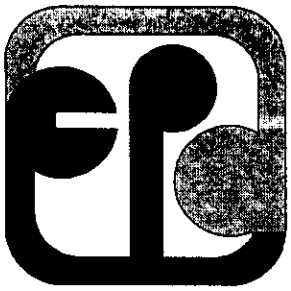

Environmental Protection Department
Hong Kong Government

TOLO HARBOUR ACTION PLAN

(An Updated Report
with Progress up to December 1996)

Water Policy and Planning Group
March 1997

CONTENTS

LIST OF TABLE AND FIGURES

1. INTRODUCTION

1.1 Water quality in Tolo Harbour deteriorated with the development of the new towns of Sha Tin and Tai Po around what is an almost landlocked and poorly flushed bay. The capacity of Tolo Harbour to absorb and assimilate pollutants is very limited. The situation is further exacerbated by land reclamation and population growth in other areas such as Ma On Shan resulting in an increase in pollution loading to the harbour and at the same time a reduction in the water volume available for dilution.

1.2 A dramatic downturn in water quality took place around 1980 coinciding with the first major influx of population to Sha Tin and Tai Po. The deterioration continued throughout the 1980s and this was evidenced by the very high incidence of red tides recorded in 1988. The deterioration was only partially ameliorated by the more effective operation of the Sha Tin and Tai Po Sewage Treatment Works (STWs). It was apparent that an action plan to effectively cut down pollution loading in the catchment was necessary in order to save Tolo.

1.3 With the implementation of the Tolo Harbour Action Plan (THAP) in 1987, the number of reported red tides in Tolo Harbour has been markedly reduced. The implementation of the Livestock Waste Control Scheme and the enforcement of the Water Pollution Control Ordinance (WPCO) in the Tolo Harbour and Channel Water Control Zone (WCZ) have brought some relief. Since 1990, there have been noticeable improvements in the compliance with some of the water quality objectives, in particular with bottom dissolved oxygen in the inner harbour area as well as the water quality of some of the rivers in the catchment. The number of red tides has also reduced from 39 recorded in 1988 to around 10 since 1991. These are shown in ***Figures 1 and 2***.

1.4 To ensure that effective pollution reduction is achieved and the water quality in the Tolo Harbour catchment continues to improve, it is essential that all the remaining actions outlined in the THAP are fully implemented. This paper summarizes the actions which have been undertaken in the catchment between 1987 and 1996. This is the third update of the Plan which takes into account recent changes in the implementation schedule and pollution load reduction of the various actions in the Plan.

2. PROGRAMME OF ACTION

2.1 Background

In order to achieve and maintain the water quality objectives of Tolo Harbour and reduce the occurrence of red tides, it was determined that:

- the load of biodegradable, carbonaceous organic pollutants, measured as **BOD**, should be reduced to **5,000 kg per day**;

- the load of nitrogenous pollutants, measured as **Total Nitrogen**, should be reduced to **600 kg per day**.

In addition, discharges of toxic pollutants should be strictly controlled.

In an effort to achieve these targets, the THAP was drawn up in November 1986 and implemented in 1987. The series of actions and their timing are summarized in ***Table 1***, which also indicates the load attributable to each pollution source and the extent of the reduction achieved. The decrease in organic and nutrient loading due to each action is also presented graphically in ***Figures 3 and 4***.

Individual actions of the THAP are described below:-

2.2 Action 1 : Process Modification at the Sha Tin and Tai Po STWs to Reduce Nitrogen Loading

Status : Completed in November 1991

Treated domestic and industrial wastewater from Sha Tin and Tai Po STWs constituted the two major point sources of nitrogenous, and to a lesser extent, carbonaceous pollution in Tolo Harbour.

Reduction of nitrogen load from the effluent of Sha Tin and Tai Po STWs was required as an immediate measure to reduce the frequency of red tide occurrence in Tolo. Process modification works for greater nitrogen removal at the two STWs commenced in late 1989. Part of the modification works have been completed and brought into operation since

1990. A total of $52M capital cost was spent on these process modification works.

This action was completed on the following dates:

Sha Tin STW : October 1991
Tai Po STW : November 1991

The action has resulted in a reduction of **1,230 kg of BOD per day** and of **1,060 kg of Total Nitrogen per day** going into Tolo Harbour.

2.3 Action 2 : Effluent Export from the Sha Tin and Tai Po STWs to Less Sensitive Waters
Status : Commissioned in 1995-96; full operation in mid 1997

Even after process modification for nutrient removal, effluents from Sha Tin and Tai Po STWs still contribute significantly to the overall nutrient loading in Tolo Harbour. In order to achieve the targets set in the THAP, the most reliable long term solution to reduce nutrient levels is to export the effluent discharges from these works, via a tunnel, to the less sensitive waters in Victoria Harbour.

The Tolo Harbour Effluent Export Scheme (THEES) was commissioned by the Drainage Services Department (DSD) in 1995-96. Due to technical difficulties, the pumping station at Sha Tin STW is not yet operating at its full capacity.

The commissioning dates of the THEES were:

Action 2a: Sha Tin STW - Stage I of the THEES
Status : Commissioned in April 1995, full operation in 1997

Action 2b: Tai Po STW - Stage II of the THEES
Status : Commissioned in March 1996, full operation in 1997

An assessment was made in 1996 of the initial effect of the THEES on the water quality of Kwun Tong Typhoon Shelter, Victoria Harbour and Tolo Harbour. It was shown that partial diversion of the effluent from the two

works to Victoria Harbour has not had any deleterious impact on the water quality of the latter. Since the export of effluent began in April 1995, there has been a detectable decrease in the nutrient levels in Tolo Harbour and Channel.

When in full operation, it is estimated that this action will reduce loading to Tolo by **1,464 kg of BOD per day** and **2,888 kg of Total Nitrogen per day.**

2.4 Action 3 : Provision of Sewerage to Rural Villages

Status : On-going

Untreated domestic wastewater from temporary housing and rural villages (not served by existing sewerage system) causes severe organic pollution of local rivers and streams, and contributes significantly to the remaining pollution load entering Tolo Harbour.

A study of the pollution problems in the unsewered villages in the Tolo catchment was commissioned in January 1989 and completed in June 1990. The study surveyed all unsewered villages in the catchment and drew up a master plan to provide sewerage to 165 villages over a 10 year period. Because of the difficulties encountered in the acquisition of land, there will be a 11-month delay in the completion of the first stage of the action from 1998 to 1999. The following revised timing of the action now applies:-

Stage I, Phase I	**1993 - 1999**
Stage I, Phase II	**1999 - 2001**
Stage II	**2000 - 2003**

Action 3a: Sewerage First-aid Measures

Status : Completed in November 1992

The study carried out in 1989-90 also identified seven villages where "first-aid" measures were required to solve immediate pollution problems. The measures included provision of dry weather flow interceptors and diverting polluted flows from storm drains to foul sewer. These measures were undertaken by DSD starting in 1989 and completed in November 1992.

As a result of the sewerage first-aid measures, the loads entering Tolo were reduced by **1,670 kg of BOD per day** and **300 kg of Total Nitrogen per day**. When the action of village sewerage provision is completed in 2003, it will further reduce **BOD load** to Tolo Harbour by **2,870 kg per day** and **Total Nitrogen load** by **690 kg per day**.

2.5 Action 4 : Transfer of Water Treatment Works Sludge to Sha Tin STW for Marine Disposal

Status : Completed in 1991 and operating until mid 1996 when marine disposal stopped; sludge is now disposed of at landfill site

Alum sludge derived from the Sha Tin Water Treatment Works used to be the largest point-source pollution load on Shing Mun River. It contributed some 12% of the river's total BOD load in 1987.

The construction of storage, transfer and loading facilities for the combined sewage and alum sludges were undertaken by the Water Supplies Department (WSD) and the Territory Development Department (TDD). These facilities include sludge storage tanks, sludge pipe works and a jetty for the use of a marine vessel for sludge disposal. All these facilities have been in operation since 1991. In mid 1996, marine disposal of waterworks sludge in Hong Kong was discontinued and the sludge is now dewatered and disposed of at SENT landfill site.

The proper disposal of waterworks sludge resulted in a reduction of **140 kg per day of BOD** load to Tolo Harbour. Since the amount of nitrogenous pollutants in the water works sludge was negligible, little nitrogen reduction was achieved through this action.

2.6 Action 5 : Collection and Treatment of Livestock Waste in Controlled Areas

Status : On-going

Livestock wastes from the rearing of about 12,100 pigs and 370,000 poultry in the Tolo catchment caused severe pollution of watercourses and contributed to the BOD and nitrogen loading on Tolo Harbour. Detailed planning of a 10-year Livestock Waste Control Scheme for the catchment

commenced in April 1987. Financial commitment for the scheme was made in March 1988 and the costs for implementing the scheme including financial assistance to farmers in the Tolo area between 1988 and 1991 amounted to $15.6M.

The implementation of the Livestock Waste Control Scheme commenced on 24 June 1988. All livestock farmers in the Tolo Harbour control area are now required to comply with the Waste Disposal (Livestock Waste) Regulations [1988]. EPD has provided technical advice to all affected livestock farmers to help them comply with the control measures. Regular monitoring of active farms for compliance continues and persistent non-compliant farms are subjected to the necessary enforcement actions. Since the implementation of the regulations, there has been a total of seven successful prosecutions of non-compliant farmers in the catchment. In 1996, one conviction was obtained with a fine of $7,500 being imposed .

In addition to the above, a livestock waste collection service in the Tolo area started to operate in 1987. There are 8 livestock waste collection points currently in operation in the controlled area, collecting about 30 tonnes of waste per month for treatment and disposal.

It is estimated that collection and treatment of livestock waste in controlled areas has reduced the **BOD** and **Total Nitrogen** loads to Tolo Harbour by at least **2,830 kg per day** and **530 kg per day** respectively.

2.7 Action 6 : Banning of Livestock Keeping in New Town Areas

Status : Completed in June 1988

A ban on the keeping of livestock in new towns and urban areas also came into effect on 24 June 1988 with the implementation of the livestock waste control regulations. All livestock keeping activities in the new towns have now ceased with a corresponding reduction in pollution load of **290 kg per day of BOD** and **70 kg per day of Total Nitrogen** in the Tolo Harbour area.

2.8 Action 7 : Implementation of the Water Pollution Control Ordinance (WPCO)

Status : On-going

The amendment of the WPCO in late 1990 extended legislative control to cover all discharges in the Tolo region, including those which were previously exempted. This change further strengthened the Authority's control over the entire Tolo Harbour catchment.

One of the important achievements in the enforcement of the WPCO has been the rectification of expedient connections of industrial and commercial discharges to surface watercourses and stormwater drains. Over 240 misconnections have been redirected since 1987, representing a reduction of **4,240 kg BOD** and **230 kg of Total Nitrogen per day**. As a result, the water quality of some of the watercourses entering Tolo Harbour have shown clear signs of improvement in the last five years.

As the new towns expand, there is an increasing demand on the use of sewerage facilities along with a continued incidence of illegal and expedient connections. A comprehensive Storm Drain Surveillance Programme is being implemented in the catchment. This includes conducting area-wide surveys and routine inspections so that such connections are identified and necessary actions are undertaken promptly.

Like in other industrial areas in Hong Kong, indiscriminate discharge of industrial effluents was common in the Tolo Harbour catchment. The implementation of an enforcement action plan to control industrial pollution has resulted in a reduction in the level of toxic metals in the sewage works sludges. Between 1989 and 1993, it is estimated that the amount of toxic metals entering the sewerage system in the Tolo catchment was reduced by more than 50%. On the enforcement front, 37 water pollution offenders in the Tolo catchment were prosecuted in 1996 under the WPCO and a maximum fine of $160,000 was imposed.

2.9 Action 8 : Leachate Management at Shuen Wan Landfill
Status : To be completed in 1997

Although Shuen Wan Landfill was closed in 1995, leachate generated from this site is still a potential source of pollution in the Tolo Harbour area.

A feasibility study commissioned by EPD on the restoration of Shuen Wan Landfill was completed in October 1993. The study developed a series of leachate management actions for the landfill. As an interim measure, untreated leachate was recirculated within the landfill site. For the control of leachate in the medium term, a leachate collection and pre-treatment system was constructed in 1995 and commissioned in 1996. In December 1996, DSD took over the operation and maintenance of the pre-treatment works at Shuen Wan Landfill. Pretreated leachate is currently being recirculated within the landfill site and will be directed to the Tai Po STW for further treatment in 1997.

To provide for comprehensive restoration of Shuen Wan Landfill, a contract for the installation of an advanced leachate management system was awarded and the work commenced in early December 1996. Using this system, leachate from the landfill will be monitored and unacceptable leachate migration into the surrounding groundwater and marine waters will be prevented. The leachate which has gone through preliminary treatment at the leachate pre-treatment works will receive final treatment at the Tai Po STW.

With the phased implementation of the leachate management measures at Shuen Wan Landfill, it is estimated that by the end of 1996, **the Total Nitrogen load from leachate has been reduced from 160 kg per day to 120 kg per day and the BOD load from 120 kg per day to 20 kg per day.**

2.10 Remaining Pollution Loads

When the Effluent Export Scheme is fully operational in 1997, unsewered villages and mariculture activities will be the two most significant known sources of pollution in Tolo Harbour. Unsewered villages will contribute a BOD loading of 2870 kg per day and a Total Nitrogen loading of 690 kg

per day. Mariculture on the other hand will contribute a BOD loading of 1820 kg per day and a Total Nitrogen loading of 350 kg per day.

Provision of sewerage to villages in the catchment will be carried out in stages over the next 6 years. Less polluting mariculture practices, such as the use of specially formulated pellet feed, to replace trash fish, has already been introduced in some fish culture zones and will be adopted throughout the catchment. This should further reduce pollution loading from this source.

3. CONCLUSION

3.1 Tolo Harbour has suffered from the consequences of rapid urbanisation, under provision of sewerage infrastructure, and agricultural and industrial pollution. Through the implementation of the THAP, the deterioration in water quality has been arrested and is now showing signs of recovery. With the installation of a comprehensive sewerage infrastructure, and effective treatment and disposal systems, coupled with rigorous source control, the water quality in the Tolo Harbour catchment is expected to continue to improve.

3.2 In the ten years since the THAP was formulated, the organic and nutrient pollution loads in the Tolo catchment have been substantially reduced. Without the action plan, the water quality of Tolo Harbour would have continued to decline, resulting in further destruction of aquatic biota, increased incidence of red tides, reduced aesthetic and amenity values and failure to meet the water quality objectives.

3.3 A comparison of the pollution load with and without the implementation of the THAP shows that at the end of December 1996, the THAP has effectively achieved:-

An overall reduction of BOD load by 65%
An overall reduction of Total Nitrogen load by 47%

3.4 Although there has been a delay in the full implementation of the THEES upon its commissioning in 1995-96, the full operation of the

scheme is expected to take place in 1997. Through the continued implementation of the remaining actions (provision of sewers to villages, implementation of the livestock waste control scheme, WPCO enforcement and effective management of Shuen Wan Landfill), the target BOD level of 5,000 kg per day for the Tolo Harbour should be achieved in 1997, whereas the Total Nitrogen target of 600 kg per day should be achieved around the year 2002.

3.5 With the full implementation of the THAP, the water quality of Tolo Harbour is expected to continue to improve. The damaged ecosystem in the harbour, however, may take much longer to recover.

Table 1. The Tolo Harbour Action Plan - Pollution Loads, Implementation Dates and Costs

Actions		BOD Load (kg/d) (a)			Nitrogen Load (kg/d) (a)			Starting Date	Completion Date	Slippage (months)	Cost (HK $ Million)	
		"No Action" Scenario 1996	Reduction Achieved	% Reduction	"No Action" Scenario 1996	Reduction Achieved	% Reduction				Capital	Recurrent
1. Process Modification at Sewage Treatment Works	Sha Tin	960	960	6%	880	880	14%	Aug-86	Oct-91	-	17.0	9.2
	Tai Po	270	270	2%	180	180	3%	Aug-86	Nov-91	-	35.0	4.0
2. Effluent Export Scheme *	Sha Tin	1145	468	3%	2199	712	11%	Jan-87	Apr-95	-	453.0	6.5
	Tai Po	335	22	0%	719	46	1%	Jan-87	Mar-96	1	430.0	2.6
3. Provision of Sewerage to Rural Villages	First Aid	1670	1670	10%	300	300	5%	Aug-89	Nov-92	-	7.9	0.1
	Stage I Phase I	1650	0	0%	370	0	0%	Aug-86	Nov-99	11	230.0	4.8
	Stage I Phase II	840	0	0%	220	0	0%	Jan-99	Aug-01	0	169.0	1.7
	Stage II	380	0	0%	100	0	0%	Jan-00	Jul-03	16	280.0	2.6
4. Transfer of Water Works Sludge		140	140	1%	0	0	0%	Aug-86	Jul-91	-	284.0	15.8
5. Livestock Waste Control Scheme		2940	2830	17%	570	530	8%	Aug-86	on going	-	15.6	15.6
6. Ban Livestock Keeping in New Towns		290	290	2%	70	70	1%	Aug-86	Jun-88	-		
7. Implementation of WPCO		4400	4240	25%	250	230	4%	Jul-86	on going	-	Admin. & Staff Cost Only	
8. Leachate Management at Shuen Wan Landfill		140	120	1%	160	40	1%	Dec-93	Jan-97	8	9.8	1.2
Total (Excluding Mariculture)		15160	11010		6018	2988					1931.3	64.1
Mariculture		1820	0	0%	350	0	0%					
Total Pollution Load to Tolo Harbour		16980	11010	65%	6368	2988	47%					
Remaining Pollution Load			5970	35%		3380	53%					

(a) Figures for indicative purpose only
* Due to technical problems, full operation of the scheme will take place in 1997

4/10/97

Figure 1 : Compliance of Water Quality Objectives and Red Tides Incidents in Tolo Harbour and Channel

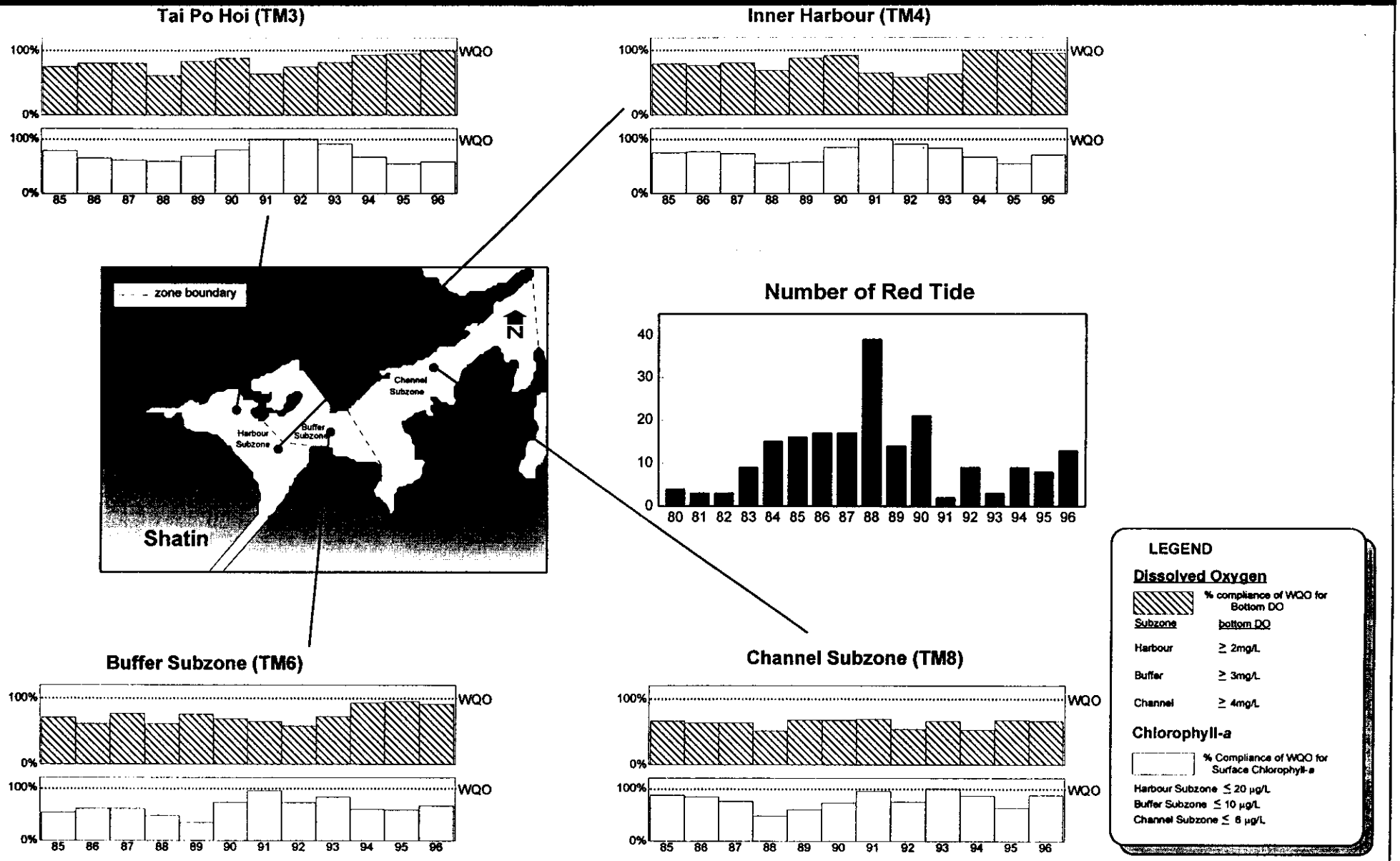

Figure 2 : Water Quality of Shing Mun River

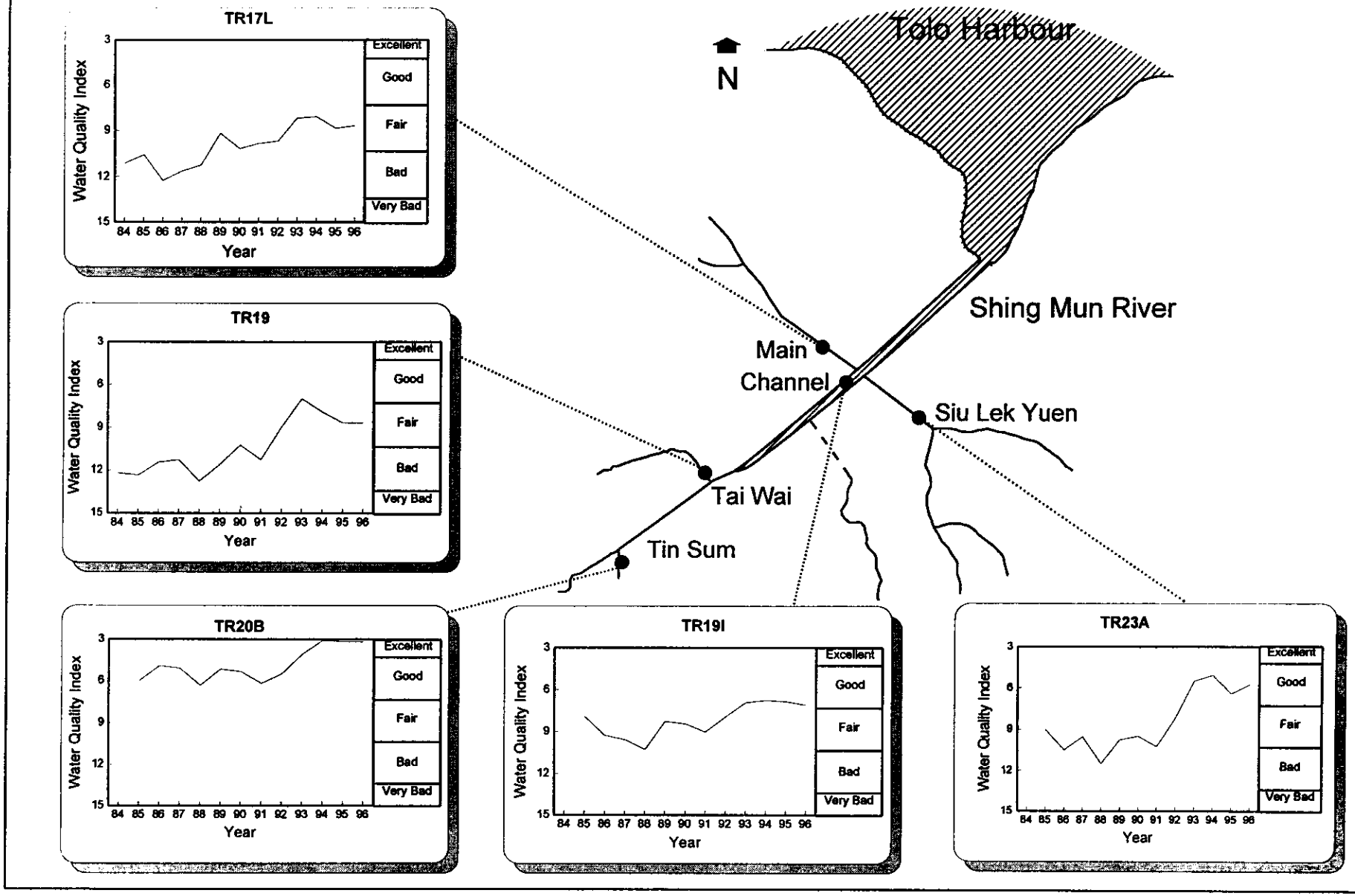

Figure 3 : Nutrient Pollution Reduction by Tolo Harbour Action Plan

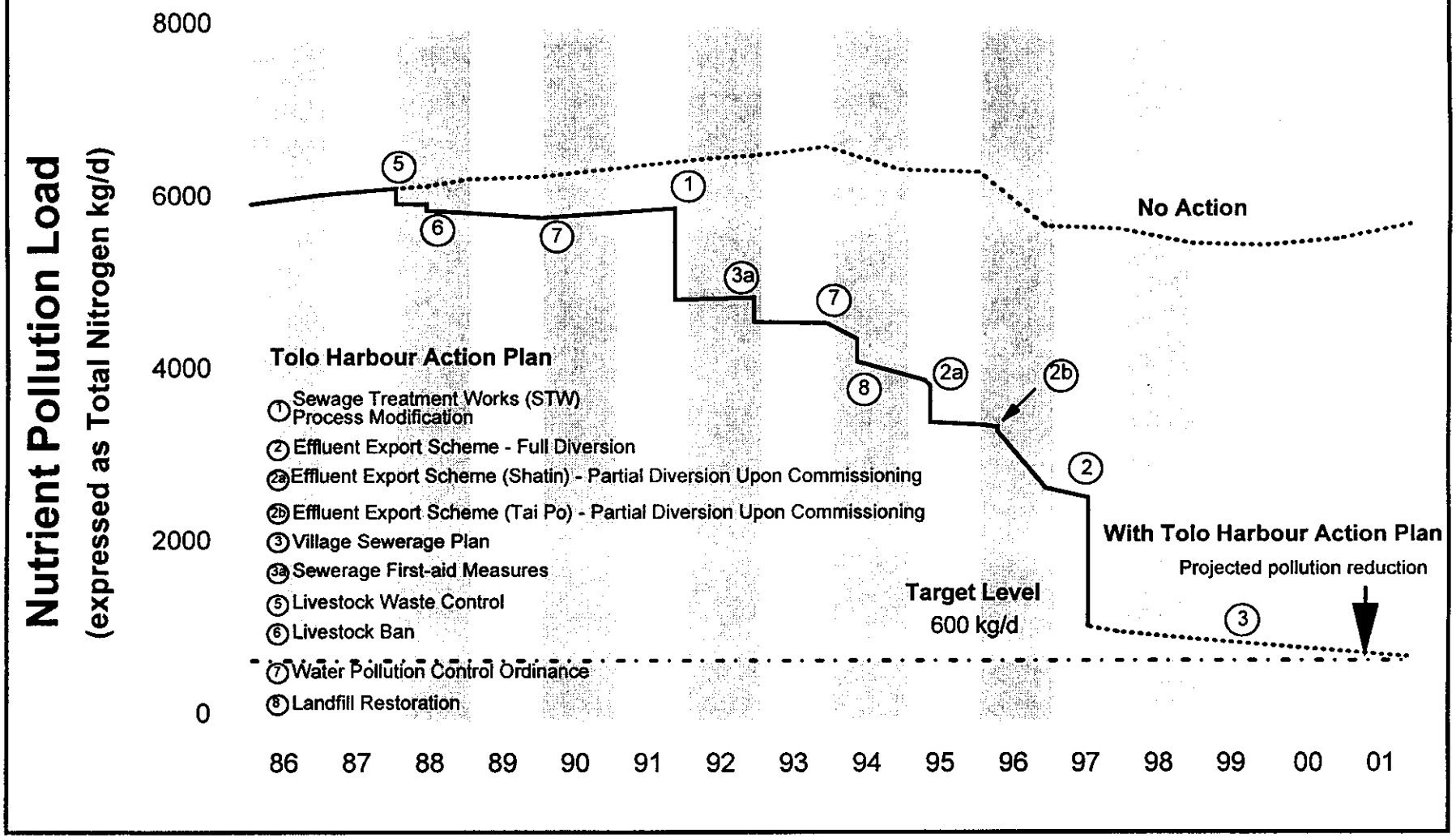

Figure 4 : Organic Pollution Reduction by Tolo Harbour Action Plan