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**TEST REPORT**

***DRAINAGE SERVICES DEPARTMENT***

**NGONG PING SEWAGE TREATMENT  
PLANT, TRUNK SEWERS AND EFFLUENT  
EXPORT PIPELINE  
OPERATION PHASE**

**FINAL REPORT**

**FOR**

**GROUND WATER MONITORING  
(FROM APRIL 2008 TO NOVEMBER 2009)**

Prepared by:

Linda Law  
Senior Environmental Officer

Checked and  
Approved by:

C. L. Lau  
Environmental Team Leader

Issued Date: 05 January 2010

Report No.: ENA90977

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沛然環境評估  
工程顧問有限公司

Our Ref: 840/10-0003

10 February 2010

*By POST and FAX (2827 8526)*

Drainage Services Department  
42<sup>nd</sup> Floor  
Revenue Tower  
5 Gloucester Road  
Wan Chai  
Hong Kong

**Attn: Mr. Ringo Mok**

Dear Sir,

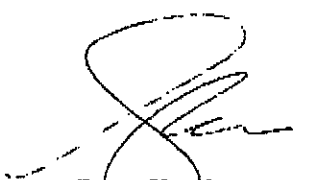
**Re: Ngong Ping Sewerage Project**  
**Groundwater Monitoring at Ngong Ping STW and Effluent Export Pipe**  
**EM&A Reports (October and November 2009) and Final EM&A Report**

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We refer to the captioned reports submitted by the environmental team, messrs ETS-Testconsult Limited, via on 19 January 2010 and the revised reports on 4 February 2010 via emails. Please note that we have no adverse comment on the captioned reports and hereby verify Condition 5 of the Environmental Permit (EP-157/2003/A)

Should you have any queries, please do not hesitate to contact the undersigned at 2815 7028 for any queries

Yours sincerely,  
For and on behalf of  
Allied Environmental Consultants Ltd

  
Grace Kwok  
Independent Environmental Checker

GK/wm

Cc. OAP Ms Ada Pang (By Email)  
ETS-Testconsult – Ms Linda Law (By Email and Fax. 2695 3944)



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## **EXECUTIVE SUMMARY**

This final report has been prepared by the Environmental Team (ET) of ETS-Testconsult Ltd for groundwater monitoring under the operation phase of "Ngong Ping Sewage Treatment Plant, Trunk Sewers and Effluent Export Pipeline" (the Project) during the reporting period from 01 April 2008 to 31 November 2009.

Under the requirements of Section 5 of "the Environmental Permit (No. EP-157/2003/A)" (the EP), EM&A programme as set out in the EM&A Manual and the EIA Report (Register No.: AEIAR-065/2002) is required to be implemented. In accordance with the EM&A manual and the EIA Report, groundwater monitoring is required for the Project.

### **Environmental Monitoring Progress**

The summary of the monitoring activities during the monitoring period is listed below:

- *Groundwater Monitoring: 19 Occasions at 3 designated locations*

### **Groundwater Monitoring**

The working principle of the ground water monitoring borehole is that if there is leakage, the effluent will find its way from the Ngong Ping Sewage Treatment Works or its effluent export pipeline into the nearest borehole. If underground water table is above the effluent export pipeline, ground water inside the borehole will be contaminated by the treated effluent. If underground water table is below the effluent export pipeline, the borehole will be partially filled with the treated effluent. Laboratory tests on the water samples taken from the boreholes will be able to reveal if there is any leakage of treated effluent.

Refer to the ground water monitoring on 26 May 2009, the test results of groundwater at WM10 and WM11 were at low level in E-coli except at WM12. Refer to the testing results of other test parameters, no significant difference is found between WM10, WM11 and WM12 and hence there is no evidence of any leakage of treated effluent from effluent export pipeline. The high level of E-coli at WM12 is considered to be due to the contamination from wild-life.

The results of other testing parameters during the monitoring period show no contamination of ground water by any treated effluent. In other words, it is evident that there was no leakage of treated effluent from the Ngong Ping Sewage Treatment Works or its effluent export pipeline into the water gathering ground.

### **Environmental Complaints**

No complaints were received in this monitoring period.

### **Notification of summons and successful prosecutions**

There were no notification of summons and prosecutions with respect to environmental issues in the monitoring period.



## 1.0 INTRODUCTION

The construction works of Ngong Ping Sewage Treatment Works (NPSTW) was certificated completed on 09 March 2006 and the NPSTW was handed over to "Drainage Services Department" (DSD) for operation and maintenance from 10 March 2006. "ETS-Testconsult Limited" (ETL) has been commissioned as Environmental Team (ET) to carry out groundwater monitoring at Ngong Ping according to the EM&A Manual.

This annual report presents the results of groundwater monitoring during the reporting period from 01 April 2008 to 31 November 2009.

## 2.0 PROJECT INFORMATION

### 2.1 Background

Master Plan (OI SMP) Study in December 1994 and drew up a SMP for Lantau Island, Cheung Chau, Lamma Island, Peng Chau and other smaller and less populated islands. The SMP comprises provisions for upgrading and expanding the sewerage systems to cover unsewered areas.

This sewerage project is the Stage 1 works under the OI SMP and can be divided into 3 packages as follows:

*Package 1 – Ngong Ping STW with tertiary treatment*

*Package 2 – Ngong Ping main trunk sewer and effluent export pipeline*

*Package 3 – Ngong Ping village sewerage system*

This Project only covers the operation phase of Package 1 and Package 2. The general layout plan of the project is shown in Appendix D (Drawing No. 23400/EN/098).

The existing treatment facilities at Ngong Ping include grease traps and septic tanks, with discharge locally to soakaways. Following the opening of the Statue of Buddha in December 1993, the number of visitors to Ngong Ping increased significantly. Besides, the Cable Car system linking Tung Chung and Ngong Ping was being planned for commissioning in June 2006. It will certainly further increase the number of visitors in Ngong Ping. The existing treatment and disposal facilities were found to be inadequate, with significant quantities of sewage being directly discharged into the local stream. It was under this setting that the recommendation to provide a local sewerage system and a centralised treatment system for Ngong Ping was put forward in the OI SMP in 1994.

The Project was planned, designed, operated and maintained by the DSD. During the operation phase of NPSTW, DSD will follow the environmental monitoring recommendation stated at the M&A Manual that was prepared with reference to the EIA Report (Register No.: AEIAR-065/2002) to avoid the contamination of the water gathering ground.

### 2.2 Site Description

The general layout plan of the project is shown in Appendix D. The groundwater monitoring locations are also shown in the Drawing No. 23400/R/VS/406.

### 2.3 Project Organization and Management Structure

The line of communication of project organization with respect to the on-site environmental management and monitoring program are shown in Appendix A.

### 2.4 Contact Details of Key Personnel

The key personnel contact names and telephone numbers, and construction programme are shown in table 2.1.

Table 2.1 Contact Details of Key Personnel

Organization	Project Role	Name of Key Staff	Tel. No.	Fax No.
DSD	Contractor	Mr. P C Wu	2594 7199	2827 6657
ETL	Contractor's Environmental Team	Mr. C L Lau (ET Leader)	2946 7791	2695 3944

### 3.0 GROUNDWATER QUALITY MONITORING

#### 3.1 Monitoring Locations

Groundwater quality monitoring was undertaken at nine designated boreholes shown in Tables 3.1.

Table 3.1 Locations of Groundwater Quality Monitoring

Sampling Point	Location
WM10	Ngong Ping Village
WM11	Ngong Ping Village
WM12	Ngong Ping Village

#### 3.2 Monitoring Parameters

Monitoring of the groundwater monitoring parameters are listed below:

- Biochemical Oxygen Demand (BOD<sub>5</sub>), mg/L;
- Ammonia Nitrogen (NH<sub>4</sub><sup>+</sup>-N), mg/L;
- Nitrate + Nitrite Nitrogen (NO<sub>2</sub><sup>-</sup>+NO<sub>3</sub><sup>-</sup>), mg/L;
- pH value;
- Turbidity, NTU;
- Oil & Grease (O&G), mg/L;
- Total Phosphates (TP), mg/L;
- Synthetic detergents, mg/L;
- E-coli, cfu/100ml.

#### 3.3 Monitoring Frequency

The monitoring frequency of the groundwater monitoring is summarized in Table 3.3.

Table 3.3 The frequency of the Groundwater Monitoring

Parameter	Frequency	No. of Boreholes
Biochemical Oxygen Demand	Once per month	9
Ammonia Nitrogen		
Nitrate + Nitrite		
pH value		
Turbidity		
Oil & Grease		
Total Phosphates		
Synthetic detergents		
E-coli		



### 3.4 Monitoring Methodology and Equipment Used

A water sampler comprising a transparent PVC cylinder, with a capacity of not less than 2 liters, was lowered into the water body at the predetermined depth. The opening ends of the sampler were then closed accordingly and water samples were collected.

The sample container, made by high-density polythene / glass, was rinsed with a portion of the water sample. The groundwater sample was then transferred to the container, labeled with a unique sample ID and sealed with a screw cap. The water samples were stored in a cool box maintained at 4°C. The groundwater samples were then delivered to a local HOKLAS-accredited laboratory (Environmental Laboratory, ETS-Testconsult Ltd, HOKLAS Registration No. 022) on the same day for analysis.

The summary of testing methods of testing parameters as recommended by EIA or required by EPD were shown in Table 3.4.

Table 3.4 Summary of testing procedures

Laboratory Analysis	Testing Procedure	Detection Limit
Biochemical Oxygen Demand	In house method TPE/001/W or BS 6068 : Section 2.14 : 1990	2.0 mg/L
Ammoniacal Nitrogen	In house method TPE/016/W, refer to APHA 19ed 4500-NH <sub>3</sub> F & G	0.13 mg/L
Nitrate + Nitrite	In house method TPE/023/W, refer to APHA 19ed 4500-NO <sub>3</sub> B	0.004 mg/L
pH (at 25°C)	In house method TPE/003/W, refer to APHA 19ed APHA 4500-H <sup>+</sup> B	Detection range: 4.0-10.0
Turbidity	In house method TPE/005/W, refer to APHA 19ed 2130B	0.5 NTU
Oil & Grease	APHA 19ed 5520 B	5.0 mL
Total Phosphate	In house method base on ASTM D 515-88	0.05 mg/L
Synthetic detergents	In house method based on APHA 19ed 5540 C & D	0.1 mg/L
E-coli	DoE Section 7.8 & 7.9 plus in-site urease test	<1 cfu/100ml

### 3.5 Groundwater Monitoring Results

During this reporting period, groundwater monitoring was carried out at the designated manholes once per month. The groundwater quality measurement results during the monitoring period are detailed in Appendix B. Graphical presentation of the monitoring parameters for this reporting month is shown in Appendix C.

Refer to the ground water monitoring on 26 May 2009, the test results of groundwater at WM10 and WM11 were at low level in E-coli except at WM12. Refer to the testing results of other test parameters, no significant difference is found between WM10, WM11 and WM12 and hence there is no evidence of any leakage of treated effluent from effluent export pipeline. The high level of E-coli at WM12 is considered to be due to the contamination from wild-life.

The results of other testing parameters during the monitoring period show no contamination of ground water by any treated effluent. In other words, it is evident that there was no leakage of treated effluent from the Ngong Ping Sewage Treatment Works or its effluent export pipeline into the water gathering ground.

## 4.0 ENVIRONMENTAL NON-CONFORMANCE

### 4.1 Summary of Groundwater Quality Monitoring

The results of all testing parameters during the monitoring period show no contamination of ground water by any treated effluent. In other words, it is evident that there was no leakage of treated effluent from the Ngong Ping Sewage Treatment Works or its effluent export pipeline into the water gathering ground.



**4.2 Summary of Environmental Complaints**

No complaints were received in the monitoring period.

**4.3 Summary of Notification of Summons and Prosecution**

There was no notification of summons respect to environmental issues registered in the monitoring period.

**5.0 IMPLEMENTATION STATUS**

**5.1 Implementation Status of Environmental Mitigation Measures**

DSD has been implementing the required environmental mitigation measures indicating in Clause 4.5.20 of the EM&A manual.

**5.2 Implementation Status of Environmental Complaint Handling**

No complaints were received in the monitoring period. The details of the complaint-log are presented in Table 5.1.

Table 5.1 Statistical Summary of Environmental Complaints

Reporting Month	Complaint Statistics			
	Frequency	Cumulative	Aspect	Investigation Results and Follow up Actions
April 08	0	0	---	---
May 08	0	0	---	---
June 08	0	0	---	---
July 08	0	0	---	---
Aug 08	0	0	---	---
Sept 08	0	0	---	---
Oct 08	0	0	---	---
Nov 08	0	0	---	---
Dec 08	0	0	---	---
Jan 09	0	0	---	---
Feb 09	0	0	---	---
Mar 09	0	0	---	---
April 09	0	0	---	---
May 09	0	0	---	---
June 09	0	0	---	---
July 09	0	0	---	---
Aug 09	0	0	---	---
Oct 09	0	0	---	---
Nov 09	0	0	---	---

**5.3 Implementation Status of Notification of Summons and Prosecution**

There were no notifications of summons respect to environmental issues registered in this monitoring period.

**6.0 CONCLUSION**

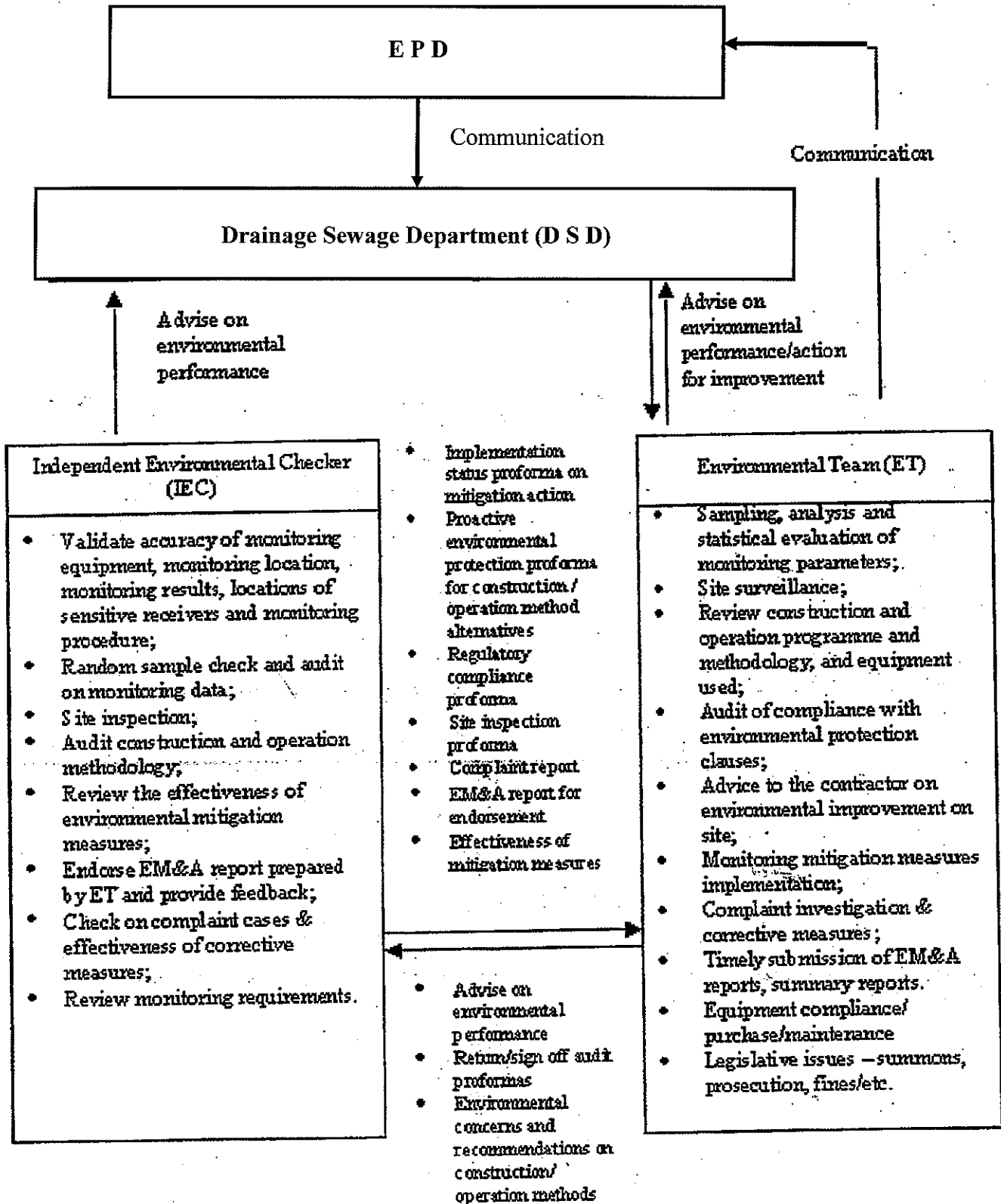
The results of all testing parameters during the monitoring period show no contamination of ground water by any treated effluent. In other words, it is evident that there was no leakage of treated effluent from the Ngong Ping Sewage Treatment Works or its effluent export pipeline into the water gathering ground





## Appendix A

### Lines of Communication





## **Appendix B**

### **Groundwater Monitoring Results**



**Biochemical Oxygen Demand (mg/L)**

Date	Borehole No.		
	WM10	WM11	WM12
28/04/2008	3.3	9.2	7.6
29/05/2008	<2.0	<2.0	<2.0
27/06/2008	<2.0	<2.0	<2.0
28/07/2008	<2.0	<2.0	6.8
25/08/2008	<2.0	<2.0	<2.0
29/09/2008	<2.0	4.2	<2.0
27/10/2008	<2.0	2.3	3.7
24/11/2008	<2.0	2.6	2.1
29/12/2008	2.4	3.3	2.4
29/01/2009	<2.0	<2.0	2.3
25/02/2009	3.5		<2.0
26/03/2009	3.6		<2.0
28/04/2009	<2.0	<2.0	<2.0
26/05/2009	3.8	<2.0	<2.0
25/06/2009	2.5	3.1	4.5
14/07/2009	<2.0	<2.0	<2.0
11/08/2009	2.9	<2.0	<2.0
29/10/2009	<2.0	<2.0	7.3
30/11/2009	<2.0	<2.0	5.3

**Synthetic Detergents (mg/L)**

Date	Borehole No.		
	WM10	WM11	WM12
28/04/2008	0.1	<0.1	<0.1
29/05/2008	<0.1	<0.1	<0.1
27/06/2008	<0.1	<0.1	<0.1
28/07/2008	<0.1	<0.1	<0.1
25/08/2008	<0.1	<0.1	<0.1
29/09/2008	<0.1	<0.1	<0.1
27/10/2008	<0.1	<0.1	<0.1
24/11/2008	<0.1	0.1	0.2
29/12/2008	<0.1	0.2	0.2
29/01/2009	<0.1	0.2	0.2
25/02/2009	<0.1		0.1
26/03/2009	0.2		0.1
28/04/2009	0.3	0.8	0.2
26/05/2009	0.3	0.3	0.2
25/06/2009	<0.1	0.1	0.1
14/07/2009	0.1	<0.1	<0.1
11/08/2009	<0.1	<0.1	<0.1
29/10/2009	<0.1	<0.1	<0.1
30/11/2009	<0.1	<0.1	<0.1

**Total Phosphates (mg/L)**

Date	Borehole No.		
	WM10	WM11	WM12
28/04/2008	<0.1	<0.1	<0.1
29/05/2008	<0.1	<0.1	<0.1
27/06/2008	0.14	0.14	<0.1
28/07/2008	<0.1	0.1	<0.1
25/08/2008	<0.1	0.1	<0.1
29/09/2008	<0.1	0.13	<0.1
27/10/2008	0.31	0.45	0.36
24/11/2008	0.2	0.28	0.2
29/12/2008	0.16	0.5	0.28
29/01/2009	0.55	0.4	0.33
25/02/2009	0.16		0.17
26/03/2009	0.1		0.26
28/04/2009	<0.1	0.2	<0.1
26/05/2009	<0.1	0.19	<0.1
25/06/2009	<0.1	<0.1	<0.1
14/07/2009	<0.1	<0.1	<0.1
11/08/2009	<0.1	<0.1	<0.1
29/10/2009	0.1	<0.1	<0.1
30/11/2009	<0.1	0.11	<0.1

**pH value**

Date	Borehole No.		
	WM10	WM11	WM12
28/04/2008	7.2	6.8	6.5
29/05/2008	7.2	7.1	6.3
27/06/2008	5.9	7.1	6.6
28/07/2008	5.5	7.1	7.4
25/08/2008	6.1	7.1	7.4
29/09/2008	6.2	7.3	7.2
27/10/2008	4.8	5.4	5.7
24/11/2008	5.4	5	5.4
29/12/2008	6.6	4.9	5.6
29/01/2009	6.1	4.9	5.3
25/02/2009	6.6		5.6
26/03/2009	6.5		5.5
28/04/2009	7.4	6.8	6
26/05/2009	7.1	6.5	6.1
25/06/2009	5.6	6	5.9
14/07/2009	5	5.6	5.6
11/08/2009	5.2	6.2	6.4
29/10/2009	5.3	5.4	5.5
30/11/2009	6.1	5.2	5.6

**Nitrate & Nitrite Nitrogen (mgN/L)**

Date	Borehole No.		
	WM10	WM11	WM12
28/04/2008	0.64	0.55	0.36
29/05/2008	1	0.6	0.78
27/06/2008	0.36	0.16	0.14
28/07/2008	0.24	0.57	<0.04
25/08/2008	0.26	0.36	0.13
29/09/2008	0.3	0.5	0.19
27/10/2008	0.25	0.52	1.40
24/11/2008	0.22	0.57	1.50
29/12/2008	0.07	0.76	1.80
29/01/2009	0.16	0.8	1.30
25/02/2009	0.07		1.20
26/03/2009	0.38		1.20
28/04/2009	0.35	1.2	1.60
26/05/2009	0.26	0.69	2.10
25/06/2009	0.59	0.55	0.71
14/07/2009	0.42	0.66	1.40
11/08/2009	0.19	0.1	0.06
29/10/2009	0.23	0.68	1.40
30/11/2009	0.13	0.77	3.00

**Oil & Grease (mg/L)**

Date	Borehole No.		
	WM10	WM11	WM12
28/04/2008	<5.0	<5.0	<5.0
29/05/2008	<5.0	<5.0	<5.0
27/06/2008	<5.0	5	<5.0
28/07/2008	<5.0	<5.0	<5.0
25/08/2008	<5.0	<5.0	<5.0
29/09/2008	<5.0	<5.0	<5.0
27/10/2008	<5.0	5.1	<5.0
24/11/2008	<5.0	<5.0	<5.0
29/12/2008	<5.0	<5.0	<5.0
29/01/2009	<5.0	<5.0	<5.0
25/02/2009	<5.0		<5.0
26/03/2009	<5.0		<5.0
28/04/2009	<5.0	<5.0	<5.0
26/05/2009	5	<5.0	<5.0
25/06/2009	<5.0	<5.0	<5.0
14/07/2009	<5.0	<5.0	<5.0
11/08/2009	<5.0	<5.0	<5.0
29/10/2009	<5.0	<5.0	<5.0
30/11/2009	<5.0	<5.0	<5.0

**Turbidity (NTU)**

Date	Borehole No.		
	WM10	WM11	WM12
28/04/2008	140	130	70
29/05/2008	22	480	34
27/06/2008	41	24	<0.5
28/07/2008	31	19	1.4
25/08/2008	11	5.2	3
29/09/2008	30	62	150
27/10/2008	10	510	25
24/11/2008	6.8	8.6	10
29/12/2008	62	220	22
29/01/2009	76	420	16
25/02/2009	140		31
26/03/2009	210		20
28/04/2009	44	220	17
26/05/2009	27	170	8.3
25/06/2009	17	190	3.4
14/07/2009	19	29	1.6
11/08/2009	29	9.3	3.1
29/10/2009	18	92	29
30/11/2009	25	120	13

**Ammonia Nitrogen (mgN/L)**

Date	Borehole No.		
	WM10	WM11	WM12
28/04/2008	<0.25	<0.25	<0.25
29/05/2008	<0.25	<0.25	<0.25
27/06/2008	<0.25	<0.25	<0.25
28/07/2008	<0.25	<0.25	<0.25
25/08/2008	<0.25	<0.25	<0.25
29/09/2008	<0.25	<0.25	<0.25
27/10/2008	<0.25	<0.25	<0.25
24/11/2008	<0.25	<0.25	<0.25
29/12/2008	<0.25	<0.25	<0.25
29/01/2009	<0.25	<0.25	<0.25
25/02/2009	<0.25		<0.25
26/03/2009	<0.25		<0.25
28/04/2009	<0.25	<0.25	<0.25
26/05/2009	<0.25	<0.25	<0.25
25/06/2009	<0.25	<0.25	<0.25
14/07/2009	<0.25	<0.25	<0.25
11/08/2009	<0.25	<0.25	<0.25
29/10/2009	<0.25	<0.25	<0.25
30/11/2009	<0.25	<0.25	<0.25

**E-coli (cfu/100ml)**

Date	Borehole No.		
	WM10	WM11	WM12
28/04/2008	120	10	24
29/05/2008	900	620	3200
27/06/2008	1900	700	1000
28/07/2008	<1	17	<1
25/08/2008	5	7	140
29/09/2008	4	4	370
27/10/2008	4	0	34
24/11/2008	13	3	10
29/12/2008	4	0	0
29/01/2009	0	0	0
25/02/2009	0		0
26/03/2009	1200		0
28/04/2009	34	0	230
26/05/2009	1300	26	120000
25/06/2009	10	<1	33
14/07/2009	10	12	45
11/08/2009	2	37	6
29/10/2009	10	0	27
30/11/2009	0	0	0

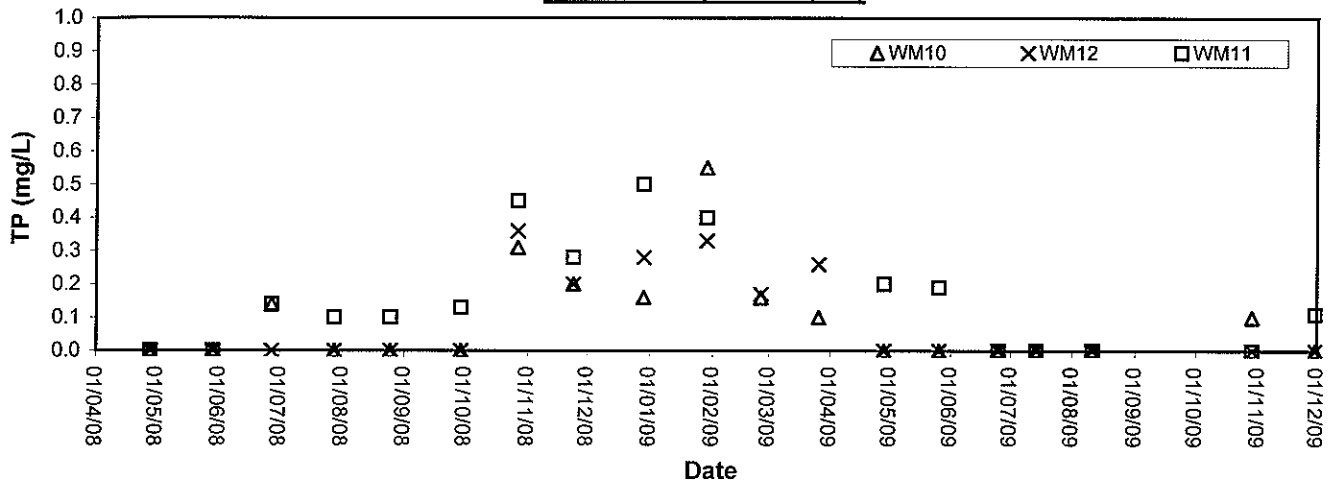


## Appendix C

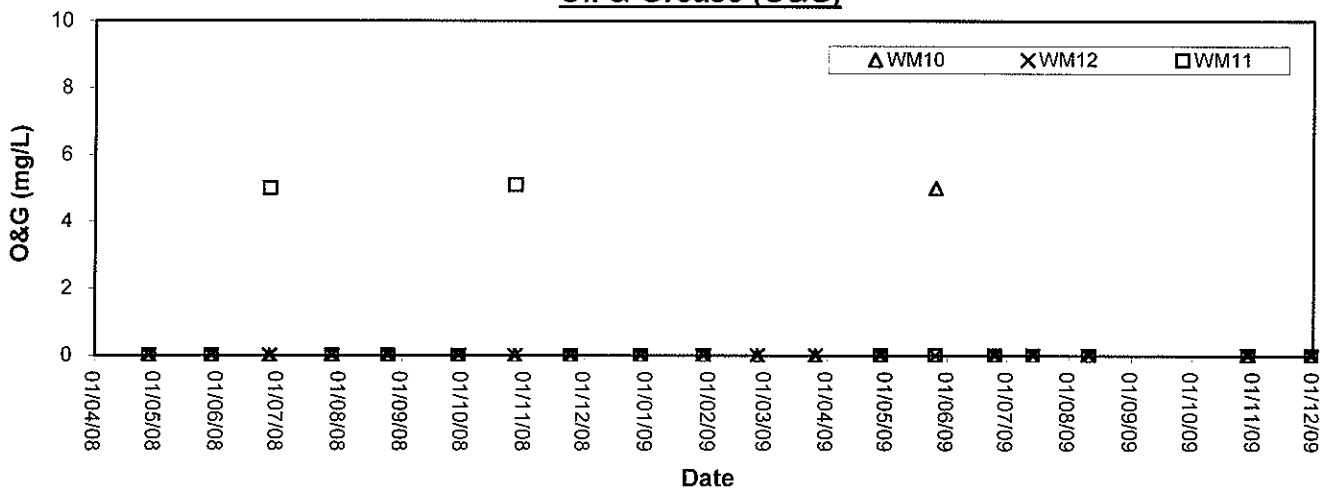
### Graphical Plots of Groundwater Monitoring Data



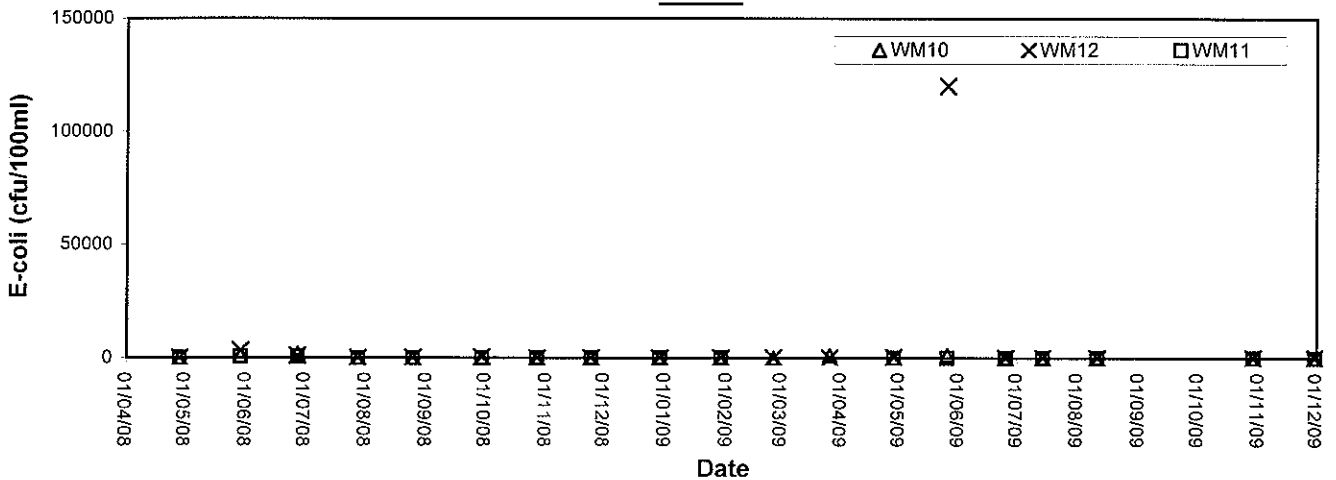
### Total Phosphates (TP)



### Oil & Grease (O&G)

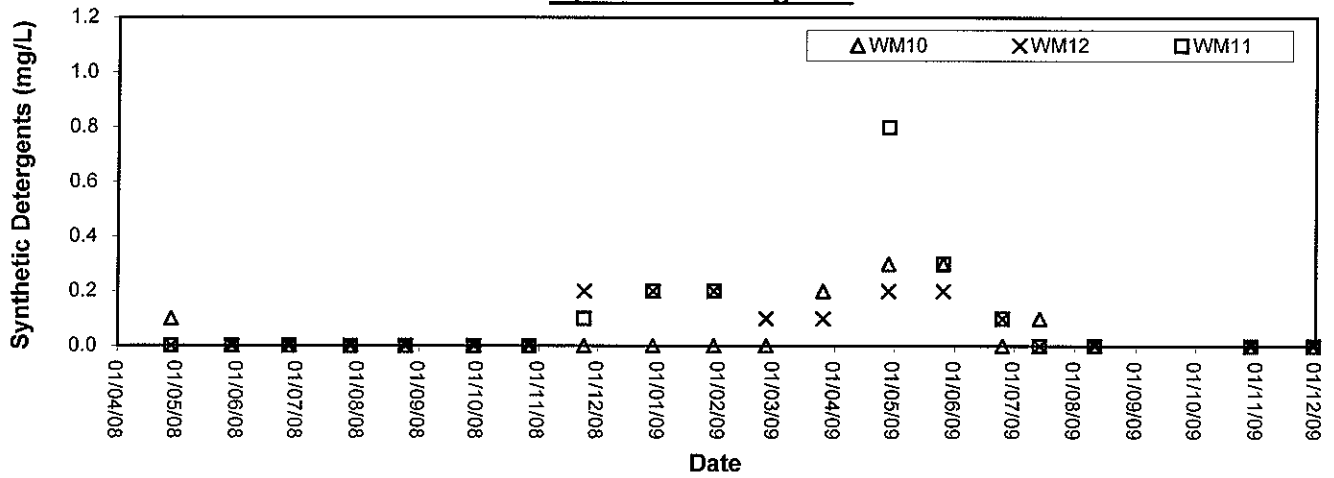


### E-coli

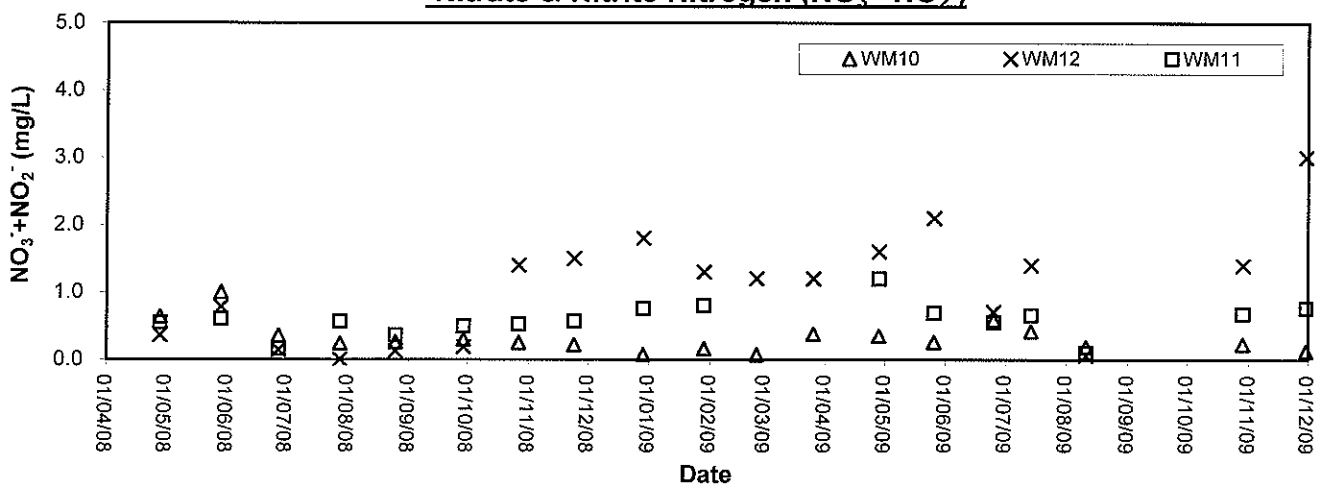




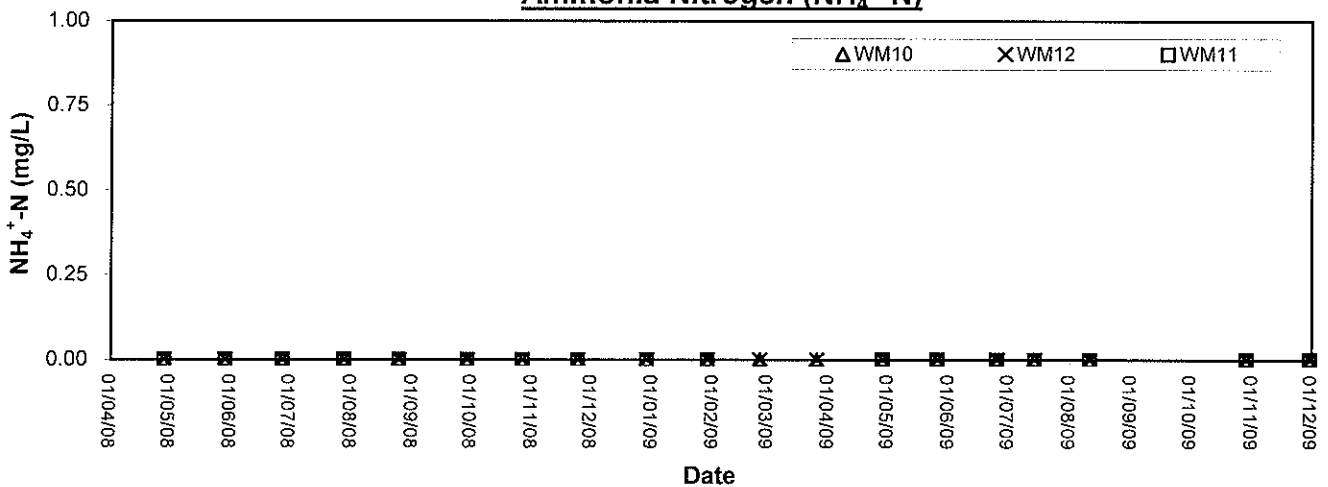
### Synthetic Detergents



### Nitrate & Nitrite Nitrogen ( $\text{NO}_3^- + \text{NO}_2^-$ )

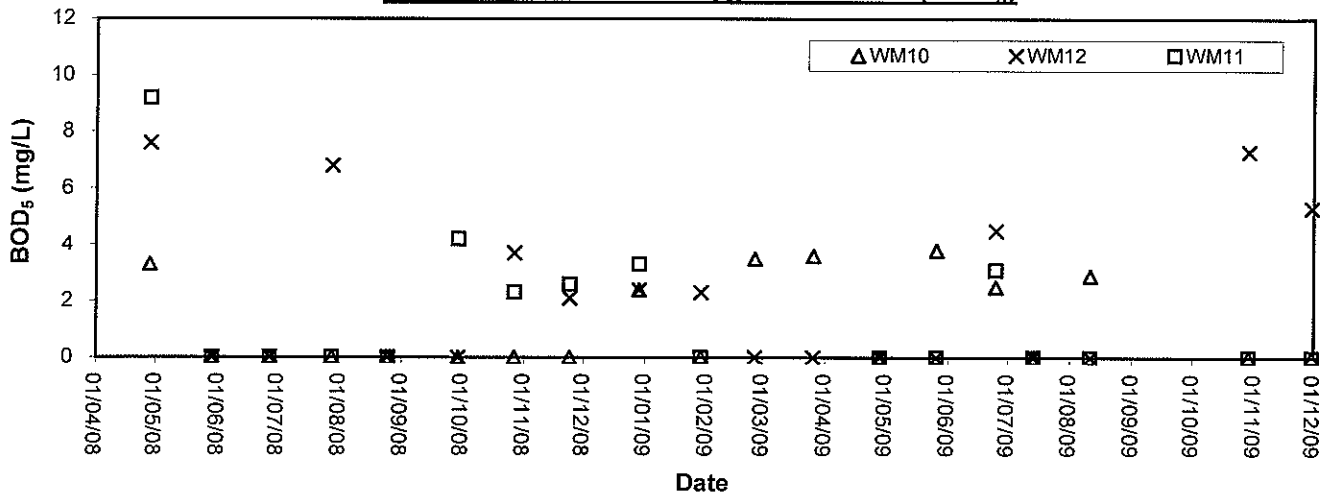


### Ammonia Nitrogen ( $\text{NH}_4^+ - \text{N}$ )

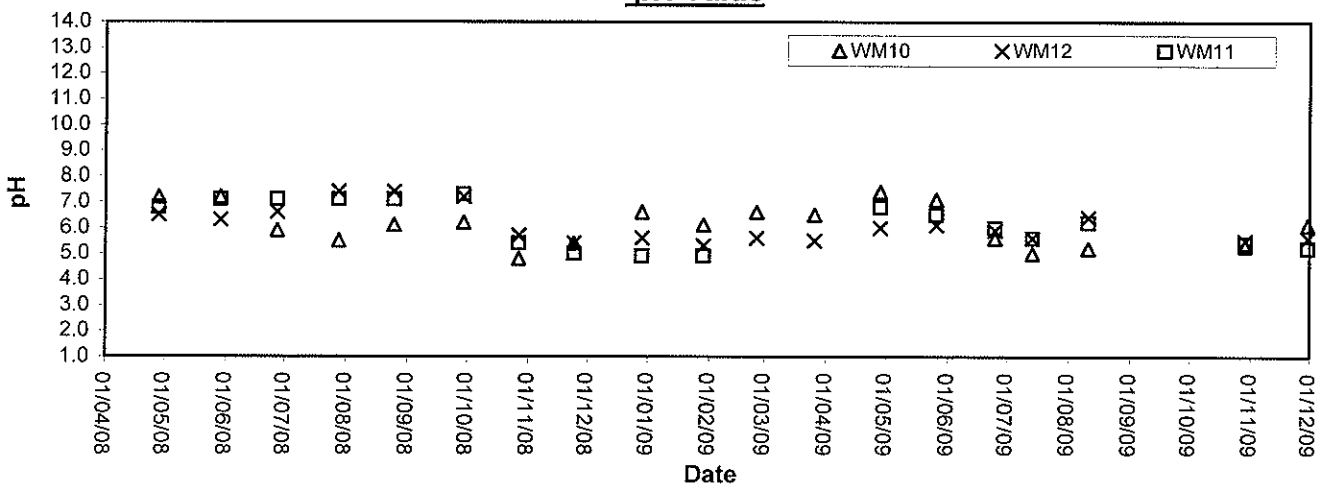




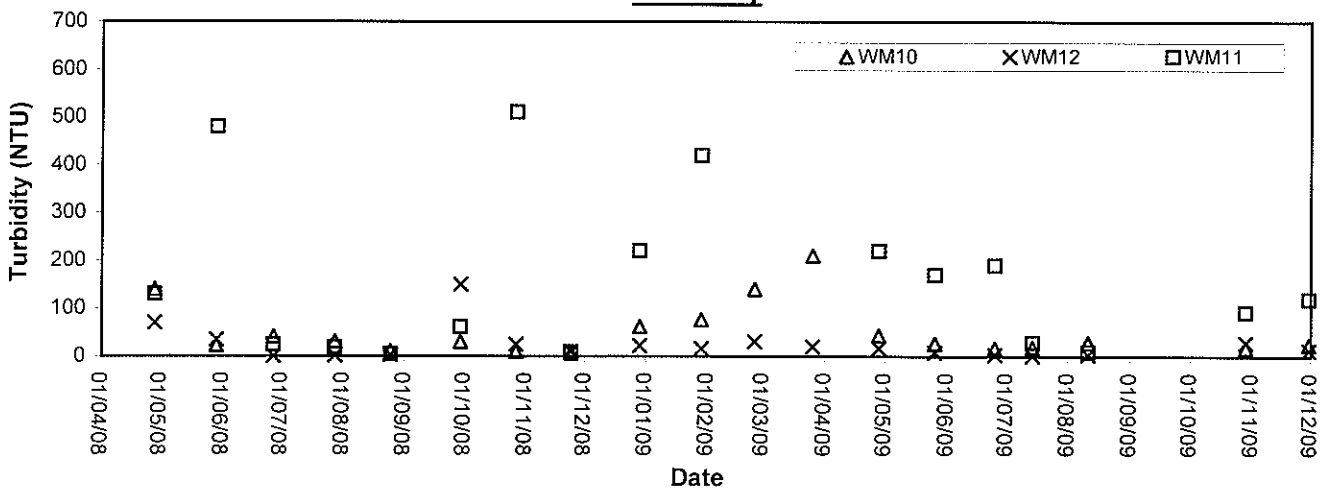
### 5-day Biochemical Oxygen Demand (BOD<sub>5</sub>)



### pH Value



### Turbidity

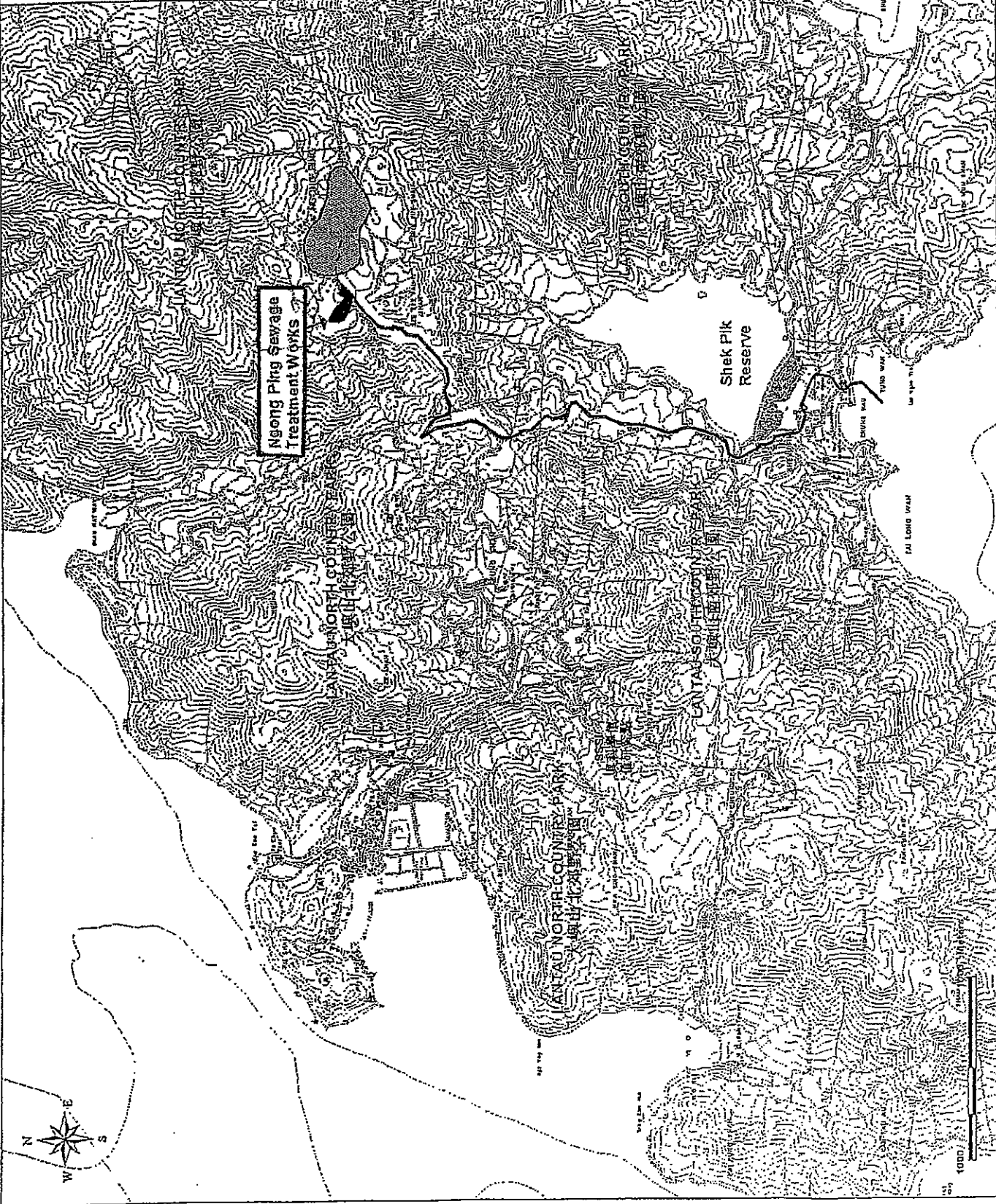









## Appendix D

### General Layout Plan



**Legend:**

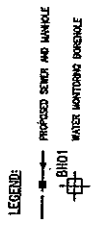
-  Proposed Effluent Export Pipeline
-  Proposed Trunk Sewer of Ngong Ping Sewerage
-  Ngong Ping Sewerage Catchment Area

<b>ARUP</b>	234,000/EN/0308				
AGREEMENT NO. CE 2001 OUTLING ISLANDS STAGE 1 PHASE 1 NGONG PING SEWERAGE TREATMENT WORKS AND SEWERAGE					
Ngong Ping Sewerage Project Scheme - General Layout					
PROJECT NO. 234,000/EN/0308	DATE Feb 03	DRAWN BY AC	CHECKED BY AC	PROJECT STATUS Preliminary	
香港特別行政區政府 環境及自然護理署 THE ENVIRONMENT AND NATURE CONSERVATION DEPARTMENT SPECIFIC ADMINISTRATION REGION					



## Figures

**NOTE:**  
 1. EXACT LOCATIONS OF GROUND WATER MONITORING BOREHOLES ARE SUBJECT TO CONFIRMATION ON SITE.



A	TENDER ISSUE	THE	07/05
Rev	Description	By	Date
Comments			

**ARUP**  
 One Arup & Partners (Hong Kong) Limited

Project No.  
**CONTRACT NO. DC200005**  
**NGONG FING VILLAGE SEWERAGE**

Drawing No. **23400/RS/406**

Drawn by	Checked by	Scale	Rev.
DATE	DATE	DATE	DATE
DATE	DATE	DATE	DATE

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